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Information technology — Control functions for coded character sets

*Technologies de l'information — Fonctions de commande pour les jeux
de caractères codés*



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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 6429 was prepared by the European Computer Manufacturers Association (as Standard ECMA-48) and was adopted, under a special "fast-track procedure", by Joint Technical Committee ISO/IEC JTC1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

This third edition cancels and replaces the second edition (ISO 6429:1988), which has been technically revised.

Annexes A, B, C, D, E, F and G of this International Standard are for information only.

Introduction

This International Standard constitutes a repertoire of a large number of control functions the definitions and coded representations of which are thus standardized. For each application the required selection of control functions can be made from this repertoire.

This third edition of ISO/IEC 6429 contains the control functions already standardized in the second edition and, in addition, new control functions needed for handling bi-directional texts, i.e. texts comprising parts written with a left-to-right script and parts written with a right-to-left script. ECMA Technical Report TR/53 gives further information and examples of handling such texts. The inclusion of these specialized control functions has required a corresponding adjustment of the definitions of some of the other control functions. Moreover, the concept of "device" had to be revised.

Information technology – Control functions for coded character sets

1 Scope

This International Standard defines control functions and their coded representations for use in a 7-bit code, an extended 7-bit code, an 8-bit code or an extended 8-bit code, if such a code is structured in accordance with International Standard ISO 2022.

This International Standard specifies technical means to handle bi-directional texts in character-imaging devices in the case of

- texts in a single script of which specific parts need to be presented in an opposite direction (for example, numbers in Arabic or Hebrew text);
- texts in different scripts presented in opposite directions (like texts in Latin and Arabic or texts in Latin and Hebrew);
- texts like the above with a horizontal line orientation and a top-to-bottom line progression.

The control functions defined in this International Standard are intended to be used embedded in character-coded data for interchange, in particular with character-imaging devices.

In general, the control functions are defined by their effects on a character-imaging input/output device. It is, therefore, necessary to make certain assumptions about the architecture of such a device. These assumptions are as unrestrictive as possible; they are specified in clause 6.

In addition to being performed the control functions may need to be represented by a graphic symbol.

The structure of this International Standard is open-ended, so that more control functions can be included in future editions.

Other standards specifying control functions may define more restricted definitions of them than those in this International Standard.

The devices to which this International Standard applies can vary greatly from each other depending on the application for which a device has been specifically designed. It is technically and economically impractical for one device to implement all the facilities specified in this International Standard. The intention is that in any type of device only a limited selection of the facilities appropriate to the application will be implemented.

2 Conformance

2.1 Types of conformance

Full conformance to a standard means that all of its requirements are met. Conformance will only have a unique meaning if the standard contains no options. If there are options within the standard they must be clearly identified, and any claim of conformance must include a statement that identifies those options that have been adopted.

This International Standard is of a different nature since it specifies a large number of facilities from which different selections may be made to suit individual applications. These selections are not identified in this International Standard, but must be identified at the time that a claim of conformance is made. Conformance to such an identified selection is known as limited conformance.

The facilities selected for a particular application may be registered according to ISO 2375 for ease of reference in information interchange.

2.2 Conformance of information interchange

A CC-data-element within coded information for interchange is in conformance with this International Standard if the coded representations of control functions within that CC-data-element satisfy the following conditions:

- a) a coded representation of a control function that is specified in this International Standard shall always represent that control function;
- b) a control function that is specified in this International Standard shall always be represented by the coded representation that is specified in this International Standard for that control function;
- c) any coded representation that is reserved for future standardization by this International Standard shall not appear.

c) any coded representation that is reserved for future standardization by this International Standard shall not appear.

Coded representations of control functions and modes not specified in this International Standard may appear in interchanged information subject to the above conditions (see 5.4, 5.4.1 and 7.4).

2.3 Conformance of devices

A device is in conformance with this International Standard if it conforms to the requirements of 2.3.1, and either or both 2.3.2 and 2.3.3. Any claim of conformance shall identify the document which contains the description specified in 2.3.1.

2.3.1 Device description

A device that conforms to this International Standard shall be the subject of a description that:

- i) identifies, by reference to the clauses of, or to the control functions specified in this International Standard, the selection of control functions, the coded representations of which the device can originate or can receive and interpret;
- ii) identifies the means by which the user may supply the corresponding control functions, or may recognize them, as specified respectively in 2.3.2 and 2.3.3 below.

2.3.2 Originating devices

An originating device shall be capable of transmitting within a CC-data-element the coded representations of an identified selection of control functions, and of their parameter values (including mode selection parameters), conforming to this International Standard.

Such a device shall allow the user to supply any control function that he chooses from among the identified selection for the purpose of transmitting its coded representation over the coding interface.

2.3.3 Receiving devices

A receiving device shall be capable of receiving within a CC-data-element and interpreting the coded representations of an identified selection of control functions, and of their parameter values (including mode selection parameters), conforming to this International Standard.

If the identified selection contains a control sequence for which a default value for a parameter is specified in this International Standard, the identified selection shall include the default value both in explicit and in implicit representations.

Such a device shall make available to the user any control function that is within the identified selection, and the coded representation of which is received over the coding interface, in such a form that the user can recognize it from among the control functions within the identified selection.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1745:1975, *Information processing - Basic mode control procedures for data communication systems*.

ISO 2022:1986, *Information processing - ISO 7-bit and 8-bit coded character sets - Code extension techniques*.

ISO 2375:1985, *Data processing - Procedure for registration of escape sequences*.

ISO 8613-6:1989, *Information processing - Text and office systems - Office Document Architecture (ODA) and interchange format - Part 6: Character content architectures*.

4 Notation and definitions

4.1 Notation

In this International Standard a convention has been adopted to assist the reader. Capital letters are used to refer to a specific control function, mode, mode setting, or graphic character in order to avoid confusion, for example, between the concept "space" and the character SPACE.

It is intended that this convention and the acronyms of the modes and the control functions be retained in all translations of the text.

This International Standard uses the notation of the form *xx/yy*, where *xx* represents the column number 00 to 07 in a 7-bit code table or 00 to 15 in an 8-bit code table, and *yy* represents the row number 00 to 15.

4.2 Definitions

For the purpose of this International Standard, the following definitions apply.

4.2.1 Active area: The area in the data component which contains the active data position.

The area in the presentation component which contains the active presentation position.

4.2.2 Active field: The field in the data component which contains the active data position.

The field in the presentation component which contains the active presentation position.

4.2.3 Active line: The line in the data component which contains the active data position. The line in the presentation component which contains the active presentation position.

4.2.4 Active page: The page in the data component which contains the active data position. The page in the presentation component which contains the active presentation position.

4.2.5 Active position: The character position which is to image the graphic symbol representing the next graphic character or relative to which the next control function is to be executed.

NOTE - In general, the active position is indicated in a display by a cursor.

Active data position

In the data component the character position which is to receive the next graphic character or the next control function from the data stream and relative to which certain control functions are to be executed.

Active presentation position

In the presentation component the character position which is to receive the next graphic character for graphic image output and relative to which certain control functions are to be executed.

NOTE - In general, the active presentation position is indicated in a display by a cursor.

4.2.6 Area: A series of successive character positions that are not necessarily on the same line.

4.2.7 Auxiliary device: A device connected to a character-imaging device for the purpose of inputting, storing, retrieving, or imaging data.

4.2.8 Bi-directional data: Data containing text strings which are to be presented in different writing directions, like left-to-right and right-to-left.

4.2.9 Bit combination: An ordered set of bits used for the representation of characters.

4.2.10 Byte: A bit string that is operated upon as a unit.

4.2.11 To cancel: To mark data in such a way that it can be ignored in subsequent processing.

4.2.12 Character: A member of a set of elements used for the organization, control or representation of data.

4.2.13 Character-imaging device: A device that gives a visual representation of data in the form of graphic symbols using any technology, for example cathode ray tube or printer.

4.2.14 Character path: The sequential order of the character positions along a line of the presentation component.

4.2.15 Character position: The portion of a display that is imaging or is capable of imaging a graphic symbol.

In the data component a position available for receiving a graphic character for further presentation processing.

In the presentation component a position available for receiving a graphic character for the rendering of the graphic image output.

4.2.16 Character progression: The sequential order of the character positions along a line of the data component.

4.2.17 To clear: To remove the display of data or the information used for the display of data, for example tabulation stops marking the boundaries between fields.

4.2.18 Coded character set; code: A set of unambiguous rules that establishes a character set and the one-to-one relationship between the characters of the set and their bit combinations.

4.2.19 Coded-character-data-element (CC-data-element): An element of interchanged information that is specified to consist of a sequence of coded representations of characters, in accordance with one or more identified standards for coded character sets.

NOTE 1

In a communication environment according to the reference model for Open Systems Interconnection of ISO 7498, a CC-data-element will form all or part of the information that corresponds to the Presentation-Protocol-Data-Units (PPDU) defined in that International Standard.

NOTE 2

When information interchange is accomplished by means of interchangeable media, a CC-data-element will form all or part of the information that corresponds to the user data, and not that recorded during formatting and initialization.

4.2.20 Code extension: The techniques for the encoding of characters that are not included in the character set of a given code.

4.2.21 Code table: A table showing the character allocated to each bit combination in a code.

4.2.22 Control character: A control function the coded representation of which consists of a single bit combination.

4.2.23 Control function: An action that affects the recording, processing, transmission, or interpretation of data, and that has a coded representation consisting of one or more bit combinations.

4.2.24 Control sequence: A string of bit combinations starting with the control function CONTROL SEQUENCE INTRODUCER (CSI), and used for the coded representation of control functions with or without parameters.

4.2.25 Control string: A string of bit combinations which may occur in the data stream as a logical entity for control purposes.

4.2.26 Cursor: A special indicator used in a display to mark the active presentation position.

4.2.27 Data component: The device component which is used for storing the received data for further presentation processing.

4.2.28 Decimal mark: A graphic symbol, usually a FULL STOP or a COMMA, used to separate the fractional part of a decimal number from the integer part of that number.

4.2.29 Default: A value or a state that is to be assumed when no value or state is explicitly specified.

4.2.30 To delete: To remove the contents from character positions and closing the resulting gap by moving adjacent graphic characters into the empty positions.

4.2.31 To designate: To identify a set of characters that are to be represented, in some cases immediately and in others on the occurrence of a further control function, in a prescribed manner.

4.2.32 Device: A component of information processing equipment which can transmit, and/or receive, coded information within CC-data-elements.

NOTE - It may be an input/output device in the conventional sense, or a process such as an application program or gateway function.

4.2.33 Display: The region for visual presentation of data on any type of character-imaging device, including printer, cathode ray tube and similar devices.

4.2.34 Editor function: A control function used for editing, altering or transposing the visual arrangement of data.

- 4.2.35 Eligible:** The term used to denote an area considered for transmission or transfer.
- 4.2.36 Environment:** The characteristic that identifies the number of bits used for representing a character in a data processing or data communication system or in a part of such a system.
- 4.2.37 To erase:** To remove the contents from character positions and leaving the resulting gap open.
- 4.2.38 Escape sequence:** A string of bit combinations that is used for control purposes in code extension procedures. The first of these bit combinations represents the control function ESCAPE.
- 4.2.39 Field:** An area consisting of the character position at a character tabulation stop (beginning of the field) and the character positions up to, but not including, the character position at the following character tabulation stop (end of the field).
- 4.2.40 Final Byte:** The bit combination that terminates an escape sequence or a control sequence.
- 4.2.41 Formator function:** A control function (format effector or presentation control function) describing how the originator of the data stream wishes the information to be formatted or presented.
- 4.2.42 Graphic character:** A character, other than a control function, that has a visual representation normally hand-written, printed or displayed, and that has a coded representation consisting of one or more bit combinations.
- 4.2.43 Graphic rendition:** The visual style of displaying a set of graphic symbols.
- 4.2.44 Graphic symbol:** A visual representation of a graphic character or of a control function.
- 4.2.45 Guarded area:** A special case of a qualified area, the contents of which may be excluded from transmission as a data stream and from transfer to an auxiliary input/output device.
- 4.2.46 Initial state:** The state a device has after it is made operational. It is the recommended "reset" state of the modes.
- 4.2.47 Intermediate Byte:** a) In an Escape Sequence, a bit combination that may occur between the control function ESCAPE (ESC) and the Final Byte.
b) In a Control Sequence, a bit combination that may occur between the control function CONTROL SEQUENCE INTRODUCER (CSI) and the Final Byte, or between a Parameter Byte and the Final Byte.
- 4.2.48 To invoke:** To cause a designated set of characters to be represented by the prescribed bit combinations whenever those bit combinations occur.
- 4.2.49 Line:** A set of a consecutive character positions.
- 4.2.50 Line home position:** A reference position on a line in the data component ahead of which the active data position can normally not be moved.
A reference position on a line in the presentation component ahead of which the active presentation position can normally not be moved.
- 4.2.51 Line limit position:** A reference position on a line in the data component beyond which the active data position can normally not be moved.
A reference position on a line in the presentation component beyond which the active presentation position can normally not be moved.
- 4.2.52 Line orientation:** The term used to describe the way in which a line will appear in the graphic image output. In this International Standard, line orientation may only be vertical or horizontal.
- 4.2.53 Line progression:** The direction of presentation of successive lines.
- 4.2.54 Operating system:** The software that controls the execution of computer programs and that may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services.
- 4.2.55 Page:** A set of consecutive lines.
- 4.2.56 Page home position:** A reference position on a page in the data component ahead of which the active line (the line that contains the active data position) can normally not be moved.
A reference position on a page in the presentation component ahead of which the active line (the line that contains the active presentation position) can normally not be moved.

4.2.57 Page limit position: A reference position on a page in the data component beyond which the active line (the line that contains the active data position) can normally not be moved.

A reference position on a page in the presentation component beyond which the active line (the line that contains the active presentation position) can normally not be moved.

4.2.58 Parameter Byte: In a control sequence, a bit combination that may occur between the control function CONTROL SEQUENCE INTRODUCER (CSI) and the Final Byte, or between CSI and an Intermediate Byte.

4.2.59 Presentation component: The device component which is used for producing the graphic image output.

4.2.60 Private (or experimental) use: The means of representing a non-standardized control function or mode in a manner compatible with this International Standard.

4.2.61 Protected area: A special case of a qualified area, the contents of which are protected against manual alteration and may also be protected against erasure.

4.2.62 Qualified area: A string of character positions with which certain characteristics are associated.

4.2.63 Repertoire: A specified set of characters that are represented by one or more bit combinations of a coded character set.

4.2.64 Scroll: The action whereby all, or part of, the graphic symbols of a display are moved in a specified direction.

4.2.65 Selected area: A string of character positions, the contents of which may be eligible to be transmitted in the form of a data stream or to be transferred to an auxiliary input/output device.

4.2.66 Tabulation: The technique of identifying character positions or lines in a display for the purpose of arranging information systematically.

4.2.67 Tabulation stop: The indication that a character position or a line is to be used for tabulation; a character tabulation stop may also serve as a boundary between fields.

4.2.68 User: A person or other entity that invokes the services provided by a device.

NOTE 1

This entity may be a process such as an application program if the "device" is a code convertor or a gateway function, for example.

NOTE 2

The characters, as supplied by the user or made available to the user, may be in the form of codes local to the device, or of non-conventional visual representations, provided that clause 2.3 above is satisfied.

5 Coded representation

5.1 General

Each control function in this International Standard belongs to one of the following types:

- a) elements of the C0 set;
- b) elements of the C1 set;
- c) control sequences;
- d) independent control functions;
- e) control strings.

5.2 Elements of the C0 set

These control functions are represented in 7-bit and 8-bit codes by bit combinations from 00/00 to 01/15.

The definitions and the coded representations of the control functions are specified in 8.3 (see also table 1).

The 3-byte escape sequence designating and invoking this C0 set is ESC 02/01 04/00.

NOTE 1

The use of this escape sequence implies that all control functions of this C0 set must be implemented.

NOTE 2

It is assumed that even with no invoked C0 set the control character ESCAPE is available and is represented by bit combination 01/11.

Table 1 - Bit combinations representing the control functions of the C0 set

Row number	Column number	
	00	01
00	NUL	DLE
01	SOH	DC1
02	STX	DC2
03	ETX	DC3
04	EOT	DC4
05	ENQ	NAK
06	ACK	SYN
07	BEL	ETB
08	BS	CAN
09	HT	EM
10	LF	SUB
11	VT	ESC
12	FF	IS4
13	CR	IS3
14	SO or LS1	IS2
15	SI or LS0	IS1

5.3 Elements of the C1 set

These control functions are represented

- in a 7-bit code by 2-byte escape sequences of the form ESC Fe, where ESC is represented by bit combination 01/11 and the Final Byte Fe is represented by a bit combination from 04/00 to 05/15;
- in an 8-bit code by bit combinations from 08/00 to 09/15; however, when the announcer sequence ESC 02/00 04/06 according to International Standard ISO 2022 is used, the control functions of the C1 set are represented by ESC Fe sequences as in a 7-bit code.

The definitions and the coded representations of the control functions are specified in 8.3 (see also table 2a and table 2b).

The unallocated bit combinations are reserved for future standardization and shall not be used. For the bit combinations 04/04 (see table 2a) and 08/04 (see table 2b) see F.8.2 in annex F.

The 3-byte escape sequences designating and invoking this C1 set are ESC 02/06 04/00 and ESC 02/02 04/03.

NOTE - The use of these escape sequences implies that all control characters of this C1 set must be implemented.

Table 2a - Bit combinations representing the Final Byte Fe for the control functions of the C1 set in the 7-bit code

Row number	Column number	
	04	05
00	-	DCS
01	-	PU1
02	BPH	PU2
03	NBH	STS
04	-	CCH
05	NEL	MW
06	SSA	SPA
07	ESA	EPA
08	HTS	SOS
09	HTJ	-
10	VTS	SCI
11	PLD	CSI
12	PLU	ST
13	RI	OSC
14	SS2	PM
15	SS3	APC

Table 2b - Bit combinations representing the control functions of the C1 set in an 8-bit code

Row number	Column number	
	08	09
00	-	DCS
01	-	PU1
02	BPH	PU2
03	NBH	STS
04	-	CCH
05	NEL	MW
06	SSA	SPA
07	ESA	EPA
08	HTS	SOS
09	HTJ	-
10	VTS	SCI
11	PLD	CSI
12	PLU	ST
13	RI	OSC
14	SS2	PM
15	SS3	APC

5.4 Control sequences

A control sequence is a string of bit combinations starting with the control function CONTROL SEQUENCE INTRODUCER (CSI) followed by one or more bit combinations representing parameters, if any, and by one or more bit combinations identifying the control function. The control function CSI itself is an element of the C1 set.

The format of a control sequence is

CSIP ... PI ... IF

where

- a) CSI is represented by bit combinations 01/11 (representing ESC) and 05/11 in a 7-bit code or by bit combination 09/11 in an 8-bit code, see 5.3;
- b) P ... P are Parameter Bytes, which, if present, consist of bit combinations from 03/00 to 03/15;
- c) I ... I are Intermediate Bytes, which, if present, consist of bit combinations from 02/00 to 02/15. Together with the Final Byte F, they identify the control function;

NOTE - The number of Intermediate Bytes is not limited by this International Standard; in practice, one Intermediate Byte will be sufficient since with sixteen different bit combinations available for the Intermediate Byte over one thousand control functions may be identified.

- d) F is the Final Byte; it consists of a bit combination from 04/00 to 07/14; it terminates the control sequence and together with the Intermediate Bytes, if present, identifies the control function. Bit combinations 07/00 to 07/14 are available as Final Bytes of control sequences for private (or experimental) use.

The definitions and the coded representations of the control functions are specified in 8.3 (see also tables 3 and 4). Coding examples are shown in clause B.1 in annex B.

Table 3 - Bit combinations representing the Final Byte of control sequences without Intermediate Bytes

Row number	Column number			
	04	05	06	07
00	ICH	DCH	HPA	Private Use
01	CUU	SEE	HPR	
02	CUD	CPR	REP	
03	CUF	SU	DA	
04	CUB	SD	VPA	
05	CNL	NP	VPR	
06	CPL	PP	HVP	
07	CHA	CTC	TBC	
08	CUP	ECH	SM	
09	CHT	CVT	MC	
10	ED	CBT	HPB	
11	EL	SRS	VPB	
12	IL	PTX	RM	
13	DL	SDS	SGR	
14	EF	SIMD	DSR	
15	EA	--	DAQ	

Table 4 - Bit combinations representing the Final Byte of control sequences with a single Intermediate Byte 02/00

Row number	Column number			
	04	05	06	07
00	SL	PPA	TATE	Private Use
01	SR	PPR	TALE	
02	GSM	OOB	TAC	
03	GSS	SPD	TCC	
04	FNT	DTA	TSR	
05	TSS	SLH	SCO	
06	JFY	SLL	SRCS	
07	SPI	FNK	SCS	
08	QUAD	SPQR	SLS	
09	SSU	SEF	SPH	
10	PFS	PEC	SPL	
11	SHS	SSW	SCP	
12	SVS	SACS	-	
13	IGS	SAPV	-	
14	-	STAB	-	
15	IDCS	GCC	-	

The unallocated bit combinations are reserved for future standardization and shall not be used. Bit combination 06/13 is reserved for use as the Final Byte with the control function IDENTIFY UNIVERSAL CHARACTER SUBSET (IUCS) according to clause 17 of ISO/IEC 10646. See also F.8.3 in annex F.

5.4.1 Parameter representation

A control sequence may contain a string of Parameter Bytes P ... P representing one or more parameters to complete the specification of the control function.

The Parameter Bytes are bit combinations from 03/00 to 03/15. The parameter string is interpreted as follows:

- If the first bit combination of the parameter string is in the range 03/00 to 03/11, the parameter string is interpreted according to the format described in 5.4.2.
- If the first bit combination of the parameter string is in the range 03/12 to 03/15, the parameter string is available for private (or experimental) use. Its format and meaning are not defined by this International Standard.

5.4.2 Parameter string format

A parameter string which does not start with a bit combination in the range 03/12 to 03/15 shall have the following format:

- A parameter string consists of one or more parameter sub-strings, each of which represents a number in decimal notation.
- Each parameter sub-string consists of one or more bit combinations from 03/00 to 03/10; the bit combinations from 03/00 to 03/09 represent the digits ZERO to NINE; bit combination 03/10 may be used as a separator in a parameter sub-string, for example, to separate the fractional part of a decimal number from the integer part of that number.
- Parameter sub-strings are separated by one bit combination 03/11.
- Bit combinations 03/12 to 03/15 are reserved for future standardization except when used as the first bit combination of the parameter string.
- An empty parameter sub-string represents a default value which depends on the control function.

- f) In each parameter sub-string, leading bit combinations 03/00 are not significant and may be omitted. If the parameter sub-string consists of bit combinations 03/00 only, at least one of them must be retained to indicate the zero value of the sub-string.
- g) If the parameter string starts with the bit combination 03/11, an empty parameter sub-string is assumed preceding the separator; if the parameter string terminates with the bit combination 03/11, an empty parameter sub-string is assumed following the separator; if the parameter string contains successive bit combinations 03/11, empty parameter sub-strings are assumed between the separators.
- h) If the control function has more than one parameter, and some parameter sub-strings are empty, the separators (bit combination 03/11) must still be present. See F.10 in annex F.

Coding examples are shown in clause B.2 in annex B.

5.4.3 Types of parameters

In a control sequence with parameters, each parameter sub-string corresponds to one parameter and represents the value of that parameter. The number of parameters is either fixed or variable, depending on the control function. If the number of parameters is variable, neither the maximum number of values nor the order in which the corresponding actions are performed are defined by this International Standard.

A parameter may be purely numeric or it may be selective, i.e. denoting one of a numbered list of actions the control function can perform.

In the case of selected parameters a particular parameter value may have the same meaning as a combination of two or more separate values.

Unassigned selective parameter values are reserved for future standardization.

5.5 Independent control functions

These control functions are represented in 7-bit and 8-bit codes by 2-byte escape sequences of the form ESC Fs, where ESC is represented by bit combination 01/11 and the Final Byte Fs is represented by a bit combination from 06/00 to 07/14.

The definitions and the coded representations of the control functions are specified in 8.3 (see also table 5).

Table 5 - Independent control functions

Row number	Column number	
	06	07
00	DMI	-
01	INT	-
02	EMI	-
03	RIS	-
04	CMD	-
05	-	-
06	-	-
07	-	-
08	-	-
09	-	-
10	-	-
11	-	-
12	-	LS3R
13	-	LS2R
14	LS2	LS1R
15	LS3	-

The unallocated bit combinations are reserved for future standardization and shall not be used.

NOTE - ESC Fs sequences are registered in the ISO International Register of Coded Character Sets to be Used with Escape Sequences, which is maintained by the Registration Authority for ISO 2375. Any candidates for ESC Fs sequences have to be approved by ISO/IEC JTC1/SC2 for registration. The coding for the Final Byte, Fs, will then be assigned by the Registration Authority.

5.6 Control strings

A control string is a string of bit combinations which may occur in the data stream as a logical entity for control purposes. A control string consists of an opening delimiter, a command string or a character string, and a terminating delimiter, the STRING TERMINATOR (ST).

A command string is a sequence of bit combinations in the range 00/08 to 00/13 and 02/00 to 07/14.

A character string is a sequence of any bit combination, except those representing START OF STRING (SOS) or STRING TERMINATOR (ST).

The interpretation of the command string or the character string is not defined by this International Standard, but instead requires prior agreement between the sender and the recipient of the data.

The opening delimiters defined in this International Standard are

- a) APPLICATION PROGRAM COMMAND (APC)
- b) DEVICE CONTROL STRING (DCS)
- c) OPERATING SYSTEM COMMAND (OSC)
- d) PRIVACY MESSAGE (PM)
- e) START OF STRING (SOS)

6 Device concepts

The definitions of the control functions in this International Standard are based on general assumptions about the architecture of a character-imaging device. Examples of devices conforming to these concepts are: an alphanumeric display device, a printer or a microfilm output device.

A character-imaging device is a device which is capable of receiving a data stream that consists of coded control functions and graphic characters, and is capable of producing a graphic image output. This output must be readable by a human being according to the various traditional writing conventions such as left-to-right, right-to-left, top-to-bottom and bottom-to-top. The graphic image output is, in general, produced in the form of one or more rectangular arrays of character positions and lines which are called pages.

If the device is an input/output device rather than merely an output device, it is also capable of transmitting a data stream that consists of coded control functions and graphic characters; the transmitted data stream is, in general, composed of a combination of data which have been sent to the device and data which have been entered locally into the device, for example by an associated keyboard.

A number of facilities for the organization of the graphic image output and for establishing the direction of presented text are provided by this International Standard. A device may support all of these facilities or only a subset of them appropriate to the application.

The definitions in this International Standard assume a bi-directional device which has both a presentation component (see 6.1.1) and a data component (see 6.1.3). In the case of a uni-directional device or a bi-directional device without a data component, all references to active data position, data component, character progression, etc., are to be read as referring to active presentation position, presentation component, character path, etc., resp.

Refer to ECMA Technical Report 53 for more explanation.

6.1 Components

A device consists either of an input component, a presentation component and a data component, or of an input component and a presentation component only.

The input component is capable of receiving the information to be imaged from a manual input device such as a keyboard or from a data stream. This International Standard does not deal with the input component.

The presentation component which is present in uni-directional as well as in bi-directional devices is used for producing the graphic image output. The output may, for example, be rendered on a display or a printer.

The data component which is generally provided in bi-directional devices only is used to store the received information for further presentation processing.

6.1.1 Presentation component

The presentation component is capable of presenting the information in successive lines; each line consisting of successive character positions. The lines, as well as the character positions, are identified by the consecutive numbers 1, 2, 3 ...

The line orientation in the presentation component is either horizontal or vertical. This defines the way in which a line will appear in the produced graphic image output.

For horizontal line orientation, the direction of the line progression can be:

- top-to-bottom, or
- bottom-to-top.

For vertical line orientation, the direction of the line progression can be:

- left-to-right, or
- right-to-left.

The sequential order of the character positions along a line of the presentation component is called the character path.

The character path along a line can be:

- left-to-right or right-to-left (in the case of horizontal line orientation), or
- top-to-bottom or bottom-to-top (in the case of vertical line orientation).

The lines are numbered according to the established line progression.

The character positions are numbered according to the established character path.

Each character position either is in the erased state or images a graphic symbol. A graphic symbol represents SPACE, a graphic character, or a control function for which a graphical representation is required.

The initial state of all character positions is "erased".

Depending on the implementation, there may or may not be a distinction between a character position in the erased state and a character position imaging SPACE.

6.1.2 The active presentation position

At any time, there is a unique character position in the presentation component which is called the active presentation position.

The active presentation position is the character position which is to receive the next graphic character of the data stream for graphic image output or a control function for which a graphical representation is required. The active presentation position in the presentation component is also the character position relative to which certain control functions are to be executed (see 6.4).

The active presentation position can be moved explicitly (see 6.1.7) or indirectly (see 6.1.8). In the case where a device has no data component, the active presentation position can also be moved implicitly (see 6.1.6).

NOTE - In a display it is common practice to mark the active presentation position by means of a special visible indicator which is called the cursor.

The line containing the active presentation position is called the active line; the field containing the active presentation position is called the active field; the area containing the active presentation position is called the active area; the page containing the active presentation position is called the active page.

6.1.3 Data component

In the data component the received data stream is structured into successive lines; each line consisting of successive character positions. The lines, as well as the character positions, are identified by the consecutive numbers 1, 2, 3

The sequential order of the character positions along a line of the data component is called the character progression.

In this International Standard, the line orientation in the data component is considered to be horizontal, the line progression is considered to be top-to-bottom, the character progression is considered to be left-to-right.

The lines are numbered according to the line progression.

The character positions are numbered according to the character progression.

Each character position either is in the erased state or contains a graphic character, or a control function.

The initial state of all character positions is "erased".

Depending on the implementation, there may or may not be a distinction between a character position in the erased state and a character position containing SPACE.

6.1.4 The active data position

At any time, there is a unique character position in the data component which is called the active data position.

The active data position is the character position which is available for the next graphic character or the next control function of the received data stream. The active data position is also the character position relative to which certain control functions are to be executed (see 6.4).

The active data position can be moved implicitly (see 6.1.6) or explicitly (see 6.1.7) or indirectly (see 6.1.8).

The line containing the active data position is called the active line; the field containing the active data position is called the active field; the area containing the active data position is called the active area; the page containing the active data position is called the active page.

6.1.5 Relationship between active data position and active presentation position

In a uni-directional device, whether it has a presentation component only or a presentation component and a data component, there is no difference between the active data position and the active presentation position.

In a bi-directional device, if it has a presentation component and a data component, the active presentation position is the character position in the presentation component that corresponds to the active data position in the data component. Because of the possible differences between character progression and character path, as in some bi-directional environments, the coordinates of the active data position in the data component and of the active presentation position in the presentation component may differ.

Some control functions act on, and affect, the active data position whereas other control functions act on, and affect, the active presentation position. When one of these positions is so modified, the other is updated accordingly. This is referred to as indirect movement (see 6.1.8).

In the situation where a data component is not present in a device then the characteristics of the data component, active data position, active data position movement, character progression, etc., are treated as if they are identical with the respective characteristics of the presentation component, active presentation position, active presentation position movement, character path, etc., resp..

6.1.6 Implicit movement

An implicit movement is a movement of the active data position which is performed after a graphic character is received, or a control function, for which a graphical representation is required. In uni-directional devices the direction of the implicit movement of the active data position in the data component is the same as the direction of the character progression; in devices without a data component the implicit movement applies to the active presentation position in the presentation component and is then the same as the direction of the character path. In bi-directional devices the direction of the implicit movement may be different from the direction of the character progression. The direction is the same as the direction of the character progression until it is modified by an appropriate control function.

If the direction of the implicit movement is the same as that of the character progression and the active data position is not the last character position of the active line, the active data position is moved to the following character position of that line.

If the direction of the implicit movement is opposite to that of the character progression and the active data position is not the first character position of the active line, the active data position is moved to the preceding character position of that line.

When the active data position has been modified by an implicit movement, the active presentation position in the presentation component is updated accordingly; this is referred to as indirect movement (see 6.1.8).

NOTE - In the following situation, the effect of an attempt to move the active data position is not defined by this International Standard:

- an attempt to perform an implicit movement when the active data position is the last character position of a line and the direction of the implicit movement is the same as that of the character progression, or when the active data position is the first character position of a line and the direction of the implicit movement is opposite to that of the character progression;

Depending on the implementation, an attempt to perform such movements may

- 1) cause a wrap-around movement;
- 2) cause the position to be blocked (a condition in which no graphic character can be entered until a valid explicit position movement is performed);
- 3) cause the position to remain where it is but permit graphic characters to be entered thereby replacing or overstriking the previously entered character;
- 4) cause the cursor to disappear from the operator's view;
- 5) cause the cursor to move to the opposite end of the display but one column or row offset;
- 6) cause scrolling to occur;
- 7) cause other implementation-dependent action.

6.1.7 Explicit movement

In the data component an explicit movement is a movement of the active data position that is performed when a control function is executed which causes the active data position to be moved to a specified character position in the data component. When the active data position has been modified by an explicit movement, the active presentation position in the presentation component is updated accordingly; this is referred to as indirect movement (see 6.1.8).

In the presentation component an explicit movement is a movement of the active presentation position that is performed when a control function is executed which causes the active presentation position to be moved to a specified character position in the presentation component. When the active presentation position has been modified by an explicit movement, the active data position in the data component is updated accordingly; this is referred to as indirect movement (see 6.1.8).

NOTE - In the following situation, the effect of an attempt to move the active data position or the active presentation position is not defined by this International Standard:

- an attempt to perform an explicit movement to a non-existing character position, for example beyond the last character position of a line, or beyond the last line of a page.

Depending on the implementation, an attempt to perform such movements may

- 1) cause a wrap-around movement;
- 2) cause the position to be blocked (a condition in which no graphic character can be entered until a valid explicit position movement is performed);
- 3) cause the position to remain where it is but permit graphic characters to be entered thereby replacing or overstriking the previously entered character;
- 4) cause the cursor to disappear from the operator's view;
- 5) cause the cursor to move to the opposite end of the display but one column or row offset;
- 6) cause scrolling to occur;
- 7) cause other implementation-dependent action.

6.1.8 Indirect movement

In the data component an indirect movement is the movement by which the active data position is modified to reflect a modification of the active presentation position by an explicit movement (see 6.1.7) in the presentation component.

In the presentation component an indirect movement is the movement by which the active presentation position is modified to reflect a modification of the active data position by an implicit movement (see 6.1.6) or by an explicit movement (see 6.1.7) in the data component.

6.2 The data stream

The data stream is considered to be a continuous stream. It may be structured in messages, records and/or blocks, but this does not affect the operation of the devices at the abstract level of description in this International Standard; the logical or physical units of data are regarded as being concatenated to form one continuous data stream.

6.2.1 Data organization

Text within a data stream can be viewed as being constructed from character strings. Each such string may contain nested strings. Characters within a string are organized in the order in which they are intended to be read.

Each string has a direction associated with it. The direction may be associated with the string using a control function or a higher-level protocol. If the direction is not determined in this way, then the direction is the same as that of the currently established character path.

6.3 The graphic image output

In this International Standard, the graphic image output is regarded as being produced in the form of a continuous stream, but it may eventually be made available character-by-character, line-by-line, or page-by-page.

The graphic image output may consist of one or more pages of a predetermined size.

A page is composed of a predetermined number of lines, each composed of a predetermined number of character positions. During the operation of the device, the number of lines per page, the number of character positions per line, the line spacing, and the character spacing may be changed by appropriate control functions.

The graphic image output is constructed in the presentation component from the data stream stored in the data component, and according to the line orientation and line progression of the presentation component. The presentation of characters along a line in the presentation component is dependent on the character path, the character progression and the direction associated with the string.

The size of a character position may be fixed or may depend on the graphic symbol of the character being imaged.

The font design of the graphic symbols is not defined by this International Standard.

6.4 Formator functions and editor functions

Two classes of control functions have an action on the layout or positioning of information in character-imaging devices. They are formator functions and editor functions. The principal difference between editor functions and formator functions is that the latter are sensitive to the FORMAT EFFECTOR ACTION MODE (FEAM); whereas the former are not (see annex A).

6.4.1 Formator functions

They are format effectors and presentation control functions. Formator functions may be part of the data stream. They describe how the originator of the data stream wishes the information to be formatted or presented.

Therefore, if formator functions are not stored by the receiving device they shall be regenerated by the device for subsequent transmission to additional recipients in order to preserve data integrity.

In uni-directional devices the active presentation position (or the active line, where applicable) is the reference position against which formator functions are performed. In bi-directional devices certain formator functions are performed against the active data position (or the active line, where applicable) in the data component, dependent on the setting of the DEVICE COMPONENT SELECT MODE (DCSM).

Formator functions are processed depending on the setting of the FORMAT EFFECTOR ACTION MODE (FEAM) of the device.

6.4.2 Composite graphic characters

Composite graphic characters may be obtained by using formator functions only; editor functions shall not be used for this purpose (see clause A.2 in annex A).

6.4.3 Editor functions

The main purpose of editor functions is to edit, alter or transpose the visual arrangement of data.

Editor functions are performed immediately and do not become part of the data stream.

In uni-directional devices the active presentation position (or the active line, where applicable) is the reference position against which editor functions are performed. In bi-directional devices certain editor functions are performed against the active data position (or the active line, where applicable) in the data component, depending on the setting of the DEVICE COMPONENT SELECT MODE (DCSM).

6.5 Selected and qualified areas

This clause is applicable primarily to buffered input/output devices. It may also be applicable to unbuffered input/output devices when the SEND/RECEIVE MODE (SRM) is set to SIMULTANEOUS.

6.5.1 Selected areas

A selected area is a string of character positions in the presentation component, the contents of which may be eligible (see 7.3.1) to be transmitted in the form of a data stream or to be transferred to an auxiliary input/output device (see 6.6).

The beginning of a selected area is established by START OF SELECTED AREA (SSA). The character position in the presentation component which is the active presentation position after the receipt of SSA is the first character position of the selected area.

The end of a selected area is established by END OF SELECTED AREA (ESA). The character position in the presentation component which is the active presentation position before the receipt of ESA is the last character position of the selected area.

The character positions in a line of a selected area are ordered according to the character path of this line.

6.5.2 Qualified areas

A qualified area is a string of character positions in the presentation component with which certain characteristics are associated, such as one or a combination of the following:

- a) the contents are protected against manual alteration;
- b) the kind of characters which are permitted to be entered is restricted (for example, to numeric or alphabetic characters only);
- c) the contents are protected against erasure;
- d) a tabulation stop is associated with the first character position;
- e) the contents are to be excluded, i.e. guarded (see 6.5.2.2) from transmission as a data stream, or from transfer to an auxiliary input/output device (see 6.6).

The beginning of a qualified area is established by DEFINE AREA QUALIFICATION (DAQ). The character position in the presentation component which is the active presentation position after receipt of DAQ is the first character position of the qualified area. The type of area qualification is specified by the parameter value of DAQ. The end of a qualified area is established by the beginning of the following qualified area.

The order of the character positions in a line of a qualified area can be the same as, or opposite to, the character path of this line.

6.5.2.1 Protected areas

A protected area is a special case of a qualified area. It is a string of character positions, the contents of which are protected against manual alteration and may also be protected against erasure depending on the setting of the ERASURE MODE (ERM). A protected area may, in general, be either guarded or unguarded.

6.5.2.2 Guarded areas

A guarded area is a special case of a qualified area. It is a protected area the contents of which are excluded from transmission as a data stream and from transfer to an auxiliary input/output device, depending on the setting of the GUARDED AREA TRANSFER MODE (GATM).

Alternatively to using DEFINE AREA QUALIFICATION (DAQ), START OF GUARDED AREA (SPA) combined with END OF GUARDED AREA (EPA) can be used. The start of a guarded area is then established by START OF GUARDED AREA (SPA). The end of the guarded area is then established by END OF GUARDED AREA (EPA). The character position which is the active presentation position after receipt of SPA is the first character position of the guarded area. The character position which is the active presentation position before the receipt of EPA is the last character position of the guarded area.

NOTE - Interaction between guarded areas established by SPA and EPA, and those established by DAQ is not defined by this International Standard.

6.6 Auxiliary input/output devices

This clause is applicable primarily to buffered input/output devices. It may also be applicable to unbuffered input/output devices when the SEND/RECEIVE MODE (SRM) is set to SIMULTANEOUS.

Data transfer from, or to, an auxiliary input/output device is initiated either by the operation of an appropriate key on a keyboard or by the control function MEDIA COPY (MC) appearing in the received data stream.

If there is more than one auxiliary input/output device, the relevant device is specified by the parameter value of MC.

An input data stream which is received from an auxiliary device is processed in the same way as any other received data stream. The method of terminating the input from the auxiliary device depends on the implementation.

6.7 Tabulation and fields

Tabulation is the technique of identifying character positions or lines, as related to the presentation component, for the purpose of arranging information systematically. A character position or a line which is identified for tabulation is indicated by a tabulation stop.

Tabulation stops in the presentation component introduce fields and act as boundaries between fields. The field is defined as a string of character positions starting at the position of the character tabulation stop (beginning of the field) up to, but not including, the position of the following character tabulation stop (end of the field). The order of character positions within the field as well as the order of tabulation stops within a line in the presentation component is determined by the character path of this line.

A character tabulation stop is assigned to a character position by the control functions CURSOR TABULATION CONTROL (CTC), CHARACTER TABULATION SET (HTS), TABULATION ALIGNED CENTRED (TAC), TABULATION ALIGNED LEADING EDGE (TALE), TABULATION ALIGNED TRAILING EDGE (TATE), TABULATION CENTRED ON CHARACTER (TCC).

A line tabulation stop is assigned to a line by the control function LINE TABULATION SET (VTS).

7 Modes

7.1 The concept of modes

This International Standard is intended to be applicable to a very large range of devices, in which there are variations. Some of these variations have been formalized in the form of modes. They deal with the way in which a device transmits, receives, processes, or images data. Each mode has two states. The reset state is shown first in the definitions in 7.2.

The states of the modes may be established explicitly in the data stream by the control functions SET MODE (SM) and RESET MODE (RM) or may be established by agreement between sender and recipient. In an implementation, some or all of the modes may have one state only.

To ensure data compatibility and ease of interchange with a variety of equipment the use of modes is deprecated. If modes have to be implemented for backward compatibility it is recommended that the reset state of the modes be the initial state. Otherwise, explicit agreements will have to be negotiated between sender and recipient, to the detriment of "blind" interchange.

7.2 Definition of modes

The modes are set and reset by the control functions SET MODE (SM) and RESET MODE (RM). The parameters of SM or RM specify the modes which are affected. In each of the mode definitions below, the first state is caused by RM, the second one by SM.

The modes are listed in the alphabetical order of their acronyms. It is intended that the acronyms be retained in all translations of the text. See also table 6.

Table 6 - Mode summary

Acronym	Reset-state set-state	Name	Defined in
BDSM	EXPLICIT IMPLICIT	BI-DIRECTIONAL SUPPORT MODE	7.2.1
CRM	CONTROL GRAPHIC	CONTROL REPRESENTATION MODE	7.2.2
DCSM	PRESENTATION DATA	DEVICE COMPONENT SELECT MODE	7.2.3
ERM	PROTECT ALL	ERASURE MODE	7.2.4
FEAM	EXECUTE STORE	FORMAT EFFECTOR ACTION MODE	7.2.5
FETM	INSERT EXCLUDE	FORMAT EFFECTOR TRANSFER MODE	7.2.6
GATM	GUARD ALL	GUARDED AREA TRANSFER MODE	7.2.7
GRCM	REPLACING CUMULATIVE	GRAPHIC RENDITION COMBINATION MODE	7.2.8
HEM	FOLLOWING PRECEDING	CHARACTER EDITING MODE	7.2.9
IRM	REPLACE INSERT	INSERTION REPLACEMENT MODE	7.2.10
KAM	ENABLED DISABLED	KEYBOARD ACTION MODE	7.2.11
MATM	SINGLE MULTIPLE	MULTIPLE AREA TRANSFER MODE	7.2.12
PUM	CHARACTER SIZE	POSITIONING UNIT MODE	subclause F.4.1 of annex F
SATM	SELECT ALL	SELECTED AREA TRANSFER MODE	7.2.14
SRM	MONITOR SIMULTANEOUS	SEND/RECEIVE MODE	7.2.15
SRTM	NORMAL DIAGNOSTIC	STATUS REPORT TRANSFER MODE	7.2.16
TSM	MULTIPLE SINGLE	TABULATION STOP MODE	7.2.17
TTM	CURSOR ALL	TRANSFER TERMINATION MODE	7.2.18
VEM	FOLLOWING PRECEDING	LINE EDITING MODE	7.2.19
ZDM	ZERO DEFAULT	ZERO DEFAULT MODE	subclause F.4.2 of annex F

The definitions of the modes cover bi-directional devices which have both a presentation component (see 6.1.1) and a data component (see 6.1.3). In the case of a uni-directional device or a bi-directional device without a data component, all references to active data position, data component, character progression, etc., are to be read as referring to active presentation position, presentation component, character path, etc., resp.

7.2.1 BDSM - BI-DIRECTIONAL SUPPORT MODE

EXPLICIT:

Control functions are performed in the data component or in the presentation component, depending on the setting of the DEVICE COMPONENT SELECT MODE (DCSM).

IMPLICIT:

Control functions are performed in the data component. All bi-directional aspects of data are handled by the device itself.

7.2.2 CRM - CONTROL REPRESENTATION MODE

CONTROL:

All control functions are performed as defined; the way formator functions are processed depends on the setting of the FORMAT EFFECTOR ACTION MODE (FEAM). A device may choose to image the graphical representations of control functions in addition to performing them.

GRAPHIC:

All control functions, except RESET MODE (RM), are treated as graphic characters. A device may choose to perform some control functions in addition to storing them and imaging their graphical representations.

NOTE - All control functions, except RM, are affected.

7.2.3 DCSM - DEVICE COMPONENT SELECT MODE

PRESENTATION:

Certain control functions are performed in the presentation component. The active presentation position (or the active line, where applicable) in the presentation component is the reference position against which the relevant control functions are performed.

DATA:

Certain control functions are performed in the data component. The active data position (or the active line, where applicable) in the data component is the reference position against which the relevant control functions are performed.

NOTE - Control functions affected are: CPR, CR, DCH, DL, EA, ECH, ED, EF, EL, ICH, IL, LF, NEL, RI, SLH, SLL, SPH, SPL.

7.2.4 ERM - ERASURE MODE

PROTECT:

Only the contents of unprotected areas are affected by an erasure control function.

ALL:

The contents of protected as well as of unprotected areas are affected by an erasure control function.

NOTE - Control functions affected are: EA, ECH, ED, EF, EL.

7.2.5 FEAM - FORMAT EFFECTOR ACTION MODE

EXECUTE:

Formator functions are performed immediately and may be stored in addition to being performed.

STORE:

Formator functions are stored but not performed. In this case, the specified action is intended to be performed by another device when the associated data are transmitted or transferred.

NOTE - Control functions affected are: BPH, BS, CR, DTA, FF, FNT, GCC, GSM, GSS, HPA, HPB, HPR, HT, HTJ, HTS, HVP, JFY, NEL, PEC, PFS, PLD, PLU, PPA, PPB, PPR, PTX, QUAD, RI, SACS, SAPV, SCO, SCS, SGR, SHS, SLH, SLL, SLS, SPD, SPI, SPQR, SRCS, SRS, SSU, SSW, STAB, SVS, TAC, TALE, TATE, TBC, TCC, TSS, VPA, VPB, VPR, VTS.