

ANSI/CEA Standard

Line 21 Data Services

ANSI/CEA-608-E R-2014

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(Formulated under the cognizance of the CEA **R4.3 Television Data Systems Subcommittee.**)

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FOREWORD

This standard was developed under the auspices of the Consumer Electronics Association (CEA) Technology & Standards R4.3 Television Data Systems Subcommittee.

eXtended Data Services (XDS) are additional services provided in Line 21 Field 2 data. New services may have been standardized by CEA since the publication of this standard. No attempt is made to list XDS Private Data Services, although it is requested that users of such services notify CEA of Private Data packet assignments. XDS services, whether Private Data or not, may not be meant for transmission to the television receiver.

CEA-608-E supersedes CEA-608-D.

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LINE 21 DATA SERVICES

1 Purpose and Scope

This section describes the purpose and scope of the entire standard.

1.1 Purpose

CEA-608-D is a technical standard and guide for using or providing Closed Captioning services or other data services embedded in line 21 of the vertical blanking interval of the NTSC video signal. This includes provision for encoding equipment and/or decoding equipment to produce such material as well as manufacturers of television receivers which are required to include such decoders in their equipment as a matter of regulation (see Annex F). It is also a usage guide for producing material using such equipment, and for distributing such material.

This standard describes the specifications for creation, transmission, reception, and display of caption data, plus the relationship of Caption Mode data to other line 21 data. A comparison of decoders meeting Federal Communications Commission (FCC) rules to all decoders designed prior to the drafting of those rules and a timetable for the implementation of features which are unique to the different generations of decoders are retained from the prior version.

ATSC DTV Closed Captioning, as well as a method of carrying the CEA-608-E data stream in ATSC DTV is documented in CEA-708-C.

Guidance on digital transmission of CEA-608-E signals is provided in SMPTE 334 and SMPTE EG-43.

1.2 Scope

Where recommendations or requirements are made for service providers, they apply to anyone who creates, transmits, or modifies data, i.e., someone other than an equipment manufacturer. For example, a "caption service provider" could be the agency which creates the captions for a program, the distribution system (e.g. network) which carries the captions on line 21, or the local affiliate which uses its own data encoder to insert Text Mode or XDS between the captions. In a few cases specific categories of service providers are called out.

It is recommended that regardless of the function to be performed, the reader should become familiar at least with all the introductions to sections of this standard to avoid unintentionally degrading other services, and then concentrate on the sections which are appropriate to the activity being undertaken.

While there is no legal requirement to abide by this standard or its recommended practices, except for those portions labeled regulatory, it is strongly recommended that this advice be followed by line 21 data service providers and manufacturers of equipment used to transmit and receive these data services. Failure to follow these practices is likely to result in a degraded and inferior service and a non-uniform, unpredictable display of captions, text or operation of XDS features on the consumer's receiver.

It is necessary to abide by this Standard to be CEA-608-E compliant, however while methods described in this standard for the inclusion of a service shall be followed, unless otherwise stated no service is mandatory.

1.3 Other Vertical Interval Lines

Nothing in this standard shall preclude the use of the methods described in this standard for transmission of data on other lines of the Vertical Interval or when allowed the video portion of the NTSC television signal.

1.4 Antecedent Documents

CEA-608-E not only is an updated version, but it also includes and supersedes those documents listed in Section 2.4.

2 References

The following standards contain provisions that, through reference in this text, constitute normative provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Section 2.1.

2.1 Normative References

CEA-542-B, Cable Television Channel Identification Plan, July 2003

ECMA 262, Script language specification (June, 1997)

FIPS PUB 6-4, Counties and Equivalent Entities of the United States, Its Possessions, and Associated Areas, 8/31/90

IEC 61880-2: (2002-09) Video System (525/60) Video and Accompanied Data Using the Vertical Blanking Interval -- Part 2 525 Progressive Scan System

IEC 61880: (1998-01), Video System (525/60) Video and Accompanied Data Using the Vertical Blanking Interval -- Analogue Interface

ANSI/IEEE 511:1979, Standard on Video Signal Transmission Measurement of Linear Waveform Distortion

IETF RFC 791, Internet Protocol: DARPA Internet Program—Protocol Specification

IETF RFC 1071, Computing the Internet Checksum

IETF RFC 1738, Uniform Resource Locators (URL), (December, 1984)

ISO-8859-1: 1987, Information processing—8-bit single-byte coded graphic character sets – Part 1: Latin alphabet No. 1

ISO-8601: 1988, Data elements and interchange formats - Information interchange - Representation of dates and times

2.2 Informative References

ATSC A/53E, ATSC Digital Television Standard, With Amendment 1, April 18, 2006

ATSC A/65C, Program and System Information Protocol for Terrestrial Broadcast and Cable, With Amendment No. 1, May 9, 2006

CEA-708-C, Digital Television (DTV) Closed Captioning, July, 2006

CEA-766-C, U.S. Region Rating Table (RRT) and Content Advisory Descriptor for Transport of Content Advisory Information using ATSC Program and System Information Protocol (PSIP), July, 2006

Federal Communications Commission, R&O FCC 98-35,
<http://www.fcc.gov/Bureaus/Cable/Orders/1998/fcc98035.html>

Federal Communications Commission, R&O FCC 98-36,
http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/1998/fcc98036.html

CRTC letter decision, Public Notice CRTC 1996-36, Respecting Children: A Canadian Approach to Helping Families Deal with Television Violence,
(English) <http://www.crtc.gc.ca/archive/ENG/Notices/1996/PB96-36.HTM>
(French) <http://www.crtc.gc.ca/archive/FRN/Notices/1996/PB96-36.HTM>

CRTC letter decision, Public Notice CRTC 1997-80, Classification System for Violence in Television Programming

(English) <http://www.crtc.gc.ca/archive/ENG/Notices/1997/PB97-80.HTM>

(French) <http://www.crtc.gc.ca/archive/FRN/Notices/1997/PB97-80.HTM>

SMPTE 12-1999, Television, Audio and Film—Time and Control Code

SMPTE 170-2004, Composite Analog Video Signal – NTSC for Studio Applications

SMPTE 331-2004, Television – Element and Metadata Definitions for the SDTI-CP

SMPTE EG-43-2004, System Implementation of CEA-708-B and CEA-608-B Closed Captioning

2.3 Regulatory References

47 C.F.R. 15.119, Closed Caption Decoder Requirement for Television Receivers

47 C.F.R. 15.120, Program Technology Blocking Requirements for Television Receivers

2.4 Antecedent References

EIA-702, Copy Generation Management System (Analog) (1997)

EIA-744-A, Transport of Content Advisory Information using Extended Data Service (XDS) (1998)

EIA-745, Transport of Cable Channel Mapping System Information using Extended Data Service (XDS), 1997

EIA-746-A, Transport of Internet Uniform Resource Locator (URL) Information Using Text-2 (T-2) Service (1998)

EIA-752, Transport of Transmission Signal Identifier (TSID) Using Extended Data Service (XDS) (1998)

EIA-806, Transport of ATSC PSIP Information to Affiliate Broadcast Stations Using Extended Data Service (XDS) (2000)

NOTE—The topic discussed in EIA-806 has been removed from CEA-608-E.

2.5 Reference Acquisition

ANSI/CEA/EIA Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800.854.7179; Fax 303.397.2740; Internet <http://global.ihs.com> ; Email global@ihs.com

SMPTE Standards:

- Society of Motion Picture & Television Engineers, 595 W. Hartsdale Ave., White Plains, NY 10607-1824 USA Phone: 914.761.1100 Fax: 914.761.3115; Email: eng@smpte.org; Internet <http://www.smpte.org>

ATSC Standards:

- Advanced Television Systems Committee (ATSC), 1750 K Street N.W., Suite 1200, Washington, DC 20006; Phone 202.828.3130; Fax 202.828.3131; Internet <http://www.atsc.org/standards.html>

ECMA Standards:

- European Computer Manufacturers Association (ECMA), 114 Rue du Rhône, CH1204 Geneva, Switzerland; Internet <http://www.ecma-international.org/publications/index.html>

FCC

- FCC Regulations, U.S. Government Printing Office, Washington, D.C. 20401; Internet <http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199847>

FIPS Standards:

- National Institute of Standards and Technology and Information Technology, U.S. Government Printing Office, Washington, D.C. 2040; <http://www.itl.nist.gov/fipspubs/>

IETF Standards:

- Internet Engineering Task Force (IETF), c/o Corporation for National Research Initiatives, 1895 Preston White Drive, Suite 100, Reston, VA 20191-5434 USA; Phone 703-620-8990; Fax 703-758-5913; Email ietf-info@ietf.org ; Internet <http://www.ietf.org/rfc/rfc0791.txt?number=791> and <http://www.ietf.org/rfc/rfc1071.txt?number=1071>

IEC and ISO Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com> ; Email global@ihs.com
- ISO Central Secretariat, 1, rue de Varembe, Case postale 56, CH-1211 Genève 20, Switzerland; Phone + 41 22 749 01 11; Fax + 41 22 733 34 30; Internet <http://www.iso.ch> ; Email central@iso.ch

3 Definitions

3.1 Definitions

With respect to definition of terms, abbreviations and units, the practice of the Institute of Electrical and Electronics Engineers (IEEE) as outlined in the Institute's published standards shall be used. Where an abbreviation is not covered by IEEE practice or CEA-608-E practice differs from IEEE practice, then the abbreviation in question is described in Section 3.2.1 or 3.2.2.

3.2 Terms Employed

3.2.1 Acronyms¹

AC	Article Clear
AE	Article End
ANE	Article Name End
ANS	Article Name Start
AOF	Reserved (formerly Alarm Off)
AON	Reserved (formerly Alarm On)
ANSI	American National Standards Institute
ASB	Analog Source Bit
ASCII	American Standard Code for Information Interchange
APS	Analog Protection System
ANSI	American National Standards Institute
ATSC	Advanced Television Systems Committee
BS	Backspace
CEA	Consumer Electronics Association
CGMS	Copy Generation Management System
CR	Carriage Return
CRTC	Canadian Radio-television and Telecommunications Commission
DER	Delete to End of Row
DVR	Digital Video Recorder
ECMA	European Computer Manufacturers Association
EDM	Erase Displayed Memory
EIA	Electronic Industries Alliance
ENM	Erase Non-Displayed Memory
EOC	End of Caption
FCC	Federal Communications Commission
FIPS	Federal Information Processing Standard
FON	Flash On
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IRE	Institute of Radio Engineers
ISO	International Organization for Standardization
NRZ	Non-Return-to-Zero
NTSC	National Television Standards Committee
PAC	Preamble Address Code
PSP	Pseudo Sync Pulse
RCD	Redistribution Control Descriptor
RCL	Resume Caption Loading
RDC	Resume Direct Captioning
RTD	Resume Text Display
RU2	Roll Up Captions 2 Rows
RU3	Roll Up Captions 3 Rows
RU4	Roll Up Captions 4 Rows
SMPTE	Society of Motion Picture and Television Engineers

¹ While some commands are included in Section 3.2.1, a complete list of commands may be found in 47 C.F.R. §15.119.

TC1	TeleCaption I
TC2	TeleCaption II
TO1	Tab Offset 1 Column
TO2	Tab Offset 2 Columns
TO3	Tab Offset 3 Columns
TR	Text Restart
TSID	Transmission Signal Identifier
URL	Uniform Resource Locator
UTC	Coordinated Universal Time ²
XDS	eXtended Data Service

3.2.2 Glossary (Informative)

Base Row: The bottom row of a roll-up display. The cursor always remains on the base row. Rows of text roll upward into the contiguous rows immediately above the base row.

Box: The area surrounding the active character display. In Text Mode, the box is the entire screen area defined for display, whether or not displayable characters appear. In Caption Mode, the box is dynamically redefined by each caption and each element of displayable characters within a caption. The box (or boxes, in the case of a multiple-element caption) includes all the cells of the displayed characters, the non-transparent spaces between them, and one cell at the beginning and end of each row within a caption element in those decoders which use a solid space to improve legibility.

Character: A single group of 7 data bits plus a parity symbol.

Captioning: Textual representation of program dialogue that may include other program descriptions.

Caption File: A computer file that defines the captions used by a captioning encoder.

Captioning Diskette: A computer diskette with a caption file written on it. This file has captioning data used by an encoder to insert captions.

Captioning Sync: The timing relationship between the picture and the appearance of captions on that picture. See Section E.2.

Caption Master Tape: The earliest videotape generation of a production on which captions have been recorded.

Cell: The discrete screen area in which each displayable character or space may appear. A cell is one row high and one column wide.

Channel Grazing: When a viewer changes channels frequently to search for a desired show.

Channel Surfing: When a viewer changes channels frequently to search for a desired show.

Column: One of 32 vertical divisions of the screen, each of equal width, extending approximately across the full width of the Safe Caption Area (see also). Two additional columns, one at the left of the screen and one at the right, may be defined for the appearance of a box in those decoders which use a solid space to improve legibility, but no displayable characters may appear in those additional columns. For reference, columns may be numbered 0 to 33, with columns 1 to 32 reserved for displayable characters.

Control Code or Control Character: The framing characters of an XDS packet, or the characters that control the display of text in closed captioning.

Default: 1) A condition which exists when no explicit parameters are given, or 2) A specified parameter to be used when an explicit parameter is not intended to be recognized or acted upon. Examples:

² Since unanimous agreement could not be achieved by ITU on using either the English word order CUT, or the French word order, TUC, a compromise to use neither was reached.

- a) If no PAC is received after a Carriage Return (CR) in roll-up style captioning, the default position for the new row is Indent 0.
- b) A mid-screen PAC can be preceded by a default address that is used by any decoder which does not recognize mid-screen PACs.

Display Disable: To turn off the display of captions or text (and accompanying background) at the receiver, rather than through codes transmitted on line 21 which unconditionally erase the display. The receiver may disable the display because the user selects an alternate mode, e.g. TV Mode, or because no valid line 21 data are present.

Display Enable: To allow the display of captions or text when they are transmitted on line 21 and received as valid data.

NOTE—For display to be enabled, the user shall have selected Caption Mode or Text Mode, and valid data for the selected mode shall be present on line 21.

Displayable Character: Any letter, number, or symbol which is defined for on-screen display, plus the 0x20 space.

Element: In a pop-on or paint-on style caption, each contiguous area of cells containing displayable characters and non-transparent spaces between those characters. A single caption may have multiple elements. An element is not necessarily a perfect rectangle, but may include rows of differing widths.

Encoder: A device that adds the caption data signal to line 21 of an NTSC video signal.

Erase Display: In Caption Mode, to clear the screen of all characters (and accompanying background) in response to codes transmitted on line 21. The caption service provider can accomplish the erasure either by sending an Erase Displayed Memory (EDM) command or by sending an Erase Non-Displayed Memory (ENM) command followed by an End of Caption (EOC) command, effectively making a blank caption "appear." Display can also be erased by the receiver when the caption memory erasure conditions are met, such as the user changing TV channels.

To clear the screen of all characters without affecting the solid background box in Text Mode, the text service provider can accomplish the erasure by sending a Text Restart (TR) command. Display can also be erased by the receiver under the same memory erasure conditions as captions.

Field Reversal: Some video processing equipment (Time Base Correctors, Tape Machines, etc.) may place video from field 1 on field 2, and place video from field 2 on field 1.

General Purpose Captioning: Captioning done for wide distribution in which the exact specifications of the decoders to be used are unknown. Open captioning is not general purpose because the specifications of the character generator are known and controllable. Closed captioning done for a closed user group in which the decoder model used for viewing can be specified is also not general purpose. Thus, this phrase refers to closed captioning which may be accessed by general audiences who provide their own decoders and who, therefore, need captions which provide compatible displays on all decoder models.

Hex Notation: Hexadecimal notation in the format 0x00, 0x01... 0x0F. In some tables the prefix 0x may not be included.

Immediately: When receiver functions are supposed to occur "immediately," it is expected that they occur in the same video frame as or no more than one video frame after, the receipt of the command which triggers the function. In the case of redundant control-byte pairs, such as Erase Displayed Memory, receipt of the command means upon receipt of the first of the redundant pairs, assuming it passes parity.

Informational Character: The characters within the packet that contain the message. Informational Characters are always sent in pairs. This excludes the Start, Continue, End, Type & Checksum characters.

Integration: The process of interleaving data from multiple sources into a single field of line 21. See Section E.4.

IRE Units: A linear scale for measuring the relative amplitudes of the components of a television signal with the zero reference at blanking level. For example, composite video systems are normally operated with 140 IRE units = 1.0 V p-p, while component video systems are normally operated with 100 IRE units = 0.7 V p-p. (From SMPTE 170 Annex B).

Live Captioning: The insertion of captioning information into a video feed during transmission to the viewer. This may be done via a "real-time" (simultaneous caption creation and transmission) or "live-display" (manually triggered captions from a computer file) method.

Odd Parity: An odd number of '1' bits within the 8 bit byte.

Packet: A collection of two byte pairs that conveys a complete piece of information.

Packet Class: A group of XDS-related packet types. Seven Classes are used: Current, Future, Channel Information, Miscellaneous, Public Service, Reserved, and Private Data.

Packet Type: A single and complete piece of XDS information. 127 unique Packet Types are allowed for each Packet Class.

Post-production Master Tape: The earliest videotape generation of a complete production. This usually does not have line 21 data encoded.

Program Distribution Path: The various locations that a television program passes through from creation to viewing. See Section 4.2 and Figure 1.

Re-encoding - Reading the existing line 21 data in a video feed, combining this data with data from a local source and inserting this combined data back into line 21. See Integration in Section E.4.

Row: One of 15 horizontal divisions of the screen, each of equal height, extending across the full width of the Safe Caption Area.

Safe Caption Area: The area of the television picture within which captioning and text shall be displayed to ensure visibility of the information on the majority of home television receivers.

Solid Background: An opaque mask shown behind displayable characters to enhance their legibility. In Caption Mode, use of a solid background is optional; when used, the solid background changes shape and size to conform to the caption element(s) displayed. In Text Mode, use of a solid background is required; the solid background completely fills the box area regardless of the presence or parameters of displayable characters.

Solid Space: One cell of the solid background in which no displayable character is present.

Special Characters: Displayable characters (except for "transparent space") which require a two-byte sequence of one non-printing and one printing character. The non-printing byte varies depending on the data channel. Regular characters require a unique one-byte code which is the same in either data channel.

Sub-packet: A contiguous group of two-character pairs that begins with a XDS control character and ends with a command to restore operation to the previous state.

Text: When written with an upper-case "T," refers to Text Mode. When written with a lower-case "t," refers to any combination of displayable characters.

Transparent Space: Transmitted as a special character, it is a one-column-wide space behind which program video is always visible.

Type Character: The character following the Control character which indicates a specific XDS packet type.

Window: The invisible rectangle that defines the top and bottom limits of a roll-up caption. The window can be 2 to 4 rows high. The lowest row of the window is called the base row.

3.3 Compliance Notation

As used in this standard, “*shall*” denotes a mandatory provision of the standard. “*Should*” denotes a provision that is recommended but not mandatory. “*May*” denotes a feature, whose presence does not preclude compliance that may or may not be present at the option of the implementer.

Unless a section or subsection is explicitly labeled Informative or Regulatory, it shall be considered Normative. A section or subsection labeled Informative or Regulatory remains as such through the end of that (sub) section level.

Each Annex is explicitly labeled as Normative, Informative, or Regulatory.

4 Background (Informative)

4.1 Data Types in the Line 21 Signal

The data signal on line 21 consists of independent data on field 1 and field 2. Each data channel may contain specific types of data packets as shown in Table 1.

Field 1 Packets				Field 2 Packets			
Name*	Field	Data Channel	Description	Name*	Field	Data Channel	Description
CC1	1	C1	Primary Synchronous Caption Service	CC3	2	C1	Secondary Synchronous Caption Service
CC2	1	C2	Special Non-Synchronous Use Captions	CC4	2	C2	Special Non-Synchronous Use Captions
T1	1	C1	First Text Service	T3	2	C1	Third Text Service
T2	1	C2	Second Text Service	T4	2	C2	Fourth Text Service
				XDS	2	C3	XDS

* The hyphen in the name is optional (T-1 or T1).

Table 1 Field 1 and Field 2 Packets

The Primary Synchronous Caption Service (CC1) is primary language captioning data that should be in sync with the sound, preferably to a specific frame. The Secondary Synchronous Caption Service (CC3) is an alternate captioning data channel usually used for second language captions. CC3 should also be in sync with the sound, although it may be a different language.

The Special Non-synchronous channel (CC2, CC4) carries data that may be intended to augment information carried in the program. It need not be in sync with the sound. Delays of several seconds within the program are to be expected and should not affect the integrity of the data.

Due to bandwidth used by XDS in field 2, Text Services should use channels T1 and/or T2 (field 1) if possible; T3 and T4 should be used only if T1 and T2 are not sufficient.

Text Service T2 may be used for the transmission of broadcast related URLs as specified in Section 7.10.

In the interest of efficient bandwidth utilization, data shall not be duplicated in more than one data channel or field.

Text and XDS have equal priority after captioning. In order to maintain this balance and the integrity of field 2 text data through downstream encoders, Text providers should consider the downstream line 21 environment and restrict Text bandwidth usage as discussed in Section E.7.2.

The XDS packets break down into several packet types (Current program information, Future Program Information, etc.) and some packet types of multiple fields (Program Length, Title, Etc.). Section 9 describes the packet definitions in detail.

This mixture of several data types requires a guideline for processing to assure the integrity of the data is maintained through numerous distribution stages and channels.

This standard recommends a default mode of operating but does not preclude overriding default settings or the addition of features beyond those mentioned here.

4.2 Program Distribution Paths

Figure 1 describes the possible distribution paths for a captioned program. The shaded boxes indicate points that may add data packets to an existing captioning signal.

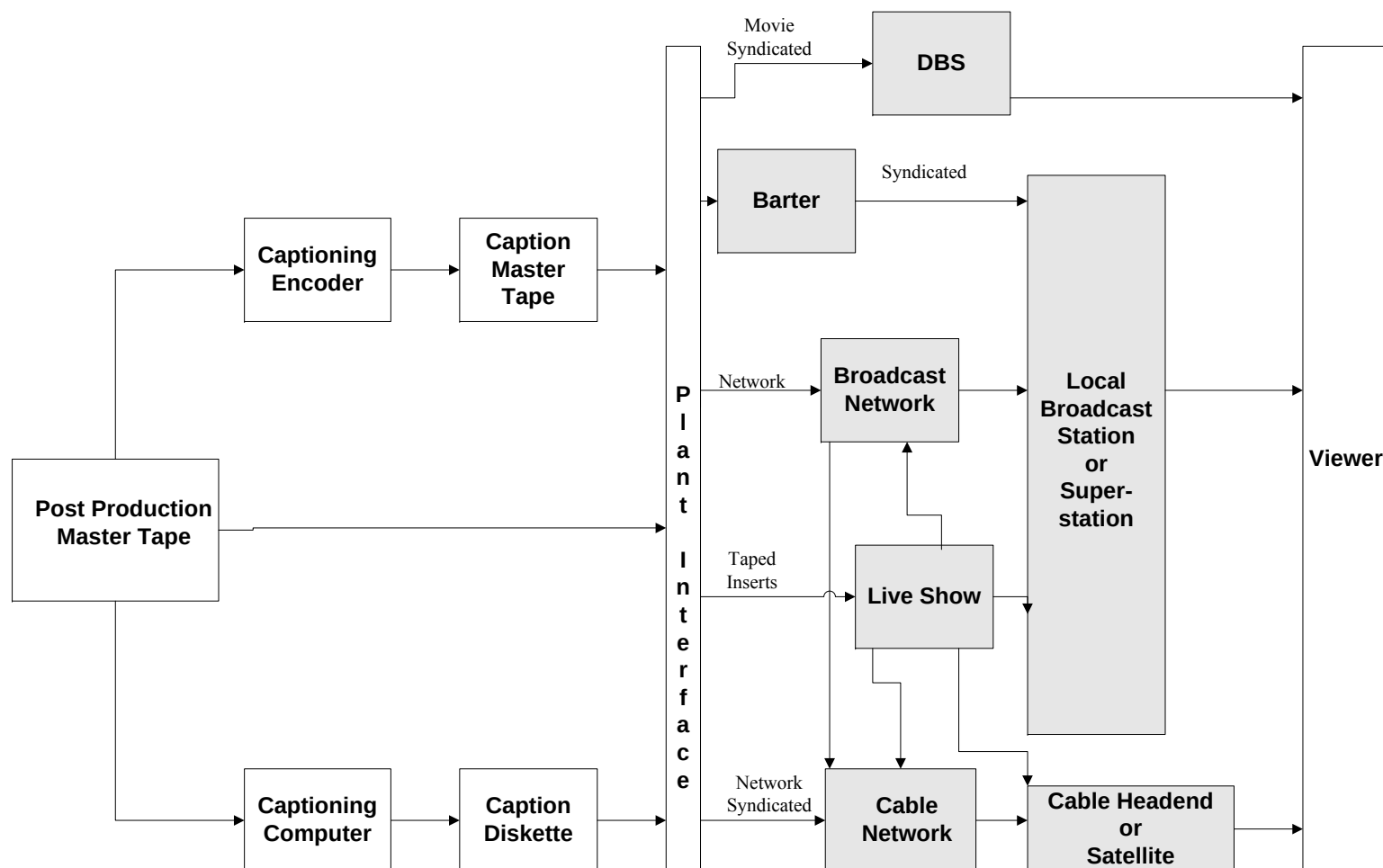


Figure 1 Program Distribution Path for Closed Captioned Programming

Shaded Box Represents a potential re-encoding point

Figure 1 Program Distribution Path for Closed Captioned Programming

5 Signal Characteristics

5.1 Introduction

This section describes the signal format used to encode data for transmission on line 21 of the television picture. It contains important information related to both encoders and decoders. This information is provided to ensure compatibility between encoders and decoders.

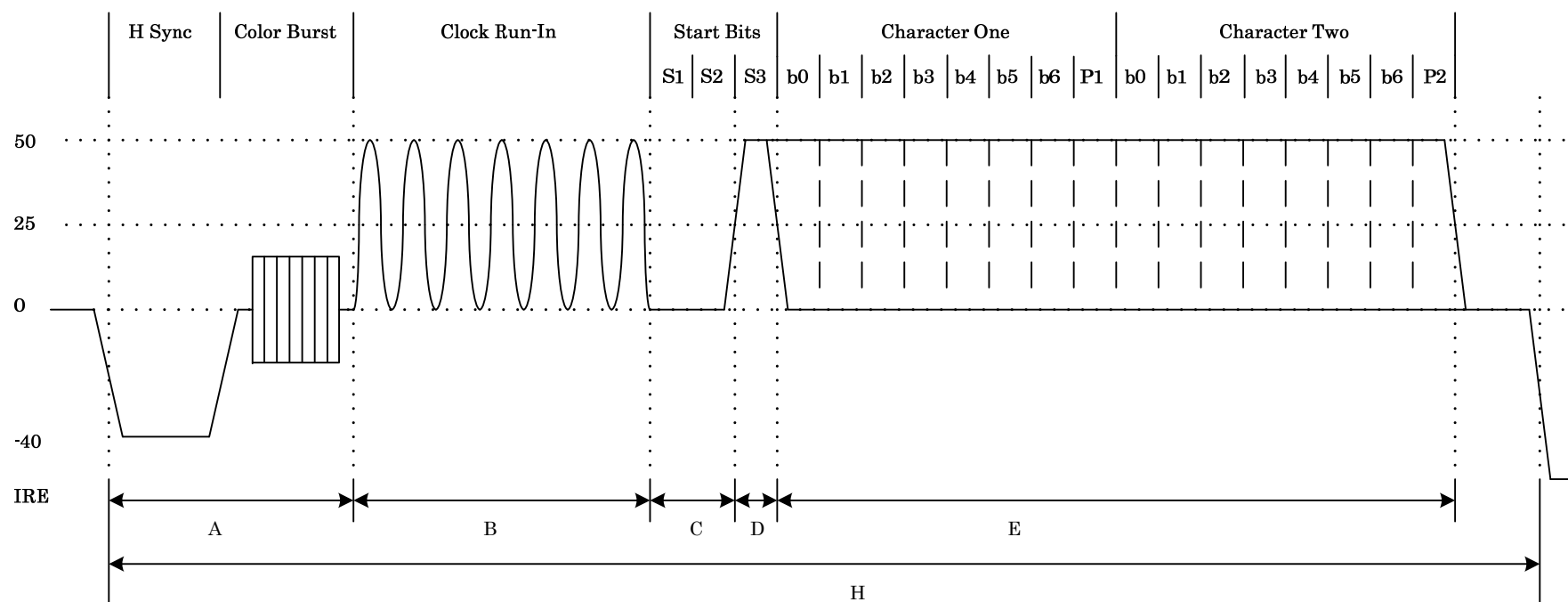
5.2 Line 21 Waveform

Figure 2 shows the signal waveform. The Clock Run-In is a symmetrical sine wave with its maximum and minimum amplitudes being equal to the logic "1" and "0" levels respectively of the encoded data. The Clock Run-In is also in phase with all of the logic level transitions of the Start and Data bits. The three Start bits follow the same specifications as the Data bits, but are always defined to be "0","0","1".

Table 2 shows the signal specifications. Table 2 contains a section related to encoders and another section related to decoders. The specifications for these two sections are different to allow for distortions introduced by the transmission channel. The encoder shall be designed to produce an output that complies with applicable FCC Rules (47 C.F.R. 73.682(a) (22) (i) and 73.699 Fig.17) and should produce an output as close to the nominal specifications as possible.

The decoder shall be designed to accept as large a variance from the nominal specifications as possible.

The tolerances given for the decoder are suggested minimum tolerances.



NOTES:

- 1) All interval measurements are made from the midpoints (half amplitude) on all edges.
- 2) If only Field 1 is being encoded, Field 2 may be 0 IRE, 7.5 IRE (setup) or clock run in with two null characters. If only Field 2 is being encoded, Field 1 shall be clock run in with two null characters.
- 3) If both fields are to be encoded, each field shall be encoded within the tolerances specified in Table 1. The transmission channel between the encoder output and the decoder input shall not change the difference in the amplitudes of corresponding signal parameters between the two fields by more than 5 IRE.
- 4) Deviations introduced anywhere in the signal due to source generated switching transients shall be not greater than ± 2 IRE. However, decoders should accept larger deviations which may be introduced by passing the signal through a transmission channel and/or signal security system.
- 5) No setup level allowed.
- 6) Line 21, Field 2 is also known as line 284.

Figure 2 Line 21 Waveform Diagram

Interval	Description	Encoder Minimum	Encoder Nominal	Encoder Maximum	Decoder Highest Lower Bound	Decoder Nominal	Decoder Lowest Upper Bound
A	H-Sync to Clock Run-In	10.250 μ s	10.500 μ s	10.750 μ s	10.000 μ s	10.500 μ s	11.000 μ s
B	Clock Run-In ^{2,3}		6.5 D (12.910 μ s)			6.5 D (12.910 μ s)	21.4 D ⁴ (4.250 μ s)
C	Clock Run-In to Third Start Bit ³		2.0 D (3.972 μ s)			2.0 D (3.972 μ s)	
D	Data Bit ^{1,3}		1.0 D (1.986 μ s)			1.0 D (1.986 μ s)	
E	Data Characters ⁵		16.0 D (31.778 μ s)			16.0 D (31.778 μ s)	
H	Horizontal Line ¹		32.0 D (63.556 μ s)			32.0 D (63.556 μ s)	
	Rise/Fall Time of Data Bit Transitions ⁶		0.240 μ s	0.288 μ s		0.240 μ s	0.480 μ s
	Data Bit High (Logic Level One) ⁷ Clock Run-In Maximum	48 IRE	50 IRE	52 IRE	38 IRE ⁸	50 IRE	62 IRE ⁸
	Data Bit Low (Logic Level Zero) ⁷ Clock Run-In Minimum	0 IRE	0 IRE	2 IRE	-2 IRE ⁸	0 IRE	12 IRE ⁸
	Data Bit Differential (High-Low) Clock Run-In Differential (Max-Min)	48 IRE	50 IRE	52 IRE	40 IRE ⁸	50 IRE	60 IRE ⁸

NOTES

- 1) The Horizontal Line frequency f_H is nominally 15734.26 Hz $\pm$ 0.05 Hz. Interval D shall be adjusted to $D = 1/(f_H \times 32)$ for the instantaneous f_H at line 21.
- 2) The Clock Run-In signal consists of 7.0 cycles of a 0.5034965 MHz (1/D) sine wave when measured from the leading to the trailing 0 IRE points. The sine wave is to be symmetrical about the 25 IRE level.
- 3) The negative going midpoints (half amplitude) of the Clock Run-In shall be coherent with the midpoints (half amplitude) of the Start and Data bit transitions.
- 4) These values have been chosen to accommodate signals generated by some existing encoders.
- 5) Two characters, each consisting of 7 Data bits and 1 Odd Parity bit.
- 6) 2T Bar (also known as a "Bar with a 2T rise (fall) time"), measured between the 10% and 90% amplitude points. 2T Bar and 2T rise shall be as defined in ANSI/IEEE 511.
- 7) The Clock Run-In Maximum level shall not differ from the Data Bit High level by more than ± 1 IRE. The Clock Run-In Minimum level shall not differ from the Data Bit Low level by more than ± 1 IRE.
- 8) These values have been chosen to accommodate amplitude variations which may be introduced by passing the signal through a transmission channel and/or signal security system.

Table 2 Line 21 Waveform Timing

5.3 Data Formats

The data signal shall be coded using non-return-to-zero (NRZ) format and employing standard ASCII 7 bit plus ODD parity character codes.

6 Closed Captioning

6.1 Introduction

Captions are program-related data which may be transmitted using either field of line 21. Captions are generally a textual transcription of the soundtrack of a video program, and as such are timed to correspond to the soundtrack. For this reason, caption data shall be given absolute priority over other data which may be carried on line 21. Caption data shall not be delayed in order to insert other data on line 21, except as may be technically necessary to control the throughput of all data.

Captioning services differ from other line 21 services, other than program content advisories, in four important ways. First, they are the only services which are always program related. Second, captioning is the only data service given regulatory protection. Third, only captions command precise screen placement and display style. Fourth, captions alone are restricted as to size (in terms of the number of rows of text displayed simultaneously) so as not to obscure too great a portion of the video image. The program content advisories are also different from other line 21 services in the first two ways listed above.

This section specifies two groups of optional features which receiver manufacturers may choose to implement in advanced closed-captioning decoders.

The first group of optional features provides for additional color choices: seven new background colors (to supplement the standard black background color) and one new foreground (character) color, black, to supplement the standard seven foreground colors. This group also provides for a "semi-transparent" background in addition to the standard opaque background.

The second group provides for up to 64 additional characters to permit correct typography in Spanish, French and other European languages. Also included are additional useful punctuation marks, special symbols, and graphic characters.

Implementation of these features is optional. However, to permit compatibility with standard decoders, these features, when implemented, shall be implemented as described in subsequent sections. This section also indicates how caption providers are expected to use these features in order to produce a meaningful display on standard decoders.

6.2 Background and Foreground Attributes

In this section, "Background" refers to the rectangular box which may surround each caption character to set it off from the underlying video (a manufacturer may, however, choose a method other than a rectangular box for this purpose). "Foreground" refers to the characters themselves. "Opaque" refers to a background color which completely obscures (or replaces) the underlying video. "Semi-transparent" refers to a background color which only partially obscures the underlying video; the background color and the underlying video are mixed together in a manner to be decided by the manufacturer.

It is expected that caption providers shall use various combinations of background and foreground colors to convey additional information about a soundtrack. For example, a particular combination might be used to indicate the words of an unseen narrator, while another combination might indicate voices emanating from telephones or loudspeakers. Colors could also help to differentiate among various dramatic characters or to indicate song lyrics, sound effects, etc.

At the manufacturer's option, an extended closed-captioning decoder may support additional Background and Foreground Attribute Codes. If such a decoder also permits the viewer to select background/foreground colors or other attributes, then the viewer's selection should take priority, and the Background and Foreground Attribute Codes described herein are to be ignored whenever the viewer has selected something other than the default.

A manufacturer may choose not to implement the background opacity attribute (opaque versus semi-transparent). In that case, the bit which indicates background opacity is ignored by the decoder; opaque background should be the default. Caption providers should note that semi-transparent background colors may not be available on all extended decoders.

A manufacturer may choose not to implement all the colors in Table 3. If the code for a non-implemented background color is received, the decoder should default to a black background. However, if the Foreground Attribute Code for black foreground is implemented, all the Background Attribute colors should be implemented also. This is to avoid the possibility that a black foreground is selected with a non-implemented background color, resulting in black characters against a black background.

Each Background Attribute Code appears in the display as if a standard space had been received. Such a code sets the current background color (and opacity - opaque or semi-transparent if supported) to the specified value; the displayed space character shall be entirely in the new color and opacity. The new background color and opacity shall remain in effect until the end of the row, or until another Background Attribute Code is received, whichever comes first. If the opacity attribute is not supported, the default opacity is opaque (or another opacity or background feature selected by the viewer or manufacturer). If no Background Attribute Code is received before the first character of an empty row, the default background attribute is opaque black (or other default selected by the viewer or manufacturer).

Each Background Attribute Code incorporates an automatic backspace (BS) for backward compatibility with standard decoders. The captioning service provider is expected to precede each Background Attribute Code with a standard space. A standard decoder shall display the space and ignore the Background Attribute Code. An extended decoder shall also display the space, but upon receipt of the Background Attribute Code, backspace and then display a space which changes the background color and/or opacity. In this way, either type of decoder shall display a single space, and text formatting shall be the same on all decoders.

The Foreground Attribute codes are included in this specification for extended decoders in order to provide the eighth color, black, as a character color. When selecting black as the foreground color, the caption service provider shall select a background color other than black. As with standard Mid Row Codes, the Foreground Attribute Codes turn off italics and flash, and the least-significant bit controls underlining (see Table 3).

Each Foreground Attribute Code incorporates an automatic BS for backward compatibility with standard decoders. The captioning service provider shall precede each Foreground Attribute Code with a standard space. A standard decoder shall display the space and ignore the Foreground Attribute Code. An extended decoder shall also display the space, but then, upon receipt of the Foreground Attribute Code, BS and then display a space which contains the new foreground-color selection. In this way, either type of decoder shall display a single space, and text formatting shall be the same on all decoders.

The behavior of Mid Row Codes, Preamble Address Codes (PACs), Tab Offset Codes and transparent spaces is the same on either type of decoder.

Data Channel 1	Data Channel 2	Mnemonic ¹	Description
10 20	18 20	BWO	Background White, Opaque
10 21	18 21	BWS	Background White, Semi-transparent
10 22	18 22	BGO	Background Green, Opaque
10 23	18 23	BGS	Background Green, Semi-transparent
10 24	18 24	BBO	Background Blue, Opaque
10 25	18 25	BBS	Background Blue, Semi-transparent
10 26	18 26	BCO	Background Cyan, Opaque
10 27	18 27	BCS	Background Cyan, Semi-transparent
10 28	18 28	BRO	Background Red, Opaque
10 29	18 29	BRS	Background Red, Semi-transparent
10 2A	18 2A	BYO	Background Yellow, Opaque
10 2B	18 2B	BYS	Background Yellow, Semi-transparent
10 2C	18 2C	BMO	Background Magenta, Opaque
10 2D	18 2D	BMS	Background Magenta, Semi-transparent
10 2E	18 2E	BAO	Background Black, Opaque
10 2F	18 2F	BAS	Background Black, Semi-transparent

17 2D	1F 2D	BT	Background Transparent
17 2E	1F 2E	FA	Foreground Black
17 2F	1F 2F	FAU	Foreground Black Underline
¹ Because B in the second character of Mnemonics is reserved for the color Blue, Black is represented by A.			

Table 3 Background and Foreground Attribute Codes

6.3 Closed-Group Extensions (Informative)

Receiver manufacturers and caption service providers may choose to assign new features and/or characters to otherwise unassigned portions of the code space. To maintain compatibility, it is recommended that CEA be consulted regarding all such assignments.

The special assignments in Table 4 are used to support two-byte character sets for captioning some Asian languages. These code assignments are not compatible with caption decoders as specified by the FCC; video materials incorporating them should not be distributed in the North American market.

Data Channel 1	Data Channel 2	Description
17 24	1F 24	Select the standard line 21 character set in normal size.
17 25	1F 25	Select the standard line 21 character set in double size.
17 26	1F 26	Select the first private character set.
17 27	1F 27	Select the second private character set.
17 28	1F 28	Select the People's Republic of China character set: GB 2312-80.
17 29	1F 29	Select the Korean Standard character set: KSC 5601-1987.
17 2A	1F 2A	Select the first registered character set.

Table 4 Special Assignments

6.4 Character Sets (Normative)

The characters shown in Section 6.4.1 and Section 6.4.2 use a particular printed font. This font is for illustrative purpose only. The manufacturer may choose to implement the standard and optional characters in any font style they deem appropriate.

6.4.1 Standard

The following 112 standard characters shall be the 'basic set' of closed captioning characters for NTSC.

upper-case alphabet:	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
lower-case alphabet:	a b c d e f g h i j k l m n o p q r s t u v w x y z
accented letters:	á à â ã ç é è ê ì í î ï Ñ ñ ó ô ú û
punctuation and signs:	! , . : ' " # % & @ / () [] + - ÷ < = > ? ° ¢ \$ £ ® ™ ½ ¿
numerals:	0 1 2 3 4 5 6 7 8 9
other characters:	music note, standard space, transparent space, solid block

NOTE—Some of the above characters are incompatible with TeleCaption I. The one fourth and three fourths characters in the TeleCaption I character set have been replaced with the registered mark and trademark symbols, respectively.

NOTE—For the hex codes corresponding to these characters, see Table 49 and Table 50 in Section F.1.1.1, which copies the Character Set Table of 47 C.F.R. 15.119(g).

The basic character set permits mixed-case captioning in Spanish and French, with a few exceptions (for example, the "e" with diaeresis is not available, so the French word "Noël" cannot be spelled correctly in mixed case). For captioning in all upper case the only available accented letter is "Ñ".

6.4.2 Optional Extended Characters

This specification adds enough new upper- and lower-case accented letters to permit complete typography in Spanish and French, as well as certain other languages which use the Latin alphabet.

For the sake of simplicity, ligature combinations such as (Æ, æ, and ij) have been omitted from the table of 64 Extended Characters. The list also includes the ASCII characters which were omitted from the basic closed-captioning specification.

The order of characters in the list approximately reflects their relative importance to the North American audience. It is suggested that a manufacturer who wishes to support less than the full list should add characters in the order shown. Miscellaneous characters have been intermixed with the alphabetic characters so that each additional language group is contained within a block of 8 or 16 characters.

The languages appear in the following order: Spanish, French, Portuguese, German, and Danish. If all 64 characters are included, Italian, Finnish, and Swedish are also supported.

Each of the 64 Extended Characters incorporates an automatic BS. When an Extended Character is received, the cursor moves to the left one column position (unless the Extended Character is the first character on a row), erasing any character which may be in that location, then displays the Extended Character. This action is the same in both caption and Text mode and in all three captioning styles. For

example, to include a lower-case "u" with umlaut/diaeresis in the captioning, the caption provider shall send a standard "u" followed by the Extended Character "ü". On a basic receiver which does not implement Extended Characters, "u" shall be displayed and the code for "ü" shall be ignored. On a receiver which implements Extended Characters, the "u" shall be replaced by "ü".

In pop-on captioning style, the backspacing and replacement occur in the non-displayed memory, so they are invisible to the viewer. In roll-up and paint-on styles, the backspacing and replacement may be visible (although very rapid), depending on implementation.

NOTE1—One of the Extended Characters is the **opening single quote**. This character is intended to match the **apostrophe**, which is included in the basic character set. It is recommended that the apostrophe be curled so that it can be used as a closing single quote; that is, the standard apostrophe and the opening single quote (if implemented) should be mirror images of each other. The basic character table published by the FCC shows the apostrophe as curled.

NOTE2—An extended character cannot be implemented in the 32nd position due to the 32 character per line limit.

Each Extended Character requires two bytes. The first byte is 0x12 or 0x13 for data channel one (0x1A or 0x1B for data channel two). The second byte is in the range of 0x20 to 0x3F.

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Add the 8 characters in Table 5 to the basic character set to support **Spanish**:

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
12 20	1A 20	Á	capital A with acute accent	Portuguese
12 21	1A 21	É	capital E with acute accent	French, Portuguese
12 22	1A 22	Ó	capital O with acute accent	Portuguese
12 23	1A 23	Ú	capital U with acute accent	Portuguese
12 24	1A 24	Ü	capital U with diaeresis or umlaut	French, German, Portuguese
12 25	1A 25	ü	small u with diaeresis or umlaut	French, German, Portuguese
12 26	1A 26	‘	opening single quote [see NOTE3]	
12 27	1A 27	¡	inverted exclamation mark [see NOTE4]	

Table 5 Extended Character Set—Spanish

NOTE3--The curled opening single quote is the mirror image of the standard curled apostrophe (included in the basic character set), which may be used as a curled closing single quote.

NOTE4--The small "i" can serve as an inverted exclamation mark in the standard fonts developed by PBS and NCI, but this might not be true in other fonts.

Add the 8 **miscellaneous** characters in Table 6 to the basic character set plus **Spanish**.

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
12 28	1A 28	*	Asterisk	ASCII
12 29	1A 29	'	plain single quote [see NOTE5]	
12 2A	1A 2A	—	em dash [see NOTE6]	
12 2B	1A 2B	©	Copyright	
12 2C	1A 2C	SM	Service mark [see NOTE7]	
12 2D	1A 2D	●	round bullet	
12 2E	1A 2E	“	opening double quotes	
12 2F	1A 2F	”	closing double quotes	

Table 6 Extended Character Set—Miscellaneous

NOTE5—The plain (non-curved) single quote is ambidextrous (symmetrical), like the standard double-quote character included in the basic character set.

NOTE6—The em dash extends the entire width of its character cell, so that two of them together appear connected. This character is designed to be used with the vertical bar and corner characters for drawing boxes (see Notes 8 and 9).

NOTE7—The service mark symbol is used to satisfy certain legal requirements. There are various legal ways in which this symbol may be drawn or displayed. For example, the "S" may be drawn next to the "M" or over the "M". It is preferred that the service mark be superscripted, i.e., XYZSM. It is left to each individual manufacturer to interpret these symbols in any way that meets the legal needs of the viewer.

Add the 16 characters in Table 7 to the basic set with Spanish to support **French**.

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
12 30	1A 30	À	capital A with grave accent	Italian, Portuguese
12 31	1A 31	Â	capital A with circumflex accent	Portuguese
12 32	1A 32	Ç	capital C with cedilla	Portuguese
12 33	1A 33	È	capital E with grave accent	Italian, Portuguese
12 34	1A 34	Ê	capital E with circumflex accent	Portuguese
12 35	1A 35	Ë	capital E with diaeresis or umlaut mark	
12 36	1A 36	ë	small e with diaeresis or umlaut mark	
12 37	1A 37	Î	capital I with circumflex accent	
12 38	1A 38	Ï	capital I with diaeresis or umlaut mark	Portuguese
12 39	1A 39	ï	small i with diaeresis or umlaut mark	Portuguese
12 3A	1A 3A	Ô	capital O with circumflex	Portuguese
12 3B	1A 3B	Ù	capital U with grave accent	Italian, Portuguese
12 3C	1A 3C	ù	small u with grave accent	Italian, Portuguese
12 3D	1A 3D	Û	capital U with circumflex accent	
12 3E	1A 3E	«	opening guillemets	
12 3F	1A 3F	»	closing guillemets	

Table 7 Extended Character Set—French

Add the 16 characters in Table 8 to the basic set with Spanish and French to support **Portuguese**.

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
13 20	1B 20	Ã	capital A with tilde	
13 21	1B 21	ã	small a with tilde	
13 22	1B 22	Í	capital I with acute accent	
13 23	1B 23	Ì	capital I with grave accent	Italian
13 24	1B 24	ì	small i with grave accent	Italian
13 25	1B 25	Ò	capital O with grave accent	Italian
13 26	1B 26	ò	small o with grave accent	Italian
13 27	1B 27	Õ	capital O with tilde	
13 28	1B 28	õ	small o with tilde	
13 29	1B 29	{	opening brace	ASCII
13 2A	1B 2A	}	closing brace	ASCII
13 2B	1B 2B	\	backslash	ASCII
13 2C	1B 2C	^	caret	ASCII
13 2D	1B 2D	_	Underbar	ASCII
13 2E	1B 2E		pipe	ASCII
13 2F	1B 2F	~	tilde	ASCII

Table 8 Extended Character Set—Portuguese

Add the 8 characters in Table 9 to the basic set with Spanish, French, and Portuguese to support German.

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
13 30	1B 30	Ä	Capital A with diaeresis or umlaut mark	Finnish, Swedish
13 31	1B 31	ä	small a with diaeresis or umlaut mark	Finnish, Swedish
13 32	1B 32	Ö	Capital O with diaeresis or umlaut mark	Finnish, Swedish
13 33	1B 33	ö	small o with diaeresis or umlaut mark	Finnish, Swedish
13 34	1B 34	ß	eszett (mall sharp s)	
13 35	1B 35	¥	yen	
13 36	1B 36	¤	non-specific currency sign	
13 37	1B 37		Vertical bar [see NOTE8]	

Table 9 Extended Character Set—German

NOTE8—The vertical bar extends the entire height of its character cell, so that one of them above another appears connected. This character is designed to be used with the em dash and corner characters for drawing boxes (see Notes 6 and 9).

Add the 8 characters in Table 10 to the basic character set to support **Danish**.

Data Channel 1	Data Channel 2	Symbol	Description	Also needed for:
13 38	1B 38	Å	capital A with ring	Swedish
13 39	1B 39	å	small a with ring	Swedish
13 3A	1B 3A	Ø	capital O with slash	
13 3B	1B 3B	ø	small o with slash	
13 3C	1B 3C	┌	upper left corner [see NOTE9]	
13 3D	1B 3D	┐	upper right corner [see NOTE9]	
13 3E	1B 3E	└	lower left corner [see NOTE9]	
13 3F	1B 3F	┘	lower right corner [see NOTE9]	

Table 10 Extended Character Set--Danish

NOTE9—These four characters extend to the limits of their respective character cells so that contiguous instances of them appear to be connected. They are designed to be used with the em dash and vertical bar for drawing boxes (see Notes 6 and 8).

7 Text Mode

7.1 Introduction

Text Mode is a data service, generally not program related, which may be transmitted using either field of line 21. Text Mode data are always displayed as soon as they are received and are intended to be displayed in a manner which isolates them from the video program used to transmit the data. Once the display window is filled these data are always scrolled upward through the display window provided by the decoder. The Text Mode service provider has limited control of the timing and screen placement of the display, except to transmit data in discrete rows and to affect the placement of characters within their given row.

Discussions of Text Mode in this standard are made by explicit reference or by spelling the word "Text" using an upper-case T. The word "text" with a lower-case t refers to a character or string of characters transmitted for display in any service mode.

This document describes the specifications for creation, transmission, reception, and display of Text Mode data, plus the relationship of that data to other line 21 data.

One of the Text Mode data services (Text-2) may also be used to transmit Internet Uniform Resource Locators (URLs). This is done to associate resources on the Internet with television broadcast content.

7.2 Text Mode Service Providers and Equipment Manufacturers

A Text Mode may be used that consists of data formatted to fill a box which in height is not less than 7 rows and not more than 15 rows (all of which should be contiguous), and in width is not less than 32 columns. Text should be displayed over a solid background to isolate it from the unrelated program video. Each row of text contains a maximum of 32 characters. If the solid background does not extend the full width of the screen, at least one solid space equal to a single column width may be placed before the first character and after the last character of each row to enhance legibility.

7.3 Field 2 Text Bandwidth Considerations

Text and XDS have equal priority. In order to maintain this balance and the integrity of field 2 Text data through downstream encoders, Text providers should consider the downstream line 21 environment and restrict Text bandwidth usage as discussed in Section E.7.2.

7.4 Real-Time Scrolling Display

All products that support the Text Mode shall have the real-time scrolling display. This shall be the default display style for Text. Other display styles may be used in addition, but are not required.

The Text Mode shall be initiated by receipt of a Resume Text Display command (RTD) or TR command (TR). In Text Mode, the method of presenting characters depends on whether all available rows have been put on the screen. When Text Mode has initially been selected and the specified Text memory is empty, the cursor starts at the topmost row, Column 1, and moves down to Column 1 on the next row each time a CR is received until the last available row is reached.

A variety of methods may be used to accomplish the scrolling, provided that the text is legible while moving.

For example, as soon as all of the available rows of text are on the screen, Text Mode switches to the standard roll-up type of presentation. Each time a CR is received, the text in the top row of the window is erased from memory and from the display. The remaining rows of text are each rolled up into the next highest row in the window, leaving the base row blank and ready to accept new text. This roll-up shall appear smooth to the viewer and shall take no more than 0.433 seconds to complete. The cursor is automatically placed at Column 1 (pending receipt of a PAC).

Once the cursor reaches the 32nd character position on any row, all subsequent characters received prior to a CR, PAC, or BS shall be displayed in that position, replacing any previous character occupying that cell.

In Text Mode, the cursor cannot be moved randomly around the window. The cursor moves automatically one column to the right after each character or Mid-Row Code received. Receipt of any PAC shall move the cursor to the indicated indent position on the current row, ignoring row information contained in the address. Tab offsets have the same effect in Text mode as they have in caption mode. The TR command shall erase all characters on the screen and move the cursor to the topmost row, Column 1.

Receipt of a BS shall move the cursor one column to the left, erasing the character or Mid-Row Code occupying that location.

If the reception of data for a row is interrupted by data for an alternate data channel the display of Text shall resume from the same cursor position if a RTD command is received and no PAC is given which would move the cursor. A character remains displayed until scrolled off the top of the window, until another character is addressed to the same location, until erased by a BS, or until all text is erased simultaneously by receipt of a TR Command or by the consumer switching data channels (C1/C2) or fields (F1/F2) or selecting receiver functions which use the display memory of the decoder, or by the sustained loss of valid data.

The Delete to End of Row (DER) command shall erase from memory any characters or control codes starting at the current cursor location and in all columns to its right on the same row.

7.5 Other Real-Time Display Methods

In addition to (but not instead of) the scrolling type of display described above, alternate dynamic display methods may be used under viewer control. These additional methods shall be capable of displaying the same format of text data while providing a suitable method of moving the text to keep up with continuous data reception. Some examples might include:

- a) A reduced size (less than 7 rows) window, scrolling display that could be repositioned on the screen.
- b) A "CRAWL" style in which a single, continuous row of text appears from the right and moves across the screen to the left.
- c) The text may be displayed in a manner that looks like the Paint-On style.
- d) A smaller or larger font size may be used.
- e) A "PAGE-POP-ON" style could be used, where a full page would appear at once, followed by subsequent pages one after the other.
- f) A "PUSH-ON" style could be used where a new page pushes the old page off all at once. The new page appears at the right and is moving left.

Many other display methods might be used to display the Text as a viewer-selected alternative to the default scrolling mode.

7.6 Delayed Display

The data received in the Text Mode may be accumulated in memory during other modes for later retrieval and display. A memory buffer may also be provided to capture data displayed in real time for later review. Any of the display methods may be used to display this optional style.

7.7 Other Interruptions

The Text Mode data stream shall be terminated by the receipt of data for another service. In the case of a received Erase Displayed Memory (EDM) or Erase Non-Displayed Memory (ENM) command, that command shall be acted upon as appropriate for caption processing without terminating the Text Mode data stream. Any unidentified data, PACs, Mid-Row Codes, Flash On (FON), or BS command received following an EDM or ENM shall be considered a continuation of Text Mode data. Only the six caption specific commands in the current data channel shall terminate Text Mode: EOC, RCL, RDC, RU2, RU3, or RU4. In the case of line 21, field 2 services, Text Mode shall also be terminated when an XDS control byte is received.

7.8 Automatic Erasure of Text and Background

Decoders have the option of providing an automatic erase of the displayed caption memory if no activity has occurred for at least 16 seconds (see Section C.9). This option does not apply to Text Mode displays. There should be no automatic erasure of the character-display memory except when valid data are lost, when the viewer selects a non-Text Mode receiver function, or when the viewer switches the receiver channel, data channel, or the selected field.

The reason that Text Mode should not be treated the same way as the Caption Mode is that Text displays are not synchronized to program audio and are often designed for longer durations. Text Mode data may be received with longer delays between bytes because of display considerations and because Caption Mode has priority.

7.9 Data Channel Nomenclature for Text Services

To assist consumers in differentiating among various data channels, the nomenclature Section 4.1 (Table 1) is recommended for use in all materials directing viewers to Text Mode services.

7.10 Transmitting URLs in T-2

Uniform Resource Locators (URLs) are compact string representations of a location for use in identifying an abstract or physical resource on the Internet. URLs can be transmitted in the T-2 service, and may be used by receiving devices to permit the linking of television programs with related content on the Internet so that the content from these Internet services may be combined, mixed or shared by the receiving device.

A URL may be lengthy and its transmission may be interrupted by CC1, CC2 or T1 transmissions. After completing the interruption and before transmitting more of the URL, the transmitter shall return to T2 Text mode by sending a RTD command; the TR command shall not be used for this purpose.

On receipt of a TR command, a receiver may terminate any unfinished URL. That is, it may consider the ensuing T2 text receptions to be a new T2 Text message (which may be text or the start of another URL).

7.11 Character Set

Characters included in URLs on T-2 between 0x20 and 0x7E are interpreted as ISO-8859-1 characters (also known as Latin-1 and compatible with US-ASCII), rather than as CEA-608-E characters. Although the CEA-608-E and ISO-8859-1 character sets are largely compatible, some character codes have different meanings in the two sets. For example, the character 0x2A is an asterisk ("*") in ISO-8859-1, and shall be interpreted as such if it is included in a URL in T-2, but elsewhere in CEA-608-E this character is interpreted as a lower-case "a" with an acute accent ("á"). A complete list of the characters between 0x20 and 0x7E in both character sets is given in Annex A (informative). Characters outside the range 0x20 to 0x7E shall not be used for purposes of Section 7, and shall be discarded. The second byte of two-byte control codes shall also be discarded.

7.12 Standard Syntax

URLs should be transmitted in T-2 by using the following general format:

```
<url>[attr1:val1][attr2:val2]...[attrn:valn][checksum]
```

In other words, the URL is enclosed in angle brackets, followed by zero or more pairs of attributes and values in square brackets, which is then followed by a checksum in square brackets. (These delimiters were chosen because they are explicitly excluded from URLs by IETF 1738 and are present in the standard CEA-608-E character set.) For example:

```
<http://advsponsor.net>[type:sponsor][name:Advertising Sponsor][0xEA77]
```

Previous versions of this standard allowed the word "type:" to be omitted to conserve bandwidth, but this usage has been disallowed because it introduced ambiguities into the syntax and made parsing difficult.

In order to detect data corruption, checksum shall be added at the end. To compute the checksum, adjacent characters in the string (starting with the left angle bracket) are paired to form 16-bit integers; if there are an odd number of characters, the final character is paired with an octet of zeros. The checksum is computed so that the one's complement sum of all of these 16-bit integers plus the checksum equals the 16-bit integer with all 1 bits (-0 in one's complement arithmetic). This checksum is identical to that used in the Internet Protocol (described in IETF RFC 791); further details on the computation of this checksum are given in IETF RFC 1071. This 16-bit checksum is transmitted as four hexadecimal digits in square brackets following the right square bracket of the final attribute/value pair (or following the right angle bracket if there are no attribute/value pairs). The checksum is sent in network byte order, with the

most significant byte sent first. Because the checksum characters themselves (including the surrounding square brackets) are not included in the calculation of the checksum, they shall be stripped from the string by the receiver before the checksum is recalculated there. Characters outside the range 0x20 to 0x7E (including the second byte of two-byte control codes) shall not be included in the checksum calculation.

Four attributes are defined in this standard: "type", "name", "expires", and "script." The "type" attribute indicates what sort of content the URL is associated with (for example, content related to the current television program or with the broadcast network). The type can be any one of the values in Table 11 (and is case insensitive).

Value	URL is associated with
PROGRAM	the current program
NETWORK	the broadcast network
STATION	the local station
SPONSOR	a commercial sponsor or advertiser for the current program
OPERATOR	the service (e.g., cable or satellite) operator

Table 11 URL Types

The "name" attribute indicates a human-readable title for the resource. It can be any string of characters between 0x20 and 0x7E except square brackets (0x5B and 0x5D) and angle brackets (0x3C and 0x3E), and should be kept as short as possible to conserve bandwidth.

The "expires" attribute enables the author to specify the last date the URL is valid, after which it should be ignored by the receiving device. The time format conforms to the ISO-8601 standard. A recommended usage is the form *yyyymmddThhmmss*, where the capital letter "T" separates the date from the time. It is possible to shorten the date string by reducing the resolution. For example *yyyymmddThhmm* (no seconds specified) is valid, as is simply *yyyymmdd* (no time specified at all). For XDS applications, times are assumed to be in UTC (Coordinated Universal Time).

The "script" attribute enables the triggering of specific actions within the content referenced by the URL. The value specifies a script fragment that is to be sent to the page and executed; the scripting language shall be compatible with ECMA-262 (for example, "JavaScript™" or "JScript™"). The script is executed when the content referenced by the URL is displayed on the receiving device. If that content is currently being displayed, the script fragment is immediately executed. The context for the script is the root document corresponding to the URL specified.

In order to conserve the limited bandwidth of line 21, the four standard attributes should be abbreviated as indicated in Table 12.

Long form	Abbreviation
Expires:yyyy	e:yyyy
Name:xxx	n:xxx
Script:zzz	s:zzz
Type:ttt	t:ttt
Type:network	t:n
Type:operator	t:o
Type:sponsor	t:a
Type:station	t:s
Type:program	t:p

Table 12 Abbreviated Forms

Other attributes could be defined at a later date. However, all other single character attribute names and single character "type" attribute values are reserved for use in future standards. Receivers should ignore attributes they do not understand.

All of the following examples would be valid:

```
<http://www.receivermfr.com>[0x6C1D]
<http://www.tvmanufacturer.com>[0xF03A]
<http://www.newmfr.com>[name:New][0xC015]
<http://www.advsponsor.com>[type:sponsor][0xF412]
<http://www.showcontent.com/StandardsToday>[expires:19921228][0x6D86]
<http://www.stdnetwork.com>[t:n][script:doThis("now")][0xE530]
<http://www.newnetwork.org>[t:network][n:NEW][0x42C3]
<http://www.newsponsor.com>[type:sponsor][s:buyNow()][0xA217]
<http://www.lastsite.com>[n:Last][e:19991231T115959][0x65CE]
<http://www.improvedprogram.com>[t:p][n:The Improved Program][0x1FE4]
<http://www.anothersponsor.net>[t:s][strange:ignore][0xFDCB]
```

In the last case, most receivers would presumably ignore the non-standard “strange” attribute and its value, although the bytes would be used in the calculation of the checksum. URLs are not limited to the “http:” scheme, so the following are also valid:

```
<mailto:info@advsponsor.net>[t:s][0x73BC]
<news:alt.tv.program>[t:p][0x141C]
```

7.13 Special Characters

In some cases, it is necessary to include characters in URLs, attributes, or values, that are not within the character set described in 7.11 (i.e., letters in non-English alphabets) or are excluded by this standard for other reasons (i.e., square brackets in scripts or names). These characters shall be encoded using the standard Internet URL mechanism of the percent character (“%”) followed by the two digit hexadecimal value of these characters in ISO-8859-1.

7.14 Bandwidth Considerations

To preserve sufficient bandwidth for other services on field 1 of line 21, and to provide for timely transmission, URLs inserted on T-2 should be as short as possible. Toward that end, service providers are urged to transmit only those attributes that are truly needed for their application, omitting optional attributes if possible, and to use abbreviated attribute names and values in all cases. “Name” attributes should be kept to a minimum, for both bandwidth and display considerations. Where possible, the path component of the URL (following the host name) should be as short as possible or omitted. Because captioning data shall always have priority over all Text-2 data, long URLs generally cannot be broadcast without interruption. URL transmissions should be limited to 25% of the total field 1 bandwidth, even if more bandwidth is available after captioning, to allow for other downstream services.