ATTACHMENT #1: The "CBS Petition." [5]

CBS

CBS Inc., 51 West 52 Street
New York, New York 10019
(212) 975-4321

Law Department

ORIGINAL FILE

RM-3727

Dear Mr. Tricarico: July 28, 1980

Please find attached an original and 11 copies of a Petition for Rulemaking to amend Part 73, Subpart E of the Rules Covering Television Broadcast Stations to Authorize Teletext.

If you have any questions concerning the attached, please contact me at (212) 975-8422.

Very truly yours,

Michael Rose

Michael Rose
Attorney

Honorable William J. Tricarico
Secretary
Federal Communications Commission
1919 "M" Street, N.W.
Washington, D.C. 20554

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Before the
Federal Communications Commission
Washington, D.C. 20554

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In re Amendment of Part 73, Subpart E of the Rules Governing Television Broadcast Stations to Authorize Teletext	RM No. RM-3727

TO: The Commission

PETITION FOR RULEMAKING

CBS Inc. ("CBS"), pursuant to Section 1.401 of the Commission's Rules, hereby petitions the Federal Communications Commission for the issuance of rules which would allow television broadcast licensees to transmit teletext. Adoption of teletext rules and standards is essential at this time to permit implementation by United States broadcasters, such as CBS, of this major technological advance, already in use in other countries, and to channel the United States development of teletext into practical public service in furtherance of the Commission's mandate to "encourage the larger and more effective use of radio in the public interest."*

* Section 303(g), Communications Act of 1934, as amended.

I. Introduction

Teletext is the generic term for systems that transmit alphanumeric information (letters, numbers, characters) to the home television receiver. The information is sent by special data signals transmitted simultaneously with the normal television picture or in lieu of picture information. Equipped with a special decoder, a television receiver can extract and translate that information to appear as letters, numbers and graphics on the television screen. Thus, the viewer has access to an electronic "magazine." With the use of a hand-held control unit, much like a small calculator, the viewer can select from hundreds of "pages" of teletext information. Teletext is an interrogative service. Viewers can request any page at any time in any sequence, and the page stays on the screen as long as the user wants.

As is more fully explained in this Petition, the teletext system CBS proposes is compatible with other presently known communication technologies and is theoretically and practically capable of incorporating future advances. These two qualities -- compatibility and extensibility -- which permit the system to adapt to new features and uses, are among the most desirable qualities of any information system. Technically, the proposed system may be summarized as a software-based, asynchronous, variable format system employing specific scanning lines in the vertical blanking interval ("VBI") or, on a full field basis, using any or all active picture scanning lines.

II. Statement Pursuant to Section 73.682(b) of the Commission's Rules

A. CBS sets forth the following as the nature of the rules proposed: Section 73.681 should be amended to include a definition of the word "Teletext"; Section 73.682(a) should be amended to add a subsection to define the permissible transmission standards; and Section 73.699 should be amended to add a new Engineering Chart, with appropriate footnotes. These amendments are more fully described in Exhibit I, attached hereto.

B. The proposed changes will have no effect on other transmission standards that have been adopted by the Commission for television broadcast stations; the proposed changes are entirely additive.

C. As more fully described in the Engineering Statement, attached as Exhibit II, experimentation and field tests authorized by the Commission and conducted by CBS over its television network and at CBS Owned television station KMOX-TV St. Louis, during 1979-1980, demonstrate that television service can be expanded by the addition of teletext, and that this addition is technically feasible.

D. The proposed changes and modifications of standards will neither affect operation nor contribute to obsolescence of television receivers.

E. Those stations opting to transmit local teletext would require a teletext encoder, a page storage device and a multiplexer to insert teletext into the television signal.

F. For the reasons set forth below, and in the attached exhibits, the proposed teletext system and the associated changes and modifications in the adopted standards will serve the public interest, convenience and necessity.

III. Teletext Uses

A. How it Works

Simply stated, teletext operates by converting pages of information into electronic, digital impulses. All of these pages of information are then superimposed upon a standard television signal and broadcast at a high rate of speed. After transmission of the complete set of pages, the cycle repeats. Each frame or page contains a unique number ("header") which permits a viewer to access a specific page.

A viewer "calls up" a page by pressing numbers on a key pad (as in a hand-held calculator) associated with the teletext decoder. The decoder then searches the continuous stream of information, singles out the specified page, and displays it on the viewer's television screen.

All the foregoing occurs in an under-utilized segment of the television signal -- the vertical blanking interval. This segment normally appears as a horizontal black bar on a deliberately misadjusted television set. Portions of this bar, the first nine lines, are employed in synchronizing the various signal elements, thereby maintaining a precise television picture. Lines 17 through 21 are currently authorized for a variety of ancillary signals. CBS proposes that the remaining lines, specifically lines 10 through 16 of the VBI, be dedicated to teletext.

B. How it Serves

News, sports, weather and financial information could be primary teletext offerings. In-depth stories and features, headlines and sports scores could be programmed and updated and available to the teletext user upon request. Locally generated information could be applied in many ways. For instance, local commuters could check on the latest traffic conditions or updated transportation schedule information. Consumer information, such as a shoppers' guide, could be provided. Reports could be displayed in different ways, including maps and charts; and because the system is interrogative, the viewer need not wait for such reports to "recycle." In fact, the various uses of teletext are as infinite as the imagination.

Teletext could provide exceptionally efficient captioning to the hearing-impaired community, which, of course, could benefit as well from the general visual information provided by teletext. Of particular importance to the hearing-impaired is the economic fact that the market for teletext decoders would be driven by the broader demand of the general public for this flexible information provider, rather than being limited to those desiring specialized captioning. This would help to establish the decoder market in the first instance and would tend to hold down the volume-sensitive price of decoders.

IV. A United States Teletext Standard

A. The Need For A Single Standard and Prompt Adoption

The public interest will be served by prompt adoption of FCC rules and standards for broadcast teletext. Research, experimentation and field testing in Europe for more than ten years and in the United States for the last few years have preceded this Petition. Although the United States has traditionally been in the forefront of advances in broadcast technology, teletext systems have already been introduced, either on a regular or pilot program basis, in England, Australia, France, Canada, Sweden, Japan and West Germany. Other pilot programs are planned to begin shortly in other countries. CBS believes that it is now appropriate to adopt standards governing transmission of teletext.

The system proposed herein is highly extensible, thus permitting system growth and innovation as the technology evolves. Moreover, teletext receivers, manufactured pursuant to these standards, can be made compatible with later systems, such as videotex -- a complementary two-way information system using a telephone set connection.

The CBS field tests and analyses of the various teletext systems, as described in Exhibit II, clearly indicate that the software-based, variable format system* proposed, a modification of the ANTIOPE system, is sufficiently

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* In a variable or asynchronous format system, the position of data on the television scanning line is independent of the position of that data on the display.

developed for immediate utilization and offers many inherent advantages over fixed format systems.* Moreover, the variable format is at the forefront of current international telecommunications technology. Further, CCITT (the international telecommunications organization) has endorsed software-based telecommunications systems for the proposed Integrated Services Digital Network model currently being planned.**

In the United States, systematic development of teletext requires a common standard, which only the Commission can provide.*** Delay now will only discourage the

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* In a fixed or synchronous format system, the position of data on the television scanning line bears a direct relationship with the position of the corresponding characters on the television receiver display. This dependence acts as a restraint both on the creative use of the system and on its future compatibility with other systems, such as videotex.

** See, CCITT Study Group III Meeting Report, April 18-24, 1980, Geneva, Document T-28E.

*** CBS has participated actively in the industry activity currently underway under the aegis of the Broadcast Television Systems Committee, Subcommittee on Teletext, which is being sponsored by EIA, looking towards a recommendation to the Commission of a single teletext standard. The Subcommittee has been very active and productive during the past year and a half of its existence, but is much behind schedule. The Subcommittee was to have completed its task by the first of January in order to arrive at a single teletext "standard.". CBS is concerned that unless a positive step is taken now, teletext may be denied to the American public for a long time to come.

substantial investment and coordination needed to launch teletext by encouraging the proliferation of incompatible systems. This will prove wasteful in the long run to broadcasters, viewers, information suppliers and receiver manufacturers alike. It is commonly recognized by manufacturers that the major portion of teletext decoder costs is in volume-sensitive integrated circuit chips. Consequently, broadcasters and viewers alike will benefit by prompt adoption of teletext rules and standards. CBS believes that after adoption of the proposed standards, teletext receivers will be made available by manufacturers in sufficiently large quantities to reduce significantly the cost of integrated circuit chips, thus placing teletext within the means of the general public.* It can be anticipated, however, that prototype model decoders for field trials and marketing tests will become available almost immediately.

Convinced of the public benefits to be derived from a carefully thought-out teletext system, CBS has engaged in an extensive program of experiments and testing at CBS laboratories and in the field. Test results are offered with this Petition.

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* TELIDON, the other variable format system, is more complex. However, the system proposed herein allows for future incorporation of new features, such as those included in TELIDON, and can do so without making early teletext equipment obsolete. Indeed, the introduction of a practical teletext system will undoubtedly fuel consumer demand for increasing sophistication.

B. CBS Tests

CBS designed its teletext experiments and field tests in order to identify and propose a system which is as inherently compatible and extensible as possible. CBS then extensively tested both principal teletext systems. Key engineering personnel were assigned to this work. A variety of teletext formats were examined. Widely different reception conditions were located and tested.

CBS tested all available systems sufficiently developed for widespread implementation. As discussed in Exhibit II, fully analyzed were (1) the synchronous, fixed format systems known as CEEFAX and ORACLE, including various modifications; and (2) the asynchronous, variable format system known as ANTIOPE. These systems were the only ones which had equipment available for CBS testing. Thus, the TELIDON system, also an asynchronous system, was not tested by CBS.

Test transmissions were conducted under STAs issued by the FCC at the request of CBS. Tests were conducted at KMOX-TV St. Louis and on the CBS Television Network. In connection with the network authorization, additional field tests were conducted in the Los Angeles area using the transmissions of KNXT. Detailed test results are set forth in Appendix A to CBS' annexed Engineering Statement (Exhibit II).

Transmissions for the KMOX-TV test consisted of teletext test pages and related test signals, decoded on European teletext equipment modified for the U.S. 525-line NTSC television system. Five different transmission rates were employed ranging from 3.7 megabits per second (Mb/s) to 6.2 Mb/s.

Extensive field measurements were made throughout the KMOX-TV service area. KNXT transmissions tested teletext reception in the more mountainous Los Angeles terrain. Testing on the CBS Television Network examined the reliability of teletext transmissions over long distances.

C. <u>Transmission Standards</u>

In its evaluation of teletext systems, CBS also studied relevant engineering aspects of all systems. As a result of those studies, CBS proposes the following transmission standards.

<u>Bit rate</u>. CBS proposes that a bit rate of 5.727272 Mb/s be specified as the United States transmission standard. CBS has tested a variety of bit rates, at both higher and lower levels than proposed. The highest fixed bit rate possible would be preferable in the interest of spectrum conservation and access time. Nevertheless, the wide variety of reception conditions characteristic of the United States requires a slightly more conservative rate. CBS

believes that 5.727272 Mb/s offers a unique advantage. It is a precise multiple of the television line frequency (364H) and bears a discrete fractional relationship to the color subcarrier (8/5sc). Thus, the color subcarrier oscillator already in television receivers may be used as a very precise timing signal for teletext, significantly reducing error rates. The Commission should be aware also that the 5.727272 Mb/s figure proposed herein has been tested and accepted in Japan, which utilizes the same television transmission standards that are employed in the United States.

Vertical blanking interval lines. CBS has concluded that teletext signals having an amplitude of approximately 70 IRE units can be transmitted on VBI lines 15 and 16 without causing degradation in picture quality on television receivers. The same tests demonstrate that such transmission on lines 10 through 14 causes some degradation to picture quality on sets manufactured before 1974. In the CBS tests in St. Louis, approximately 11 percent of such older receivers were so affected in certain localities. CBS believes, however, that within a few years, lines 10 through 14 will be suitable for teletext.

Adaptive equalizer training signal. A generally accepted technique for information or image correction in teletext transmission is the use of a compensating device in a teletext decoder or receiver termed a "time domain equalizer." A time domain equalizer can compensate for multipath reflections which might otherwise cause erroneous decoding. Known for over 20 years, such devices only now are within reach through integrated circuitry. An equalizer device may correct the teletext signal alone, or correct both the teletext and full-picture signals. To this end, a "training" signal, used to activate the equalizer, ought to be part of the transmission. However, it must first be determined whether such a training signal should be included in a non-variable portion of the teletext signal, or in a portion of the television synchronization waveform. CBS proposes to provide for the introduction of such a training signal after its specific location has been determined.

V. Conclusions

CBS' field tests and comprehensive analyses set forth in Exhibit II clearly demonstrate that the variable format system possesses unmistakable advantages over the fixed format system for the following reasons:

A. The system is basically a software-based system and, as such, is highly extensible, permitting system growth and innovation as the technology evolves.

B. This technology will afford an extremely high degree of compatibility between broadcast teletext and two-way, videotex system decoders.

C. Equally significantly, the coding structure proposed herein offers singular versatility. It is not a special, single-purpose language suited only to television broadcast signals. Rather, it may be used without modification for transmission of information over many different types of transmission systems.

CBS firmly believes that the state of the art of teletext is ripe for rulemaking. The benefits of broadcast teletext services are obvious. With the testing reported herein, issues are now sharply focused. The Commission is presented with an opportunity to apply useful learning to practical and worthwhile public service.

ACCORDINGLY, CBS requests expedited consideration of this Petition for Rulemaking and adoption of the teletext rules and standards proposed herein.

Respectfully submitted,

CBS Inc.

By ______
Eleanor S. Applewhaite

By ______
Mark W. Johnson

By ______
Michael Rose

Its Attorneys

Dated: July 29, 1980

EXHIBIT I

<u>Proposed Rules</u>

In compliance with Section 1.401(c) of the Commission's Rules, CBS sets forth specifically the following as the substance of the rules proposed:

(a) Section 73.681, which contains the definitions applicable to television technical standards, would be amended by inserting following the definition of "synchronization" the following definition of teletext:

> "<u>Teletext</u>. A digital data system associated with a broadcast signal for the transmission of information, intended primarily to display pages of text and pictorial material on the screen of suitably equipped receivers."

(b) Subsection 73.682(a) (Transmission Standards) should be amended by adding the following new subparagraphs:

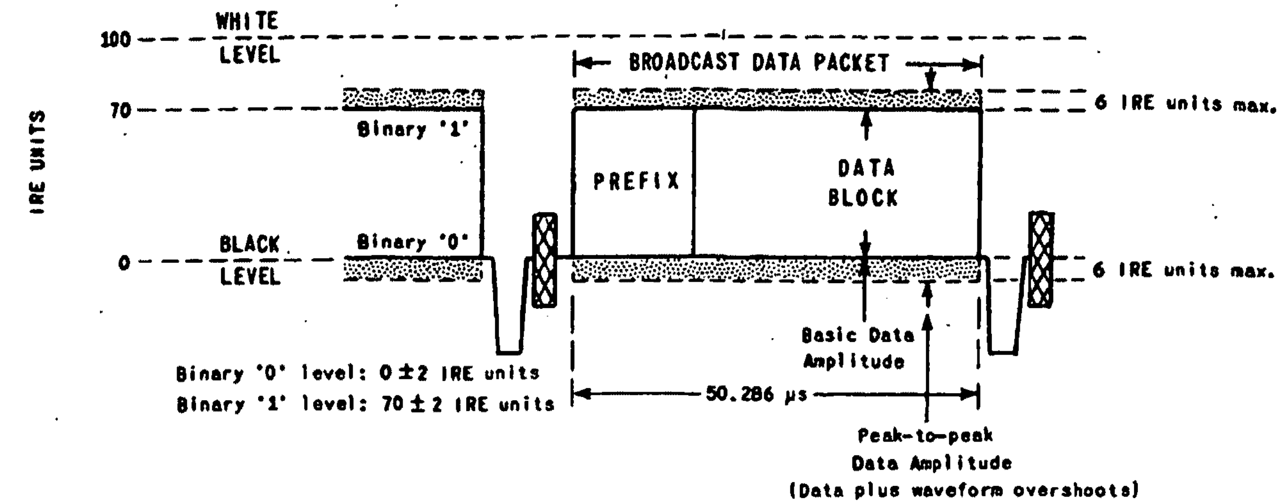
> "(24)(i) Teletext signals may be transmitted on specific scanning lines in the vertical blanking interval or on all active picture scanning lines.
>
> "(24)(ii) Lines 10 through 16 of the vertical blanking interval may be used for the transmission of teletext. Lines 10-14 may be used for the transmission of teletext upon an affirmative showing that, based on relevant facts, including pulse amplitude level, no significant degradation will be caused to the program signal as viewed on home receivers.
>
> "(24)(iii) Teletext signals shall conform to Figure 18 of Section 73.699. The system shall be a variable format, asynchronous system. The data bit rate for transmission shall be 5.727272 Mb/s (364 times line frequency, 8/5 times color subcarrier frequency). The transmitted data shall be in the form of a data packet consisting of 36, 8-bit bytes arranged into a prefix and data block. The prefix may consist either of 5 bytes for vertical blanking interval applications or 8 bytes for full field teletext transmission applications. A code signifying the end of one display row and the start of another row may appear within the data block.

"(24)(iv) A reference pulse for a decoder-associated adaptive equalizer filter, designed to improve the decoding of teletext signals, may be inserted in the vertical interval in conformance with Note 10 associated with Figure 18.

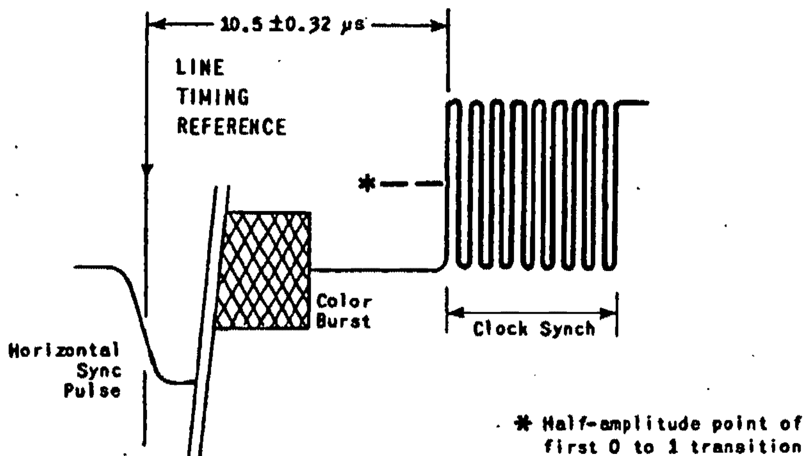
"(24)(v) Teletext signals shall cause no significant degradation to any portion of the visual or aural signals nor produce emissions outside of the authorized television channel.

"(24)(vi) Transmission of visual emergency messages pursuant to Section 73.1250 shall take precedence and shall be cause for interrupting teletext transmission."

(c) Section 73.699 (Engineering Charts) should be amended by adding as Figure 18:



DATA LEVELS



DATA TIMING

Note:
1. The structure shown above related to a variable format or asynchronous system, wherein a code signifying the end of one display row and the start of another row may appear within the data block.
2. The data bit rate is 5.727272 Mb/s (364xH, 8/5 x S.C.) ± 16 b/s
3. The teletext signal consists of 288 binary bits (pulse or no pulse) per television scanning line.
4. The data signal is coded using non-return-to-zero (NRZ) format.
5. The broadcast data packet consists of 36 8-bit bytes arranged into: a prefix and a data block.
6. The prefix has two options:
   short prefix of 5 bytes: CS CS BI P1 P2
   long prefix of 8 bytes: CS CS B2 P1 P2 P3 CI PL
   For vertical interval applications the short prefix is used.
   P, CI and PL represent packet address, continuity index and packet length.
7. The clock run-in signal (CS) is specified as 10101010.
8. The framing code is specified as follows:
   when used with short prefix: (B1) 00100001
   when used with long prefix: (B2) 11100111
9. The pulses are shaped to limit spectral energy to the nominal video baseband.
10. A special pulse designed as a training signal for an adaptive equalizer in a receiver may be transmitted on an otherwise unused line between 10-14 inclusive. The pulse is shaped to limit spectral energy to the nominal video baseband.

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EXHIBIT II

ENGINEERING STATEMENT IN SUPPORT OF

CBS PETITION FOR RULE MAKING

FOR A TELETEXT SYSTEM

July 21, 1980

Submitted by: R.A. O'Connor RAOC

Reviewed by: W.C. Nicholls WCN

Approved by: J.A. Flaherty F

EXHIBIT II

ENGINEERING STATEMENT IN SUPPORT OF CBS PETITION FOR RULE MAKING FOR A TELETEXT SYSTEM

APPENDICES

Appendix A - Reports on the CBS field tests, Phases 1, 2 and 3.

Appendix B - "Broadcast Teletext System Standard" -- the complete system description.

I. INTRODUCTION

1. On March 9, 1979, The Federal Communications Commission granted to CBS Inc. ("CBS") Special Temporary Authority (STA) to include experimental teletext signals within the vertical blanking interval of transmissions of its Owned Station KMOX-TV St. Louis, Mo. The test transmissions consisted of teletext test pages and related test signals intended for decoding on equipment modified for the U.S. 525-line television system that was supplied by British and French broadcasting entities. This equipment was designed in accord with the teletext systems developed in those countries. Test transmissions of both systems were conducted at five different transmission rates ranging from 3.7 megabits per second (Mb/s) to 6.2 Mb/s. Extensive field measurements were made throughout the KMOX-TV service area.

2. On November 9, 1979 the Commission granted to CBS another STA to transmit teletext test signals in the vertical blanking interval of programs transmitted over the CBS Television Network, in order to determine the reliability of such transmissions over long distances. In accordance with this STA which covered radiation of the test transmissions by any CBS owned or affiliated station, additional field measurements were made in the Los Angeles area using the test transmissions over CBS Owned Station KNXT.

3. Details on all of these tests are attached hereto as Appendix A.

II. BASIC SYSTEM DIFFERENCES

4. The British teletext system (CEEFAX/ORACLE) is a synchronous, or fixed format system, in which the position of data on the television scanning line bears a direct relationship with the position of the corresponding display

characters on the presentation on the television receiver. In the initial phase of the tests over KMOX-TV St. Louis the equipment supplied involved a one-to-one relationship between the television scanning line and the row presentation, with a display row presentation of 32 characters. In subsequent tests a "geared" system was used to provide a display row presentation of 40 characters per row. A fixed relationship between television line and display row still existed but not on a one-to-one basis. This "gearing" feature did not alter the basic synchronous or fixed format concept.

5. The French teletext system (ANTIOPE) is an asynchronous, or variable format system, in which there is no relationship between the data on a television scanning line and the position of that data on the display. In this type of system there is no dependence on the television line structure for the position of the displayed data. Although these tests did not include the Canadian teletext system, (TELIDON) this system is also an asynchronous system, similar in many respects to the ANTIOPE system, but with significant differences relating to the approach to graphics. (TELIDON is discussed further herein).

6. Subsequent to these field tests an enhanced version of CEEFAX/ORACLE was described which, in theory, could provide the same features as the ANTIOPE system that had been tested. This enhanced system remained a fixed format system, however, for the provision of basic teletext. As in most instances of this type there are advantages and disadvantages to both approaches and a decision has to be made, on balance, of the better approach.

III. RATIONALE FOR SYSTEM SELECTION

7. The CBS engineering team working on the teletext project familiarized itself with the various teletext systems through its own first-hand test program in St. Louis and in Los Angeles. The team also became familiar with the TELIDON system. Additionally, a special intensive comparative presentation was recently conducted by the two system proponents for CBS technical personnel. This presentation consisted of a comprehensive comparative analysis of the "Polyglot C" system, and the ANTIOPE system. As a result of these studies it was concluded that all three of the major systems are capable of providing, at some point in time, virtually the same type of features. All systems are potentially capable of: alphanumerics; high resolution graphics; and the same long list of attributes, handled either on a serial ("spacing") basis, or on a parallel ("non-spacing") basis; as well as free-form data transmission.

8. However, each system proposes to accomplish this goal in a somewhat different manner. The fundamental difference, as indicated earlier, is the concept of a fixed format system, as opposed to the concept of the variable format system. Each system has advantages and disadvantages. It is the judgment of the CBS technical experts that, on balance, the variable format approach provides a better base for extensibility, than does the fixed format approach, or the hybrid "Polyglot C" system. By extensibility is meant the ease with which the basic system may be adapted to the changing technology. The ANTIOPE and the TELIDON systems employ the variable format. The proposed Polyglot C system in its "unhook" mode -- the mode that would be used for all extensible functions beyond parallel attributes and

Dynamically Refinable Character Sets (DRCS) would also be, basically, a variable format system. However, for the provision of basic teletext, the fixed format would be retained. (One reason for this is, of course, to maintain compatibility with existing decoders. It is estimated that there will be about 100,000 such decoders in service in the U.K. by the end of 1980.)

9. Another consideration favoring the variable format concept, is the fact that the system is more in accord with the "packet" concept that is rapidly developing within the International Telephone & Telegraph Consultative Committee (CCITT). This feature will provide greater compatibility with additional data transmission systems such as videotex.

10. Although the Polyglot C system can theoretically accommodate the known possible extensibility features such as compatibility with videotex the proposed technique for doing this, which involves additional processing at the source, could pose problems and be more error-prone than the straightforward method -- the method being proposed for international standardization. Furthermore, there is cause for concern with respect to currently unknown extensibility features which are bound to surface in the future.

11. Compatibility with videotex is a very important consideration. If a variable format system is selected, with coding and display features in accord with international standards, the addition of the videotex feature will be far simpler and less expensive than it would be in the case of the Polyglot C system.

12. In view of the rapidly decreasing cost of integrated circuits and

the extreme volume-sensitivity of the market the question of costs is largely a matter of opinion and speculation. There is every reason to believe that within the time frame of 2-4 years after FCC authorization, when teletext-equipped receivers might become available in large quantities, costs will be commensurate with the benefits to be provided. "Cost" is but one part of the really significant factor -- the cost/benefit ratio. The costs must be related to the benefits received!

13. It would be possible to design a minimal decoder, one that is "cheaper" and one that would interpret teletext attributes on a serial or "spacing" basis. No matter how low the cost of any such decoder, the benefits to be derived in a commercially viable teletext system in the United States would not be sufficiently great to justify even this low cost. Teletext as would be used in the United States would be a highly creative commercial service that would depend heavily on the parallel attribute features of teletext. Teletext in the United States could not be commercially viable, given the creative limitations of a serial attribute system. Proponents of the proposed Polyglot C fixed format system indicate that the system should be capable of providing parallel attributes at a lower decoder cost than for a variable format system. Proponents of the variable format system claim the reverse is true. Actually there would probably not be any significant difference in decoder cost, and in any event the desirability of a variable format system is of transcendent importance.

14. Both ANTIOPE AND TELIDON are based on the variable format concept, and the coding techniques are very similar as indicated previously. The basic difference between the two systems is the approach to graphics,

where the TELIDON system is based on Picture Description Instructions (PDI) encoding. Admittedly the cost/benefit ratio consideration is a matter of judgment. In CBS's view the introduction of the PDI approach in first generation teletext decoders would result in a teletext receiver cost that the consumer would find to be too expensive. CBS believes, however, that any system chosen should be able to accommodate the PDI approach in the future when economically justified.

Based on these considerations a variable format system is proposed. The proposal covers two optional prefixes, a five-byte prefix for vertical interval application, and an eight-byte prefix for full-field operation. For the introduction of teletext in the United States, a modification of the ANTIOPE system is proposed, the detailed coding scheme of which is included herein as Appendix B.

IV. PROPOSED DATA BIT RATE

15. As indicated in Appendix A, the reports on the field trials, satisfactory teletext reception was achieved at all but the highest data bit rate of 6.2 Mb/s. Considerable multipath interference was encountered in these tests. Man-made interference, from ignition noise and radiation from power lines, was encountered to a degree not anticipated. Despite all these sources of interference, however, teletext reception was quite satisfactory in a very high percentage of locations, at all but the highest data bit rate. It can be expected that in areas of more severe multipath distortion, such as in large "canyon" cities, and in instances where lower-quality receiving antenna installations are involved, teletext reception

will be not as good as results have indicated in these tests. It might be argued, accordingly, that a lower bit rate might be considered for a national service, that is a bit rate lower than would be indicated as a result of these tests. However, in view of the improvements that are certain to be made in teletext receivers, it is concluded that as high a data rate as can reasonably be justified should be selected. A rate lower than 6.2 Mb/s but close to it should be established. Specifically, for the reasons listed below, a bit rate of 5.727272 Mb/s is proposed.

16. This data bit rate of 5.727272 Mb/s has been selected for teletext by Japan, which also employs the 525-line standard. This specific value enjoys a unique relationship in that it represents not only a multiple of H, the horizontal line frequency of 15,750 Hertz, specifically 364 times H, but also a discrete fractional relationship to the color subcarrier frequency of 3.5954545 MHz, specifically 8/5 times subcarrier. Such a relationship to the color subcarrier will allow for the use of the color subcarrier oscillator in television receivers as a more accurate timing signal for the teletext data signals, which could significantly reduce the bit error rate.

17. Among the features that may be incorporated into future teletext receivers which should greatly improve the error performance and the ruggedness of teletext reception are:

- synchronous detection
- surface acoustic wave (SAW) IF filters
- adaptive time domain equalizer (see Section VI)
- adaptive decoder "slicing" strategy
- group delay corrector
- color lock clock (clock synchronization signal locked to the color subcarrier).

With the introduction of teletext it is highly probable that certain transmitter improvements will also be implemented including better group delay by means of SAW filters, and a reduction in incidental carrier phase modulation, which should enhance the application of synchronous detection in receivers.

18. With a variable format system it will also be possible to add new features without any change in the basic standard. One such change that has been suggested in the introduction of a one-byte suffix at the end of the data block which could provide a forward error correction scheme that could correct a single bit error anywhere within the data block.

19. All of these factors argue for the selection of a relatively high data bit rate. Considering these factors along with the field test data, a data bit rate of 5.727272 Mb/s is justified.

V. PROPOSED VERTICAL INTERVAL LINES

20. During all the field tests conducted by CBS, teletext signals having an amplitude of approximately 70 IRE units were transmitted on vertical blanking interval lines 15 and 16 without any significant problems. Signals of this amplitude on these two lines will cause no significant visibility problems on television receivers. In accordance with the Special Temporary Authority granted to CBS, transmissions were also conducted on lines 13 and 14 but, due to some instances of reported visibility, these transmissions were halted immediately. The percentage of receivers where such visibility problems occurred was about 11%.

21. With the introduction of all-transistor color and black and white receivers, which occurred approximately in 1974, the visibility phenomenon changed. Receivers manufactured since then do not pose any significant visibility problem on any line from line 10 forward. Within a few years, when older sets have been removed from service, lines 10-14 inclusive will become available for teletext.

22. The degree of visibility is also related to the amplitude of the signals. Tests have shown that, with the amplitude reduced below the normal teletext level of 70 IRE units, visibility is reduced considerably. Consequently, lines 15 and 16 should be authorized immediately while lines 10 through 14 could be used when it is shown that no significant degradation will be caused to the program signal as viewed on home receivers.

VI. PROVISION FOR ADAPTIVE EQUALIZER TRAINING SIGNAL

23. One of the most promising techniques for the improvement of the error performance of teletext is the concept of a time domain equalizer in a receiver that would compensate for multipath reflections that can result in a erroneous decoding. (Multipath reflections are the source of "ghosts" in the picture presentations). The concept of such an equalizer has been known for over 20 years. However, it is only now, with the advent of integrated circuitry, that such a device has become economically viable. At least four television receiver manufacturers are known to have developed prototype models of such devices, with one manufacturer already working on the integrated circuit chip mask.

24. Some of these devices correct the teletext signal alone; others correct both the teletext and picture signals. In all cases a "training" signal is needed in the transmitted signal to activate the equalizer. For a teletext-only system, a non-variable portion of the teletext signal itself, such as the clock run-in, provides this function. For the other types, a portion of the television synchronization waveform may be used, such as the leading edge of vertical sync or a separate and special training signal may be required. This matter is still the subject of active consideration within the industry but an optimum solution is not yet at hand.

25. If it develops that a separate training signal is desirable, this would be a very short-duration pulse, such as a one T or sin x/x pulse inserted in the middle of an otherwise unused vertical interval line. The total energy in such a pulse would be so small that it would be highly unlikely that such a pulse would be visible, even if it were introduced in the near future, on one of the early lines between 10 and 14. Provision for the subsequent introduction of such a training signal is recommended.

VII. RESPONSE TO STA CONDITIONS

26. In the STAs granted to CBS for the KMOX-TV and network tests, the Commission requested a detailed report and analysis of the data. In the case of the KMOX-TV STA, a set of picture monitor, waveform monitor and vectorscope photographs under various operating conditions was requested.

27. A. KMOX-TV Tests

Included as part of Appendix A are detailed reports on the tests at

St. Louis, divided into two sections, Phase 1 and Phase 2. * Included herein are the following requested photographs, all taken of the radiated signal, at the transmitter site, from a probe in the transmission line feeding the station demodulator:

Figure 1.	Picture monitor without data signals.
Figure 2.	Picture monitor with data signals.
Figure 3.	Picture monitor presentation with vertical hold misadjusted to show vertical interval.
Figure 4.	Full-field color bars on waveform monitor without data signals.
Figure 5.	Full-field color bars on waveform monitor with data signals.
Figure 6.	Full-field color bars on vectorscope without data signals.
Figure 7.	Full-field color bars on vectorscope with data signals.
Figure 8.	Vertical interval without data signals.
Figure 9.	Vertical interval with data signals.
Figure 10.	VIR signal without data signals.
Figure 11.	VIR signal with data signals.

28. These observations showed no adverse effect on the full-field or program signal caused by the addition of the teletext data signals. (The Phase 1 and Phase 2 reports also include many picture monitor, waveform monitor and eye-height photographs taken in the field, off-the-air, at the various measuring sites.

* The Phase 2 report also covers measurements made on teletext test transmissions over KDNL-TV Channel 30 in St. Louis.

FIGURE 1

WITHOUT DATA SIGNALS

FIGURE 2
WITH DATA SIGNALS

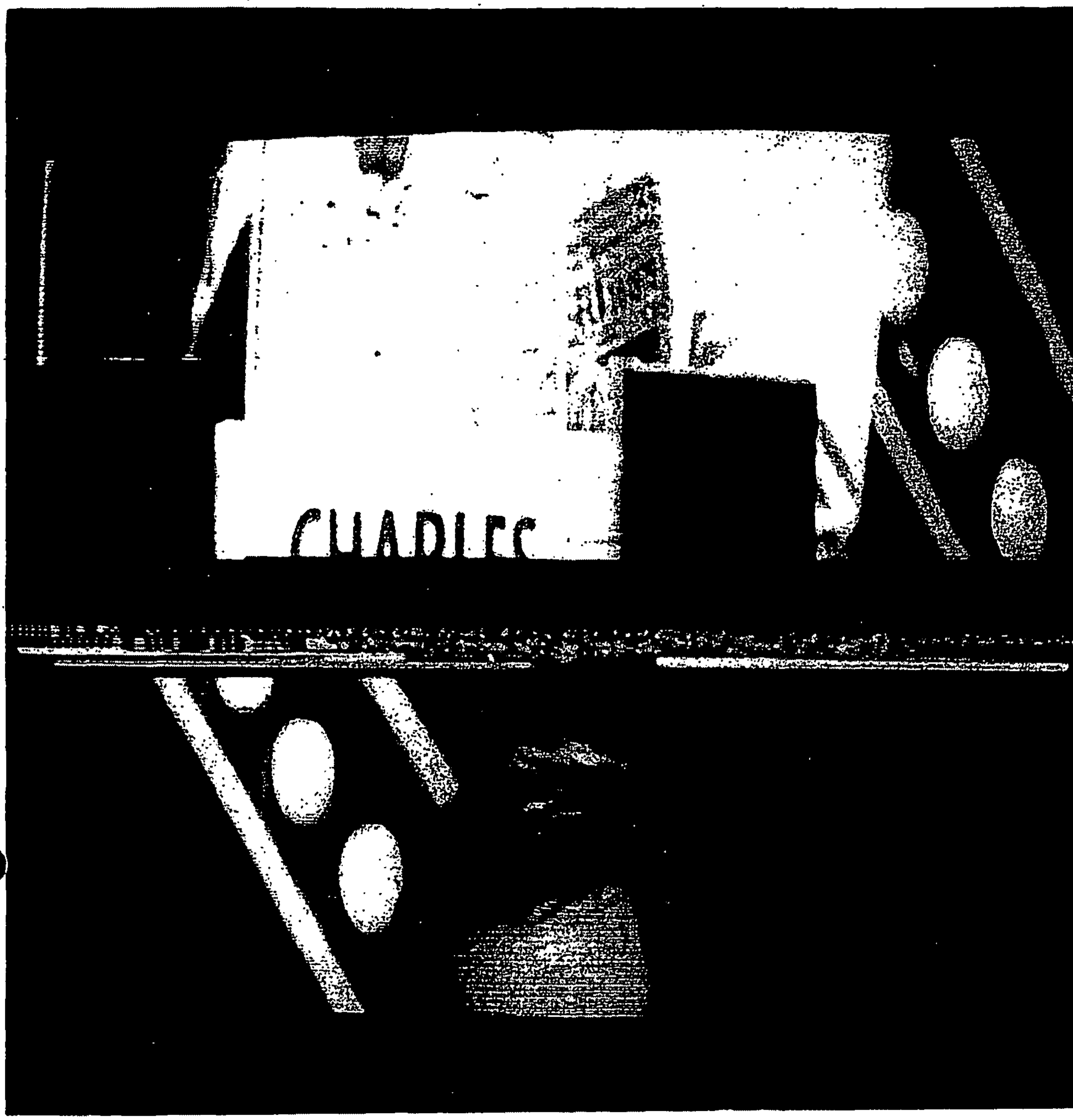

FIGURE 3

VERTICAL INTERVAL DISPLAYED

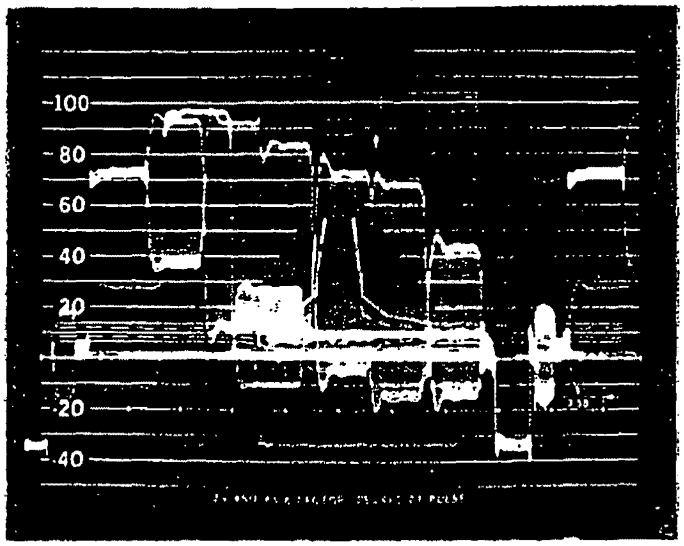

FIGURE 4

WITHOUT DATA SIGNALS

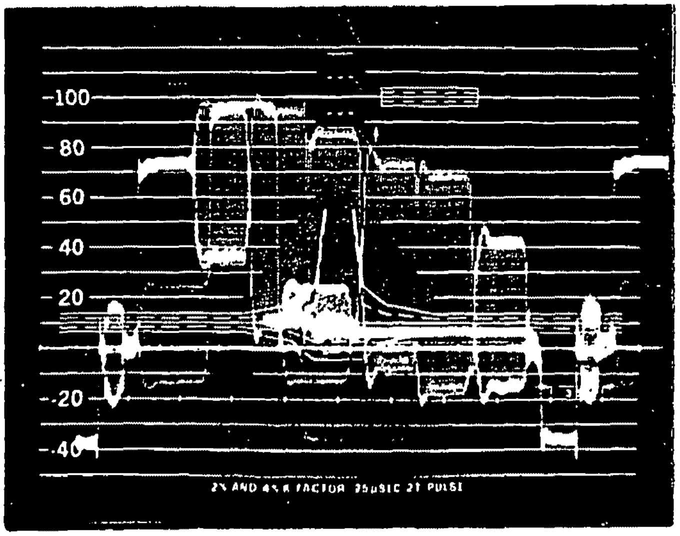

FIGURE 5

WITH DATA SIGNALS

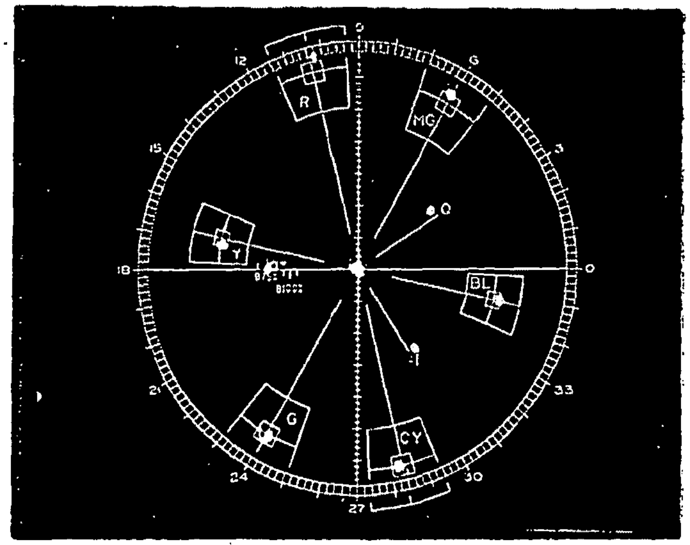

FIGURE 6
WITHOUT DATA SIGNALS

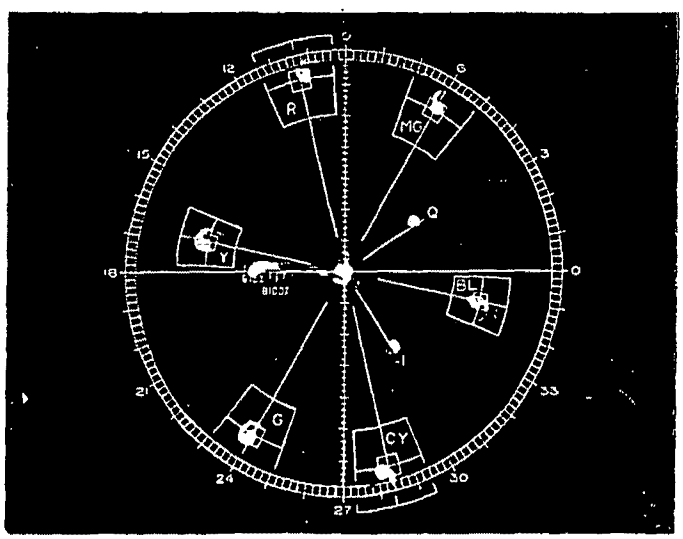

FIGURE 7
WITH DATA SIGNALS

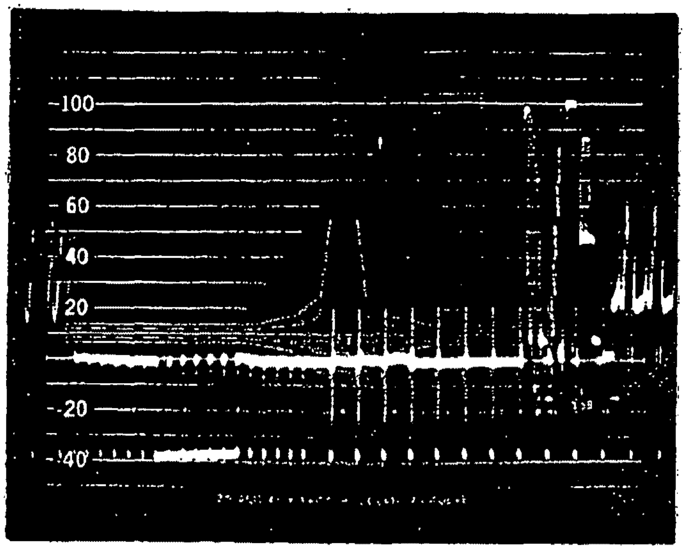

FIGURE 8
WITHOUT DATA SIGNALS

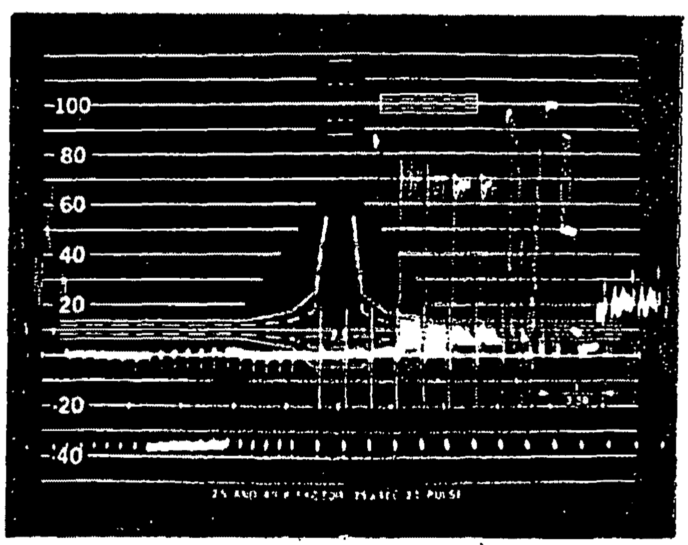

FIGURE 9
WITH DATA SIGNALS

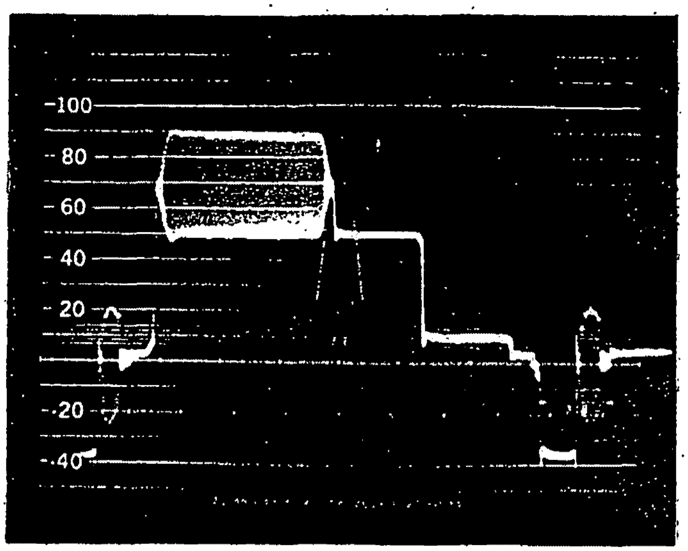

FIGURE 10
WITHOUT DATA SIGNALS

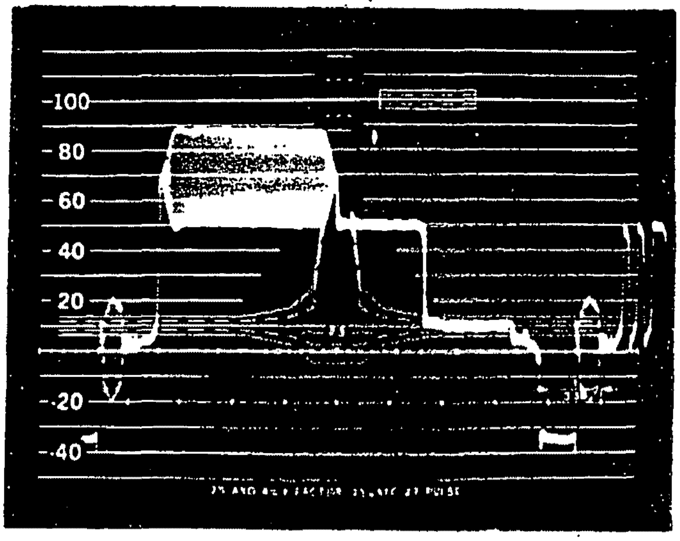

FIGURE 11
WITH DATA SIGNALS

29. B. Network Tests

As part of the network tests, the network signal that originated in New York was fed to the KNXT transmitter with additional field measurements made in the Los Angeles area. A report on these measurements is also included in Appendix A as the Phase 3 report.

30. The principal objective of the network tests was to determine if the teletext data signals suffered any significant degradation over long distance transmission facilities. Bit error rate measurements were made in Los Angeles, at the end of the CBS physical network, and also at St. Louis, on three separate days. Additionally, the standard measurements and observations that were made at each field measurement point were also made at the network terminal points in Los Angeles and St. Louis. The transmission quality performance, as measured by the vertical interval tests signals was very good, typical of the performance that is measured on a regular basis, using the network vertical interval test signals.

The most important parameter of interest was the bit error rate performance, which was excellent, as had been anticipated on a video-to-video basis. The specialized equipment used for this measurement is described in the reports of Appendix A. Basically a pseudo-random sequence of a known number of bits is transmitted, and the meter at the receiving end, which is synchronized to this transmission, detects bit errors and actually displays a cumulative count of the number of such errors. During the field tests a monitoring period of five minutes was employed. Considering that a bit error rate objective of 10^{-3}, or one bit error in a thousand, is generally regarded as suitable for teletext, this five minute period proved quite satisfactory.

31. During the network tests it was recognized that a much longer period would be required since the error performance on a video-to-video basis, as opposed to an off-air basis, would be expected to be considerably better. Consequently a period of one hour was used. During this period a total of 2.76×10^{7} bits were transmitted at all data bit rates. In all instances there were no bit error registered, indicating a bit error rate less than 3.6×10^{-8}, or approximately less than one bit error in 28 million.

32. From this it can be concluded that long distance interconnection transmission facilities will prove no problem with respect to the network transmission of teletext signals.

VIII. CONCLUSION

33. Based on the extensive field tests, and exhaustive comparative systems analysis studies described herein the following technical standards are recommended for the introduction of teletext in the United States:

- a variable format system
- a coding scheme for the introductory version of teletext based on a variation of the ANTIOPE coding structure.
- a data bit rate of 5.727272 Mb/s, at a nominal pulse amplitude level of 70 IRE units, with pulse shaping to limit spectral energy to the nominal video baseband.
- for the vertical interval application lines 15 and 16 to be authorized initially with provision for the subsequent use of additional lines between 10 and 14 inclusive.
- provision for the subsequent addition of an adaptive equalizer training pulse in the vertical interval.

ORIGINAL FILE

RM-3727

Appendix B

CBS

Broadcast Teletext System Standard

Date: 7/29/80

Prepared by: W.C. Nicholls
R.P. Seidel

Reviewed by: W. Connolly

Approved by: J.A. Flaherty

Table of Contents

SUBJECT INDEX

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INTRODUCTION

This document contains the technical description of a recommended US teletext system. The document is divided into seven major sections. Each section deals with a particular aspect of the teletext system. Section 1,2 and 3 detail the data transmission system. Sections 4,5 and 6 explain the coding used for transmission of typographical and graphic messages. Section 7 is a recommended basic level system specification that reflects the level of present day technology and the realities of the broadcast environment. Through the careful separation of functions, similar to the method employed by the International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT), the present standard is fully capable of following advances in technology without making basic level equipment obsolete.

The fundamental concept to which the CBS standard adheres is that of maintaining the distinction between the means of transporting the data and the actual message the data conveys. The transportation functions covered in Sections 1, 2 and 3 allow the system to transmit any message that can be expressed in binary form.

The method of transporting the data from the transmitter to the receiver does not alter the data in any way. The transmission system is said to be "transparent" in that it does not affect the data to be transmitted or require any knowledge of the structure of that data.

Section 4 describes the display characteristics of a teletext message. Section 5 describes the resources available to code a teletext message, however, it does not indicate how to code any particular message but rather gives the repertoire of codes available in a teletext service. Each code described in Section 5 has a specific and unique function. Section 6 describes how the messages are organized into records and the ways the record protocol can describe the contents of the record to allow for easy access to the information.

Section 7 describes the basic level system specification for broadcast teletext, the transmission of typographical and graphic message intended for display by a receiver.

In composing a teletext message, it is up to the originator to choose the proper codes to produce the desired action in the decoder. In some cases, there is more than one way of accomplishing a particular action. Additionally it is the decoder manufacturer who must design a decoder which will produce the proper display when it receives a particular code.

Section 7 describes a recommended practice for two Levels of error protection: Level 0 and Level 1. Level 1 offers more sophisticated protection than the basic Level "0". As technology improves, it will be possible to change the recommended practice. Since the Level one language is a subset of the main coding scheme described in previous sections, future decoders will be able to interpret Level one messages and Level one decoders will be able to interpret future Levels of languages. Of course enhancements such as extended graphics that are not included in Level one will not be able to be interpreted by Level one decoders. In the case when an enhanced message is received by a first Level decoder the decoder can either: 1) not display the page at all or 2) display only the parts of the page which constitute the basic Level one.

The remainder of the document includes the charts and figures associated with various sections and the Table of Contents and List of Figures. All figures refered to in this document appear at the end of the text.

To aid in the definition of terms, a glossary has been included after the figures.

1.0 DATA TRANSMISSION & WAVEFORMS

1.1 Vertical blanking interval data transmission

The 525 line 60 field NTSC (CCIR system-M) television signal includes certain lines in the field-blanking interval to allow the receiver to synchronize and field retrace before the active video picture begins. The vertical blanking interval (VBI) as seen in Figure 1 includes lines 1 through 21, which contain the vertical synchronization pulses (Lines 1 to 9) and may contain such signals as; multiburst test signal (line 17, field 1); color bar test signal (line 17, field 2); composite test signal (line 18, fields 1 and 2); VIR (line 19, fields 1 and 2); and digital data signals. Vertical blanking interval data transmission is defined as any digitally coded information inserted between lines 10 through 21 (fields 1 and 2) of the analog television signal.

1.1.1 Data line selection

Initially, line 15 and 16 of both fields 1 and 2 shall be used for teletext data transmission.

1.1.2 VBI Line Multiplexing

Future lines for VBI data transmission can be made available by time multiplexing the existing test signals and by including a vertical retrace pulse in all future receivers.

1.2 Full-Field Data Transmission

Full-field data transmission uses the active part of the video signal as well as the VBI for data insertion. This method of data transmission uses the same coding structure as VBI data transmission. Lines 10-262 in field 1 and 2 can be used for data transmission.

1.3 Transmission bit frequency

The transmission bit frequency shall be 5.727272 Mbits per second ± 16 bits per second which is the 364 multiple of the horizontal line scanning rate.

1.3.1 Color Television Transmission

When the data signal is being inserted into a color television transmission, the transmission bit frequency shall be 8/5 of the color sub-carrier frequency (3.579545 MHz ± 10 Hz) and shall be phase locked to the color sub-carrier. The maximum rate of change of the transmission bit frequency shall be 0.16 bits per second per second.

1.3.2 Monochrome Television Transmission

When the data signal is being inserted into a monochrone television transmission (with no burst), the transmission bit frequency shall be 5.727272 Mbits per second ± 16 bits per second and phase locked to the horizontal line scanning rate (364 times).

1.4 Data Modulation Type

The amplitude modulated data shall use non-return-to-zero (NRZ) code.

1.5 Data-Pulse Shape

After shaping, the spectrum of the NRZ data is described by the curve in Figure 2. This spectral content is determined by a Nyquist filter with a roll-off of 100% followed by a phase corrected low-pass filter with a cut-off frequency of 4.2 MHz. The impulse response of the combined filters is shown in Figure 3. The impulse response of the Nyquist filter can be described as follows:

Let I(t) = impulse response

Fmax = highest frequency of the spectrum (5.727272 MHz)

fo = frequency at the center of the slope of the filter (2.86 MHz)

α = (fmax-fo)/fo = 1

T = period of one bit, (approximately 174.6 nsec)

t = time

$$I(t) = \frac{SIN\ (\pi t/T)}{(\pi t/T)} \times \frac{COS\ (\alpha \pi t/T)}{1-(2\alpha t/T)^2}$$

1.6 Data Timing

The start of the data signal, as seen in Figure 4, shall be 10.5 $\pm$ 0.32 usec from the half-amplitude point of the negative going edge of horizontal sync to the half-amplitude point of the first transition from logical "0" to logical "1" of the clock synchronization.

1.7 Data Amplitude

The nominal data amplitude, as seen in Figure 5, shall be 70 ± 2 IRE for a logical "1" and 0 ± 2 IRE for a logical "0". By definition, the logical "0" is at blanking level and therefore, the data signal should not contain any pedestal or set-up.

This section has specified a nominal data amplitude however, the data waveform will contain overshoots so the peak-to-peak data amplitude will exceed the nominal data amplitude. Therefore, the peak-to-peak data amplitude shall not exceed 86 IRE units. In addition, the positive overshoots shall not exceed +6 IRE above nominal logical "1" level and the negative overshoots shall not exceed -6 IRE below blanking level.

2.0 DATA PACKET

The data packet is a stand-alone group of bits in the active part of the television line interval. The packet is organized into two sections; the packet prefix and the data block. The maximum length of the packet shall be 288 bits or 36 eight bit-bytes.

2.1 Packet Prefix

The packet prefix is composed of bit synchronization bytes (clock synchronization); byte synchronization byte (framing code); and packet address bytes. When full-field teletext is employed the prefix also contains a continuity index byte for packet loss detection and a packet length byte for variable length packets.

2.1.1 Prefix Organization

The packet prefix shall have two organizational structures. As seen in Figure 6, the 5 byte prefix is used for vertical blanking interval service and designated as follows:

CS,CS,B1,P1,P2

where CS = Clock-Synchronization byte (bit sync)

B1 = Framing Code byte (byte sync)

P1,P2 = Packet Address bytes (channel number)

As seen in Figure 7, the 8-byte prefix is used for full-field teletext service and is designated as follows:

CS,CS,B2,P1,P2,P3,CI,PL

where CS = Clock-Synchronization byte (bit sync)

B2 = Framing Code byte (byte sync)

P1,P2,P3 = Packet Address bytes (channel number)

CI = Continuity Index byte (packet loss detection)

PL = Packet Length byte (number of bytes in the data block)

2.1.1.1 Clock-synchronization bytes - CS

The first 2 bytes of each packet prefix constitutes the clock-synchronization sequence. This 16 bit alternating sequence of "1s" and "0s" provides the decoder with a reference burst in order to synchronize the decoder's data clock, and initialize the data slicer.

2.1.1.2 Framing Code

The third byte of each packet prefix constitutes the framing code and is used as a reference for byte synchronization. This code has been chosen to minimize the risk of incorrect synchronization and enables the decoder to establish byte synchronization even if one bit of the framing code was received incorrectly.

The framing code also serves as a means to differentiate between vertical interval, full-field and future services.

2.1.1.2.1 Framing Code - vertical blanking interval - B1

The framing code for vertical blanking interval transmission, as seen in Figure 6, shall be 00100001.

2.1.1.2.2 Framing Code - full-field - B2

The framing code for full-field transmission, as seen in Figure 7, shall be 11100111.

2.1.1.2.3 Framing Code - reserved - B3

A third code B3 is reserved for future use. The code shall be 10110100.

2.1.1.3 Packet Address - P

The packet address allows multiple data sources to be time multiplexed on a given television channel. The address has a dual function. First, it provides the television network with a method of routing the data packet without having to know the contents of the data block. Second, it provides the end user with a method of accessing a specific source of data that was time multiplexed at the origination point.

When vertical interval transmission is used, bytes 4 and 5 (P1 and P2) constitute the address and consist of two Hamming protected bytes which yield 2^8 or 256 possible data channels (See Section 3.0).

When full-field transmission is used, bytes 4, 5 and 6 (P1, P2 and P3) constitute the address and consist of three Hamming protected bytes which yield 2^{12} or 4096 possible data channels (See Section 3.0).

As seen in Figure 8, bits b1, b3, b5, b7 provide Hamming protection and bits b2, b4, b6, b8 contain the address information. The Hamming encoding and decoding for each byte is shown in Figure 8. This method of data protection allows the detection of an even multiple of errors and provides correction of a single error.

2.1.1.4 <u>Continuity Index</u> - CI

The continuity index is used only during full-field transmission and is the seventh byte of the packet prefix. The index is used to detect the loss of a data packet due to transmission errors. The value or number of the index sequences from 0 to 15 and increments by one each time a data packet is transmitted within a given data channel. Additional security is obtained by Hamming protection of this byte (see Figure 8 for Hamming encoding and decoding).

2.1.1.5 <u>Packet Length</u> - PL

The packet length byte is used only during full-field transmission and is the eighth byte of the packet prefix. The data packet size is variable in the full-field mode. To identify the number of bytes in the data block, the Hamming protected packet length byte specifies one of 16 possible lengths. Figure 9 is a look-up table to correlate the packet length byte with the number of bytes per packet data block.

2.2 Packet Data Block

The packet data block is the group of bytes after the packet prefix that contains the information to be transmitted.

2.2.1 Packet Data Block Size - Vertical Blanking Interval

The packet data block size for vertical blanking interval transmission, with a bit frequency of 5.727272 Mbits per second, shall be fixed at 31 bytes.

2.2.2 Packet Data Block size - Full-field

The packet data block size for full-field transmission may vary in size in accordance with the format byte specified in section 2.1.1.5 which allows the following lengths: (0,1,2,3,4,8, 12,16,20,24,28,32,36,40,44,48). With a bit frequency of 5.727272 Mbits per second the maximum length of the data block shall be 28 bytes.

3.0 DATA CHANNEL

The data channel is a signal path for transmitting binary information. Packet data broadcasting enables the broadcaster to time-division multiplex a single television channel into multiple data channels. The data channels are differentiated by a channel number described in the prefix of the packet, making it possible to constitute "virtual" data channels (see Figure 10).

3.1 Data Multiplexing

Data multiplexing of sources allows multiple data sources 1 to N to be transmitted over a single television channel. Each source is assigned a channel number by a given value of the address bytes in the packet prefix.

3.1.1 Vertical Blanking Interval Multiplexing

The vertical blanking interval service uses a 5 byte prefix of which 2 are Hamming protected address or channel number bytes. Therefore, there is a maximum of 256 possible channels. To determine the maximum useful bit rate or through-put when using 2 lines of the vertical blanking interval, it is necessary to first subtract the prefix from the data packet before computing the bit rate.

36 byte packet - 5 byte prefix = 31 data bytes

$$\frac{31 \text{ data bytes}}{\text{TV line}} \times \frac{2 \text{ lines}}{\text{field period}} \times \frac{60 \text{ field}}{\text{sec}} \times \frac{8 \text{ bits}}{1 \text{ byte}} = 29.760 \text{ k bits/sec}$$

3.1.2 Full-field Multiplexing

The full-field service uses an 8-byte prefix of which 3 are Hamming protected address or channel number bytes. Therefore, there are a maximum number of 4096 possible data channels. To determine the maximum useful bit rate or through-put when using 253 lines for full-field service, it is necessary to first subtract the prefix from the data packet before computing the bit rate.

36 byte packet - 8 byte prefix = 28 data bytes

$$\frac{28\ \text{data bytes}}{\text{TV line}} \times \frac{253\ \text{lines}}{\text{TV field}} \times \frac{60\ \text{fields}}{\text{sec}} \times \frac{8\ \text{bits}}{\text{byte}} = 3.4\ \text{Mbits/sec}$$

Figure 11 shows a sequence of data packets being transmitted in full-field service which utilizes the packet length and continuity index.

3.2 Data Demultiplexing

The data demultiplexing process uses the prefix address or channel number information for sorting the received data packets having the same address value. It is important to note that the sorting process is accomplished irrespective of the information in the data block and depends entirely on the prefix. After the demultiplexing process, the prefix has completed its task of transporting the data through the channel and can now be discarded. Figure 12 shows the demultiplexing process in operation.

3.3 Data Network Compatibility

Since the broadcaster must interface with existing data transmission networks, it is important that the data broadcasting network be based on widely accepted principles used for data network architecture.

The "packet" and "virtual channel" concepts of the internationally supported X.25 protocol for data communications are examples of data network compatibility which have been included in this broadcast teletext standard.

4.0 DISPLAY CHARACTERISTICS

4.1 Purpose

This section describes the characteristics of the visual display.

4.2 Display Format

A displayed page consists of a number of horizontal rows. Each row contains multiple character positions (columns).

An optional user service row can be included in the display format to aid the user in the operation of the decoder.

4.3 Character Format

Each character is formed by an array of points belonging to a matrix. Certain portions of the character matrix are illuminated to form the character shape; the remainder are considered to be background.

4.4 Character Repertoires

The number of characters which can be used in the system is very large, but for implementation a limited number of characters can be employed. This repertoire will be composed of alphanumeric characters and graphic "mosaic" characters (see Section 7.3). Specific shapes can be made available for display using the technique of Dynamically Redefinable Character Sets (DRCS).

4.4.1 Alphanumeric Characters

Alphanumeric characters are formed in a matrix within each character location. The alphanumeric characters, in addition to comprising the upper and lower case letters of the Latin alphabet and the digits 0 through 9, also include special symbols, punctuation marks and accents. The alphanumeric characters which may be used are not limited to Latin based alphabets.

4.4.2 Mosaic graphics

To form mosaic graphics, the character matrix is divided into six rectangles. Any combination of rectangles may be illuminated in the character matrix. Two presentations of graphics are available: contiguous and separated. In the contiguous mode, sequential graphics in a row with all six rectangles illuminated, appear as a continuous display. Contiguous graphics, when accompanied by the underline attribute, are defined as separated graphics. In the seperated mode, they appear as a series of separate rectangles. Spaces between illuminated matrix rectangles are considered to be part of the background. See Figure 13 which shows a sample graphic matrix in both presentations.

4.4.3 Other graphics

Higher level graphics such as Dynamically Redefinable Character Sets (DRCS), Picture Description Instructions (PDI's) and photographic presentation are also possible but are not defined in this document.

4.5 Attributes

Characteristics or features of a character location, row or screen are called attributes. They are referred to respectively as character attributes, row attributes and screen attributes.

4.5.1 Foreground Color

The character assumes the color selected to allow it to be displayed against the background.

4.5.2 Background Color

The alphanumeric character background assumes the color selected. The portion of the contiguous graphic character not selected as the foreground assumes the background color. The portion of the separated graphic character not selected as the foreground and the separation space (or border) assume the background color. A character may also have a transparent background.

If transparent, video from the television signal within which the teletext is encoded, is seen in the background, and the teletext character, or graphics are keyed in (inserted).

4.5.3 Multiple Height

The character occupies its column in its row and the preceding row(s) above it and thus, becomes higher but occupies the same width as a normal character. The information defines the character in the space for both its row and the same column in the previous row(s) as required.

4.5.4 Multiple Width

The character occupies its column position in the row and also the following column position(s) to the right in the same row, thus becoming wider than a normal character. The information defines the character in the space for both its column and the following column(s) it occupies.

4.5.5 Multiple Size

The simultaneous use of the attributes Multiple Height (4.5.3) and Multiple Width (4.5.4).

4.5.6 Invert

The character becomes the background; the background becomes the character.

4.5.7 Flashing

The character alternately assumes the background color and the foreground color.

4.5.8 Boxing

The character has a background box around it which can assume any of the background colors or transparent. The character and box are keyed (inserted) into the accompanying television video as a caption or subtitle. There is no restriction on the location, size, length or number of columns or rows of the boxes and characters. Consecutive boxed characters form one contiguous box, horizontally and vertically.

4.5.9 Conceal

Display of the character(s) is suppressed until a control causes it to be revealed.

4.5.10 Underline

The character is underlined. All attributes assigned to the character(s) apply to the underline. The thickness of the underline is not increased in any combination involving multiple height. Underline causes the mosaic graphics to be displayed in the separated mode.

5.0 CODING OF THE TELETEXT MESSAGE

The Teletext message is transmitted in coded form. The description of the message is made up of a sequence of codes. Each code is represented in binary form by a seven-bit byte with an additional 8th bit for odd parity checking.

The codes are combined in sequences according to the international standard ISO 2022 in its revised version. The codes can be divided into three major groups:

- codes to describe displayable characters
- codes to describe character attributes
- codes to describe layout and control functions.

5.1 The Coding of Displayable Characters

Teletext character coding is based on the CCITT international Alphabet #5 (which is based on ASCII) and includes, in addition to a space, 94 different codes representing the primary set of displayable characters. The primary or GØ set does not contain all the characters and symbols needed for a teletext service or the set of mosaic graphics. It is thus neccesary to define a G1 set of mosaic graphics and a G2 set of additional characters and symbols. A fourth set, G3, is undefined at this time but can be used for graphic extensions. The access to these additional sets is accomplished through unique code sequences. Sets GØ, G1, G2 and G3 can be changed from their normal configuration through escape sequences as specified in ISO 2022 and shown in Figure 14.

5.1.1 The GØ Basic Alphanumeric Set

The GØ basic alphanumeric set is the primary set and is implicitly invoked. This basic set contains all the upper and lower case alphabetic characters of the Latin alphabet, with no accent marks plus digits 0 - 9 and a limited number of symbols such as punctuation marks. Each character of GØ is designated by a single seven-bit code plus odd parity as shown in Figure 15.

5.1.2 The G2 Extended Alphanumeric Set

Accent marks, special letters and symbols are included in the G2 extended set. (Figure 16). The extended set includes an additional 94 characters which are coded in the same way as the GØ set. Access to the G2 set is by way of a single code "SS2" (1/9) single shift 2, which is located in the CØ set of codes. (Figure 17).

When a character from G2 is desired a sequence of SS2 (1/9), followed by the requested character is used. The SS2 (1/9) is a non-locking code; thus it is not necessary to shift back into the invoked set.

5.1.2.1 Coding of Accented Characters

When an accented character is requested, a three code sequence is used. First the SS2 (1/9) code is sent which calls up the G2 set. Second, the code for the requested accent is called up from column 4 of the table which represents non-spacing characters. Finally, the code character to be accented is sent.

5.1.2.2 Coding of Special Symbols

Certain special symbols (arrows and international monetary symbols for example), do not appear in the basic GØ set. These have been placed in columns 2, 3 and column 5, 5/0 to 5/7, of G2 and are accessed by a sequence of two codes, the first being SS2 (1/9), the second being the symbol requested. Columns 2,3 and column 5, 5/0 to 5/7, contain spacing characters.

5.1.2.3 Coding Of Special Letters

Certain special letters cannot be composed by a combination of a letter from GØ and an accent from G2. These characters have been placed in columns 6 and 7 of G2 and are accessed by a combination of two codes, the first being SS2 (1/9), the second being the special letter requested. Columns 6 and 7 contain spacing characters.

5.1.2.4 Extension Of G2 Set

Column 5, spaces 5/8 to 5/15, of G2 is undefined and may be used to code additional characters.

5.1.2.5 Character Set G3

The characters which normally reside in G3 are not defined. Access to G3, however, is accomplished by the code SS3, (1/13) single shift 3. See Section 5.5.2.5.

5.1.3 Coding of Mosaic Graphic Characters

Character set G1, Figure 18, which is identical in structure to GØ and G2, contains an array of mosaic graphic symbols.

To access a mosaic graphic symbol from the G1 set, a code from CØ (Figure 17), "SO" (0/14) (shift out), must be sent. The code SO (0/14), is a locking code which affects the meaning of the codes for displayable characters which follow it. To return to the basic set GØ, one of two codes from CØ, SI (0/15) (shift in), or US (1/15) unit separator is required whichever occurs first. The SI (0/15) or the US (1/15) code restores the original situation. Every sequence of display codes included between a SO (0/14) and SI (0/15) or US (1/15) represents a character from the G1 set.

5.2 Coding of Character Attributes

Character attributes are coded by a sequence of codes from the set of control codes. The first code of any attribute sequence is the ESC (1/11) (escape) which is located in the CØ set, (Figure 17).

5.2.1 Basic Level Attribute Codes

Thirty one codes are used in the basic level. Access to the basic attribute table (see C1 set, Figure 19) is via ESC (1/11) followed by a single code from the C1 set which is located in the escape table, Figure 20, columns 4 or 5.

5.2.2 Attribute Extension Coding

There are two ways to acheive the extentions of attributes 1) using the control sequence introducer, CSI (5/11) 2) designation of supplementary Cl sets through escape sequence.

The CSI is located in the Cl set position (5/11). It is used according to ISO specification DIS 6429.

Other Cl sets can be designated and invoked through a three character escape sequence commencing with ESC (1/11). Followed by a code from the basic escape table, 2/2 followed by a final character (F). See Figures 14 and 20. Once a new Cl set is invoked attributes are accessed by escape sequences.

5.3 Coding of Row Attributes

Row attribute display controls are coded by a four character escape sequence: ESC (1/11), (2/3), (2/0) and a final character which is taken from Cl, columns 4 and 5 of the escape table. (See Figure 20).

5.4 Coding of Screen Attributes

Screen attributes display controls are also coded by a four character escape sequence: ESC (1/11), (2/3), (2/1) followed by a final character which is also taken from Cl, columns 4 and 5 of the escape table. Screen attribute can also be alternately specified by means of the record header. See Section 6.2.3.2.

5.5 Function Coding

The teletext message uses three types of function coding classified as follows:

- layout function codes
- extension codes
- control function codes.

All of the codes are non-spacing and non-printing codes. Each of the codes has a specific function as described in the following sections.

All codes belong to set CØ which is always invoked unless an escape sequence specifies a different C set. (See Section 5.2). The code location indicators refer respectively to the column and row numbers as used in the seven-bit code table. Figure 21 shows the form of this table.

5.5.1 Layout Function Codes

The following codes affect the layout of the display. The codes can be used singularly or in groups.

5.5.1.1 CR (0/13) Carriage return: returns the cursor to beginning of the row it is on.

5.5.1.2 LF (0/10) Line feed: positions the cursor vertically down to the next row. The cursor remains at the same position horizontally.

5.5.1.3 US (1/15) Unit separator: this code has two functions:

1) cursor movement
2) attribute default

The two non-printable characters following this code move the cursor to the designated unit described by those characters. If these are both from column 3 (3/0 to 3/9) they represent in decimal form respectively the tens and units of the row address of the first character to be displayed. This first character will be displayed on the first character position of the addressed row. If both of the two non-printable characters following US are from columns 4 to 7, (4/0) to (7/14), they represent respectively, in binary form with 6 useful bits, the row address and the column address of the first character to be displayed.

The US code also signals the decoder to cancel all attributes and reset the decoder to the default condition and shift back to the GØ set.

Example: to place the letter D in column 1 of row 5, the following sequence would be used:

US (1/15);	(3/0);	(3/5);	"D" (4/4)
unit separator	binary coding of row 5 column 1		the letter "D"

If one wished to place the letter C in column 25 row 5 following sequence would be sent:

US (1/15);	(4/5);	(5/9);	"C" (4/3)
unit separator	binary coding of row 1 column 25		the letter"C"

In each of these examples, all attributes are reset to default.

5.5.1.4. BS (0/8) Backspace: causes the cursor to go back one characer position.

5.5.1.5 HT (0/9) Horizontal tab: causes the cursor to move forward one character position.

5.5.1.6 VT (0/11) Vertical tab: causes the cursor to move up one row.

5.5.1.7 FF (0/12) Form Feed: Used to achieve complete erasure of the page except the optional service row "0". The cursor returns to row one in its current position. If the cursor is in row 20, column 25, for instance, and the FF code is sent, the cursor will jump to row 1, column 25 and the page will be erased. If the cursor must be returned to column 1 of row 1 from the same position, then the additional code CR (0/13) (carriage return) must be sent. FF is considered an implicit record separator.

5.5.1.8 REP (1/2) Repeat: indicates that the preceding character must be repeated n times as defined by a character which represents, in binary form with six usable bits, the number of repetitions.

Example: to repeat a space 11 times the code sequence would be:

SP	REP	4/10
Space	repeat	the number of repeats (10) in six-bit coded binary

1 space plus 10 repeated spaces = 11 spaces. The sequence A REP (4/10) will result in the letter "A" plus 10 repeated A's for a total of 11 "A's".

5.5.1.9 SP (2/0) Space: causes the cursor to space one character position. The character space occupied by a SP code will assume the background features of the characters preceding it. SP will respond to the invert attribute code. SP is affected by all the attributes except, by definition, a space does not flash.

5.5.1.10 CAN (1/8) Cancel character: causes the remaining character positions of the row to become spaces which assume all the attributes of the cursor position. The cursor reverts back to its original position after completing the CAN function.

5.5.2 Extension Codes

The extension codes define character set extensions and code extensions.

5.5.2.1 ESC (1/11) Escape: an escape sequence consists of two or more seven-bit combinations. The first is always the bit combination of ESCAPE and the last is always that of the Final Character. Final Characters are the 79 characters of columns 3 to 7 of the seven-bit code table, excluding position 7/15.

The meaning of an escape sequence is determined by the seven-bit combination representing its Intermediate Character(s), if any, and by the seven-bit combination representing its Final Character. Intermediate Characters are the 16 characters of column 2 of the seven-bit code table.

5.5.2.2 SO (0/14) Shift out: the SO code is used to shift out of the basic GØ set and into the Gl set. SO is a locking function. See Section 5.1.3.

5.5.2.3 SI (0/15) Shift in: the SI code is used to shift back into the basic GØ set from the Gl set. SI is a locking function. See Section 5.1.3.

5.5.2.4 SS2 (1/9) Single shift 2: the SS2 code is used to shift into set G2 from GØ. SS2 is a non-locking function. It must be sent before every character in the G2 set. See Section 5.1.2.

5.5.2.5 SS3 (1/13) Single shift 3: used to shift into set G3 from GØ. SS3 is a non-locking function. It must be sent before every character in the G3 set. See Section 5.1.2.5.

5.5.3 <u>Control Function Codes</u>

Control function codes are non-printing and non-spacing codes which are used to mark boundaries within the teletext data flow.

5.5.3.1 SOH (0/1) Start of header: indicates the start of a new record header. See Section 6.1.

5.5.3.2 RS (1/14) Record separator: used to separate records. Returns the cursor to column one of row one. Often referred to as "Home".

5.5.3.3 ETX (0/3) End of text: indicates the end of the record data field. See Section 6.4.

5.5.3.4 EOT (0/4) End of transmission: indicates the end of the record. See Section 6.4.

5.5.3.5 NUL (0/0) Nul: used as a "stuffing" byte. Must be ignored by the decoder.

5.6 Default Conditions

The decoder should have a certain "standard" or default condition when power is first applied and as described below.

5.6.1 Full Screen

At the start of a page, the screen attributes are in effect. If none, the screen attributes default to white foreground, black background, normal height, normal width, not inverted, not flashing, not boxed, not concealed, and not underlined.

5.6.2 Row

Row attributes take priority over screen attributes. If none, row attributes default to screen attributes.

5.6.3 Character

Character attributes take priority over row attributes. If none, character attributes default to row attributes.

6.0 TELETEXT MESSAGE PROTOCOLS

Teletext messages are made up of a variable number of characters organized into rows. These rows are in turn organized into screens or pages of information. The screen size is limited only by the display device used. The screens of information are in turn organized into records. A record is the largest grouping possible. A record may contain one or more screens of information. A record may also contain only part of a screen.

The record is divided into four parts:(as seen in Figure 22)

- Record start
- Record header
- Data field
- Record end

6.1 Record Start

Records are identified by a sequence of codes at the beginning and end of the record. The sequence SOH (0/1) Start of Header and RS (1/14) Record Separator is used to define the start of the record.

6.2 Record Header

The record header is the part of the record which is transmitted before the data field. The record header contains three bytes of Hamming protected addressing, a link function and a sequence of bytes which aids in the interpretation of the data field to follow. The record header is of variable length depending on the interpretation sequence. The record header immediately follows the record separator byte.

6.2.1 Address Bytes

A sequence of three Hamming protection address bytes A1 A2 A3 is used.

If A1 = 0 - 9 The record is a teletext message to be displayed. In this case A1 represents the hundredths value. A2 and A3 then respectively represent the tens and units of the record or page number.

If A1 = A - F The record is not intended for display. A2 and A3 then also indicate a record not intended for display.

6.2.2 Link Function

The link function is a single Hamming protected byte immediately following the address bytes A1, A2, A3. The link is intended to link together records identified by the same address and associated with the same message.

Since the link function is Hamming protected, there are 4 information bits. As seen in Figure 24, bits b2, b4, b6 are used to indicate the order of the linked record (ie. first, second, ...eighth). Bit b8 is used to indicate the existence of additional linked records (b8=0) or the last linked record in the sequence (b8=1).

In the case of multiple records defining a single message to be displayed only the first record in a series of linked records must include the record interpretation sequence. In this case, the link byte acts as an end-of-header flag for each subsequent linked record. The subsequent records are interpreted according to the definition sequence of the first record.

6.2.3 Interpretation Sequence

The interpretation sequence, as seen in Figures 22 and 23, gives general information that helps in the interpretation of the record to which it is attached. It is used by the decoder to detect the presence of certain functions such as an alarm page or a partial page or the presence of extended features. The interpretation sequence is divided into two sections:

The Designation bytes ($Y\emptyset_1$ - $Y\emptyset_x$)

The Specification bytes ($Y1_1$ - YX_x)

All of the Y bytes are protected by Hamming codes, thus there are only 4 usable bits per byte called b2, b4, b6, and b8. If the first usable bit of $Y\emptyset_1$ (which is b2) equals 0, the $Y\emptyset_1$ will not be followed by another YØ byte. If bit b2 of $Y\emptyset_1$ is equal to 1, then it indicates an additional Y byte $Y\emptyset_2$. The same rule applies to $Y\emptyset_2$ which in turn can indicate a $Y\emptyset_3$. The YØ sequence is only ended when the first usable bit of the last YØ is equal to 0.

The remaining usable bits (b4, b6, b8) of any YØ byte points to a group of specification bytes. Each bit of the

YØ designation byte is associated with a specification function, either specifying the function by default (b_x = 0) or calling the function (b_x = 1) and thus specifying it with a two byte sequence.

6.2.3.1 Interpretation Sequence Default

When $YØ_1$ has bits b2, b4, b6 and b8 equal to 0, it is the end of the record header and all the record specification functions are specified by default. (The default value corresponds to value "0" of the usable bits except when specified differently.)

6.2.3.2 Interpretation Of The Specification Bytes Associated With Byte YØ1

Bit b4 of $YØ_1$ as seen in Figure 23 is used to point to bytes $Y1_1$ and $Y1_2$ and is used to help information access by the user. It applies to the record to which it is associated and identifies the type of information contained in the record.

BYTE $Y1_1$

b2 = 1 Cover message: If the user has requested the data channel but has not requested a particular page, this function causes the automatic presentation of this record, which could be, for example, the cover of the magazine.

b4 = 1 Index message: indicates that the contents of this record is an index of the pages avaialble in a particular magazine. It allows the terminal to locate the index page without knowledge of it's page number.

b6 = 1 Automatic reading: This bit when high will cause the decoder to display the record with which it is associated even in the absence of any page number instructions to the decoder. The bit may be repositioned from page to page within this magazine in a time frame chosen by the source.

b8 = 1 Alarm message : Indicates that the associated record has a priority function which can be interpreted by the decoder to overide any other function.

BYTE $Y1_2$

b2
b4
b6
b8 } Unspecified for further extension

Bit b6 of $YØ_1$ as seen in Figure 23 is used to point to bytes $Y1_3$ and $Y1_4$ and is used to interpret the message contained in the record.

BYTE $Y1_3$

b2 = 1 Update message: This is a flag that indicates that the message contained in the record replaces a previous message with the same address.

b4 = 1 Partial message: This indicates that the message contained in the record completes or will be completed by other messages.

b6 = 1 Caption message: This bit indicates that the message is a caption which implies a screen transparent background.

b8 = 1 Concealed message: This bit indicates that the message should not be revealed until a reveal message is sent, or until the user manually reveals the message. This performs the same function as the screen attribute conceal. See Section 5.4.

BYTE $Y1_4$

b2, b4, b6, b8 } Unspecified Reserved for further extensions

Bit b8 of $Y\emptyset_1$, as seen in Figure 23, is used to point to bytes $Y1_5$ and $Y1_6$ which are used to indicate both the type of coding of the messages and the error protection level being used.

BYTE $Y1_5$

b2 = 1 Reserved for future use

b4 and b6 Four types of messages (see Figure 23 Note 1)

= 00 - Basic Typographic

= 01 - Reserved for graphic extensions

= 10 - Reserved for graphic extensions

= 11 - Reserved for graphic extensions

b8 Unspecified

BYTE $Y1_6$

The action of this byte depends on $Y1_5$ for a specific coding language.

b2 Unspecified

b4 Unspecified

b6 and b8 = Four levels of coding of the message (see figure 23 note 2)

= 00 - Level 0 of error protection being used

= 01 - Level 1 of error protection being used

= 10 - Unspecified

= 11 - Unspecified

6.2.3.3 <u>Interpretation of the Specification bytes associated with byte YØ2</u>

The specific functions of the bytes $Y2_{1-6}$ and all other YX_x bytes are undefined at this time and are reserved for future extension.

6.3 Data field

The record data field immediately follows the record header. It is composed of a sequence of codes as defined in Section 5 which explicitly describes the presentation of the message.

6.4 Record End

The record is ended by the combination of two codes ETX (0/3), end of text, and the code EOT (0/4), end of transmission. The end of the record is normally immediately followed by the SOH RS sequence, indicating the beginning of the next record. No stuffing bytes are needed to complete a record.

7. BASIC LEVEL SYSTEM SPECIFICATIONS

This section describes a recommended basic interpretation of the teletext standard specified in Sections 4, 5, and 6 which allows virtually unlimited character sets and attributes.

Because present television reception is subject to such factors as ignition noise and multipath interference, a certain amount of error protection is needed as described herein.

A minimum subset of available characters (known as a repertoire) and attributes that each decoder will be expected to interpret and display correctly will also be provided in Section 7.

Additionally, fallback procedures describe the correct way to interpret a character or attribute if the decoder is not able to display or use it.

Section 7 will also recommend a display format (number of characters and rows).

The final sections specify the page numbering scheme and details of captioning using teletext.

7.1 Levels of system error protection

The basic system has the capability of four levels of error protection as defined below. The level in use is shown in the record header by the Yl_6 Bytes.

Level 0: Determined by byte Yl_6, b6 = 0 and b8 = 0. This mode is directly compatible with the CCITT Recommendation S.g for interactive videotex and has no special protection for the broadcast environment. In level 0 each code is to be interpreted directly as described in Sections 5 and 6. This is the most flexible mode but also the least protected. Error detection is provided only by odd parity in the ASCII characters and Hamming protection of certain other bytes. (See Section 7.9.2).

Level 1: Determined by byte Yl_6 b6 = 0 and b8 = 1. This mode, while retaining full compatibility with CCITT Recommendation S.g employs additional error protection. Certain important codes are additionally protected by combining them with other codes and by repetition. (Level 1 is described in section 7.9)

Level 2: Determined by byte Yl_6 b6 = 1 and b8 = 0 is undefined.

Level 3: Determined by byte Yl_6 b6 = 1 and b8 =1 is undefined.

The remainder of section 7 describes a teletext system based on level 1.

7.2 Display Format

A displayed page, or screen, will consist of 40 character positions per row by 20 rows plus an optional service row, numbered zero, for a total of 21 displayed rows. (Additional rows are possible in the future due to the extensible nature of the system.)

In the basic system, page display is accomplished with a combination of characters, control codes, and attributes.

7.3 Displayed Characters

When displayed on a television receiver, characters are created within a matrix, consisting of television scanning lines and dots. In the case of a decoder which is not intended to handle DRCS, the dimensions of this matrix is left to the discretion of the decoder manufacturer.

7.3.1 Character Repertoire

The following characters are possible. A subset of these characters will be chosen to constitue the basic set.

CHARACTERS	NAME or DESCRIPTION
a	small a without diacritical mark
A	capital A without diacritical mark
á	small a with acute accent
Á	capital A with acute accent

à	small a with grave accent
À	capital A with grave accent
â	small a with circumflex accent
Â	capital A with circumflex accent
ä	small a with diaeresis or umlaut mark
Ä	capital A with diaeresis or umlaut mark
ã	small a with tilde
Ã	capital A with tilde
ă	small a with breve
Ă	capital A with breve
å	small a with ring
Å	capital A with ring
ā	small a with macron
Ā	capital A with macron
ą	small a with ogonek
Ą	capital A with ogonek
æ	small æ diphthong
b	small b without diacritical mark
B	capital B without diacritical mark
c	small c without diacritical mark
C	capital C without diacritical mark
ć	small c with acute accent
Ć	capital C with acute accent
ĉ	small c with circumflex accent
Ĉ	capital C with circumflex accent

č	small c with caron
Č	capital C with caron
ċ	small c with dot
Ċ	capital C with dot
ç	small c with cedilla
Ç	capital c with cedilla
d	small d without diacritical mark
D	capital D without diacritical mark
ď or d'	small d with caron
Ď	capital D with caron
e	small e without diacritical mark
E	capital E without diacritical mark
é	small e with acute accent
É	capital E with acute accent
è	small e with grave accent
È	capital E with grave accent
ê	small e with circumflex accent
Ê	capital E with circumflex accent
ë	small e with diaeresis or umlaut mark
Ë	capital E with diaeresis or umlaut mark
ě	small e with caron
Ě	capital E with caron
ė	small e with dot
Ė	capital E with dot
ē	small e with macron

Ē	capital E with macron
ę	small e with ogonek
Ę	capital E with ogonek
f	small f without diacritical mark
F	capital F without diacritical mark
g	small g without diacritical mark
G	capital G without diacritical mark
ǵ	small g with acute accent
ĝ	small g with circumflex accent
Ĝ	capital G with circumflex accent
ğ	small g with breve
Ğ	capital G with breve
ġ	small g with dot
Ġ	capital G with dot
Ģ	capital G with cedilla
h	small h without diacritical mark
H	capital H without diacritical mark
ĥ	small h with circumflex accent
Ĥ	capital H with circumflex accent
i	small i with dot and without other diacritical mark
I	capital I without diacritical mark
í	small i with acute accent
Í	capital I with acute accent
ì	small i with grave accent
Ì	capital I with grave accent

î	small i with circumflex accent
Î	capital I with circumflex accent
ï	small i with diaeresis or umlaut mark
Ï	capital I with diaeresis or umlaut mark
ĩ	small i with tilde
Ĩ	capital I with tilde
İ	capital I with dot
ī	small i with macron
Ī	capital I with macron
į	small i with ogonek
Į	capital I with ogonek
ı	small i without dot
j	small j with dot and without other diacritical mark
J	capital J without diacritical mark
ĵ	small j with circumflex accent
Ĵ	capital J with circumflex accent
k	small k without diacritical mark
K	capital K without diacritical mark
ķ	small k with cedilla
Ķ	capital K with cedilla
ĸ	small k, Greenlandic
l	small l without diacritical mark
L	capital L without diacritical mark
ĺ	small l with acute accent
Ĺ	capital L with acute accent

ľ or ľ	small l with caron
Ľ or Ľ	capital L with caron
ļ	small l with cedilla
Ļ	capital L with cedilla
ł	small l with stroke
Ł	capital L with stroke
l·	small l with middle dot
L·	capital L with middle dot
m	small m without diacritical mark
M	capital M without diacritical mark
n	small n without diacritical mark
N	capital N without diacritical mark
ń	small n with acute accent
Ń	capital N with acute accent
ñ	small n with tilde
Ñ	capital N with tilde
ň	small n with caron
Ň	capital N with caron
ņ	small n with cedilla
Ņ	capital N with cedilla
ŉ	small n with apostrophe
o	small o without diacritical mark
O	capital O without diacritical mark
ó	small o with acute accent
Ó	capital O with acute accent

ò	small o with grave accent
Ò	capital O with grave accent
ô	small o with circumflex accent
Ô	capital O with circumflex accent
ö	small o with diaeresis or umlaut mark
Ö	capital O with diaeresis or umlaut mark
õ	small o with tilde
Õ	capital O with tilde
ő	small o with double acute accent
Ő	capital O with double acute accent
ō	small o with macron
Ō	capital O with macron
ø	small o with slash
Ø	capital O with slash
p	small p without diacritical mark
P	capital P without diacritical mark
q	small q without diacritical mark
Q	capital Q without diacritical mark
r	small r without diacritical mark
R	capital R without diacritical mark
ŕ	small r with acute accent
Ŕ	capital R with acute accent
ř	small r with caron
Ř	capital R with caron
ŗ	small r with cedilla
Ŗ	capital R with cedilla

s	small s without diacritical mark
S	capital S without diacritical mark
ś	small s with acute accent
Ś	capital S with acute accent
ŝ	small s with circumflex accent
Ŝ	capital S with circumflex accent
š	small s with caron
Š	capital S with caron
ş	small s with cedilla
Ş	capital S with cedilla
t	small t without diacritical mark
T	capital T without diacritical mark
ť or t'	small t with caron
Ť	capital T with caron
ţ	small t with cedilla
Ţ	capital T with cedilla
ŧ	small t with stroke
Ŧ	capital T with stroke
u	small u without diacritical mark
U	capital U without diacritical mark
ú	small u with acute accent
Ú	capital U with acute accent
ù	small u with grave accent
Ù	capital U with grave accent
û	small u with circumflex accent
Û	capital U with circumflex accent

ü	small u with diaeresis or umlaut mark
Ü	capital U with diaeresis or umlaut mark
ũ	small u with tilde
Ũ	capital U with tilde
ŭ	small u with breve
Ŭ	capital U with breve
ű	small u with double acute accent
Ű	capital U with double acute accent
ů	small u with ring
Ů	capital U with ring
ū	small u with macron
Ū	capital U with macron
ų	small u with ogonek
Ų	capital U with ogonek
v	small v without diacritical mark
V	capital V without diacritical mark
w	small w without diacritical mark
W	capital W without diacritical mark
ŵ	small w with circumflex accent
Ŵ	capital W with circumflex accent
x	small x without diacritical mark
X	capital X without diacritical mark
y	small y without diacritical mark
Y	capital Y without diacritical mark

ý	small y with acute accent
Ý	capital Y with acute accent
ŷ	small y with circumflex accent
Ŷ	capital Y with circumflex accent
ÿ	small y with diaeresis or umlaut mark
Ÿ	capital Y with diaeresis or umlaut mark
z	small z without diacritical mark
Z	capital Z without diacritical mark
ź	small z with acute accent
Ź	capital Z with acute accent
ž	small z with caron
Ž	capital Z with caron
ż	small z with dot
Ż	capital Z with dot

<u>**DECIMAL DIGITS**</u>

1	digit 1
2	digit 2
3	digit 3
4	digit 4
5	digit 5
6	digit 6
7	digit 7
8	digit 8
9	digit 9
0	digit 0

CURRENCY SIGNS

¢	cent sign
$	dollar sign
¤	international currency sign
£	pound sign
¥	yen sign

PUNCTUATION MARKS

«	angle quotation mark left
»	angle quotation mark right
'	apostophe
:	colon
,	comma
!	exclamation mark
“	double quotation mark left
”	double quotation mark right
-	hyphen or minus sign
¡	inverted exclamation mark
(	left parenthesis
_	low line
.	period
?	question mark
"	quotation mark
\	reverse slant
)	right paranthesis
;	semicolon
‘	single quotation mark left
’	single quotation mark right
/	slant

ARITHMETIC SIGNS

÷	divide sign
=	equals sign
1/8	fraction one-eighth
1/4	fraction one-fourth
3/8	fraction three-eights
1/2	fraction one-half
5/8	fraction five-eights
3/4	fraction three-quarters
7/8	fraction seven-eights
>	greater than sign
<	less than sign
x	multiply sign
π	pi
±	plus or minus sign
+	plus sign
^{2}	superscript two
^{3}	superscript three

MISCELLANEOUS SYMBOLS

&	ampersand
*	asterisk
@	commercial at
c	copyright
°	degree
↓	down arrow
←	left arrow

{	left brace
[	left square bracket
µ	micro sign
•	middle dot
♪	musical note
#	number sign
Ω	ohm
%	percent sign
R	regestered
→	right arrow
}	right brace
]	right square bracket
§	section
↑	up arrow
|	vertical bar

7.3.2 Mosaic Graphics

The six-section character, (2x3) with or without border, as described in Section 4.4.2, is used. The basic system has characters shown in the G1 coding table, Figure 18.

7.4 Fallback Modes

Fallback modes differ from default conditions (Section 5.4). They refer to the display a decoder produces when it receives a message it cannot accurately display. See the sections which follow for examples.

7.4.1 Character Fallback

Characters which cannnot be displayed in a certain decoder type will result in an approximation wherever possible. If, for example, â is sent and the decoder is not able to generate and display the ^ , it displays the "a" only.

7.4.2 Control Set Fallback

Control codes which cannot be used shall be ignored and shall not cause any misinterpretation by the decoder.

7.4.3 Attribute Fallback

Attributes which cannot be correctly reproduced and displayed by a decoder will result in either an approximation of the attribute (light blue will be shown as saturated primary blue or a shade of grey) or none at all. In no case will the decoder scramble the character or screen , or display incorrect characters.

7.5 Control character repertoire

The following control codes are available in the basic system. See Section 5.3.1 for coding and explanation.

CAN	Cancel
CR	Carriage return
EOT	End of transmission
ETX	End of transmission
ESC	Escape
LF	Line Feed
NUL	Null
REP	Repeat
RS	Record separator
SI	Shift in
SO	Shift out
SOH	Start of header
SS2	Single shift two
SS3	Single shift three
US	Unit separator

7.6 Attributes

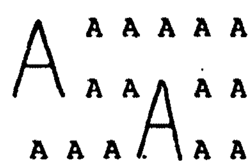
The basic attribute set is that which is defined in the C1 set as seen in Figure 19 and explained in Section 4.5. This includes a basic color palete which contains black and white and 6 saturated colors: red, green, yellow, blue, magenta and cyan.

The basic C1 set also has provisions for four character sizes: normal size, double height, double width and double height and width (also referred to as double size). Additionally the following attributes are available: flashing, conceal, reveal, underline, boxing , invert and transparent background.

Double heights must not be staggered (i.e. they may not appear on two contiguous rows).

Example:

is authorized



is prohibited

All attributes are non-spacing. If the decoder cannot handle non-spacing attributes, it goes to the default mode. See Section 7.4.3

7.7 Record Protocol

The basic system uses a record protocol as listed below.

7.7.1 Record start

The record start shall be two codes sent consecutively as follows: SOH/RS. These codes will always be sent together

7.7.2 Record header

The record header shall consist of: A_1, A_2, A_3, L, Y

7.7.2.1 Address Bytes

The address bytes are described in section 6.2.1.

7.7.2.2 Link bytes

The link byte is used as described in Section 6.2.2.

7.7.2.3 Y Designation bytes

The basic system uses all the Y bytes, defined in Section 6.2.3.

7.8 Record End

The record end shall consist of two codes sent consecutively as follows: ETX EOT. These codes will always be sent together in Level one .

7.9 Error Protection

Various error protection techniques are employed in the record.

7.9.1 Parity Error of Characters

The information contained within the data block uses the most significant bit of each byte, b8, for odd parity error detection, with the exception of those listed in section 7.9.2 If the sum of bits b1 to b7 is even, then b8 = 1.

If the sum of bits b1 to b7 is odd, then b8 = 0. This technique is used in Levels 0 and 1.

7.9.2 Hamming Protected Characters

Additional protection is provided to certain control codes and sequences by the use of Hamming protection (See Figure 5). As seen in Figure 7, bits b1, b3, b5, and b7 provide Hamming protection and bits b2, b4, b6, and b8 contain the data.

This method of data protection allows the detection of an even multiple of errors and provides correction of a single error. The following codes use the interleaved Hamming protection technique:

A_1 A_2 A	Page Numbers
L	Link
Y	Interpretation Sequence

7.9.3 Combinations

Because of the importance of certain codes (which could affect the page layout if errors occurred), special combinations are used to increase the system reliability in Level 1. They are:

CR LF	To move cursor from its present location to character position 1 in row following. The CR and LF characters will always be sent as a pair in Level 1 language.

US X Y US X Y — The sequence US X Y is identical to the one defined in Section 5.5.1.3 except that it is always sent twice, each code retaining its odd parity protection. In Level 1 language, these codes will always be sent together.

REP X X BS — The repeat sequence is protected by sending the number of repeats (X) twice followed by BS (0/8)

SOH RS — This combination signals the start of a record. In Level 1 language these codes will always be sent together.

ETX EOT — The end of a record is marked by this combination. In Level 1 language these codes will always be sent together.

7.9.4 Redundancy

Two control characters are always sent twice in Level 1. They are: SO and SI

7.9.5 Codes Never Sent Alone

The following codes are never sent alone in Level 1:

BS	REP
CR	RS
EOT	SOH
ETX	US
LF	

7.9.6 Invalid Codes

These codes are invalid codes for use in Level 1 language in either the vertical blanking interval or in the full field mode:

FF

HT

VT

7.9.7 Codes Used Alone

The codes below are included for completeness since they do not fall into any previous category and may be sent alone: These codes do not benifit from any special protection in Level 1.

CAN

ESC

SS2

SS3

7.10 Page Numbering Scheme

Pages have a different numbering plan depending on whether they are transmitted in the vertical interval or full field.

7.10.1 Vertical Blanking Interval

Pages in VBI service have four digits (0000 through 9999). The first two digits represent the magazine number from P_1 P_2 and the last two, the page number from A_2 and A_3 (A_1 is always 0 for VBI mode.) Since hexadecimal coding is used for both magazine and page numbers, those above 9 (i.e., A - F) are available for other uses.

7.10.2 Full Field

With full field, an expanded packet prefix is used, allowing for 4096 magazines [P_1 P_2 P_3 allow 2^{12} = 4096]. Similarly, each magazine may have 4096 pages using the record header A_1, A_2, A_3 bytes.

7.10.3 Automatic Reading Page (ARP)

As described in Section 6.2.3.2 the decoder can search for the ARP bit (Yl_1, bit 6 = 1) of one page per magazine and then display that page. The bit may move from page to page over a period of time and the decoder will continue to follow it and then display the page it flags. Access to the ARP feature of each magazine is via the selection of magazine number plus ARP mode. It is not necessary to select page numbers.

7.11 Captions Using Teletext

Teletext is an efficient means to provide a versatile and sophisticated captioning service, at various levels and for many uses.

7.11.1 Access to Captioning

Captions will all be contained in one data channel, on different pages.

7.11.2 Types of Captioning

In the basic system, two types of captioning are possible.

7.11.2.1 Mode 1 Captioning

Where only a few captions are to be sent and the timing with program video or audio is not critical, each caption record is sent with the Y caption flag raised ($Y1_3$ b6 =1). This implies two things to the decoder: provide transparent background and suppress the page display. The caption is displayed upon the reception of ETX/EOT, which occurs only at the end of the record.

7.11.2.2 Mode 2 Captioning

When many captions are sent, at various levels and in various languages, forming classes, all the varieties for a given class of captions are sent far enough ahead to allow the decoder to store the one selected. The Y caption flag ($Y1_3$ b6 = 1) is raised on each one, implying transparent background and suppress page display. The conceal flag ($Y1_3$ b8 = 1) should also be raised. After all varieties of a given caption are sent, one additional record is sent with the conceal flag low [(equal reveal) $Y1_3$ b8 = 0]. This single command causes all decoders which have been storing a class of captions to display it. This last command is seen by all decoders, regardless of what page number they may have been instructed to look for because this page has no number and has the alarm flag raised in the Y's ($Y1_1$ b8 = 1).

7.11.2.3 Caption Removal

To remove a class of captions and leave a blank screen, an alarm page is sent with the conceal flag raised, ($Y1_3$ b8 =1). This method is effective for either type of caption.

Table of Figures

COMPOSITE VIDEO SIGNAL

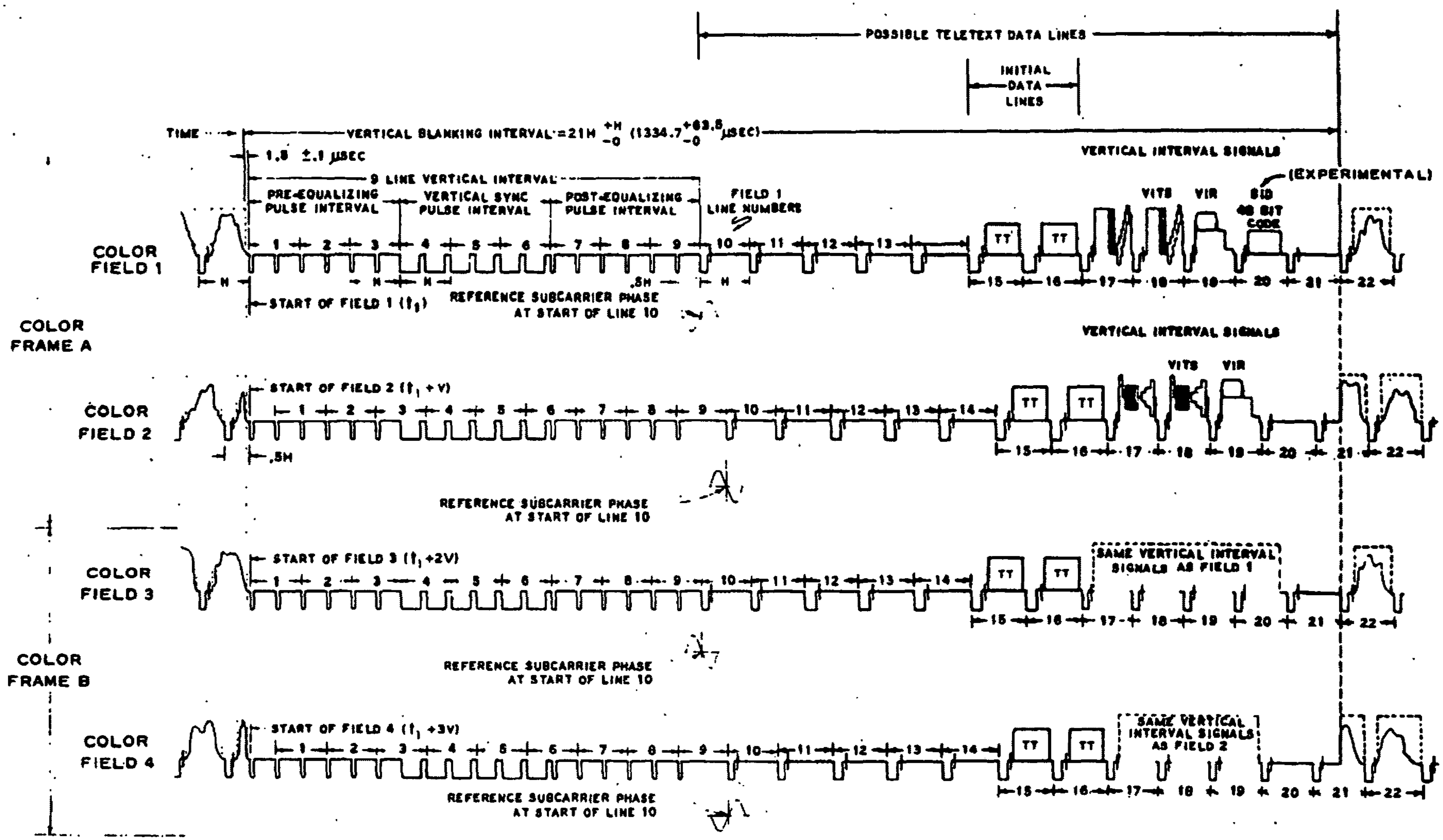


FIGURE 1

DATA SPECTRUM AFTER 100% ROLL-OFF NYQUIST FILTER + LOW PASS FILTER

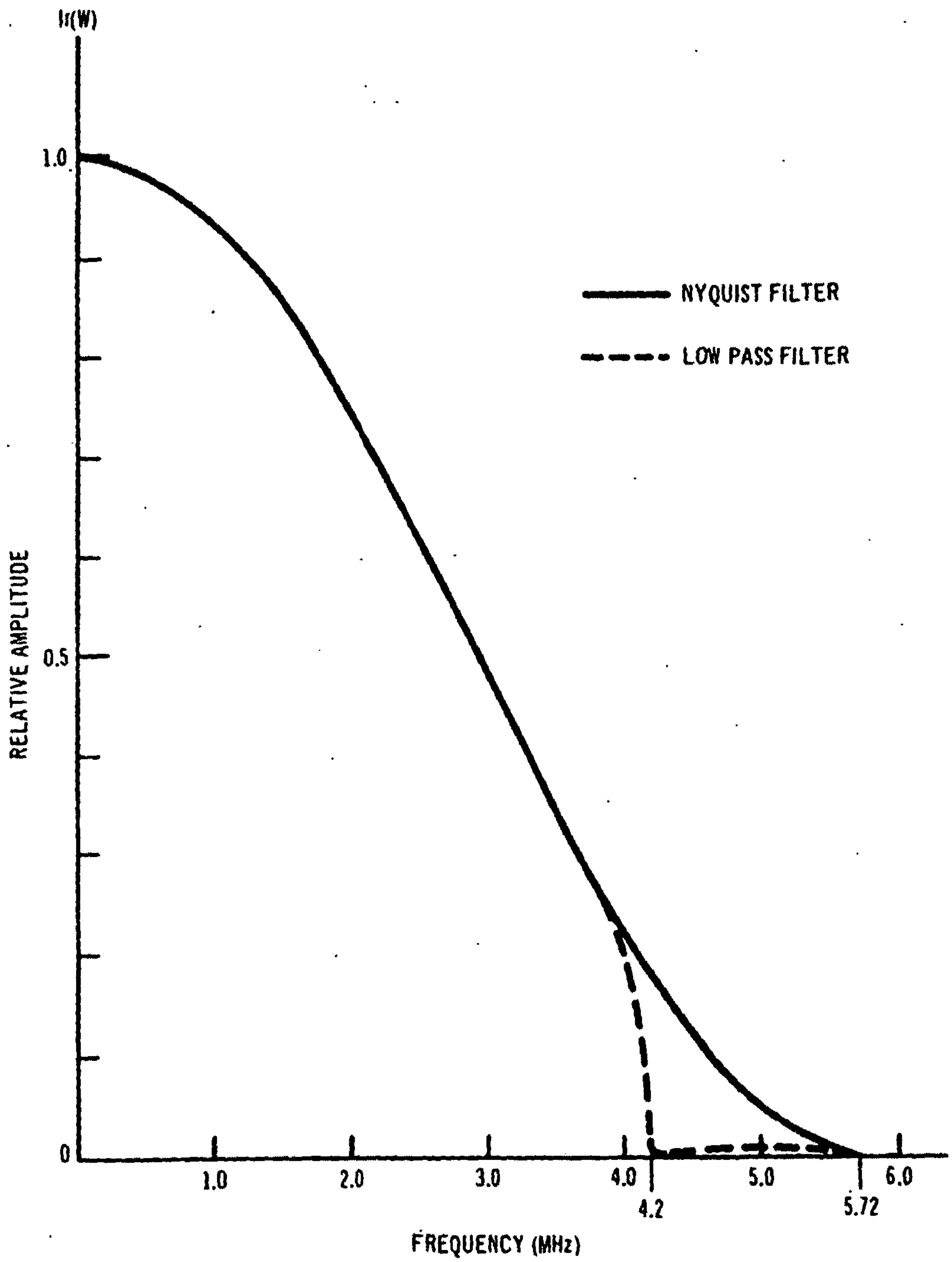


FIGURE 2

IMPULSE RESPONSE OF 100%
ROLL-OFF NYQUIST FILTER + LOW PASS FILTER

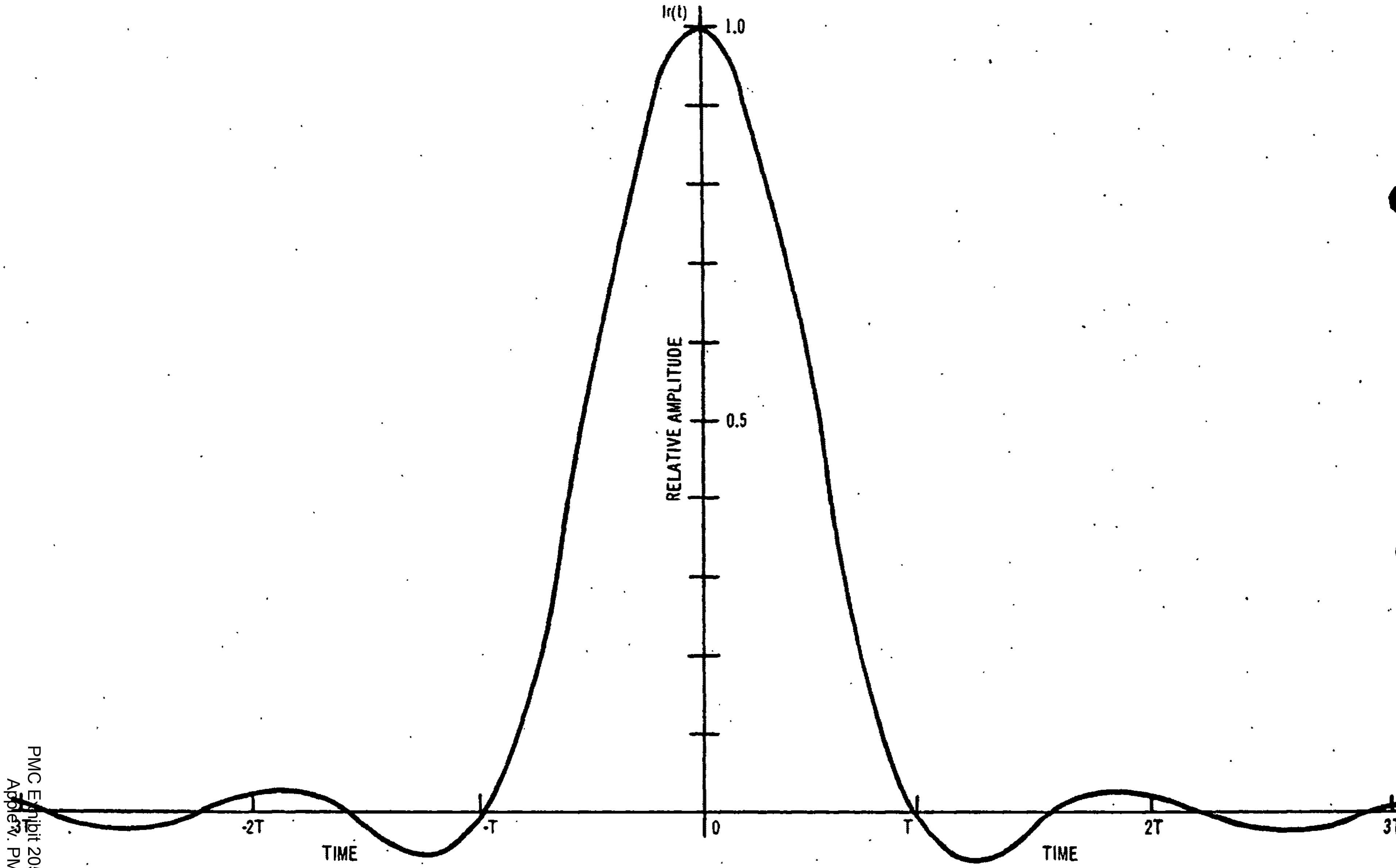


FIGURE 3

DATA TIMING

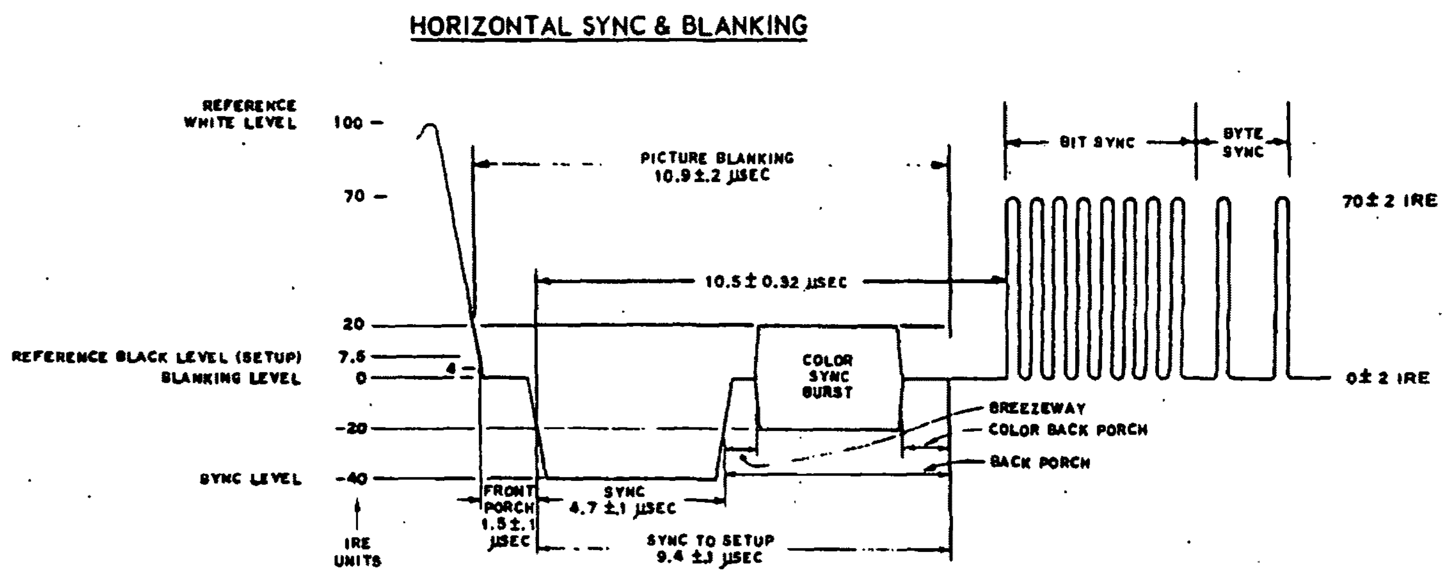
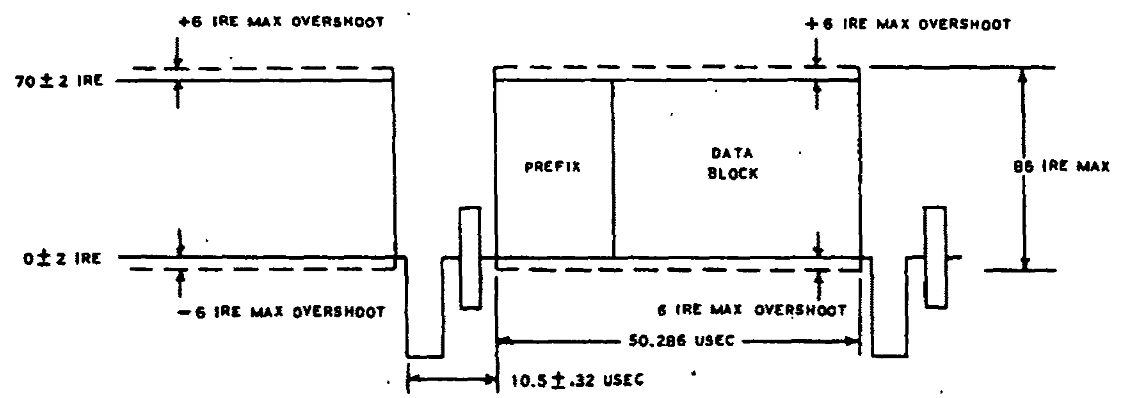


FIGURE 4

DATA AMPLITUDE



HORIZONTAL SYNC & BLANKING

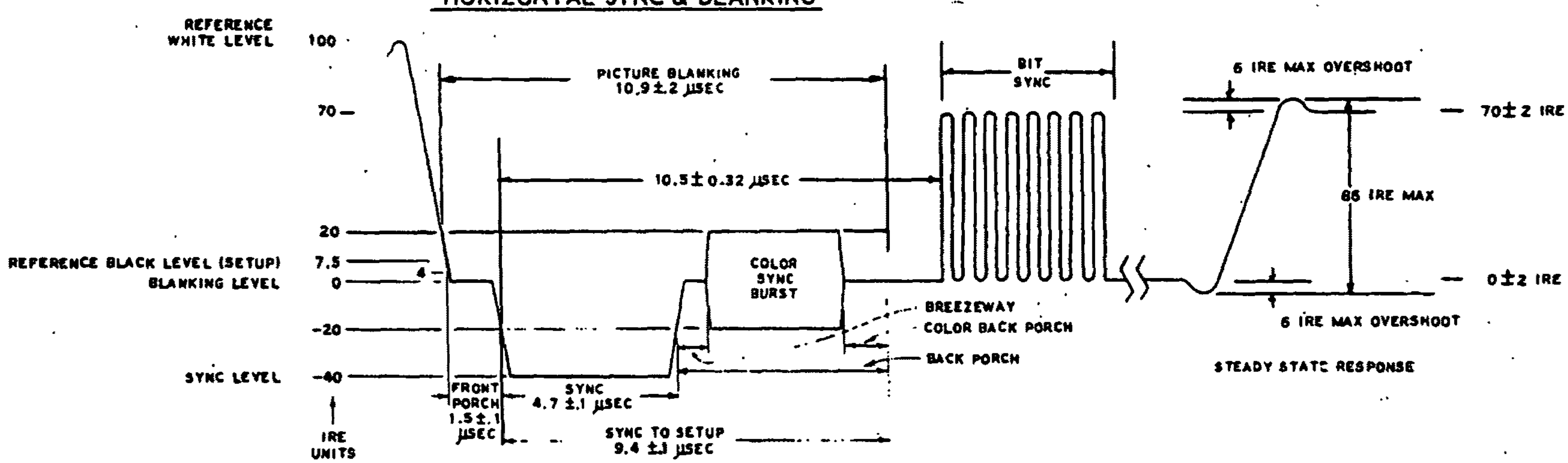
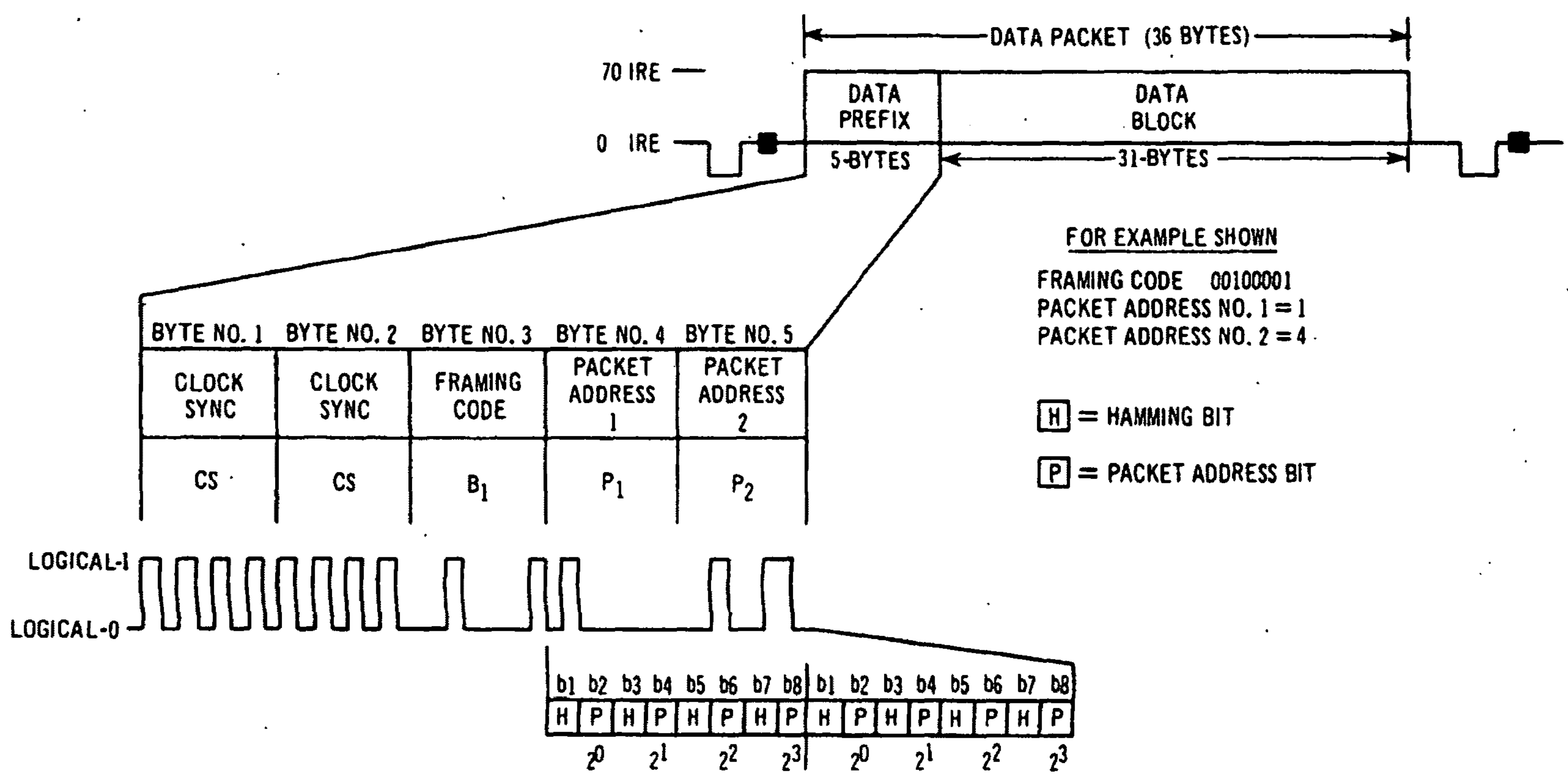


FIGURE 5

VERTICAL INTERVAL SERVICE 5-BYTE PREFIX



FOR EXAMPLE SHOWN

FRAMING CODE 00100001
PACKET ADDRESS NO. 1 = 1
PACKET ADDRESS NO. 2 = 4

H = HAMMING BIT

P = PACKET ADDRESS BIT

FIGURE 6

FULL-FIELD SERVICE 8-BYTE PREFIX

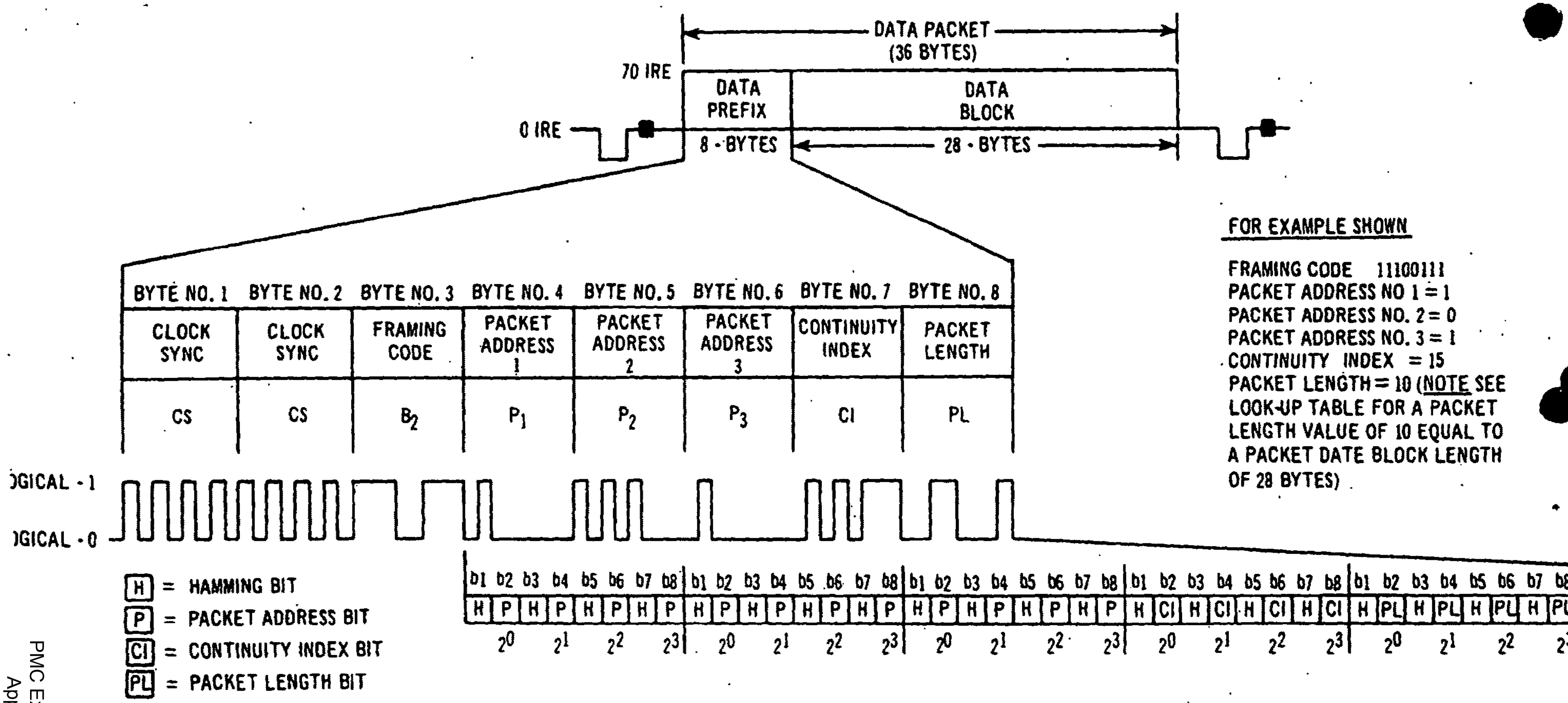


FIGURE 7

HAMMING CODE

INFORMATION BITS (b8, b6, b4, b2)

ENCODING

HEXADECIMAL NUMBER	DECIMAL NUMBER	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	1	0	1	0	1
1	1	0	0	0	0	0	0	1	0
2	2	0	1	0	0	1	0	0	1
3	3	0	1	0	1	1	1	1	0
4	4	0	1	1	0	0	1	0	0
5	5	0	1	1	1	0	0	1	1
6	6	0	0	1	1	1	0	0	0
7	7	0	0	1	0	1	1	1	1
8	8	1	1	0	1	0	0	0	0
9	9	1	1	0	0	0	1	1	1
A	10	1	0	0	0	1	1	0	0
B	11	1	0	0	1	1	0	1	1
C	12	1	0	1	0	0	0	0	1
D	13	1	0	1	1	0	1	1	0
E	14	1	1	1	1	1	1	0	1
F	15	1	1	1	0	1	0	1	0

$b7 = b8 \,\theta\, b6 \,\theta\, b4$

$b5 = b6 \,\theta\, b4 \,\theta\, \overline{b2}$

$b3 = b4 \,\theta\, \overline{b2} \,\theta\, b8$

$b1 = \overline{b2} \,\theta\, b8 \,\theta\, b6$

PROTECTION BITS (b7, b5, b3, b1)

FIRST BINARY ELEMENT TRANSMITTED (b1)

θ = EXCLUSIVE - OR

DECODING

$A = b8 \,\theta\, b6 \,\theta\, b2 \,\theta\, b1$

$B = b8 \,\theta\, b4 \,\theta\, b3 \,\theta\, b2$

$C = b6 \,\theta\, b5 \,\theta\, b4 \,\theta\, b2$

$D = b8 \,\theta\, b7 \,\theta\, b6 \,\theta\, b5 \,\theta\, b4 \,\theta\, b3 \,\theta\, b2 \,\theta\, b1$

A	B	C	D	INTERPRETATION	INFORMATION
1	1	1	1	NO ERROR	ACCEPTED
0	0	1	0	ERROR IN b8	CORRECTED
1	1	1	0	ERROR IN b7	ACCEPTED
0	1	0	0	ERROR IN b6	CORRECTED
1	1	0	0	ERROR IN b5	ACCEPTED
1	0	0	0	ERROR IN b4	CORRECTED
1	0	1	0	ERROR IN b3	ACCEPTED
0	0	0	0	ERROR IN b2	CORRECTED
0	1	1	0	ERROR IN b1	ACCEPTED
A.B.C = 0			1	MULTIPLE ERRORS	REJECTED

FIGURE 8

PACKET LENGTH BYTE LOOKUP TABLE FOR DATA BLOCK SIZE

HAMMING CODE INFORMATION BITS (b8, b6, b4, b2)

DATA BLOCK SIZE IN BYTES	PACKET LENGTH DECIMAL NUMBER	b8	b7	b6	b5	b4	b3	b2	b1
0	0	0	0	0	1	0	1	0	1
1	1	0	0	0	0	0	0	1	0
2	2	0	1	0	0	1	0	0	1
3	3	0	1	0	1	1	1	1	0
4	4	0	1	1	0	0	1	0	0
8	5	0	1	1	1	0	0	1	1
12	6	0	0	1	1	1	0	0	0
16	7	0	0	1	0	1	1	1	1
20	8	1	1	0	1	0	0	0	0
24	9	1	1	0	0	0	1	1	1
28	10	1	0	0	0	1	1	0	0
32	11	1	0	0	1	1	0	1	1
36	12	1	0	1	0	0	0	0	1
40	13	1	0	1	1	0	1	1	0
44	14	1	1	1	1	1	1	0	1
48	15	1	1	1	0	1	0	1	0

PROTECTION BITS (b7, b5, b3, b1)

FIRST BINARY ELEMENT TRANSMITTED (b1)

FIGURE 9

VIRTUAL DATA CHANNELS

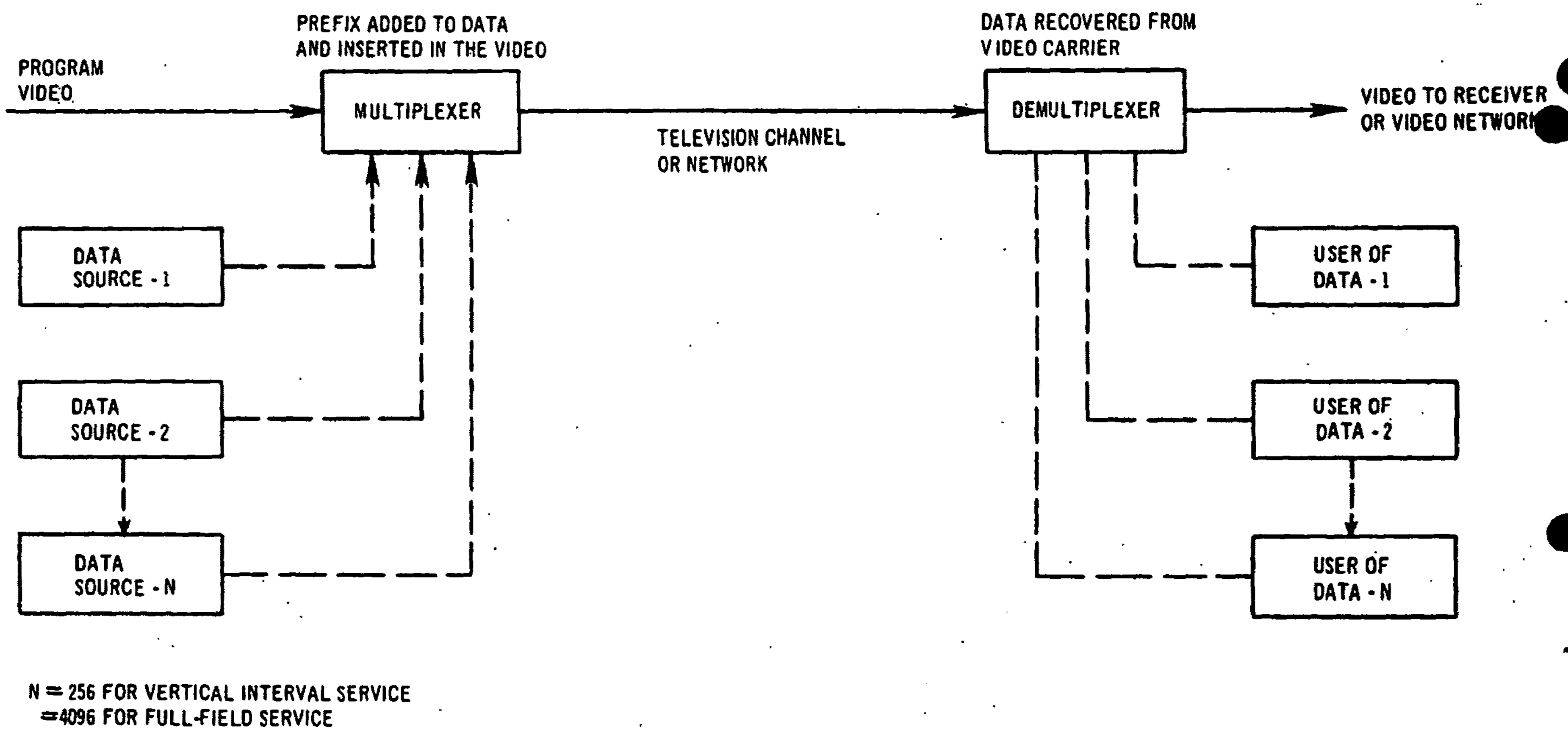
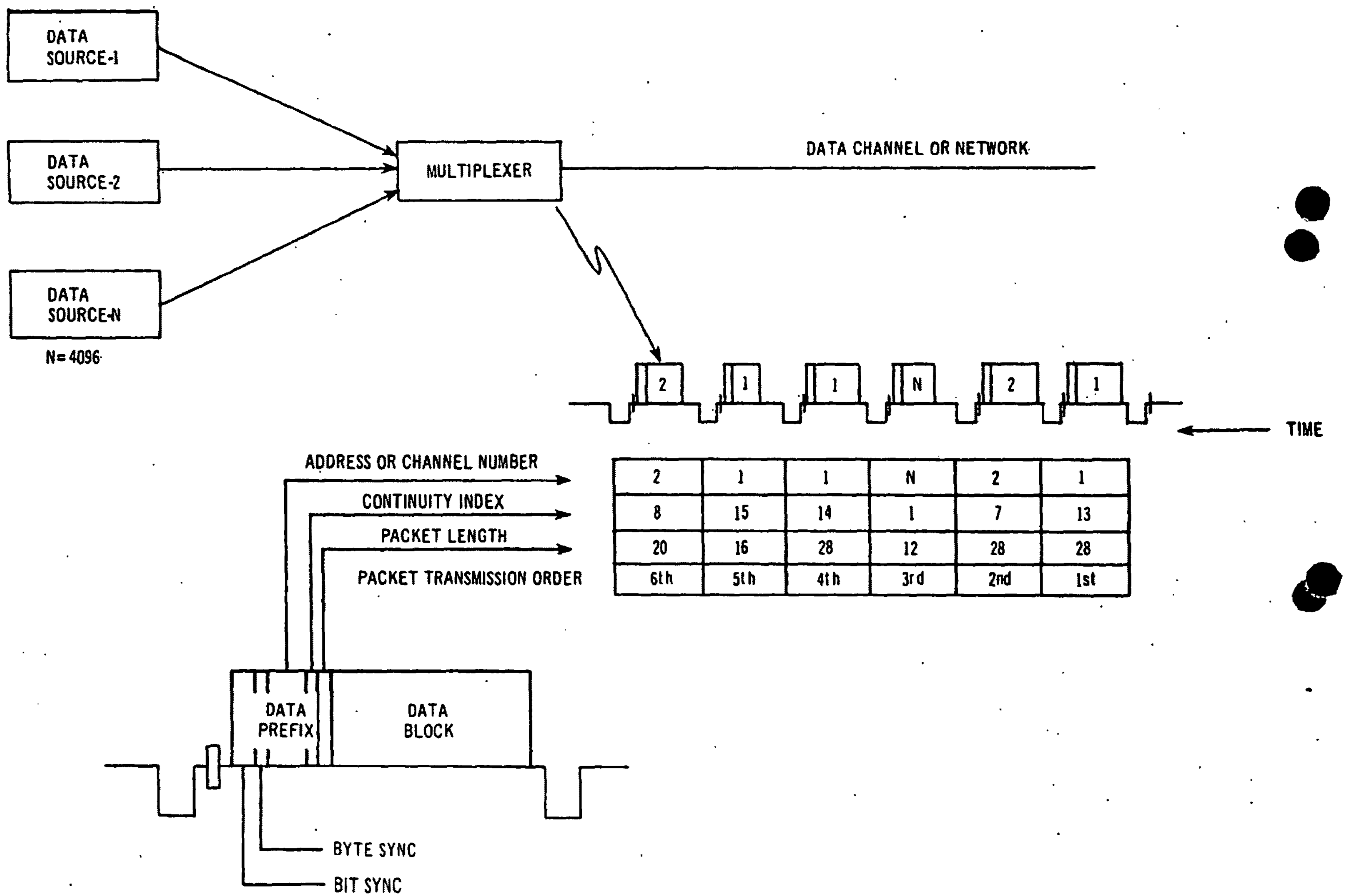


FIGURE 10

EXAMPLE OF FULL-FIELD MULTIPLEXING



ADDRESS OR CHANNEL NUMBER	2	1	1	N	2	1
CONTINUITY INDEX	8	15	14	1	7	13
PACKET LENGTH	20	16	28	12	28	28
PACKET TRANSMISSION ORDER	6th	5th	4th	3rd	2nd	1st

FIGURE 11

EXAMPLE OF DEMULTIPLEXING PROCESS

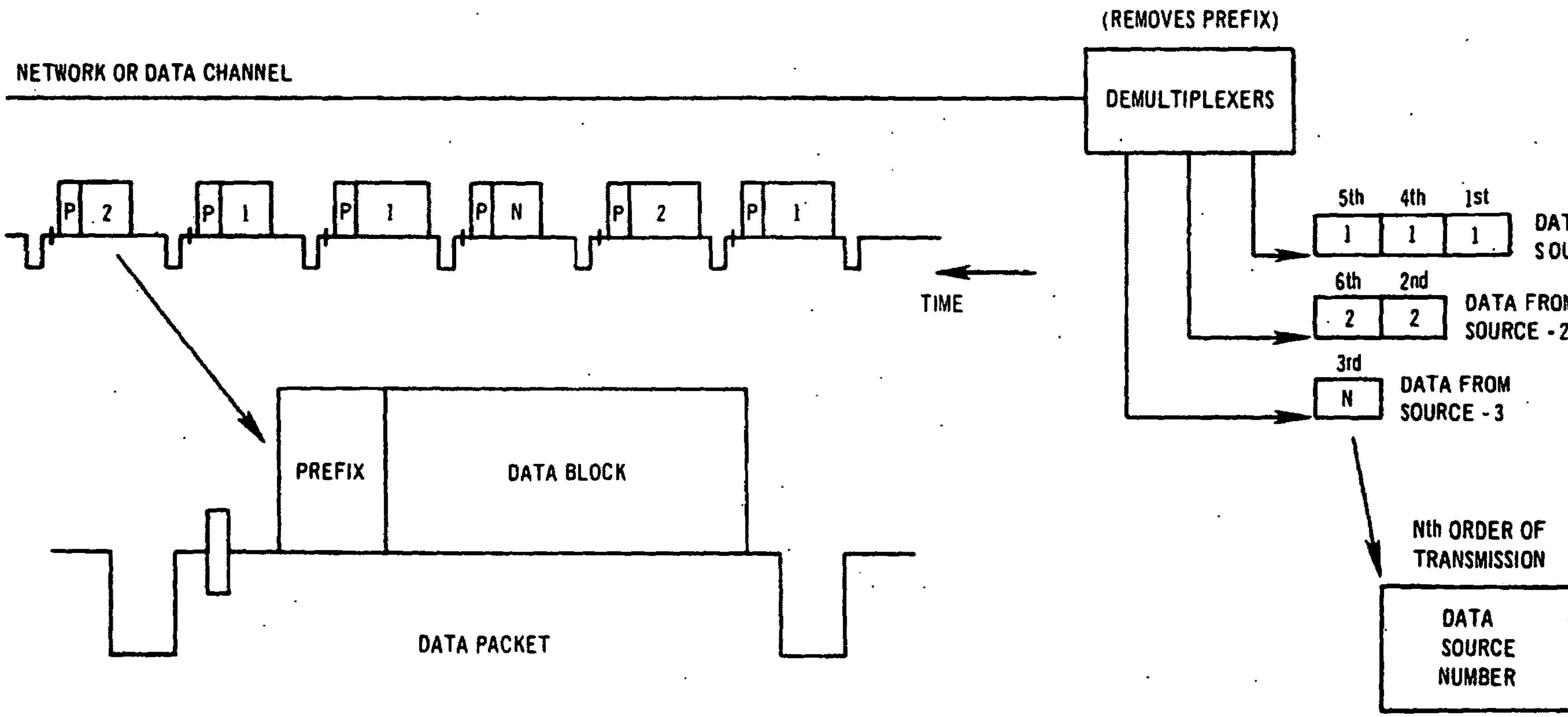


FIGURE 12

MOSAIC GRAPHIC MATRIX

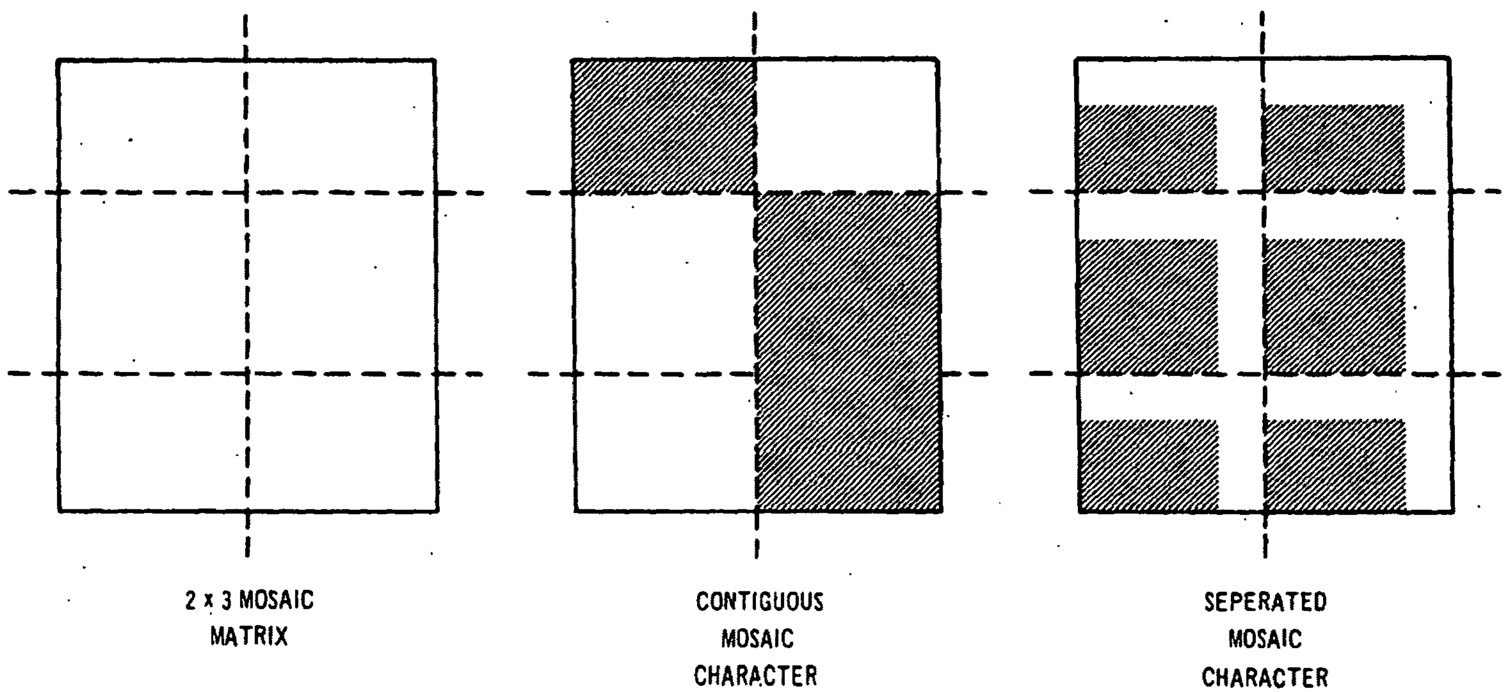


FIGURE 13

SEVEN-ELEMENT CODE EXTENSION

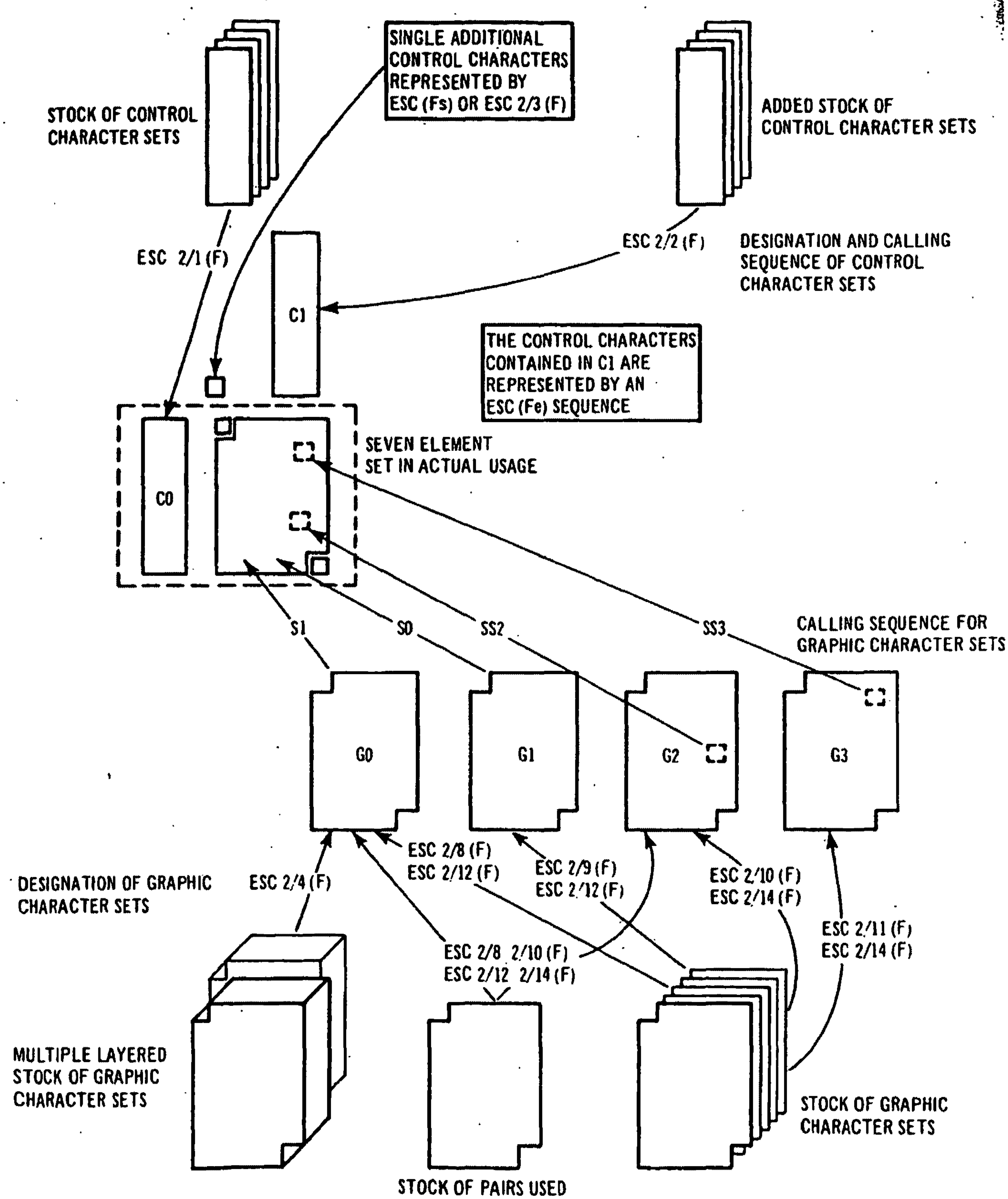


FIGURE 14

SET GO

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0				0	@	P	`	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			”	2	B	R	b	r
0	0	1	1	3			#	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			’	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	[	k	{
1	1	0	0	12			,	<	L	\	l	|
1	1	0	1	13			–	=	M	]	m	}
1	1	1	0	14			.	>	N	∧	n	~
1	1	1	1	15			/	?	O	_	o	

FIGURE 15

SET G2

b7					0	0	0	0	1	1	1	1
b6					0	0	1	1	0	0	1	1
b5					0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0				°		—	Ω	ĸ
0	0	0	1	1			¡	±	`	1/8	Æ	æ
0	0	1	0	2			¢	²	´	3/8	Đ	đ
0	0	1	1	3			£	³	^	5/8	ª	ð
0	1	0	0	4			$	x	~	7/8	Ħ	ħ
0	1	0	1	5			¥	µ	¯	♪		ı
0	1	1	0	6			#	π	˘	©	IJ	ij
0	1	1	1	7			§	·	˙	®	Ŀ	ŀ
1	0	0	0	8			¤	÷	¨		Ł	t
1	0	0	1	9			‘	’			Ø	ø
1	0	1	0	10			“	”	˚		Œ	œ
1	0	1	1	11			«	»	¸		º	ß
1	1	0	0	12			←	1/4			Þ	þ
1	1	0	1	13			↑	1/2	˝		Ŧ	ŧ
1	1	1	0	14			→	3/4	˛		Ŋ	ŋ
1	1	1	1	15			↓	¿	ˇ		ŉ	

FIGURE 16

SET CO

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
b4	b3	b2	b1									
0	0	0	0	0	NUL							
0	0	0	1	1	SOH							
0	0	1	0	2		Rep						
0	0	1	1	3	ETX							
0	1	0	0	4	EOT							
0	1	0	1	5								
0	1	1	0	6								
0	1	1	1	7								
1	0	0	0	8	BS	CAN						
1	0	0	1	9	HT	SS2						
1	0	1	0	10	LF							
1	0	1	1	11	VT	ESC						
1	1	0	0	12	FF							
1	1	0	1	13	CR	SS3						
1	1	1	0	14	SO	RS						
1	1	1	1	15	SI	US						

FIGURE 17

SET G1

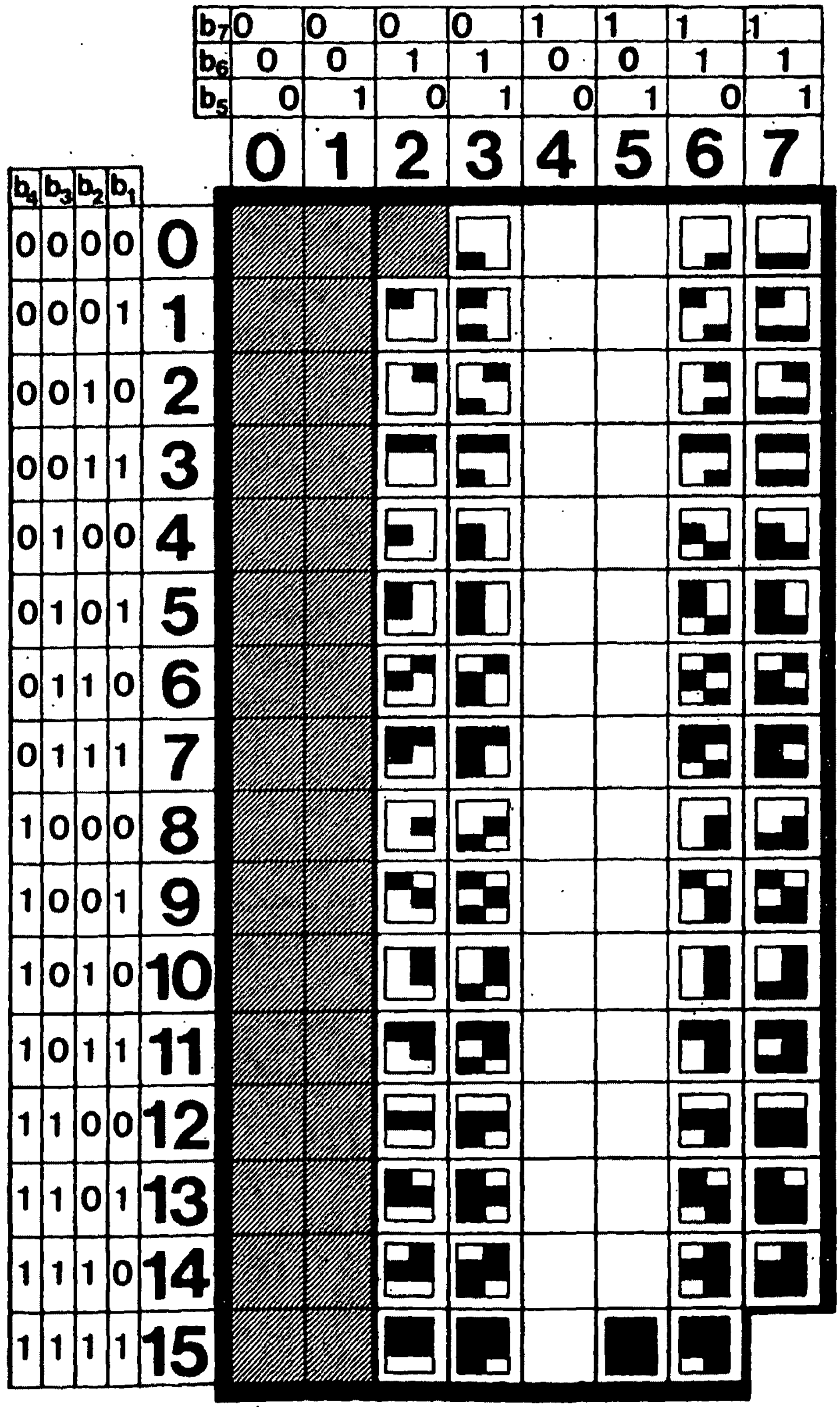


FIGURE 18

SET C1

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0					BLACK FORE-GROUND	BLACK BACK-GROUND		
0	0	0	1	1					RED FORE-GROUND	RED BACK-GROUND		
0	0	1	0	2					GREEN FORE-GROUND	GREEN BACK-GROUND		
0	0	1	1	3					YELLOW FORE-GROUND	YELLOW BACK-GROUND		
0	1	0	0	4					BLUE FORE-GROUND	BLUE BACK-GROUND		
0	1	0	1	5					MAGENTA FORE-GROUND	MAGENTA BACK-GROUND		
0	1	1	0	6					CYAN FORE-GROUND	CYAN BACK-GROUND		
0	1	1	1	7					WHITE FORE-GROUND	WHITE BACK-GROUND		
1	0	0	0	8					FLASH	CONCEAL DISPLAY		
1	0	0	1	9					STEADY	STOP UNDER-LINING		
1	0	1	0	10					END BOX	START UNDER-LINING		
1	0	1	1	11					START BOX	CSI		
1	1	0	0	12					NORMAL SIZE	NORMAL BACK-GROUND		
1	1	0	1	13					DOUBLE HEIGHT	INVERT-ED BACK-GROUND		
1	1	1	0	14					DOUBLE WIDTH	TRANS-PARENT BACK-GROUND		
1	1	1	1	15					DOUBLE SIZE	REVEAL DISPLAY		

CSI : CONTROL SEQUENCE INTRODUCER

FIGURE 19

BASIC ESCAPE TABLE

					CO SET				C1 SET			
				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
0	0	0	0	**0**	NUL		ANNOUNCEMENT OF EXTENSION		BLACK FORE-GROUND	BLACK BACK-GROUND		
0	0	0	1	**1**	SOH		INVOKES SET C0		RED FORE-GROUND	RED BACK-GROUND		
0	0	1	0	**2**		Rep	INVOKES SET C1		GREEN FORE-GROUND	GREEN BACK-GROUND		
0	0	1	1	**3**	ETX		SINGLE CONTROL FUNCTION		YELLOW FORE-GROUND	YELLOW BACK-GROUND		
0	1	0	0	**4**	EOT		MULTIPLE-BYTE GRAPHICS		BLUE FORE-GROUND	BLUE BACK-GROUND		
0	1	0	1	**5**			COMPLETE CODES		MAGENTA FORE-GROUND	MAGENTA BACK-GROUND		
0	1	1	0	**6**			FUTURE		CYAN FORE-GROUND	CYAN BACK-GROUND		
0	1	1	1	**7**			FUTURE		WHITE FORE-GROUND	WHITE BACK-GROUND		
1	0	0	0	**8**	BS	CAN	INVOKES G0 SET		FLASH	CONCEAL DISPLAY		
1	0	0	1	**9**	HT	SS2	INVOKES G1 SET	PRIVATE USE	STEADY	STOP UNDER-LINING	SINGLE CONTROL CODE - UNSPECIFIED	SINGLE CONTROL CODE - UNSPECIFIED
1	0	1	0	**10**	LF		INVOKES G2 SET		END BOX	START UNDER-LINING		
1	0	1	1	**11**	VT	ESC	INVOKES G3 SET		START BOX	CSI		
1	1	0	0	**12**	FF		INVOKES G0 SET		NORMAL SIZE	NORMAL BACK-GROUND		
1	1	0	1	**13**	CR	SS3	INVOKES G1 SET		DOUBLE HEIGHT	INVERT-ED BACK-GROUND		
1	1	1	0	**14**	SO	RS	INVOKES G2 SET		DOUBLE WIDTH	TRANS-PARENT BACK-GROUND		
1	1	1	1	**15**	SI	US	INVOKES G3 SET		DOUBLE SIZE	REVEAL DISPLAY		

CSI : CONTROL SEQUENCE INTRODUCER

FIGURE 20

SEVEN BIT CODE TABLE

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
b_4	b_3	b_2	b_1									
0	0	0	0	0								
0	0	0	1	1								
0	0	1	0	2								
0	0	1	1	3								
0	1	0	0	4								
0	1	0	1	5								
0	1	1	0	6								
0	1	1	1	7								
1	0	0	0	8								
1	0	0	1	9								
1	0	1	0	10								
1	0	1	1	11								
1	1	0	0	12								
1	1	0	1	13								
1	1	1	0	14								
1	1	1	1	15								

FIGURE 21

RECORD STRUCTURE

$YO_1 = 0111$

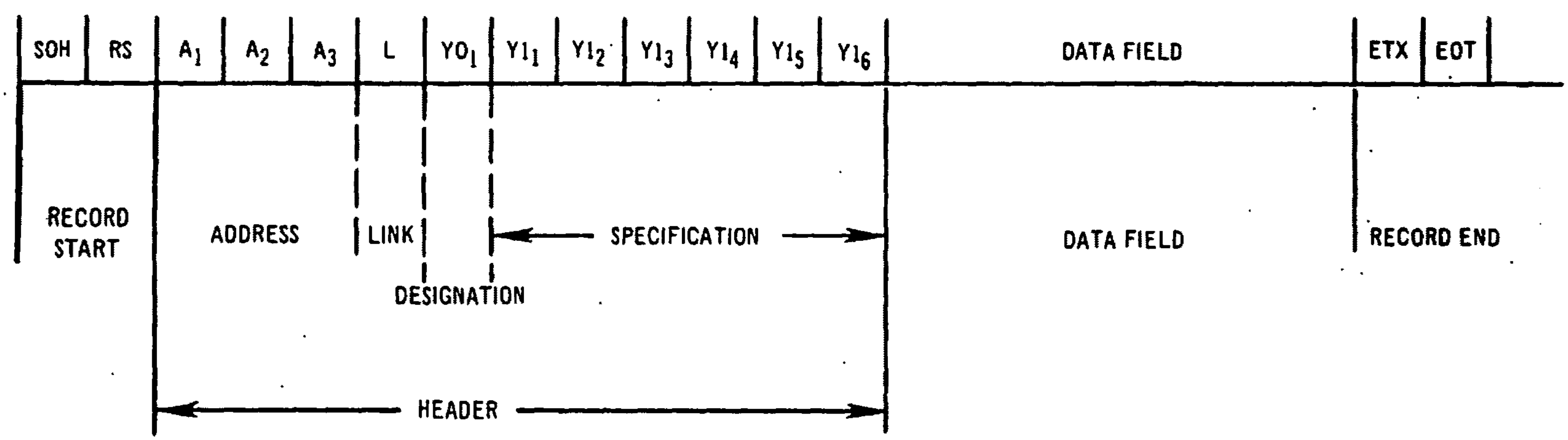
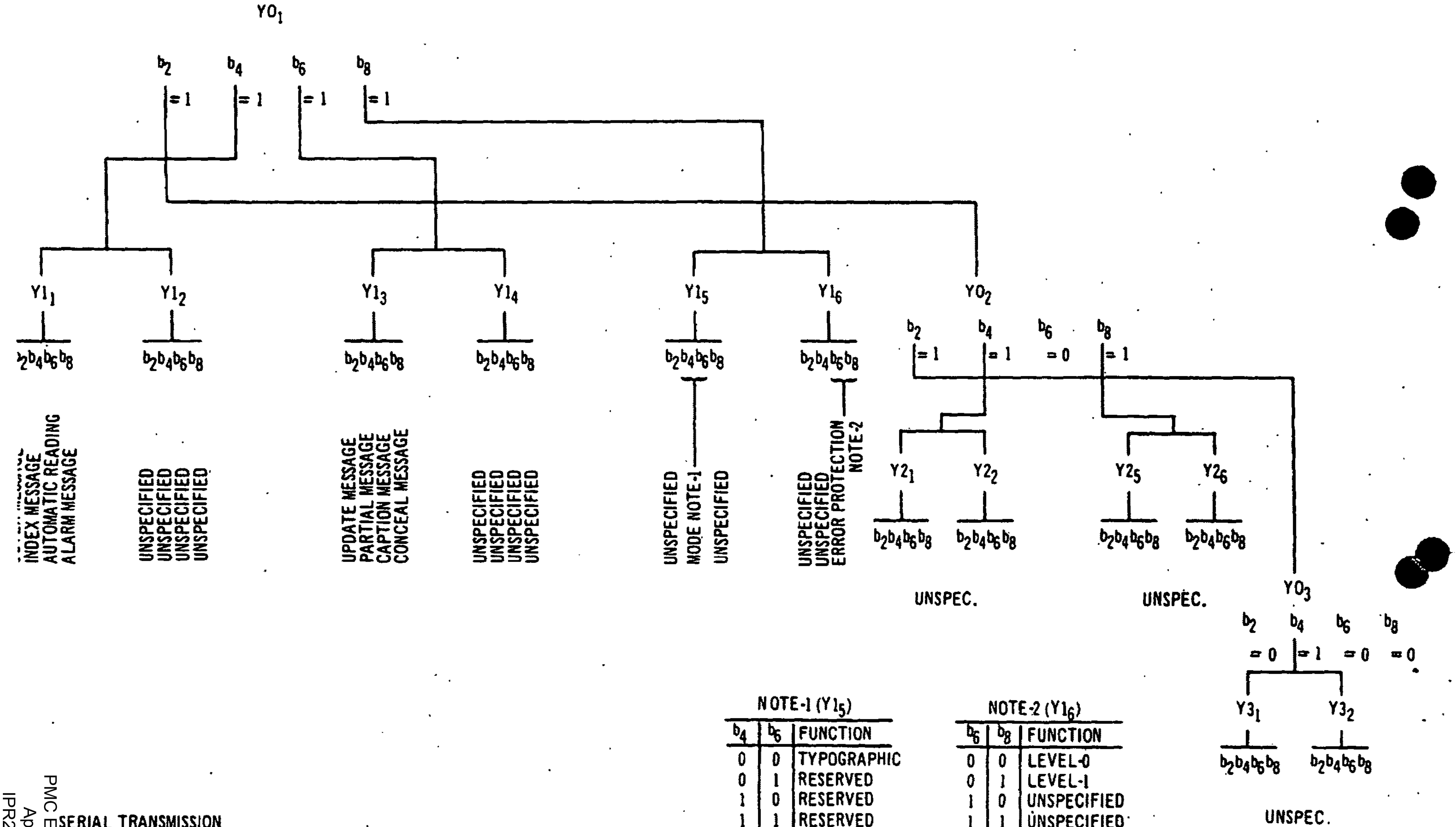


FIGURE 22

RECORD DEFINITION SEQUENCE



NOTE-1 ($Y1_5$)

b_4	b_6	FUNCTION
0	0	TYPOGRAPHIC
0	1	RESERVED
1	0	RESERVED
1	1	RESERVED

NOTE-2 ($Y1_6$)

b_6	b_8	FUNCTION
0	0	LEVEL-0
0	1	LEVEL-1
1	0	UNSPECIFIED
1	1	UNSPECIFIED

SERIAL TRANSMISSION

YO_1 $Y1_1$ $Y1_2$ $Y1_3$ $Y1_4$ $Y1_5$ $Y1_6$ YO_2 $Y2_1$ $Y2_2$ $Y2_5$ $Y2_6$ YO_3 $Y3_1$ $Y3_2$

1111 1101 0100

LINK BYTE TABLE

INFORMATION BITS (b8, b6, b4, b2)

b8	INTERPRETATION OF b8	b7	b6	b5	b4	b3	b2	b1	LINK RECORD ORDER INTERPRETATION OF b6, b4, b2
0	ADDITIONAL LINKED RECORDS TO FOLLOW	0	0	1	0	1	0	1	FIRST
0		0	0	0	0	0	1	0	SECOND
0		1	0	0	1	0	0	1	THIRD
0		1	0	1	1	1	1	0	FOURTH
0		1	1	0	0	1	0	0	FIFTH
0		1	1	1	0	0	1	1	SIXTH
0		0	1	1	1	0	0	0	SEVENTH
0		0	1	0	1	1	1	1	UNSPECIFIED
1	LAST LINKED RECORD	1	0	1	0	0	0	0	FIRST
1		1	0	0	0	1	1	1	SECOND
1		0	0	0	1	1	0	0	THIRD
1		0	0	1	1	0	1	1	FOURTH
1		0	1	0	0	0	0	1	FIFTH
1		0	1	1	0	1	1	0	SIXTH
1		1	1	1	1	1	0	1	SEVENTH
1		1	1	0	1	0	1	0	EIGHTH

PROTECTION BITS (b7, b5, b3, b1)

FIRST BINARY ELEMENT TRANSMITTED (b1)

FIGURE 24

GLOSSARY

ADDRESS - A group of bytes in the record header that is used to identify the record or page number. Each byte is Hamming code protected and has 16 possible values.

ALARM MESSAGE - A record or page that has priority over all other function and must be displayed by the decoder immediately. An alarm message is established when $Y1_1\ b_8 = 1$. The decoder must have selected the data channel which contains the alaram page for it to be received.

ATTRIBUTE - A function which provides additional meaning in the presentation of a character, row or screen, such as size, color, etc

AUTOMATIC READING PAGE - A function determined by the source that causes the record or page to increment automatically. The automatic reading function is established when $Y1_1\ b_6 = 1$.

BIT - Abbreviation for binary digit. A single unit in a binary number, (base two). Each bit in teletext can be either high (i.e., equal to logical-1) or low (i.e., equal to logical-0).

BYTE - A byte is the standard unit of coding used in teletext application. A byte is a sequence of adjacent binary digits (bits) operated on as a unit. A byte in teletext is composed of 8 bits.

CHARACTER - One of a set of elementary symbols which may be collectively arranged in order to express information. A character is defined by an array of points belonging to a matrix that describe its shape, and all other points belong to the background of the screen.

CHARACTER POSITION - The smallest position on the screen capable of containing a character.

CODE; CODED CHARACTER SET - A set of unambiguous rules that establish a character set and the one-to-one relationship between the characters of the set and their bit combinations.

CODE EXTENSION - Techniques for the encoding of characters that are not included in the character set of a given code.

CODE TABLE - A table showing the character corresponding to each bit combination in a code.

COLUMN - One of the character positions in a row. A row is made up of a number of columns numbered from 1 to N starting from the left. Each row starts with column number 1.

CONCEAL - A control function which replaces display character(s) with spaces and effectively hides the charter(s) from the viewer until a reveal command is received.

CONTROL CODES - A bit or group of bits which are non-printing (not displayed) instructions that affect the layout of the display.

CONTROL FUNCTION An action that affects the recording, processing, transmission or interpretation of data. The coded representation of a control function consists of one or more bit combinations.

CONTIGUOUS GRAPHICS - The G1 set of 64 display characters comprising all possible combinations of a 2 by 3 cell matrix. Fully illuminated matrices in adjacent columns or rows form a continuous display area.

COVER MESSAGE - A record or page that is automatically displayed when the user first selects the data channel. The cover message is established when $Y1_1$ b_2 = 1.

DATA BLOCK - The group of bytes in the data packet occuring after the packet prefix that contains the information to be transmitted.

DATA CHANNEL - A signal path for transmitting binary information that establishes a virtual link between a data source and a terminal intended to receive the data. In the broadcasting system, the vehicle is composed of horizontal television lines. Those available lines are dynamically allocated to different data sources. Each data channel is identified by the packet address (P) bytes in the packet prefix. The number of different data channels available within one television channel is dependent on the number of packet address bytes. The number of television lines used for data broadcasting only affects the data throughput, not the number of channels.

DATA FIELD - A group of bytes in the data block which defines the characters, attributes and layout of the page.

DATA PACKET - A group of bits transmitted and received as a stand-alone entity and occupying part or all of the active duration of a television line. By way of analogue, the function of the data packet can be compared to a letter in the mail. The data source places the message in an envelope which is analogous to the packet prefix. The prefix contains all the necessary information (packet address) to deliver the message (data block) to the intended user.

Once the information is delivered, the envelope or packet prefix is discarded because the transport function has been completed.

DRCS - Dynamically Redefineable Character Sets are groups of characters or graphic symbols that are not contained in the decoder hardware memory. They can be either transmitted by the data source (typically typographic DRCS) or locally generated at the terminal, (typically for fine resolution graphics).

ESCAPE SEQUENCE - A byte string that is used for control purposes in code extension procedures and that consists of two or more byte combinations. The first of these combinations corresponds to the character ESC.

FRAMING CODE - A unique fixed byte in the packet prefix which determines how the decoder should group all subsequent bits in the data packet into 8 bit bytes.

FULL-FIELD SERVICE - When all television lines, with the exception of line 1 through 9, are used to transmit data.

GRAPHIC CHARACTER - A character, other than a control character, that has a visual representation.

HAMMING CODE - An error correcting technique that was named after the inventor R.W. Hamming. Hamming codes used in teletext can correct single bit errors and detect multiple errors.

HEADER - The initial portion of a record containing any information, that is not part of the body of message. The record header contains the record addressing information and the record specification information.

INDEX MESSAGE - A record or page that will be displayed after the user selects a data channel and then selects, by means of a single button, the "index" or contents of that data channel. No specific page number need be selected. The index message is flagged when $Yl_1b_4=1$.

INTERPRETATION SEQUENCE - Hamming protected byte (s) in the data block that are used to define the "Y's". The Y's provide information to the decoder so that it can interpret the data field correctly.

LINK - One Hamming protected byte in the data block that is used to join records of the same address.

MAGAZINE - A grouping of records, usually transmitted on a single data channel.

MOSAIC GRAPHIC CHARACTER - Graphic character that are made out of a 2 x 3 matrix within each character position.

MESSAGE - Information that is to be conveyed to the user or decoder.

NON LOCKING CODE - A code extension process that changes the intrepretation of only the next character following it.

NRZ - Non-return-to-zero code is a method of coding the data, in which there is no state transition within one bit duration.

NYQUIST FILTER - A passive device which limits the band width of the data while producing minimum interference between data bits, (inter-symbol interference).

PACKET ADDRESS - A group of Hamming protected bytes in the packet prefix (P) that identifies the data source and network routing information for the packet.

PACKET PREFIX - The initial portion of a packet, that is added to the data block by the sending end and removed by the receiving end.

PAGE - Information organized into rows and columns of characters. Also called a screen.

PARITY CHECK - A means of detecting an odd number of bit errors. In the teletext system odd parity is used and defined as an odd number of logical "1s" in the 8 bit byte, including the parity bit-b_8.

PARTIAL MESSAGE - A record or page that completes or will be completed by other messages. It is established when $Y1_3$ b_4=1.

RECORD - A group of bytes transmitted in the data block that begins with the record start and terminates with the record end.

REPERTOIRE - The stock of characters and symbols available for display on the screen.

REVEAL - The display mode that causes concealed information to be displayed.

ROW - The horizontal division of the display that is composed of character positions.

SEPARATED MOSAIC - The set of character listed in set G1 with underline as an attribute. (See Figure 13).

UPDATE MESSAGE - A record or page that replaces the previous message with the same address. It is established when $Y1_1b_2=1$.

UNDERLINE - An attribute that when applied to a typographic character causes a line to be drawn beneath the character. When applied to a graphic mosaic character the underline causes seperated mosaic graphics.

VERTICAL BLANKING INTERVAL(VBI) - The area at the top of the television picture, not normally seen by the viewer, where the teletext data signal may be inserted. During this interval, the television receiver performs the vertical retrace function which returns the electron beam from the lower right of the screen to the upper left.