Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

...S USING THE VERTICAL BLANKING INTERVAL (V...
OR
...ARY COMMUNICATION MULTIPLEX OPERATION (SCM...

TELECOMMUNICATIONS ENGINEERING SERVICES

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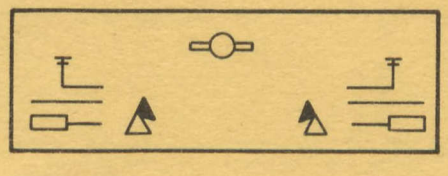
SERVICES DES TECHNIQUES DE TÉLÉCOMMUNICATIONS



Engineering Programs Branch

Direction des Programmes Techniques

SERVICES USING THE VERTICAL BLANKING INTERVAL (VBI)

OR

SUBSIDIARY COMMUNICATION MULTIPLEX OPERATION (SCMO)

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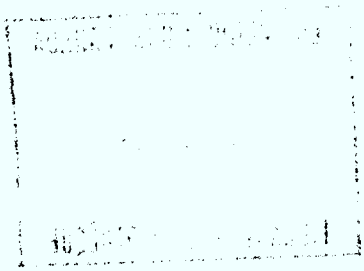
G. Nehme, P.ENG.

May, 1984



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1.0 SUMMARY

1.1 Introduction

A request and Letters of Intent were submitted, in 1983, to DOC by different companies with the objective of providing nationwide radio paging service [14] using a single VHF channel to ensure the supply of pagers to retail outlets at the lowest possible cost.

Due to these requests, DTS/DOC undertook to investigate frequency availability, technical suitability, and the possibility of time sharing a single frequency by a number of users in the VHF land mobile bands.

Based on technical analysis and consultation with the Regional staff, DOC did not find a single unused frequency on a nationwide basis across all the regions due to considerable congestion being experienced in the VHF land mobile bands. Three frequencies were found as possible candidates for nationwide paging, each involving varying degrees of problems in implementation [14]

Based on the above discussion, DOC is today investigating different techniques to permit television stations and FM radio stations to provide transmission of paging service on the vertical blanking interval (VBI) and FM subsidiary communication multiplex operation (SCMO), respectively.

Authorizing television and FM radio stations to provide paging service is generally establish the larger and more effective use of radio in the public interest, and more efficient use of the spectrum.

The Federal Communications Commission (FCC) in the U.S.A.[1] has recently approved several experiments to conduct test transmissions of teletext signals using the Vertical Blanking Interval (VBI) of television signals. Further, the Commission approved, on an experimental basis, the use of subsidiary communication Multiplex Operation (SCMO) channels of FM radio signals [1]. In each case, the Commission reserved the right to introduce further requirements, where necessary and invited the public and interested parties to comment on issues related to the use of the VBI and SCMO (see Annex A, Public Notice CRTC 1983-77).

The **VBI** is an integral part of every television signal but does not contain any part of the video picture. It was first introduced as a means of spacing the video pictures on the screen. However, with the development of improved technology, part of the VBI can now also be used for the distribution of a variety of special services.

SCMO is a technique that enables spectrum of the FM radio

stations to be utilized for a variety of services in addition to the normal stereophonic sound broadcasting.

Both VBI and SCMO have the capacity to be used for the distribution of many types of alphanumeric services, including electronic newspapers, program captions for the hearing impaired and time, weather, games and stock market information. In addition, SCMO has the capacity to provide voice and music services.

Some of the other service possibilities including raw data transmission, computer software and video game delivery, utility load management and fascimile transmissions that would use analog signalling techniques. In fact, any data transmission service for which VBI offers sufficient capacity could be provided.

Paging services stand out as one of the more significant forms of data transmission services which television stations may want to consider offering. The Commission have taken particular care to consider whether the introduction of additional competition in paging service is in the public interest. The Commission tentatively concluded that the addition of paging services is supported by the definite need for such services, and indicated that by 1985 there would by approximately three million pagers in use (General Docket No. 80-183 studies submitted by Arthur D. Little in 1975 and Frost&Sullivan in 1978).

With regard to the technical rules that will govern VBI data transmissions, the Commission proposed to apply the same technical rules adopted for teletext in BC Docket No. 81-741 (see Annex B for more details). Television stations will be able to offer paging services at the same signal level as teletext and over all VBI lines authorized for teletext. Similarly, VBI signal transmitting data will not be permitted to interfere with other radio frequency services or degrade reception of the originating station's regular programs.

The key to the success of the paging service has been the very small, inexpensive, lightweight pocket pager or "beeper". A pocket pager designed to operate within the VBI would have to incorporate an RF tuner to demodulate the television carrier to a video baseband signal, an equalizer to compensate for multipath effects, or ghosting, to which television signals are subject, and timing circuitry designed to process the digital paging signal.

There are similarly technical rules regarding the subsidiary communication multiplex operation (SCMO) channels of FM radio signals that can be used for different data services, including paging. The Commission approved, on an experimental basis, the use of SCMO channels of FM radio signals and reserved the right to introduce further requirements where necessary.

A Program Identification (PI) system for transmission of new services in addition to the normal stereophonic sound broadcasting via FM transmitters was developed in 1978 by the Swedish Telecommunications Administration. This system makes it possible to transmit supplementary services from FM transmitter, including paging, that is not related to the main program material (see section 5.0 and Annex E for more details).

In 1981, a field and laboratory tests were conducted on member station WETA-FM in Washington, D.C., to evaluate several FM/SCA (Subsidiary Communication Authorization) frequencies which are above the range authorized by the FCC. Since the FCC rules permit only one SCA (or SCMO) to be transmitted with stereo, a study was undertaken by National Public Radio (NPR) in Washington, D.C., to find if an additional subcarrier could be added, and what its performance might be (see section 5.0 and Annex E for more details).

1.2 Conclusions

The basic findings in this report are:

1) that VBI and SCMO techniques have the capacity to be used in Canada for the transmission of different services, including paging.

2) With regard to the technical rules that will govern VBI, DOC can apply the same technical transmission data rules adopted for nationwide teletext services in FCC, BC Docket No. 81-74.

3) There is no (national) technical standard that will govern FM/SCMO transmission technique. The technical aspects to allow implementation could be worked out once a decision is made on opening up the subsidiary operation to all uses. It can be assumed that the broadcaster should have control over the technical aspects of the subsidiary channel in order to ensure interference free operation of the main channel.

4) that 92 KHz subcarrier is the best choice for a new service (see Annex E); that its performance is similar to 67 KHz subcarrier; that it produces lower interference levels to main channel stereo service than 67 KHz subcarrier, and that it can be successfully operated in addition to stereo and existing services.

1.3 Report organization

This report is divided into different sections and annexes:

Section 2.0 discusses the basic technical rules for the transmission of teletext and other services, including paging, such as, data rate, pulse amplitude, pulse shaping, adaptive equalizer, and decoder.

Section 3.0 discusses the picture element, frame format, and field for the television video signal.

Section 4.0 deals mainly with the physical transmission parameters for NTSC television systems. These parameters were published by the EIA/CVCC [2] and included transmission bit rate and timing, data modulation type, data pulse shape, and data amplitude. The EIA/CVCC results were recommended as an appropriate standard for the transmission of teletext in the VBI lines.

Section 5.0 deals with a technical transmission using the SCMO Channel of FM radio signals. This is proposed by Sweden and based on theoretical and practical results [4]. Another technical study, by National Public Radio, evaluated an additional subcarrier to be used for a new service via FM stations.

Section 6.0 deals with the major findings of the study in this report. This is related to the use of VBI and SCMO for the transmission of data for nationwide paging service and other services.

Annex A contains the summary of comments received in response to CRTC Public Notice 1983-7 on issues related to the data transmission of different services using the VBI lines and SCMO channels of FM radio signals. These comments will determine what further action the Commission intends to take. Commenters were concerned about the time sharing and VBI lines 10-14 specified in DOC/BS-13. They indicated that:

- DOC should review BS-13 to optimize time sharing, and DOC-CRTC should conduct a study on vertical retrace time to open up VBI lines 10-14 (see Annex C, section 1.5).

- DOC should take steps to standardize technology to protect consumers from a confusing array of equipment choices. Use of VBI lines 10 to 14 by cable systems for pay television scrambling should not preclude or distrupt use of these lines by broadcasters. In this regard, DOC should set standards requiring satisfactory receiver performance for VBI lines 10 to 21.

- DOC should remove technical restrictions which limit SCMO to broadcast related purposes.

Annex B: contains the summary of FCC BC Docket No. 81-741 which is related to the authorization and technical rules of television stations to engage in teletext service using the VBI lines. The authorization and technical rules for teletext might be applicable to be used for different services, including paging service, using VBI lines.

Annex C: contains broadcast specification BS-13 [6] published by DOC, June 3, 1981. This specification pertains to the use of ancillary signals in the VBI of the standard television signal.

Annex D: contains the technical description of the transmission technique, coding language for a broadcast service applications in Canada. The broadcast specification BS-14 [7] is published by DOC June 19, 1981.

Annex E discusses the Programme Identification (PI) Swedish transmission system. This system is used for transmission of new services in addition to the normal stereophonic sound broadcasting via FM transmission stations. Also, Annex E discusses the technique for FM/SCA (subsidary communication authorization or SCMO) transmission and the mechanics by which SCA interference may occur to stereo receivers when an additional subcarrier frequency will be used for SCA services.

Annex F discusses the CCIR and North America standards that have been adopted for the international exchange of TV programs (Ref. 12 and 13).

2.0 Proposal for VBI Technical rules (FCC, BC Docket No. 81-741)

This section contains the technical rules proposed by the FCC for the transmission of teletext in the VBI lines. These rules are based on the authorization of VBI lines to be used for the transmission of teletext and other services, including paging [2].

- **Data rate**

  Data rate of 5.7272 Mbits/sec is recommended as an optional choice and would have the added advantage of bearing a specific relationship to the colour sub-carrier frequency. Authorization of two or more alternative data rates would complicate decoder circuitry and possibly cause degradation through mutual interference (see section 4.0 for more details).

- **Pulse amplitude**

  A pulse amplitude standard of 70 IRE units is recommended as a good compromise for decoder operation and interference considerations.

- **Pulse shaping**

The Commission proposed that data pulses shall be shaped to limit spectral energy to the nominal video baseband. Respondents to this proposal suggested that the raised cosine 100% roll-off pulse shape may be ideal for teletext, but there is no objection to the proposed rule that would permit this as well as other pulses shapes.

- **Adaptive equalizer**

  An adaptive equalizer pulse was proposed by the Commission to provide a reference signal for a device to compensate for multipath reflections. This proposal was to permit such pulses on any of the VBI lines authorized for teletext.

- **Decoders**

  The Commission requested some comments on the equipment manufacturer decoders that could be attached to existing receivers to enable them to display teletext as to whether such devices should be treated as a TV interface device or a receiver.

  Response to this issue indicated:

  - That to the extent that teletext decoders supply a modulated RF signal to the terminals of a television receiver, such decoders should be considered TV

Interface Devices.

- That external decoders might be treated as TV receivers subject to All Channel Receiver Act, and that such treatment would be unnecessary if teletext is authorized as an ancillary service.

- That the Commission provide for implementation of text decoders as part of multi-function devices.

3.0 Definition of picture element, frame and field of the television (see also Annex F)

The television video signal is an electrical representation of a moving two-dimensional optical image. The video signal is obtained by detecting the light from a small spot of the image as that spot is, in effect, scanned across the image. The spot called the **picture element** is scanned horizontally at a rapid rate and vertically at a lower rate to trace out a series of horizontal lines from top to bottom of the image, covering all the picture elements in sequence. One complete such tracing of the image is called a frame.

In practice, each frame consists of two sequential scans of the image, each scan covering half the picture elements. Each half is called a **field**. The horizontal lines of one field are interlaced between the horizontal lines of the previous field. This method of covering the image with two sequential interlaced scanning patterns is used to reduce bandwidth.

The **bandwidth** is determined by the number of picture elements per image and by the rate at which the image is scanned; this, in turn, is determined by the rate at which sequential images must be displayed.

In the television receiver, a spot of light, corresponding to a picture element in the scene, is generated electronically on the light-emitting surface of the display tube. The spot is scanned across the display tube in exactly the same manner and in synchronism with the scanning process of the camera. The intensity and color of the display tube spot are controlled to recreate the image. To support this process, the video signal must contain:

(a) information to synchronize the receiver scanning process and thereby establish the spatial position of each picture element;

(b) information as to the brightness, or luminance, of each picture element;

(c) information as to the color, or chrominance, of each picture element; and

(d) information to decode the color information, provided as color-burst signal.

A typical video-signal waveform, representing one horizontal line of a scene, is shown in Fig. A.

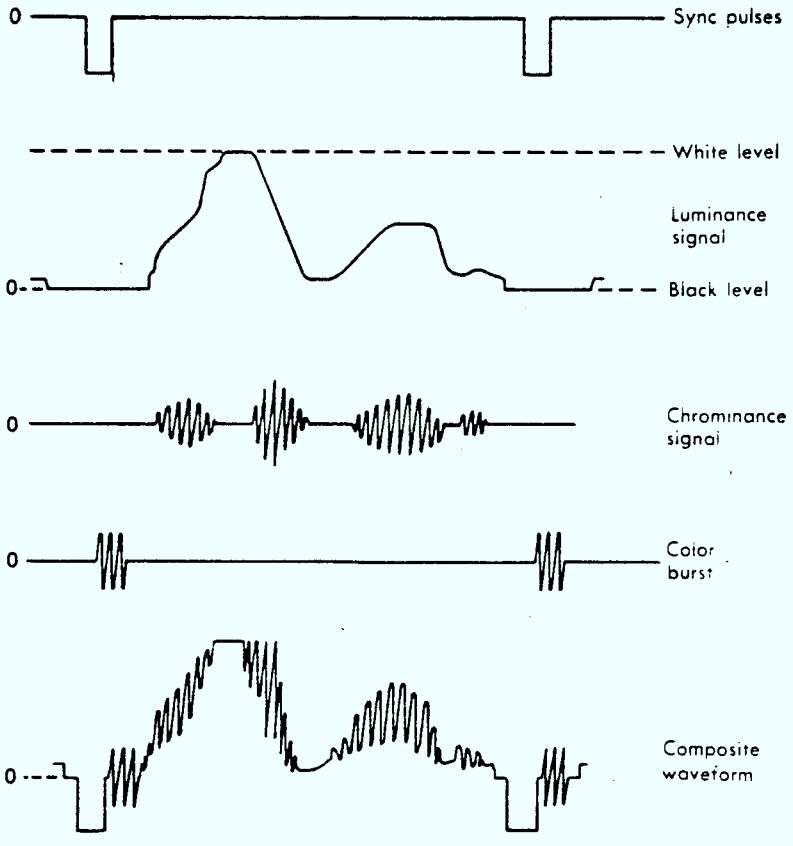


Fig. A. Video signal waveform (one horizontal line).

4.0 Data transmission and waveforms (EIA)

This section defines the physical transmission parameters for the NTSC system. These parameters were published by Electronic Industries Association (EIA) and Canadian Videotex Consultative Committee (CVCC) in 1984 (see Ref. 3 for more details).

4.1 Vertical blanking interval data transmission

4.1.1 NTSC

The 525-line 60-fields-per-second NTSC television signal (CCIR system-M) includes certain lines in the field-blanking interval to allow the receiver to synchronize and perform vertical retrace before the active video picture begins. The VBI as seen in Fig. 1 includes lines 1 through 21, which contain the vertical synchronization pulses (lines 1 to 9) and may contain Vertical Interval Test signals (VITS), Vertical Interval Reference signal (VIR), and digital data signals. VBI data transmission is defined as any digitally coded information inserted between lines 10 through 21 (fields 1 and 2) of the analog television signal.

4.2 FULL-FIELD DATA TRANSMISSION

Full-field data transmission uses the active part of the video signal as well as the VBI for data insertion. Lines 10 through 262 in field 1 and the corresponding lines in field 2 may be used for data transmission.

4.3 TRANSMISSION BIT RATE AND TIMING

The transmission bit rate shall be 5,727,272 bits per second $\pm$16 bits per second, and its maximum long-term rate of change shall be less than 0.16 bits per second.

Note that if the data signal is inserted into a colour television transmission, then the transmission bit rate may be 8/5 of the colour sub-carrier frequency (3.579545 MHz $\pm$ 10 Hz) and may be frequency locked to the colour sub-carrier. It is recommended that the transmission bit rate be phase continuous from line to line; however, because of system considerations, phase continuity may not be guaranteed from line to line.

Also note that if the data signal is inserted into a monochrome television transmission with a line scanning rate of 15,734.26 Hz, then the transmission bit rate may be the 364 multiple of the horizontal line rate. However, for a monochrome television transmission with a line scanning rate of 15,750 Hz, the transmission bit rate is not an integral multiple of the horizontal line rate and may not be phase continuous from line to line.

The half-amplitude point of the first transition from logical "0" to logical "1" of the Clock Synchronization Sequence shall be 10.48 + 0.34 us from the half-amplitude point of the negative going edge of the horizontal syne pulse. Note that this corresponds to a period of approximately 60 bits. The timing of the data signal is illustrated in Figure 4.

4.4 DATA MODULATION TYPE

The amplitude modulated data shall use Non-Return-to-Zero (NRZ) binary code.

4.5 DATA-PULSE SHAPE

The optimum pulse shape depends upon the transfer function and the noise-shape spectral density of the TV channel and has yet to be determined. In the meantime, due to the variability in TV channels, transmitters and receivers, a pulse shape producing a spectrum such as a raised cosine with a 55% to 100% roll-off is permitted. After shaping, the spectrum of the NRZ data at the output of the transmitter is typically like the one described by the example in Figure 2 showing a raised cosine spectrum with a roll-off of 100% and is also filtered by a phase-corrected low-pass filter with a cut-off frequency of 4.2 MHz. The single-pulse response of the combined shaping and low-pass filters is shown in Figure 3. The single-pulse response corresponding to a spectrum with a roll-off of (α) is as follows:

$$I(t) = \frac{\sin(\pi t/T)\cos(\alpha \pi t/T)}{(\pi t/T)(1-(2\alpha t/T)^2)}$$

where:

$I(t)$ = impulse response

f_{max} = highest frequency of the spectrum (5.727272 MHz)

f_0 = frequency at the centre of the slope of the filter (2.86 MHz)

α = roll off = $(f_{max} - f_0)/f_0$

T = period of one bit (approximately 174.6 ns)

t = time

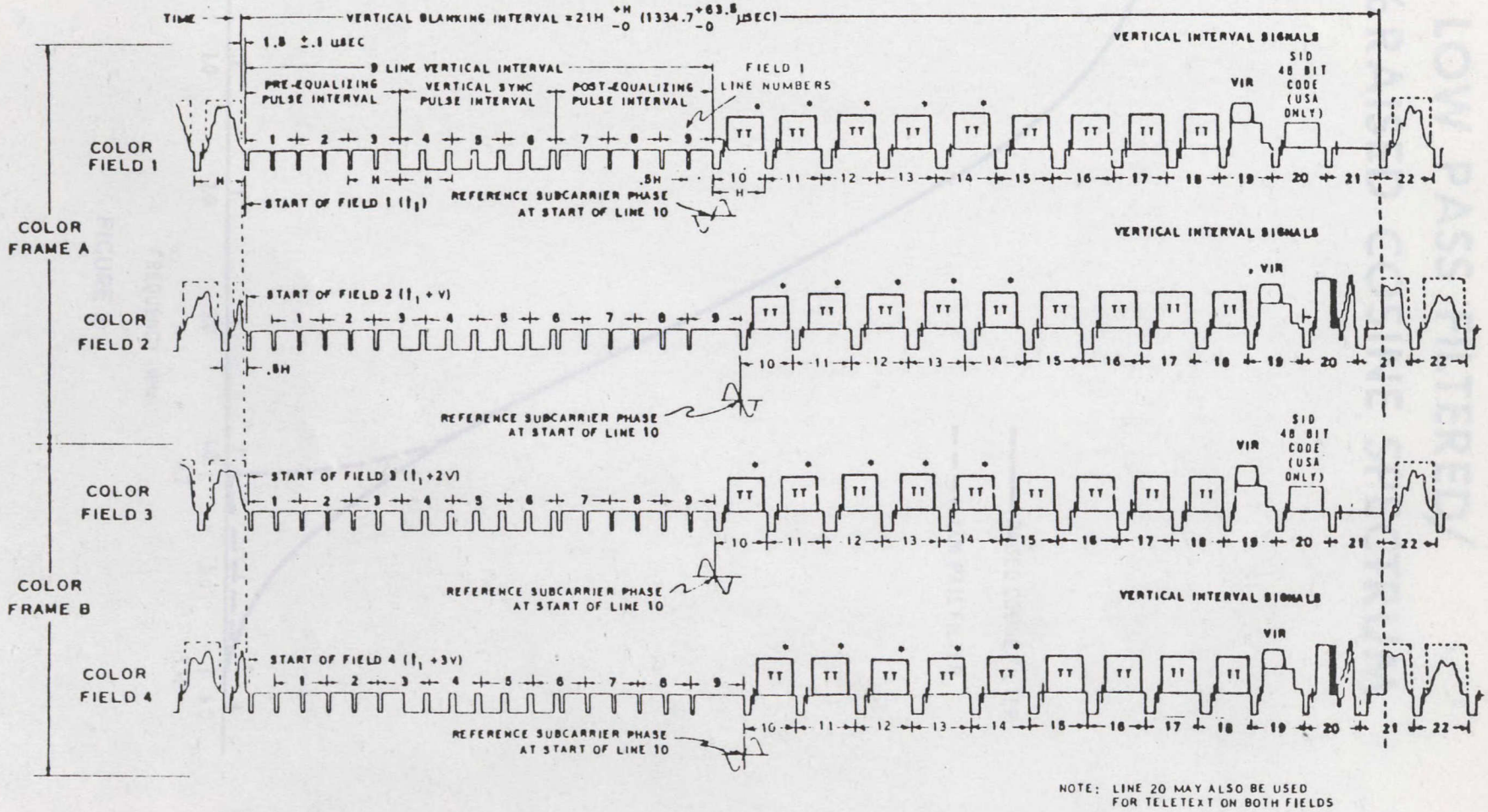
4.6 DATA AMPLITUDE

In Canada the nominal data amplitude is specified by the Government of Canada Broadcast Specification 14, published by the Department of Communications.

The nominal data levels should be 70 $\pm$ 2 IRE units and 0 $\pm$ 2 IRE units for a logical "1" and "0" respectively, unless other levels are specified by regulation. These nominal levels are shown in Figure 5. the logical "0" is nominally at blanking level.

Although nominal data levels are specified, the data waveform may contain overshoots so that the peak-to-peak data amplitude may exceed the nominal data amplitude by an amount that depends on the pulse shape and filters.

COMPOSITE VIDEO SIGNAL



NOTE: LINE 20 MAY ALSO BE USED FOR TELETEXT ON BOTH FIELDS

TT = TELETEXT

• = POTENTIAL TELETEXT

FIGURE 1

LOW PASS FILTERED/ 100% RAISED COSINE SPECTRUM

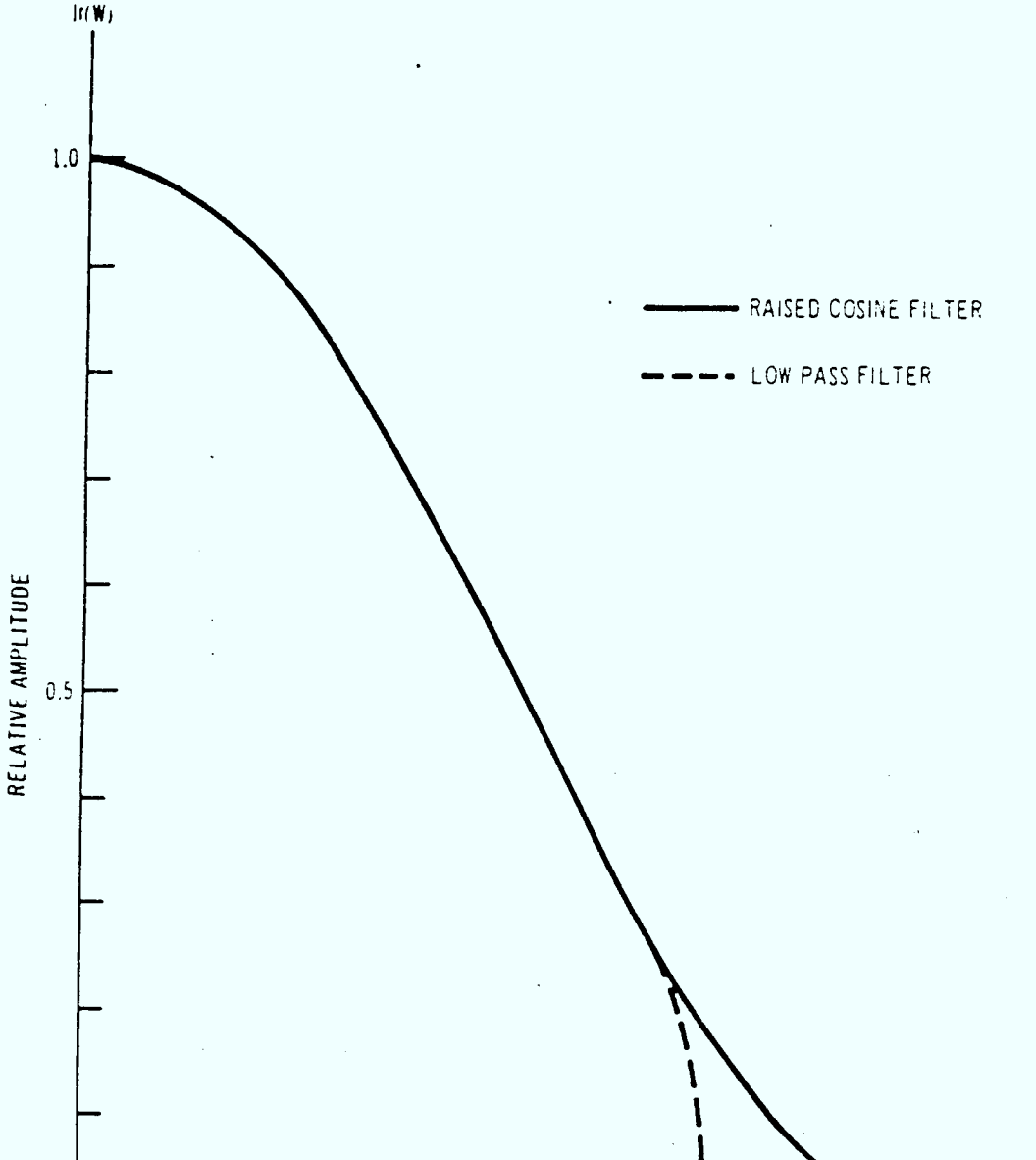


FIGURE 2

SINGLE PULSE RESPONSE OF A SHAPING FILTER WHOSE OUTPUT SPECTRUM HAS 100% RAISED COSINE ROLL-OFF+LOW PASS FILTER

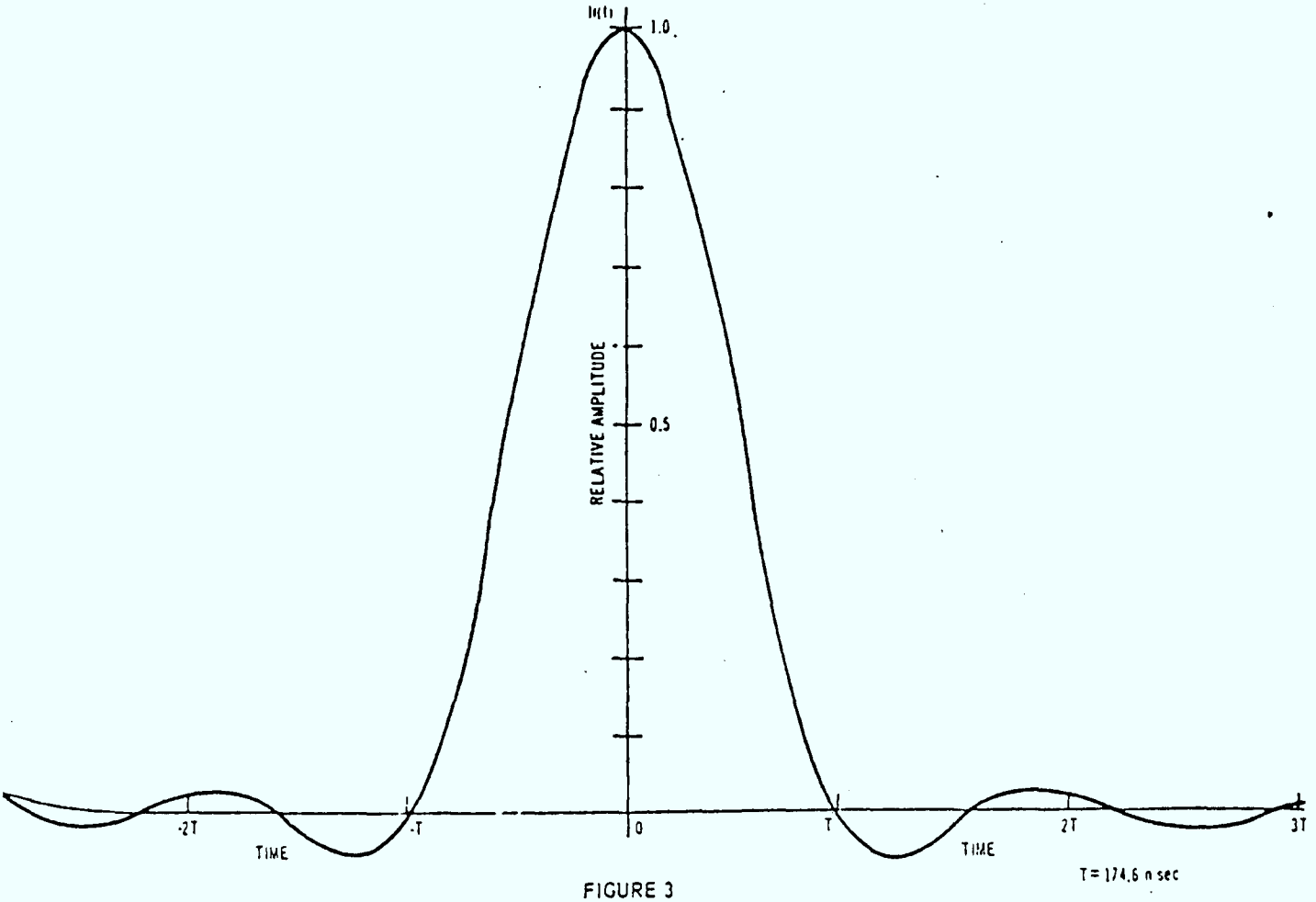


FIGURE 3

DATA TIMING

HORIZONTAL SYNC & BLANKING

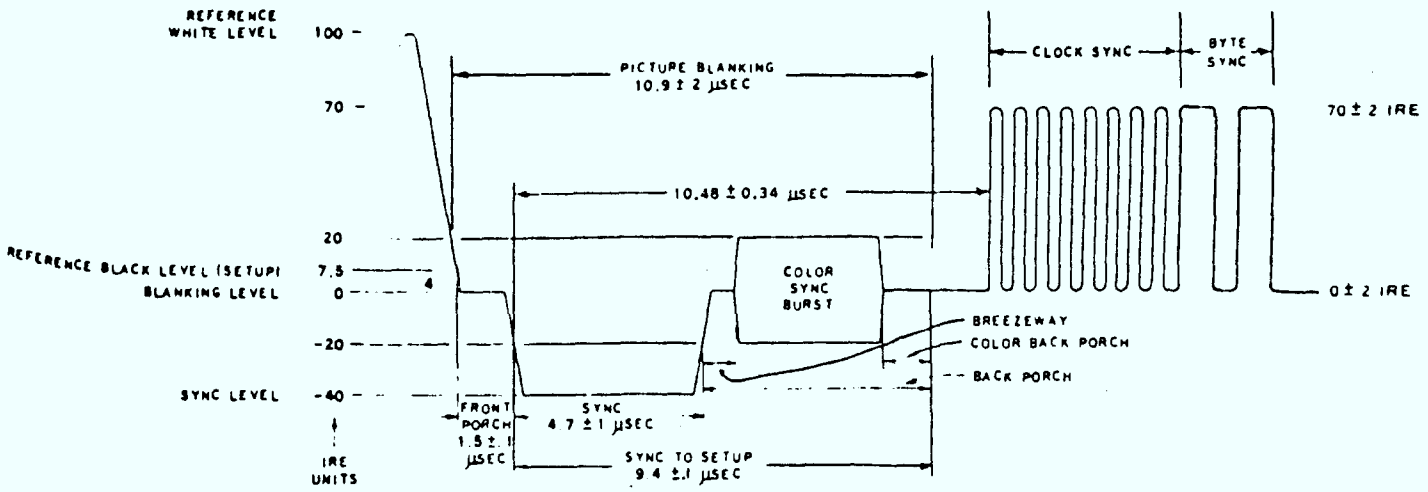
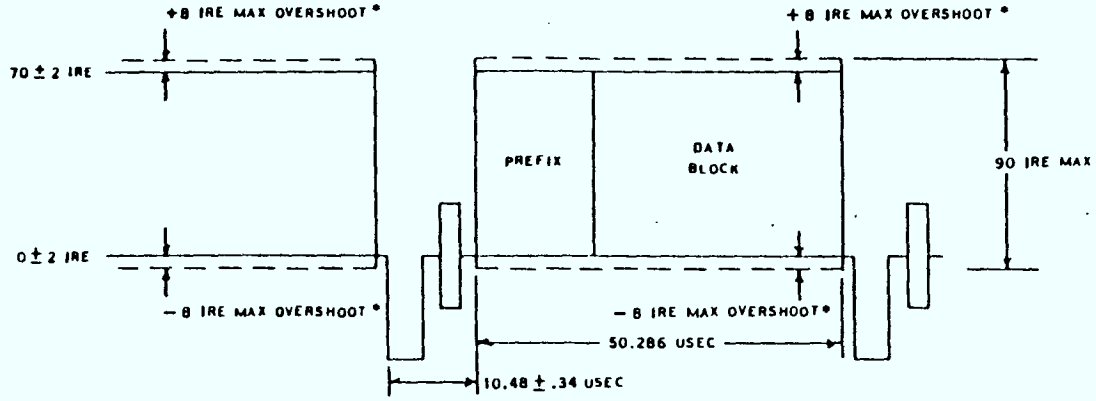
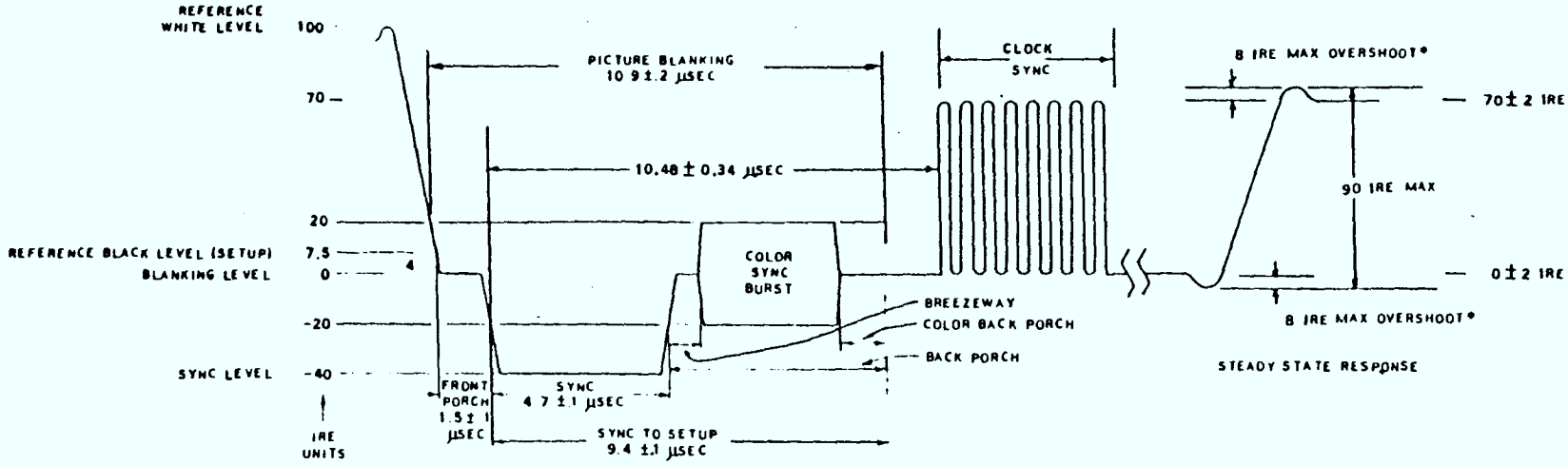


FIGURE 4

DATA AMPLITUDE



HORIZONTAL SYNC & BLANKING



* TYPICAL VALUES OF OVERSHOOT FOR THE SPECTRUM SHOWN IN FIGURE 2

FIGURE 5

5.0 Technical method for SCMO

The SCMO technique is still in its early stage of study. This technique could be used efficiently in light of new technological developments in U.S., Canada, and other Countries for the transmission of different data services without causing mutual interference to the main channel of any broadcast station.

A practical study was started in the Administration's Radio Laboratory in Sweden in 1978, with a view to determining a Program Identification (PI) system for transmission of new services in addition to the normal stereophonic sound broadcasting via FM transmitters, and the optimum modulation technique for transmitting additional information over a FM broadcasting transmitter without causing mutual interference to the main channel of any broadcast station (see Annex E for more details).

The system is composed of a 57 KHz subcarrier which is locked in phase (phase shift 90)to the third harmonic of the stereo pilot (3 x 9 = 57 KHz) and is phase modulated with a 1200 baud binary coded signal. In order to reduce the risk of interference further, a symmetrical code (Manchester) has been chosen. Low frequency products, which may cause problems, are thereby suppressed.

The above design gives an interference-free method of transmitting data over a stereo modulated FM transmitter. The design is unique and it is very close to what must be considered as the optimum solution, and it will therefore be proposed for international standardization.

The changeover to the binary coded technique also made possible the use of self-correcting codes that increase the reliability of the signal transmission considerably. The code chosen has very good characteristics and is able to correct bursts with up to 5-bit faults per block.

Digital signals are particularly suitable for processing in integrated circuits, and thus the changeover from analog signals also provided new possibilities of increasing the signal processing capacity at low cost.

Several FM/SCA frequencies were evaluated by National Public Radio (NPR) to find if an additional subcarrier (i.e., 92 KHz) could be added to be transmitted with stereo for new SCA service relative to the one permitted by FCC rules (i.e., 67 KHz).

The basic findings are that 92 KHz is the best choice for a new SCA service; that it is similar to the 67 KHz subcarrier in the case of performance, lower interference levels to main channel stereo service, and successfull operation in addition to stereo and existing SCA services (see Annex E for more details).

6.0 Conclusions

6.1 Overview

In this report we presented a preliminary study for the authorization of television stations to engage in the transmission of new and different data services on the vertical blanking interval (VBI) of the video portion of the television signal without affecting regular picture transmission. The VBI in a television signal is a period of time, consisting of 21 scanning lines, during which the vertical synchronizing pulses are transmitted but the picture information is not transmitted. In addition, for FM broadcast the subsidiary communication multiplex operation (SCMO) technique can be used for the transmission of different services. The SCMO of FM broadcast stations can be permitted to carry signals other than those of broadcast nature as long as the operation does not interfere with or perceptibly degrade, the reception and quality of the broadcast signal on the main channel of any broadcast station in the area.

Some of the proposed uses for FM SCMO's and VBI techniques are paging service, teletext, remote cueing, telemetry, teletext, etc. DOC/DTS is interested to use the VBI or SCMO techniques for nationwide paging service.

Authorization of nationwide paging service on the VBI or SCMO will provide additional opportunities for extending and diversifying the service provided by televisions or FM broadcast stations, maximize spectrum use, improve the efficiency of spectrum utilization, and assist in satisfying a demonstrated public need.

6.2 Technical rules

6.2.1 Technical rules for VBI

With regard to the technical rules that will govern VBI, the DOC can apply the same technical transmission data rules adopted for nationwide teletext services in FCC, BC Docket No. 81-741. These technical rules can be applied directly to the nationwide paging service over all VBI lines. VBI signal transmitting data will not be permitted to interfere with other radio frequency services or degrade reception of the originating station's regular programs.

With regard to particular VBI lines specified in DOC/BS-13, DOC should review the VBI lines 10-14 to optimize time sharing, DOC-CRTC should conduct a study on vertical retrace time to open up VBI lines 10-14, and a specific standards requiring satisfactory receiver performance for VBI lines 10 to 21.

6.2.2 Technical rules for SCMO

The SCMO technique for FM broadcast stations has a good potential to be used for the transmission of data for paging service, or different data services. Presently, there is no (national) technical standard that will govern SCMO transmission technique. The SCMO channel of FM broadcast station can be used efficiently in light of new technological developments, theoretical, and practical results (see Annex E for more details).

The basic findings in Annex E are that the introduction of new signals into the modulating baseband of an FM station requires attention to its possible interactions with existing baseband signals, as well as its chosen performance characteristics. However, the 92 KHz was chosen as the best choice for a new SCMO (or SCA) service; that its performance is similar to 67 KHz SCMO; that it produces lower interference levels to main channel stereo service than 67 KHz, and that it can be successfully operated in addition to stereo and existing SCMO services.

The technique used by the Swedish Telecommunications Administration can be used for the transmission of paging signals in addition to the normal stereophonic sound broadcasting via FM transmitters.

7.0 References

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ANNEX A

Comments on Issues Related to the Use of the VBI and SCMO

The CRTC in public notice, CRTC 1983-7, considered that the following matters should appropriately be the subject of consideration in comments on issues related to the use of the VBI and SCMO (see Annex B, FCC BC Docket No. 81-741).

A.1 Any VBI or SCMO service originates from the same transmitter as the television or radio signal which a licensee is authorized to broadcast. In view of the shared transmitting facilities:

a) Should VBI and SCMO services be licensed separately or should they be treated as one integral part of the television or radio broadcating transmitting undertaking?

b) If the services are licensed separately, should there be any restrictions as to who should be eligible for a licence?

c) If the services are not licensed separately, should the broadcaster be obliged to provide access to VBI and SCMO? If so, what terms and conditions should apply to such access? What licensing procedure, if any, should be imposed?

d) Do the CRTC radio and television regulations apply to these services? If not, should they be made applicable?

e) Should there be any limitations on the types of services which may be distributed?

f) Should a VBI service which is integrally related to normal programming, such as captions for the hearing impaired, be treated differently from other VBI services?

g) Should the services be able to derive revenue from advertising? If so, should there be any restrictions on the type of advertising permitted?

h) Should the services be able to derive revenue from subscription fees?

A.2 A fully developed VBI or SCMO would be able to carry a number of services. In view of the listed capacity:

a) Should the Commission establish an order of priority for the distribution of services? If so, what criteria

should be applied?

b) Should television/radio network affiliates be obliged to distribute VBI or SCMO service inserted by the network operator?

A.3 With regard to VBI:

a) Should cable television licensees be obliged to distribute services contained in the VBI of Canadian television signals?

b) Should cable television licensees be required to make improvements or modifications to their systems to ensure proper distribution of VBI services?

A.4 With respect to SCMO:

a) Should cable television licensees be obliged to distribute services contained in the SCMO channels of Canadian FM radio signals?

b) Should cable television licensees be required to make improvements to their systems to ensure the proper transmission of SCMO services?

A.5 Public Comments

Fifty two public comments (e.g., public notice CRTC 1983-7) have been received with regard to the use of the VBI and SCMO. These comments will determine what further action the commission intends to take.

1. CFAC-TV Calgary
   Calgary Television Ltd.

CFAC-TV regards the VBI as an integral part of its undertaking and its use should not be licensed separately from the overall signal. The local broadcaster should retain control over use of the VBI and not be required to broadcast VBI services originated by others including television networks unless it agrees by contract. Closed captioning should have a priority but otherwise the CRTC should not restrict or regulate the development of VBI services. Cable companies should be required to retransmit broadcast VBI services, and if necessary, be required to make technical improvements.

2. Gerry Graham, Victoria, British Columbia

Mr. Graham supports the introduction of new television services and feels that services such as teletext could serve the public well by distributing up-to-date information.

3. Lethbridge Television Ltd., Alberta

Essentially the same position as item one.

4. Canadian Co-ordinating Council on Deafness (CCCD)

The CCCD feels that the CRTC should require all television broadcasters to provide closed captioning as an essential and integral part of their main programming. Captioning should have a first priority over other VBI services; an order of priority should also be established for SCMO services to favour radio reading services for the blind and teletypewriter (TTY) news for the hearing impaired. The CCCD wants line 21 captioning maintained consistent with FCC policy in the U.S. but supports the evolution of teletext services as a medium which will greatly benefit the hearing impaired. Teletext services could be supported either by advertising or subscriptions. Television ads in the main programming could also be captioned as a service to the hearing impaired. Cable companies should be required to retransmit VBI services except in those cases where an undue financial hardship would be imposed on a small cable operator.

5. NW Radio Ltd., New Westminister, British Columbia

NW Radio submits that the SCMO is an integral part of its undertaking, that it should retain control over use of the SCMO and not be required to provide access to others, and that the CRTC should not impose unnecessary restrictions on SCMO use by broadcasters.

6. CISN-FM Radio Ltd., Edmonton, Alberta

Essentially the same position as item five.

7. Israel (Sruki) Switzer, Toronto

Mr. Switzer submits that VBI/SCMO services should be regarded as broadcasting of a new and different type, with some services integral to the main programming and other services of a non-integral nature. If the CRTC authorizes a service that is intended to be available to the general public without restriction, even though a fee may be paid, that service is broadcasting (whereas a teletext service which is only available to a restricted group such as doctors would not be broadcasting).

VBI/SCMO services integrally related to the main programming should be authorized by a simple licence amendment, and unrelated services should be licensed separately though technical and operational considerations could render separate licensing impractical. Cable companies should be required to retransmit VBI/SCMO services which fall within the definition of broadcasting.

8. Videotex Information Service Providers Association of Canada (VISPAC)

VISPAC represents in main companies developing information content and services for Telidon systems. It submits that most VBI/SCMO services will be narrowcasting and not broadcasting. Whenever there is a closed user group or designated users or addressable decoders, the acid test for broadcasting fails. Accordingly, broadcasters should be allowed at their discretion to lease VBI/SCMO capacity to third parties. The CRTC should refrain from regulating content and create an unrestricted environment which allows the broadcast, print and cable industries to meet the challenge of competition from foreign VBI/SCMO services. Cable companies should be required to retransmit Canadian services. Closed captioning should be integrated into teletext over a 5 year period.

9. Standard Broadcasting Corporation

Standard Broadcasting is involved in a teletext Field Trial through CJOH-TV Ottawa and is also providing a SCMO alpha-numeric information service to school boards, banks and investment houses through CKFM-FM Toronto.

Standard submits that the CRTC should adopt an unrestricted regulatory approach. Broadcasters should be able to use their assigned frequencies to the fullest including the ability to lease spare capacity to parties of their choice. At the same time, it is reasonable to give closed captioning a priority on the VBI and to require cable companies to retransmit the VBI/SCMO portion of broadcast signals and to make technical improvements where necessary.

10. Musitron Communications Inc., Kitchener, Ontario

Musitron provides continuous background music on the SCMO of a local radio station in Kitchener. It submits that the SCMO is the most efficient means available to distribute background music to subscribers at a reasonable cost.

11. TV Ontario

TVO has been using its VBI since January 1980 to provide an educational teletext service. TVO submits that VBI services should be licensed as an integral part and not separately from the principal broadcasting undertaking. While the CRTC has the power to regulate these services, it should not restrict their development with premature regulations. Closed captioning will eventually be integrated with teletext. Cable companies should be required to retransmit VBI services. DOC should review BS-13 to optimize time-sharing, and DOC-CRTC should conduct a study on vertical retrace time to open up VBI lines 10-14.

12. Canadian Broadcasting Corporation

The CBC is distributing Project IRIS on the VBI of its network signal and using the SCMO on FM monophonic transmissions for alternate network distribution. It has some fundamental technical reservations about the use of the SCMO on FM stereophonic transmissions but is willing to reassess SCMO use in light of new technological developments. The CRTC should hold a public hearing to examine not just the narrow area of VBI/SCMO but the full range of new services on cable. The VBI/SCMO should not be viewed as a dramatic expansion of broadcast space when viewed in the perspective of broadband cable and its potential to deliver new services.

In any event, use of the VBI/SCMO must be licensed only to broadcasters who operate the main channels and must remain subject to their control with the public interest firmly in mind. Regulation is needed for technical aspects and to ensure cable carriage of VBI/SCMO services, however, there should be no restraints placed on types of services or their content. Closed captioning can be ensured by means of licence conditions.

The CBC noted that advertising raised some very complex questions for new information services and expressed the hope that the CRTC will not need to intervene with detailed regulations. The CBC has developed advertising guidelines for its teletext magazine on Project IRIS.

DOC should take steps to standardize technology to protect the consumer from a confusing array of equipment choices. Use of VBI lines 10 to 14 by cable systems for pay television scrambling should not preclude or disrupt use of these lines by broadcasters. In this regard, DOC should set standards requiring satisfactory receiver performance for VBI lines 10 to 21.

13. The Honourable James Snow, Ontario
Minister of Transportation and Communications

Ontario favours minimal regulation for VBI/SCMO services. Broadcasters should have the right to use the VBI/SCMO at their discretion including the right to lease to other parties. Cable carriage should be negotiated except in the case of VBI/SCMO services such as closed captioning which are directly related to the main programming.

14. Rogers Cablesystems Ltd.

Rogers submits that cable companies should not be required to retransmit VBI services. The great majority of these services are not broadcasting since they will be intended for reception by a discrete portion of the public and not the general public. Technical improvements required to distribute these services should be a the discretion of the cable company.

Rogers also submits that the CRTC does not have the power to license non-broadcasting services separately, that VBI services should be authorized by way of a specific condition attached to the broadcaster's licence and that the CRTC should refrain from imposing regulations. Rogers emphasized the FCC characterization of teletext as a service which resembles and will largely compete with other print media such as newspapers and magazines. Where a VBI service such as closed captioning is clearly related to the main programming, it should be given priority for regulatory purposes. In most cases, however, VBI services will not be clearly related to the main programming, and for that reason, the CRTC should amend its existing regulations to exempt VBI services as non-broadcasting applications.

15. Alberta ACCESS

Alberta ACCESS is the licensee for CKUA-FM Edmonton. SCMO is a subsidiary but integral part of its frequency assigned for the purpose of educational broadcasting. There is a need for technical regulation, however, the CRTC should not regulate SCMO content. A SCMO service does not fall within the CRTC's jurisdiction when it is intended for reception by part of the general public.

16. Le Groupe Vidéotron Ltée

Vidéotron supports the CCTA submission (item 28 below) and makes these additional comments: It is prepared to carry VBI/SCMO services as long as it does not need to incur additional expenses beyond BP-23 requirements. The CRTC should also take into consideration that broadband cable is the most economic means to deliver new services, and that it may be advantageous to broadcasters to incorporate their VBI/SCMO services into full channel services operated by cable companies. Vidéotron is committed to the introduction of the VIDACOM universal interface. At this time, the CRTC should encourage new information services with flexible regulations.

17. CHUM Ltd.

CHUM submits that the VBI/SCMO are integral parts of broadcasting undertakings and their use should remain at the discretion of the licensee. The CRTC should encourage development of new services with minimal regulations on

content and should also ensure cable carriage. DOC should remove technical restrictions which limit SCMO to broadcast related purposes.

18. British Columbia Telephone

BC Tel submits that VBI/SCMO are enhanced services which should be dealt with in the context of wider issues associated with the provision of information services, particularly the need to meet international competition. The success of Canadian industry requires competitive flexibility free from detailed regulation and encouragement to adjust rapidly. Cable carriage should only be obligatory for closed captioning. All other VBI/SCMO services should be licensed separately from the main broadcasting undertaking with cost separation. Conventional print media should be eligible to apply for these services.

19. Radio 1540 (CHIN), Toronto

CHIN submits that broadcasters must retain control over SCMO services in order to prevent interference with the main program.

20. Elder Engineering Ltd., King City, Ontario

Elder Engineering submits on behalf of the Canadian Portuguese Radio Club that provision should be made for inclusion of third language radio broadcast services on the SCMO. Such services should be licensed separately from the main broadcasting undertaking and be subject to simple regulations.

21. CJFB-TV Swift Current, Saskatchewan

CJFB-TV submits a brief on behalf of 33 CBC private affiliates across Canada. Each affiliate should remain in control of its VBI and not be required to distribute network VBI services unless it agrees by contract. Cable carriage of VBI services should be mandatory.

22. Canadian Captioning Development Agency (CCDA)

The CCDA notes that the social and educational benefits of closed captioning are well accepted in light of the needs of 1.5 million hearing impaired Canadians. The CCDA submits that captioning is an integral part of a television service for the hearing impaired and not just a program-related service. Bill C-141 amendments to the Canadian Human Rights Act passed in March 1983 could be interpreted to provide that accessibility by the hearing impaired to television programming is a matter of right. The CCDA agrees with FCC protection of Line 21 captioning for the next five years, noting, however, that the Canadian closed captioning service has the capability to distribute simultaneously on Line 21 and teletext. In general, closed captioning should

have first priority on the VBI with affiliates required to distribute network captioning. Cable carriage of captioning should be required with technical improvements if necessary. CRTC regulations should provide that simultaneous substitution of captioned U.S. programs is not permitted if the Canadian program is not captioned.

23. CanWest Broadcasting Ltd., Winnipeg

CanWest submits that there are two central issues concerning use of the VBI: Technical standards should be put in place to ensure one type of terminal, and cable carriage of VBI services should be ensured including any necessary technical improvements.

24. Hyman Glustein, Outremont, Quebec

Mr. Glustein submits that the CRTC should limit VBI/SCMO use to communication services for the disabled and handicapped and require radio and television licensees to provide these services as part of their licences.

25. BBM Bureau of Measurement

BBM requests that some part of the VBI be left open for inclusion of a source identification signal to facilitate electronic audience metering, and that cable companies not be allowed to interfere with the VBI transmissions of broadcasters.

26. Allarcom Ltd.

Allarcom is the licensee of CITV-TV Edmonton and Superchannel pay television in Alberta. It submits that the VBI is an integral part of a broadcasting undertaking which should remain under control of the broadcaster. In general, the VBI should be used for services related to main programming. Broadcasters should not be required to provide third parties with access to the VBI in light of the alternate capacity available on cable. The CRTC should not regulate the type of services provided by broadcasters on the VBI/SCMO. Cable carriage should be mandatory for program-related VBI services.

27. Telefax

Telefax advised the CRTC by telex that it has completed a successful test of SCMO on FM radio. The CRTC requested further details.

28. Canadian Cable Television Association (CCTA)

The CCTA submits that cable companies are willing to carry broadcast VBI/SCMO services provided that they do not cause interference to cable signals and to the extent that existing cable facilities can accommodate them without incurring appreciable costs related to technical upgrading. Cable systems are now using VBI lines 10 to 13 in certain cases to operate pay television scrambling. Cable companies are planning for the introduction of new information services, and it should be noted that broadcast VBI services can be incorporated into full channel services provided by cable operators.

In general, VBI/SCMO services should be allowed to develop with a minimum of regulatory constraints. Different types of services and financing by advertising or subscriptions should be allowed. Existing CRTC regulations do not apply since most VBI/SCMO services will not be broadcasting but rather discretionary, "narrowcast" communication services. Accordingly, these services should be licensed neither separate from nor as integral part of the broadcasting undertaking, but should be authorized by way of condition of licence attached to the broadcaster's licence.

29. CTV Television Network Ltd.

CTV submits that broadcasters have a proprietary right to the use of their VBI which is an integral part of a television signal. The addition of a VBI service should be at the discretion of the television broadcaster in keeping with DOC technical specifications. The CRTC should not require broadcasters to give third parties access to the VBI. Cable companies should be required to carry broadcast VBI services and to make technical modifications if necessary. The CRTC should not restrict types of VBI/SCMO services provided by broadcasters or limit possible means of financing. Affiliate stations should be obliged to distribute network services.

30. CHEZ-FM Ottawa

CHEZ-FM outlined the undersirable effects which could result from adding a SCMO signal: reduction in stereo signal modulation, need for improved equipment, presence of noise in large number of currently available receivers and severe increase in distortion due to multipath reception. CHEZ-FM requested that FM stations be allowed to refuse any SCMO use which degrades quality of main service, and also noted that SCMO may be required in future to improve FM service with the advent of digital technology.

31. Moffat Communications Ltd., Winnipeg

Moffat Communications operates both radio and TV stations, and supports the CAB submission on VBI/SCMO services (item 45 below).

32. Coalition of Provincial Organizations of the Handicapped (COPOH), Winnipeg

COPOH is a self advocacy organization which secures the rights of the disabled in all areas of Canadian society. COPOH supports the development of VBI/SCMO services as a means of providing access to the media to handicapped Canadians. The CRTC should treat VBI/SCMO services as an integral part of broadcasting undertakings. From this, it follows that the CRTC has a responsibility to regulate these services for the public good. The CRTC should act on the recommendations made in the Obstacles report of the Special Parliamentary Committee on the Disabled and Handicapped that 1) the CBC produce radio reading programs for the visual and print handicapped, and 2) the CRTC require captioned programming as a condition of licence.

33. Maclean Hunter Cable TV

Maclean Hunter agrees with the CCTA submission (item 28 above) and makes the further comment that cable systems should be able to insert signals on any VBI/SCMO capacity which is not utilized by broadcasters.

34. TAS Pagette, Toronto

TAS Pagette holds Radio Act licences for 33 radio paging operations and 6 repeater systems for mobile radio and personal communications. TAS submits that SCMO is a viable medium for radio paging, that the SCMO should be licensed as an integral part of FM broadcasting undertakings and remain under the control of the broadcaster, and that the CRTC should establish an order of priority for SCMO services with priority given to services for the handicapped. Otherwise, the CRTC should not restrict development of SCMO services.

35. British Columbia Television

BCTV regards the VBI as property of the licensee with the result that the VBI should remain under the licensee's control. The CRTC should suggest an order of priority to guide broadcasters in developing VBI services but should allow flexibility for experimentation. Cable companies should be required to carry Canadian VBI services.

36. Canada Videolink Corp., Vancouver

Canada Videolink is a Telidon Information Provider (IP). It requests that the CRTC develop a VBI/SCMO policy based on the participation of independent IPs i.e. new services should be licensed to IPs not controlled by or directly related to existing broadcasters, publishers or carriers. Canada Videolink cited the CBC as an example of a broadcaster which had excluded independent IPs from participating in the Project IRIS teletext magasine. If it is not feasible to license VBI/SCMO services separate from the broadcasting undertaking, CRTC will face difficulties in persuading broadcasters to provide VBI/SCMO access to third parties.

37. Canadian Radio Common Carriers Association (CRCCA)

The CRCCA notes that the VBI/SCMO may be used to transmit addressed information as well as broadcast-type information. The CRTC should develop flexible regulation which encourages the development of VBI/SCMO services. Closed captioning should receive priority but radio common carriage should also be considered from the viewpoint of spectrum efficiency. DOC should ensure technical integrity and compatibility of equipment.

38. Canadian National Institute for the Blind (CNIB)

The CNIB submits that VBI/SCMO services should be licensed as an integral part of broadcasting undertakings, and that broadcasters should be obliged to reserve the VBI/SCMO for use by disabled groups to provide them with improved services.

39. CFCN-TV Calgary

CFCN-TV submits that broadcasters should retain control over the VBI as an integral part of their undertakings. There should be a voluntary understanding between the CRTC and broadcasters on what types of services should receive priority. Cable companies should be required to carry VBI services. The largest potential for VBI/SCMO will be local and regional services.

40. CHAY-FM Barrie, Ontario

CHAY-FM submits that there should be no separate licences for SCMO services since technical responsibility for and control of SCMO cannot be separated from the main channel. The CRTC should allow a wide range of SCMO services and not restrict possible means of financing. Cable carriage of SCMO services should be mandatory where the originating station is Canadian.

41. Community Information Centre of Metro Toronto (CICMT)

CICMT is developing a proposal to implement a community information service throughout Ontario. Implementation of the proposal would require that the CRTC 1) ensure cable companies provide a community information service and 2) permit advertising and sponsorship to finance the service.

42. Greater Vancouver Association of the Deaf

The CRTC should consider the needs of the hearing impaired in developing VBI policy, an in particular, should ensure that line 21 of the VBI is used to broadcast closed captioning.

43. Western Institute for the Deaf, Vancouver

Similar submission as in item 42 above.

44. Broadcast News Ltd., Toronto

Broadcast News (BN) is owned by Canadian Press Ltd. BN notes that the VBI/SCMO provide an alternate means to distribute private communications in competition with the established carriers. BN submits that there should be maximum flexibility in utilizing the VBI/SCMO.

45. Canadian Association of Broadcasters

The CAB supports the development of VBI/SCMO services as a means to increase the revenue base of local broadcasters, thereby improving service to the public. The VBI/SCMO are integral parts of broadcasting undertakings, and as such, they should remain under the licensee's control. Their use should be authorized by simple licence amendments. Broadcasters should not be required to provide third parties with access to the VBI/SCMO except as agreed by contract. CRTC regulations might apply to program-related VBI services and broadcast-type SCMO services. However, the CRTC should not limit types of services, restrict means of financing or hinder the development of new services. Closed captioning should have a priority but otherwise an order of priority for different services is not required given the availability of other means of transmission. Cable companies should be required to carry VBI/SCMO services. Tests so far indicate that cable systems maintained to BP-23 standards can retransmit VBI/SCMO services.

46. First Choice Canadian Communications Corp.

First Choice regards the VBI/SCMO as extra information carrying capacity which is ancillary to the primary television or FM radio signal. VBI/SCMO applications may be categorized under three headings: Related to primary signal, non-related broadcast services and private communications. In reconciling the competing interests, First Choice would give primary rights to the broadcaster responsible for the overall transmission to ensure that the main service is protected from possible degradation and to allow future enhancement if technology so allows. Cable companies and other signal retransmitters should not be allowed to delete VBI/SCMO services of a broadcast nature. Private communications might be deleted and the capacity used by retransmitters to provide other services if the signal originator conserts. The CRTC should establish minimal requirements and avoid rigid rules which are likely to be overtaken by technology and events.

47. Canadian Satellite Communications Inc. (CANCOM)

CANCOM submits that ownership and control of the VBI/SCMO rests with the broadcaster involved. Affiliates should be required to distribute network services. Program-related services such as closed captioning should have a priority on the VBI. The CRTC should impose minimal regulation and allow broadcasters to explore different types of services and various means of financing. Cable companies and other exhibitors should be required to retransmit VBI/SCMO services.

48. Canadian Videotex Industry Association (CVIA)

The CVIA represents in main companies who manufacture Telidon equipment. It submits that the CRTC should minimize its regulation of VBI teletext services if Canada is to meet the competitive challenge posed by U.S. teletext services. Competition will ensure diversity and obviate the need for separate licensing by the CRTC. This means that television broadcasters should have a free hand to introduce VBI services which they think will capture the attention of television viewers.

49. Combines Investigation, Consumer and Corporate Affairs Canada (CCAC)

CCAC favours unregulated market competition as the best means to achieve efficient use of VBI/SCMO capacity. Broadcasters face competition from a large number of information carriers -- cable, print, telcos, radio paging services and so forth. In this competitive environment, broadcasters would not be able to charge unduly high prices for access by third parties to the VBI/SCMO. This means that direct regulation is not required except to 1) ensure the provision of socially necessary services such as closed captioning and 2) prevent radio interference. CCAC expects that most VBI/SCMO services will not be integrally related to broadcasters' main programming, but that most services will be point-to-point or point-to-multipoint services. Cable carriage of VBI/SCMO services should be mandatory.

50. CJAZ-FM Vancouver

CJAZ-FM is in favour of developing SCMO services as a source of additional revenue.

51. Winnipeg Videon Inc.

Winnipeg Videon supports the CCTA submission (item 28 above).

52. Norpak Corporation, Kanata, Ontario

Norpak supports the CVIA submission (item 48 above).

ANNEX B

Summary for teletext in FCC BC Docket No. 81-741

B.1 Introduction

In 1981, the Commission adopted a Notice of Proposed Rule Making to consider authorizing television stations to engage in teletext service. Teletext is a new form of radio communication that involves the transmission of textual and graphic data on the vertical blanking interval (VBI) of the video portion of the television signal. The Notice was issued to study authorization of this new media form as a result of the considerable interest in teletext service and technology that has developed in the several component industries associated with television broadcasting. The authorization of teletext would serve the public interest.

B.2 Responses to the Notice

Forty-nine formal comments and twenty-seven reply comments were submitted by fifty-six parties in response to the Notice. A large number of informal comments were received from hearing-impaired citizens and from groups representing the hearing-impaired concerning the relationship between teletext and the line 21 closed caption service.

B.3 Authorization of teletext service

The Commission has decided to authorize teletext service and to regulate it under the open market approach. Thus, the rules that are adopted authorize licensees of both full service and low power television stations:

1) to operate teletext services; and

2) to choose both the kinds of services to offer and the technical systems for transmitting the data signals.

The only major limiting factor in the authorization is that teletext operations must not interfere with the regular broadcast service of the originating station, the signals of other broadcast stations, or the signals of non-broadcast radio stations.

The Commission feels that teletext authorization would increase the efficiency of broadcast television spectrum use, and teletext transmissions are technically compatible with existing broadcast television transmission standards. The experience from the various field trials on licensed stations shows that usable teletext signals can be transmitted on the VBI without degrading the quality or reception of the main television program signal or producing interference to other stations.

B.3.1 Definition of teletext

In order to provide authority for the widest possible range of individual applications and services, the Commission is defining teletext, only in general terms, as to be a visual display medium and define it as a data system for the transmission of textual and graphic information intended for display on viewing screens. The definition can be expanded to include data that is useful to widen and enhance the utility and service of teletext information.

The Commission considers teletext to be an ancillary service of broadcasters. Teletext activities would not be a primary service of television stations. Thus , teletext operations would not be subject to service guidelines or other performance standards. Point-to-point and point-to-multipoint teletext activities will be regulated according to the appropriate private radio or common carrier regulatory structure and rules.

Stations will be permitted to initiate or terminate service at their discretion without notifying the Commission. Similarly, there will be no requirement for maintaining teletext program logs.

B.3.2 Reasons of the Commission to Use an Open Regulatory Approach

1) There are many potential uses for teletext, and the different applications tend to be divergent in nature and, in some uses, with respect to technical requirements.

2) While very little is known about the market for teletext services, it is clear that the demand for its services will not be homogeneous. Based upon previous trials and tests of teletext, it appears that the need for and importance of the various applications are likely to vary across different markets and user groups. The open market approach offers features that allow it to provide for the needs of users with a minimum of involvement by the government.

B.3.3 Teletext Authority for Public Broadcasting Stations

Public television has been authorized to engage in teletext services and to offer such services on a profit-making basis. Public stations are permitted the same discretion with respect to services and technical systems as commercial stations.

B.3.4 Teletext as an Ancillary Service

Teletext is expected to provide services that are ancillary to the regular broadcast audio-visual program service of television stations. As an ancillary activity, teletext will not be required to further or promote a station's performance with respect to its public service obligation as it relates to programming.

B.4 Regulatory Status of Teletext Services

Teletext is being authorized for a wide range of services, most of which bear little, if any, relationship to the traditional forms of broadcasting. As ancillary activities, such services would not materially conflict with use of the television frequencies for the normal broadcast purposes to which their allocation is intended. However, circumstances could arise under which teletext service might take on characteristics of either communications common carriers or private carriers. For example, teletext might be used for some form of common carrier visual alert (e.g. console display, not paging) or notification service (e.g. electronic messages and/or mail). Other forms of teletext, such as business data services, could involve only the provision of transmission facilities and, depending on how they were offered, might be similar to private carrier radio systems.

It appears that paging service, including conventional tone or tone and voice based paging, may be a potential VBI use.

In all cases, involving either private or common carrier services, the applicant will not be seeking approval for its technical facilities. The Commission regards teletext use as a secondary privilege that runs with the primary television license. It should be noted that a television broadcaster that elects to use its teletext capacity for private or common carriage remains a broadcaster for all other purposes. Only the use of the VBI for non-broadcast related teletext purposes would be regulated in accordance with private radio or common carrier regulations.

The Commission has determined that individual licensees should be permitted discretion to select the technical system for teletext transmission that best suits their individual needs. The many divergent applications and uses for teletext will create broad opportunities for the success of technical variations and of specialized systems.

B.5 VBI Lines Authorized for Teletext Use

Teletext signals will be authorized on lines 14-18, and 20 of the VBI. Additionally, lines 10-13 will be made available on a phase-in basis over the next several years. There are seven lines for teletext in use now and an additional four in the

future. Those lines are authorized on a permissive use basis only and are not reserved for the exclusive use of teletext. Teletext already will be sharing some of these lines with other applications, such as the vertical interval test signal (VITS) on lines 17 and 18 and source identification codes (SIDS) on line 20.

The Commission has decided to adopt an approach that will withhold authorization of teletext on line 21 for a period of five years and will reconsider its decision at the end of that time. Postponement of action in this area will provide an opportunity to observe the development of both teletext and the line 21 caption system.

B.6 Technical Rules for Operation

The technical rules governing operation of teletext are for the most part written in general terms. They are intended principally to ensure that teletext signals do not interfere with other radio frequency services or degrade reception of the originating stations's regular programs. These rules are designed to permit a broad range of alternative systems to operate to meet particular service needs. The only specific limitation is that placed on signal level.

- the 80 IRE unit maximum signal level that is being authorized for most lines is lower than the 100 IRE unit level originally proposed. In addition, it appears that 80 IRE units will provide adequate signal strength to serve the requirements of all of the known technical systems and will also facilitate the operation of a wide range of other technical options.

- Line 14 is being authorized at a signal level of 40 IRE units through 1987 and this will be raised gradually to the 80 IRE level over the succeeding years. This will avoid potential degradation from line 14 use to reception of regular programs on some existing receivers. The schedule for phasing in lines 10-13 also increases the permissible signal levels on these lines over time.

B.6.1 Threshold Limit

One of the most important aspects of teletext interference is the potential for teletext signals to degrade significantly the ability of home television receivers to display regular programming. Because the performance capabilities of individual receivers vary considerably across both models and manufacturers, the most reasonable way to gauge the extent of receiver degradation appears to be to examine the proportion of the relevant receiver population that is affected. The Commission

has decided not to include a threshold limit for receiver degradation (e.g. a one-percent threshold limit was proposed). As a matter of policy, the Commission will use the one percent of the receiver population figure as a general guideline for limiting teletext degradation of reception of regular television service.

B.6.2 **Adaptive Equalizer Pulses**

The rules provide authority for use of an adaptive equalizer pulse on any of the VBI lines approved for teletext to aid in the correction of multipath errors. The Commission has decided not to authorize reference pulses in the vertical synchronizing waveform at this time because they have received no information concerning the potential of such signals in this area to degrade the performance of television receivers, and the reference pulse is best left to the licensee's discretion.

B.6.3 **Visual Emergency Messages**

The new rules provide that any visual emergency messages transmitted are to replace closed captions during an emergency situation. Thus, any teletext system used to provide closed caption service must have a facility for giving way to visual emergency messages during periods when captioning is being provided.

B.6.4 **Teletext decoders**

On the matter of the treatment of external teletext decoders, the Commission anticipates that there will be two basic categories of such external devices. These categories are:

(1) A teletext decoder, separate and external to a TV set, that supplies a modulated RF signal to the antenna input terminals of a television receiver - This is a TV Interface Device. The decoder must in this instance be type approved.

(2) A teletext decoder, separate and external to a TV set, that uses digital circuitry to decode the teletext signal and provides output at video baseband - This is a Class B computing device, subject to verification by the manufacturer.

The treatment of decoders built-in to a TV receiver will depend on the arrangement of the receiver and decoder components. If the teletext signal is fed directly to the TV video amplifier circuits, the TV receiver requirements apply to the entire unit. On the other hand, if the teletext signal is fed to the TV receiver front end, the decoder will be treated separately as a Class I TV device.

B.7 **Conclusion**

The Commission believes that teletext offers significant potential as a new media form and that its benefits can be realized most effectively in an environment that for the most part is free of the government intervention. The many diverse and varied applications for this technology provide opportunities for service tailored to the interest of mass audiences, specialized groups, and individuals. The regulatory structure is intended to allow the broadcast industry the flexibility to develop and offer service that is specifically suited to the requirements of individual applications and to alter this service to meet changing conditions in a dynamic environment.

An immediate implementation of the teletext rules would serve to further the development of devices the Commission finds to be in the public interest. This will provide an opportunity for extending and diversifying service from television stations and for improving the efficiency of spectrum utilization.

The rules set forth below will be effective with the adoption of the order set by the Commission. The code of Federal Regulations are amended and revised as set forth below, such as table of frequency allocations, teletext service, and transmission standards.

B.5.1 **Table of frequency allocation** (FCC)

Table of Frequency Allocations

Band (MHz)	Service	Class of Station	Frequency	Nature OF SERVICES	
		of stations			
7	8	9	10		
	*	*	*	*	*
54-72	BROADCASTING (NG142)	Television broadcasting	55.25	Video	Channel 2
			59.75	Sound	
			61.25	Video	Channel 3
			65.75	Sound	
			67.25	Video	Channel 4
			71.75	Sound	
	*	*	*	*	*
76-88	BROADCASTING (NG142)	Television broadcasting	77.25	Video	Channel 5
			81.75	Sound	
			83.25	Video	Channel 6
			87.75	Sound	
	*	*	*	*	*
174-216	BROADCASTING (NG142)	Television broadcasting	175.25	Video	Channel 7
			179.75	Sound	
			181.25	Video	Channel 8
			185.75	Sound	
			187.25	Video	Channel 9
			191.75	Sound	
			193.25	Video	Channel 10
			197.75	Sound	
			199.25	Video	Channel 11
			203.75	Sound	
			205.25	Video	Channel 12
			209.75	Sound	
			211.25	Video	Channel 13
			215.75	Sound	
	*	*	*	*	*

NG142 TV broadcast stations authorized to operate in the bands 54-72, 76-88, 174-216, 470-512, and 512-806 MHz may use a portion of the television vertical blanking interval for the transmission of teletext messages, on the condition that harmful interference will not be caused to the reception of primary services operating in these bands.

B.7.2 **Teletext service**

(a) Teletext is a data system associated with a television broadcast signal that is used for the transmission of textual and graphic information intended for display on the screens of suitably equipped receivers and of data that is intended to enhance the use of teletext information.

(b) TV broadcast stations are authorized to transmit teletext data during any time period, including portions of the day when normal programming is not broadcast.

(c) Teletext service is of an ancillary nature and as such is an elective, subsidiary activity. No service guidelines, limitations, or performance standards are applied to it other than the definitional aspects of the authorization. The kinds of service teletext may be used to provide include, but are not limited to, advertiser-supported consumer information, subscription data services, and business-oriented information.

(d) Teletext services that are common carrier in nature are subject to common carrier regulation. Licensees operating such services are required to apply to the Commission for the appropriate authorization and to comply with all policies and rules applicable to the service. Responsibility for making the initial determination of whether a particular activity is common carriage rests with the licensee. Initial determinations submitted by licensees are subject to Commission examination and may be reviewed at the Commission's discretion.

(e) The grant or renewal of a TV station license or permit will not be furthered or promoted by proposed or past teletext operation; the licensee must establish that its broadcast operation is in the public interest wholly apart from teletext activities. (Violation of rules applicable to teletext operation would, of course, reflect on a licensee's qualifications to hold its broadcast licence or permit).

(f) In all arrangements entered into with outside parties affecting non common carrier teletext operation, the licensee or permitee must retain control over all material transmitted in a broadcast mode via the station's facilities, with the right to reject any material that it deems inappropriate or undesirable.

B.7.3 **Transmission standards**

Specific scanning lines in the vertical blanking interval may be used for the purpose of transmitting teletext signals, subject to certain conditions:

(i) Teletext may be transmitted on Lines 10-18 and 20, all of Field 1 and 2. Use of specific lines is to be in accordance with Schedule I below.

(ii) No observable degradation may be caused to any portion of the visual or aural signals.

(iii) Teletext signals must not produce emissions outside the authorized television channel bandwidth. Data pulses must be shaped to limit spectral energy to the nominal video baseband.

(iv) Transmission of emergency visual messages must take precedence over, and shall be cause for interrupting, teletext that provides a visual depiction of information simultaneously transmitted on the aural channel.

(v) A reference pulse for a decoder associated adaptive equalizer filter designed to improve the decoding of teletext signals may be inserted on any portion of the vertical blanking interval authorized for teletext, in accordance with the signal levels set forth on Schedule I below.

(vi) All lines authorized for teletext transmissions may be used for other purposes upon prior approval by the Commission.

Schedule I

	1983	1984	1985	1986	1987	1988	1989	1990	1991
10	X	X	X	X	X	50 IRE	→		70 IRE
11	X	X	X	X	X	50 IRE	→		70 IRE
12	X	X	X	X	X	50 IRE	→		70 IRE
13	X	X	X	X	X	70 IRE	80 IRE	80 IRE	80 IRE
14	40 IRE	→				70 IRE	80 IRE	80 IRE	80 IRE
15	80 IRE	→							
16	80 IRE	→							
17	80 IRE */**	→							
18	80 IRE */**	→							
19	***								
20	80 IRE **	→							

* Also authorized for Vertical Interval Test Signals (VITS) that are used with remote controlled transmitters.

** Also authorized for SID signals (Source Identification signals).

*** Presently reserved to the Vertical Interval Reference (VIR) signal.

ANNEX C

BROADCAST SPECIFICATION BS-13

ISSUE-2

ANCILLARY SIGNALS IN THE VERTICAL BLANKING INTERVAL FOR TELEVISION BROADCASTING

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

BS-13
ISSUE 2

BROADCAST SPECIFICATION

ANCILLARY SIGNALS IN THE VERTICAL BLANKING INTERVAL FOR TELEVISION BROADCASTING

EFFECTIVE DATE: JUNE 3, 1981

TELECOMMUNICATION REGULATORY SERVICE

CR-13
2e ÉDITION

CAHIER DES CHARGES SUR LA RADIODIFFUSION

SIGNAUX AUXILIAIRES DANS L'INTERVALLE DE SUPPRESSION VERTICALE EN RADIODIFFUSION TÉLÉVISUELLE

MISE EN VIGUEUR: LE 3 JUIN 1981

SERVICE DE LA RÉGLEMENTATION DES TÉLÉCOMMUNICATIONS

ANCILLARY SIGNALS IN THE VERTICAL BLANKING INTERVAL FOR TELEVISION BROADCASTING

1. GENERAL

1.1 This specification pertains to the insertion and use of ancillary signals in the vertical blanking interval of the standard television signal.

1.2 The vertical blanking interval in a television signal is a period of time, consisting of 21 scanning lines, during which the vertical synchronizing pulses are transmitted but the picture information is not transmitted. The purpose of the vertical blanking interval is to permit the scanning beam in a TV receiver to return to the top of the screen without interference to the displayed picture information. Subject to certain constraints, the interval can be used to transmit other useful signals without affecting regular picture transmission.

1.3 Line numbers in the vertical blanking interval are referenced to the total number of scanning lines in each field. For field 1, line 1 starts with the first equalizing pulse while, for field 2, line 1 starts with the second equalizing pulse. Current receivers in use, however, do not have sufficient vertical retrace blanking and, with occasional exceptions, allow only lines 15 to 21 inclusive to be used to carry ancillary signals. Future TV receiver designs may eventually permit the usage of all vertical lines from 10 to 21 inclusive.

1.4 In this specification, reference for signal levels are based on the Institute of Radio Engineers' (IRE) scale for video waveforms. (A linear scale of 140 units for a signal with reference white level). In terms of this scale, the reference location of the synchronizing pulse tip is at minus 40 IRE units, white level is at plus 100 IRE units and blanking level is at 0 IRE units thereby allowing for 40 divisions of sync and 100 divisions of luminance including 7.5 divisions of set-up for the black level.

1.5 In section 2, three categories of signals are presently alloted to specific lines in the vertical blanking interval. The Department, however, will permit sharing, or a dynamic allocation of some of the lines, provided that a proper identification code is used to identify and establish where necessary the priority of each service. The characteristics of such codes require further study.

1.6 Closed captioning and other services related to the main programming normally allotted to line 21, are to be carried in the same time frame as the main TV program. The vertical interval test (VIT) and the vertical interval reference (VIR) signals will remain allotted to lines 17, 18 and 19.

2. SIGNALS FOR INSERTION

The type of signals and their application are grouped into three general categories. The three categories of signals are:

1) Maintenance of signal quality;
2) Monitoring and control;
3) Reception by the general public.

2.1 Maintenance of Signal Quality

Signals in this category, if originated by stations in Canada, must conform to the requirements of Sections 2.1.2 and 2.1.4. Such signals must not interfere with other signals intended for reception by the general public.

2.1.1 Vertical Interval Reference (VIR) Signals

VIR signals are reference signals to ascertain proper chroma amplitude and phase as well as luminance and black levels. The signals provide a reference for the operation of automatic video correctors and, for receivers with VIR correction circuitry, provide for automatic chrominance and luminance adjustment. In application, the signal is added to the

program signal at the production point where the colour balance is determined. The signal shall not be removed during signal processing.

2.1.2 VIR Signal Line Allotment and Waveform

VIR signals are alloted to Line 19, fields 1 and 2.

The VIR signal waveform is shown in Figure 1 and provides a reference for phase and amplitude of the chrominance signal compared to the color burst as well as a reference for the amplitude of the luminance and black signal levels.

2.1.3 Vertical Interval Test (VIT) Signals

VIT signals are intended for quality monitoring, control and testing of signal processing equipment and transmission circuits.

2.1.4 VIT Signal Line Allotment and Waveform

The internationally accepted VIT signals are allotted to line 17, fields 1 and 2. In addition, line 18, fields 1 and 2, are designated as optional for VIT signals at this time. However, users are urged to use only line 17 for VIT signals.

The VIT signal waveform for line 17, field 1, is shown in Figure 2.

The internationally accepted VIT signal waveform for line 17, field 2, is shown in Figure 3.

2.2 Signals for Monitoring and Control

Signals in this category, if originated by stations in Canada, shall conform to the requirements of Section 2.2.2. Such signals must not interfere with other signals intended for reception by the general public.

2.2.1 Types of signals in this caterogy are: Source identification (SID), channel identification, network monitoring and telemetry information for remote control and network communications.

2.2.2 Line Allotment and Waveforms for Monitoring and Control Signals

Signals for these purposes are allotted to line 18, fields 1 and 2. However, source identification signals may be carried on line 20. The Department might consider granting approval to use other lines with adequate justification. CRTC approval will also be required if lines 20 and 21 are involved.

2.3 Signals Intended for Use by the General Public

CRTC approval is required for carriage of this category of signals. Users are advised that the CRTC might require deletion of signals on lines 15, 16, 20 and 21 which it has not previously authorized. In such a case, appropriate technical facilities need to be provided to effect such deletion.

2.3.1 All types of signals intended for use by the general public must be planned on a non-interfering basis to regular picture transmission. Signals for alphanumeric and pictorial systems must comply with BS 14 "Television Broadcast Videotex". The Department may consider, on a case by case basis, the approval of closed captioning signals and other signals related to the main programming which do not conform to BS 14.

2.3.2 Line Allotments and Waveforms for Signals Intended for Use by the General Public

Signals for these purposes are allotted to lines 15 and 16, fields 1 and 2; line 20, fields 1 and 2; line 21, field 1, and the first half of line 21, field 2. Regarding dynamic allocation of lines see Section 1.5.

3. OTHER LINE ALLOTMENTS

3.1 Allotment for Lines 10 to 14 Inclusive

At this time, lines 10 to 14 inclusive are to remain unallotted. Permission for their use is subject to approval on a non-interfering basis to regular picture transmission and might be subject to CRTC approval.

Issued under the Authority of
the Minister of Communications

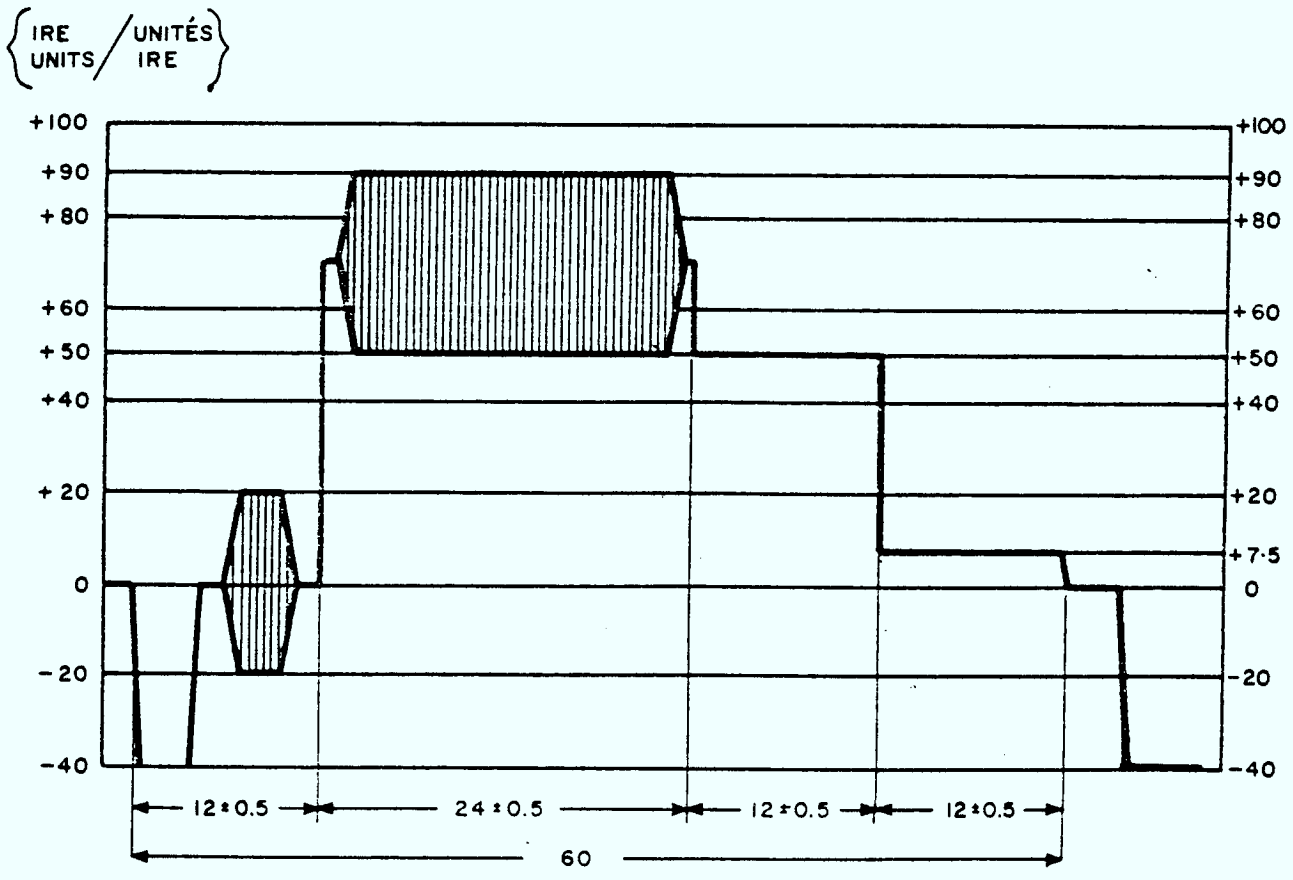
for

Dr. John deMercado
Director General
Telecommunication Regulatory
Service

VERTICAL INTERVAL REFERENCE SIGNAL

VIR

SIGNAL DE RÉFÉRENCE DE L'INTERVALLE DE SUPPRESSION VERTICALE



NOMINAL TIMING — MICROSECONDS
TEMPORISATION NOMINALE - MICROSECONDES

NOTE:- THE CHROMINANCE REFERENCE AND THE PROGRAMME COLOUR BURST HAVE THE SAME PHASE (±1°)

REMARQUE:- LA RÉFÉRENCE DE CHROMINANCE ET LA SALVE DE COULEUR DE L'ÉMISSION ONT LA MÊME PHASE (±1°)

FIGURE 1

VERTICAL INTERVAL

COMPOSITE TEST SIGNAL

SIGNAL D'ESSAI COMPOSITE DE L'INTERVALLE DE SUPPRESSION VERTICALE

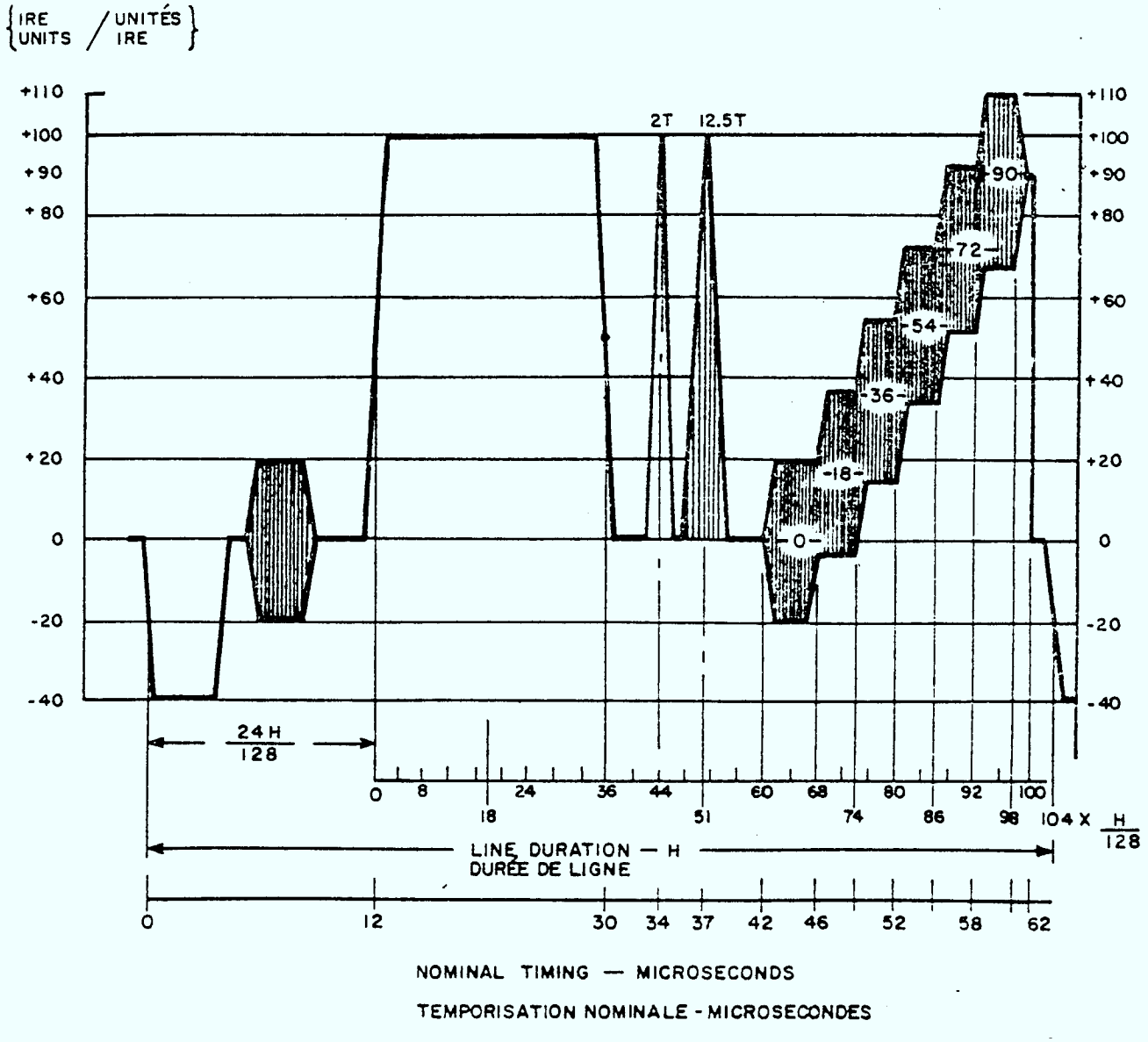
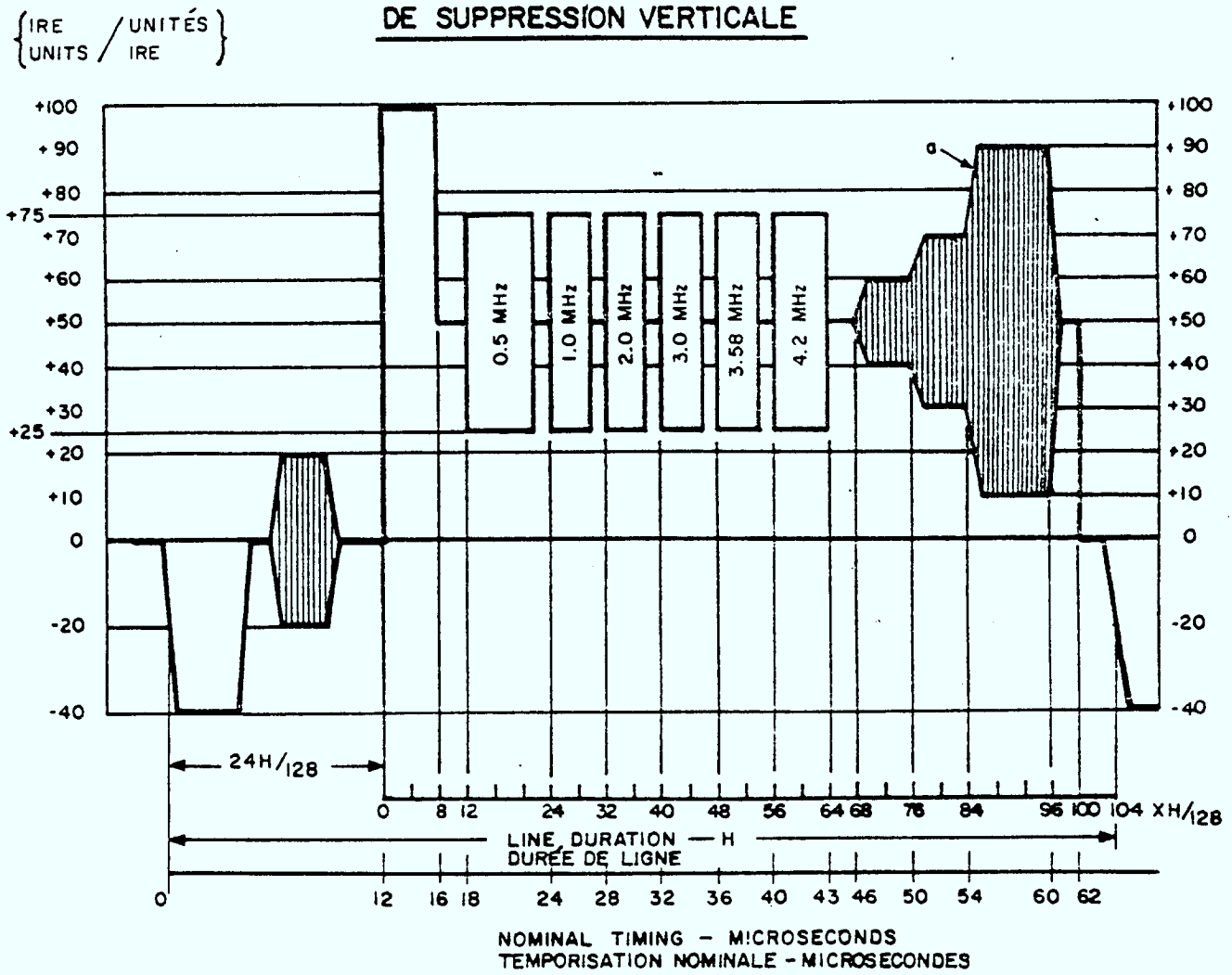


FIGURE 2

VERTICAL INTERVAL COMBINATION TEST SIGNAL

SIGNAL D'ESSAI COMBINÉ DE L'INTERVALLE DE SUPPRESSION VERTICALE



a) PHASE OF SUBCARRIER SET 90 DEGREES BACK FROM REFERENCE BURST.

a) LA PHASE DE LA SOUS-PORTEUSE EST EN RETARD DE 90 DEGRÉS PAR RAPPORT À LA SALVE DE RÉFÉRENCE

FIGURE 3

ANNEX D

BROADCAST SPECIFICATION BS-14

ISSUE-1

PROVISIONAL

TELEVISION BROADCAST VIDEOTEX

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

BS-14
ISSUE-1
PROVISIONAL

BROADCAST SPECIFICATION

TELEVISION BROADCAST VIDEOTEX

EFFECTIVE DATE: JUNE 19, 1981

TELECOMMUNICATION REGULATORY SERVICE

CR-14
1er ÉDITION
PROVISOIRE

CAHIER DES CHARGES SUR LA RADIODIFFUSION

VIDÉOTEX TÉLÉDIFFUSÉ

MISE EN VIGUEUR: 19 JUIN 1981

SERVICE DE LA RÉGLEMENTATION DES TÉLÉCOMMUNICATIONS

TELEVISION BROADCAST VIDEOTEX

Definition

Television Broadcast Videotex: A system consisting of a central data store (data base) from which digital data representing text and pictorial information is transmitted in the active portion of available TV lines through a broadcast delivery system. User terminals then interpret and display the selected data on video receivers/monitors or other terminal devices.

Introduction

The parameters outlined in this document have been selected intending to comply with the following principles and requirements:

(i) Terminal independence; this permits the use of a variety of terminals of varying capabilities, such as different levels of resolution.

(ii) Compatibility between services carried over existing communications networks (e.g. public switched telephone, off-air broadcast, satellite and cable TV networks.) and common presentation format.

(iii) Vertical blanking interval (VBI) and full field transmission compatibility.

(iv) Forward and backward compatibility; permitting future terminals to access old data and requiring that an installed inventory of terminals be able to receive and decode all future command formats in an intelligent manner.

(v) Adherence to already established national and international standards such as those contained in Appendix A.

Applicability

This document sets forth the requirements for the issuance of a Technical Construction and Operating Certificate (TC & OC) for a broadcasting transmitting undertaking when transmitting digitally encoded data for purposes including alphanumeric and/or pictorial information. The requirements also apply to a broadcasting receiving undertaking when the distributed signals are received from a broadcasting transmitting undertaking.

1.0 Data Positioning and Waveforms

Data may be transmitted in the active portion of a television line, commencing after the standard NTSC line synchronization and colour burst.

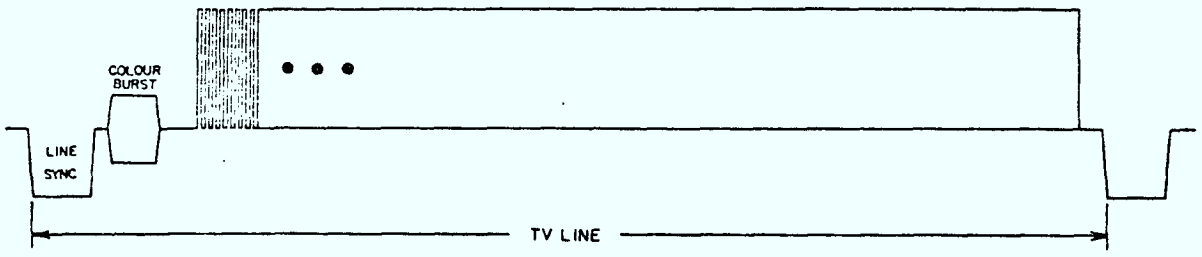


Figure 1

1.1 Vertical Blanking Interval and Full-Field Data Transmission

Data transmission uses the field-blanking interval and/or the active part of the video signal. Lines 1 through 21 in field 1 and the corresponding lines in field 2 of the 525 line 60 field/sec M/NTSC television system are designated as the vertical blanking interval (VBI). Of these, the allocation of lines 10 through 21 in field 1 and the corresponding lines in field 2 is the subject of Broadcast Specification 13. Full-field data transmission is achieved through utilization of lines 10 through 262 in field 1 and the corresponding lines in field 2 which comprises the vertical blanking interval as well as the active part.

1.2 Transmission Bit Rate

The transmission bit rate is 5,727,272 $\pm$ 16 bits/second* which is the 364th multiple of the horizontal line scanning rate for colour transmission (15,734.264 $\pm$ .044 Hz) and 8/5 of the colour sub-carrier frequency (3,579,545 $\pm$ 10 Hz). The data signal is to be phase locked to the colour sub-carrier when inserted into a colour television transmission and to the horizontal line scanning rate when inserted into a monochrome television transmission (with no burst present). The maximum rate of change of the transmission bit frequency shall be 0.16 bits/second/second.

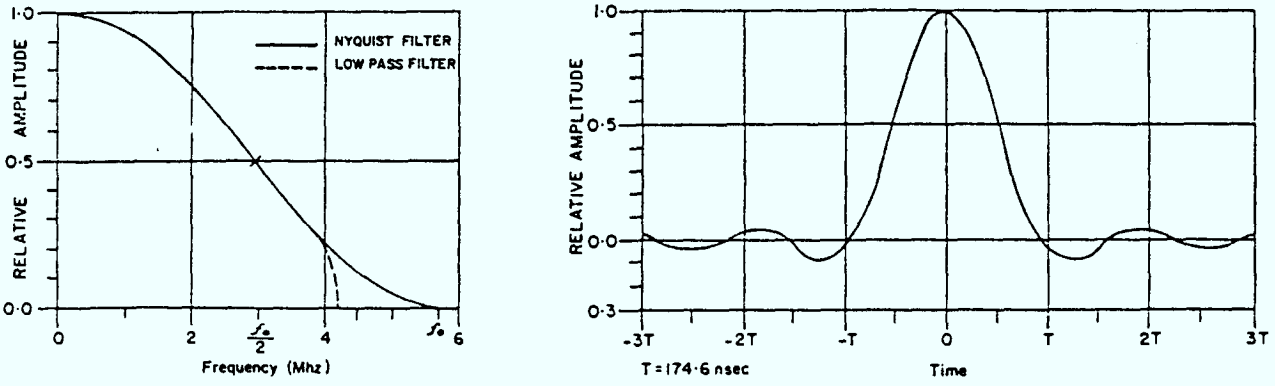
*Note: The adoption of the proposed bit rate of 5,727,272 $\pm$ 16 bits/sec will only be finalized following a period of adequate experimentation. Should it be determined that the proposed bit rate is unsatisfactory in providing adequate service, an alternate bit rate would be considered. This action would therefore necessitate the revision of related parameters as presented in this provisional document.

1.3 Data Encoding

The amplitude modulated data is non-return to zero (NRZ) binary encoded. Other encoding schemes are for further study.

1.4 Data Pulse Shape

The Spectrum of the NRZ data after shaping and Impulse Response of the Nyquist filter have the following characteristics:



BITRATE = 5·727272 MBITS/S
ROLLOFF = 100%

Figure 2

The data spectrum of the controlled raised cosine filter is described as follows:

$$H(f)=1 \quad \text{for } f<(1-R)\,f_o/2$$

$$H(f)=\frac{1}{2}\left[1-\sin\left(\frac{\pi}{2}\,\frac{f-f_o/2}{R\,f_o/2}\right)\right] \quad \text{for } |f-f_o/2|\leq R\,f_o/2$$

$$H(f)=0 \quad \text{for } f>(1+R)\,f_o/2$$

The impulse response of the Nyquist filter is as follows:

$$h(t)=\frac{\sin \pi f_o t}{\pi t}\,\frac{\cos \pi f_o t R}{1-(2f_o tR)^2}$$

where f = frequency in MHz

t = time in nanoseconds

f_o = bit rate in Mbits/sec

$f_o/2$ = center position of roll-off in MHz

R = roll-off = (i.e. 100 %)

The spectral content of the shaped data is determined by a Nyquist filter with 100% roll-off, followed by a phase corrected low-pass filter with a cut-off of 4.2 MHz.

1.5 Data Timing

The half-amplitude point of the first data bit, as shown in figure 3, is positioned 10.5 ± 0.34 μsec from the half-amplitude point of the leading edge of the horizontal sync pulse.

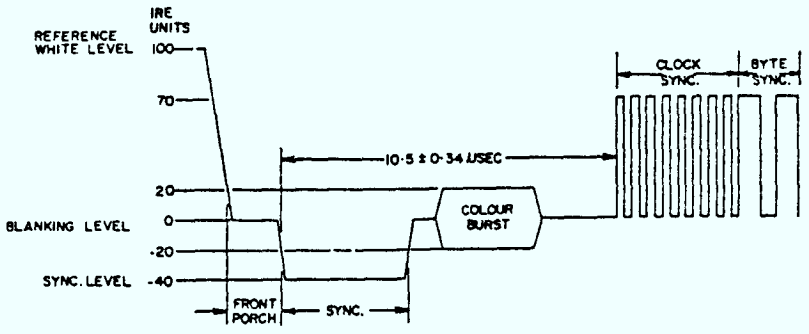


Figure 3

1.6 Data Amplitude Modulation

Data amplitude modulation parameters have been nominally established as 2 ± 2 IRE units for a logical '0' and 70 ± 2 IRE units for a logical '1', with provisions for positive and negative overshoots of 3 IRE units each. These nominal specifications permit a maximum peak-to-peak data amplitude of 78 IRE units.

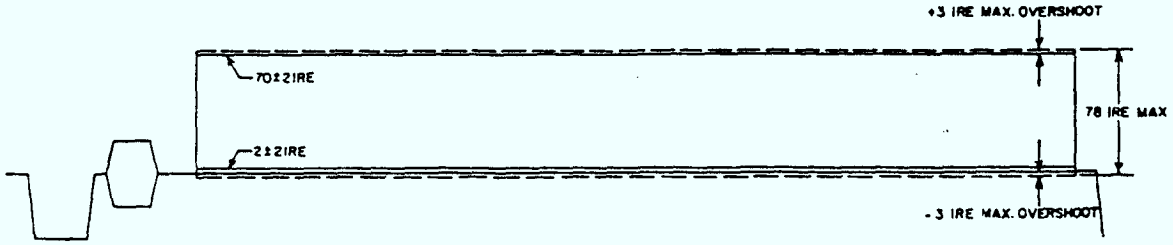


Figure 4

2.0 Data Line

The Data Line consists of a string of 288 bits (impulses) having the following format:

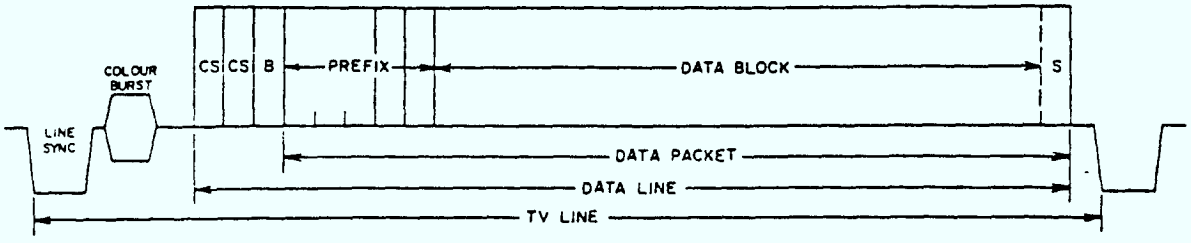


Figure 5

2.1 Bit Synchronization

The first 16 bits of the Data Line constitute the bit synchronization sequence (CS, CS) consisting of alternating 1's and 0's, leading in with '1'. This sequence provides the decoder with a reference burst in order to synchronize the decoder's data clock and initialize the data slicer.

2.2 Byte Synchronization

The next 8 bits of the Data Line constitute the Framing Code (B) and serves to define the byte structure. This code has been chosen to minimize the potential of incorrect synchronization even in the presence of a single bit error in the Framing Code. The least significant bit (b1) is always transmitted first.

The sequence identified for Television Broadcast Videotex is:

1	1	1	0	0	1	1	1	$\equiv 231_{10}$
b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1	

Two other compatible Framing Codes reserved for future use are:

1	0	0	0	0	1	0	0	$\equiv 132_{10}$
0	0	1	0	1	1	0	1	$\equiv 45_{10}$
b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1	

3.0 Data Packet

The Data Packet is an identifiable package transmitted after the Bit and Byte Synchronization codes and is made up of; a Prefix, a Data Block and an optional Suffix.

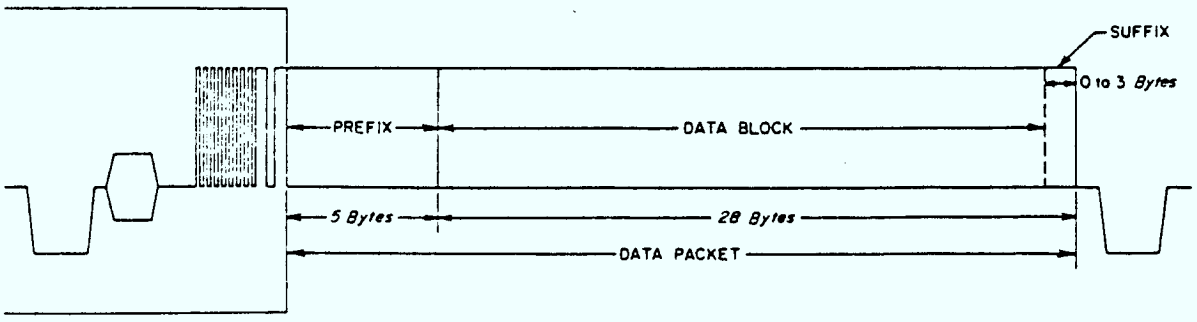


Figure 6

A Data Packet is contained within a single Data Line. Extended Packets, encompassing more than one Data Line, are for further study.

3.1 Prefix

The Prefix consists of 5 Hamming*-encoded bytes, the first 3 of which are Packet Address bytes followed by a Continuity Index byte (CI) and a Packet Structure byte (PS).

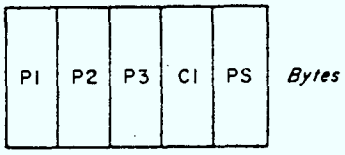


Figure 7

3.1.1 Packet Address

Three Hamming-encoded bytes (P1,P2,P3) constitute the Packet Address, yielding 2^{12} (4096) possible data channels which may be time-division multiplexed onto a single television channel. Channel numbers correspond directly to Decimal Binary Coding permitting user selection of the first 1000 channels using a simple decimal keypad. The remaining channels are reserved for future use.

The scheme allows for interleaving of combinations of up to four (4) consecutive data lines, with one Packet Address, with Data Lines of other Packet Addresses and requires a minimum time separation of 4 milliseconds for both VBI and full-field operation.

3.1.2 Continuity Index

The Continuity Index consists of one Hamming-protected byte (CI) used to detect the loss of a Data Packet due to transmission errors. The Continuity Index sequences from 0 to 15 and is incremented by 1 for each transmission of a Data Packet within a Data Channel.

* In this document, an (8,4) Hamming data protection scheme is used, thus permitting single bit error correction, and even multiple bit error detection. In any Hamming-protected byte, bits b1, b3, b5 and b7 provide error protection and bits b2, b4, b6 and b8 present the information to be conveyed. Appendix B provides the Hamming Code Table.

3.1.3 Packet Structure

The Packet Structure byte consists of a Hamming-protected byte (PS) specifying the nature of the transmitted Data Packet as follows:

Information Bits				Assigned Significance
b8	b6	b4	b2	
			0	Standard Packet
			1	Synchronizing Packet
		0		Packet full of information bytes
		1		Packet not full* of information bytes
0	0			no Suffix
0	1			1 byte Suffix
1	0			2 byte Suffix
1	1			3 byte Suffix

* Bit b4 = 1 (Packet not full of information bytes) is not used to signal the end of the Data Group.

3.2 Data Block

The Data Block, which follows the Prefix, contains the Control Data (Header) and/or Presentation Data delivered to a terminal.

The Data Block may be full, or not full of information bytes, as indicated by bit b4 of the Packet Structure byte (PS).

If the Data Block is designated 'Not Full', the non-information bytes may be assigned 'don't care' values; however odd parity must be maintained to ensure correct interpretation when a one-byte Suffix is employed.

The Data Block is reduced by the number of Suffix bytes as specified by bits b8,b6 of the Packet Structure byte:

no suffix byte; the Data Block contains 28 bytes,
1 suffix byte; the Data Block contains 27 bytes,
2 suffix bytes; the Data Block contains 26 bytes,
3 suffix bytes; the Data Block contains 25 bytes.

3.2.1 Control Data (Header)

The Header consists of information bytes used in instructing the terminal in processing Presentation Data.

3.2.2 Presentation Data

The Presentation Data is comprised of the data to be processed by the user terminal.

3.3 Suffix

An optional Suffix may follow the Data Block as determined by bits b8,b6 of the Packet Structure byte. This Suffix may contain one or more redundancy bytes which may be used by the data receiver for either error detection or correction in the Data Block.

A single byte Suffix is comprised of a longitudinal odd parity check of all bytes in the Data Block, which themselves contain an odd parity check in the most significant bit (b8) of each byte. This information forms the basis of the product code used to correct any single bit error and detect all double errors in each byte.

Other error detection/correction schemes for double or triple byte Suffixes are reserved for future assignments.

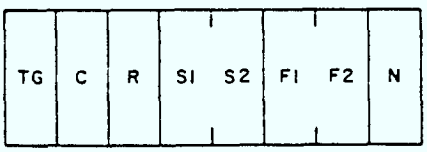
4.0 Data Group

Data Blocks associated with information from the same source (i.e. common Packet Address bytes: P1, P2, P3) may be sequentially organized into identifiable groups known as Data Groups. In broadcast videotex, these Data Groups are limited in length to a maximum of two (2) kilobytes

The beginning of a Data Group is identified by bit b2=1 of the Packet Structure byte (PS). Each Data Group is composed of a Data Group Header followed by a Record.

4.1 Data Group Header

The Data Group Header follows the Prefix and is composed of the following Hamming-protected bytes:



4.1.1 Data Group Type (TG)

This byte specifies the applicable class of processing to be applied by the data receiver.

TG = 0 designates the method of transmission used for broadcast videotex service. All other Type assignments are reserved for future use.

4.1.2 Data Group Continuity (C)

This byte is used to verify the sequence of Data Groups of a common Type (TG) in a particular Data Channel (P1, P2, P3). This continuity counter sequences from 0 to 15 and is incremented by 1 for each subsequent transmission of a Data Group of this nature.

4.1.3 Data Group Repetition (R)

This byte specifies the number of retransmissions of a given Data Group. This byte is restricted to the range 0-15.

4.1.4 Data Group Size (S1, S2)

Bytes S1, S2 specify the number of Data Blocks in a Data Group. These bytes indicate values ranging from 0 to 255.

4.1.5 Last Block Size (F1, F2)

These information bytes indicate the number of bytes in the last Data Block of a Data Group

4.1.6 Data Group Routing (N)

A single byte, under broadcaster control, which identifies the routing of a Data Group through a broadcast network. Values in the range 0-15 may be assigned to this byte to control such functions as passage through time zone delay centers. This byte is not intended for use by the decoder.

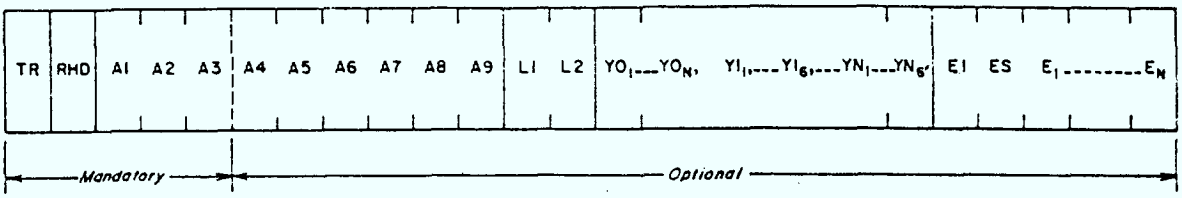
5.0 Record

The Record is essentially the same as the Data Group stripped off the Data Group Header and contains information pertinent to broadcast videotex service. Each Record is comprised of a series of up to 256 sequentially-numbered Data Blocks. The format consists of a Record Header, containing Record protocol information, followed by Presentation Data.

5.1 Record Header

The Record Header immediately follows the Data Group Header and is of variable length as determined by the Record Header Designator (RHD) and addition of optional subgroups. (Refer to Appendix C)

All Record Header bytes are Hamming-protected and are organized as follows:



5.1.1 Record Type (TR)

This byte characterizes the type of information transmitted within a Record and its associated structure. Values have been defined as follows:

Decimal Value	Record Type
0	Cyclic Broadcast (e.g: Broadcast videotex)
1	Non-Cyclic Broadcast (e.g: Captioning)
2 - 15	Reserved for Future Use

5.1.2 Record Header Designator (RHD)

The Record Header Designator byte (RHD) is comprised of 4 flags which, when set, indicate the presence of one or more following subgroups which are concatenated in the following order:

b2 : Address Extension
b4 : Record Linking
b6 : Complementary Record Classification
b8 : Header Extension Field

The status of each of the above subgroups is indicated by a single bit, where a binary '1' indicates the presence of the subgroup, and a binary '0' indicates its absence.

5.1.3 Address Bytes (A1, A2, A3, A4, A5, A6, A7, A8, A9)

Address bytes A1, A2, A3 represent a Record or Page number, and are considered mandatory. Address bytes A4, A5, A6, A7, A8, A9 are optional extension bytes which are transmitted when bit b2 of the Record Header Designator is set to '1'. In this case, bytes A1-A7 are used to represent a Document number and bytes A8, A9 represent the number of a Page within a Document.

5.1.4 Record Linking (L1, L2)

The presence of the Record Linking bytes L1, L2 is indicated by bit b4 = 1 in the Record Header Designator. These bytes immediately follow the Address bytes. These bytes are used to link together Records identified by the same address and associated with the same message. The decoder must capture linked Records in sequential order.

Bits b6, b4 and b2 of byte L1 and b8, b6, b4 and b2 of byte L2 are used to indicate the order of the linked Records. Bit b8 of L1 is used to indicate the existence of additional linked Records (b8 = 1) or the last linked Record in the sequence (b8 = 0).

5.1.5 Complementary Classification Sequence (YO_1 - YO_N, $Y1_1$ -$Y1_6$ ...YN_1 -YN_6)

The presence of the Complementary Classification Sequence subgroup is indicated by bit b6 = 1 in the Record Header Designator. This subgroup follows the Address and Link bytes, if present, or the Record Header Designator for the case b2 = b4 = 0.

This subgroup has a variable format and is divided into two sections: refer to Appendix D.

- Designation bytes (YO_1 - YO_N)

- Complementary Classification bytes ($Y1_1$-$Y1_6$,...YN_1-YN_6)

Bit b8 of any YO byte indicates the status of any additional Designation bytes, where a binary '1' indicates the presence of an additional YO byte, and a binary '0' indicates the end of a YO sequence. For example; if bit b8 of YO_1 is equal to '1' an additional YO byte designated YO_2 exists. This pattern also applies to YO_2 which in turn may indicate a YO_3 byte, etc. The YO sequence is only terminated when bit b8 of the last YO byte is equal to '0'. This scheme is illustrated in Appendix D.

The remaining usable bits (b6, b4, b2) of any YO byte point to a group of Classification bytes; refer to Appendix E. Each bit of a YO Designation byte is associated with a Classification field, either specifying a function by default (b_x = 0) or calling a function (b_x = 1) and thus specifying it with a two byte sequence.

When YO has bits b8 = b6 = b4 = b2 = 0, it is the end of the Record Header and all Record specification functions are specified by default.

5.1.6 Header Extension Field (EI, ES)

Any number of variable-length Header Extension Fields may be designated by b8 = 1 of the Record Header Designator (RHD) byte (see Appendix C). These fields directly follow the Address, Link and Complementary Classification bytes, if present, or the Record Header Designator for the case b6 = b4 = b2 = 0.

The first byte of the Header Extension Field is an extension field introducer byte (EI), with bit designations as follows:

b8 = 1 indicates further Header Extension Field(s) to follow (E_1 ... E_N)

= 0 indicates last Extension Field

b6,b4,b2 indicate Header Extension Code assignments whose values are given in Appendix E.

The second byte (ES) of the Header Extension Field indicates the number of bytes of Extension Field information in the current Extension Field

5.2 Segmentation

The Data Record may be segmented by the use of a "Segmentation Identification Sequence" which consists of a three byte sequence; the first byte of which is a specific code corresponding to the 'US' (unit separator) code taken from the C0 code table at the presentation level. The remaining two bytes are designated for use by the presentation level and to indicate the relationship of segments.

6.0 Repertoire

The presentation coding scheme for text conforming to international recommendations from the C.C.I.T.T. and C.C.I.R. permits the coding of a large repertoire of characters and special symbols covering all Latin based alphabets. The languages of primary interest in North America are English, French and Spanish. The character repertoire implemented in a particular terminal should contain the appropriate accented characters for these languages, as well as all of the characters in the CSA basic character set Z243.41 set 1 (known as ASCII in the USA). To fully present the French (for Canada) and the Spanish languages requires that all appropriate accents be displayed. Technical compatibility requires that all terminals correctly interpret all coded accents and special characters and provide at least the appropriate defaults for these languages. In addition, the following special symbols should be provided:
<< >> ¿ ¡ ♂

6.1 Presentation Coding

The presentation coding scheme for Broadcast Videotex services is that adopted by the Canadian Standards Association (CSA). This coding scheme is based on the alphageometric coding scheme described in C.C.I.T.T. Recommendation S.100 and the C.V.C.C. Videotex Field Trial Presentation Layer Standard No. 699 which are reflected in the proposed North American Standard Presentation level protocol.

6.2 Display Format

The default Display Format is defined as 20 rows of 40 alphanumeric characters per row within the S.M.P.T.E.* Safe Title Area of the television screen. Other display formats are also permitted.

* Society of Motion Picture and Television Engineers Recommended Practice RP 27.3

6.3 Display Attributes

C.V.C.C. Videotex Field Trial Presentation Layer Standard No. 699 and C.C.I.T.T. Recommendation F.300 present the various degrees of implementation of the display attributes for videotex systems.

Issued under the Authority of
the Minister of Communications

for Dr. John deMercado
Director General
Telecommunication Regulatory
Service

APPENDIX A

The parameters outlined in BS-14 have been selected intending to comply with the following established national and international standards and the recognized principles and requirements contained therein.

International Telegraph and Telephone Consultative Committee (C.C.I.T.T.):

- Recommendation S.100 "International Information Exchange for Interactive Videotex"

- Recommendation F.300 "Videotex Service"

International Radio Consultative Committee (C.C.I.R.) Report 624-1 Characteristics of Television Systems (System M/NTSC)

International Organization for Standardization (I.S.O.):

- Draft International Standard ISO/DIS 2022 "Code Extension Techniques for Use with the ISO 7-bit Coded Character Set"

- Draft International Proposal ISO/DIP 6937 "Coded Character Set for Text Communication"

- ISO/TC 97/SC 16 N 537 "Basic Specifications of the Reference Model of Open System Interconnection"

Canadian Videotex Consultative Committee (C.V.C.C.) Videotex Field Trial Presentation Layer Standard (Communications Research Centre Technical Note No. 699)

Videotex Standard: Presentation Level Protocol, May 1981, Bell System

Government of Canada Department of Communications:

- Radio Standards Specification, RSS 151: "Low Power TV Broadcasting Transmitters Operating in the 54-88 MHz, 174-216 MHz and 470-890 MHz Bands"

- Radio Standards Specification, RSS 154: "Television Broadcasting Transmitters Operating in the 54-88 MHz, 174-216 MHz and 470-806 MHz Frequency Bands"

- Broadcast Specification, BS 13: "Ancillary Signals in the Vertical Blanking Interval for Television Broadcasting".

HAMMING CODE TABLE

INFORMATION BITS

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

PROTECTION BITS

where

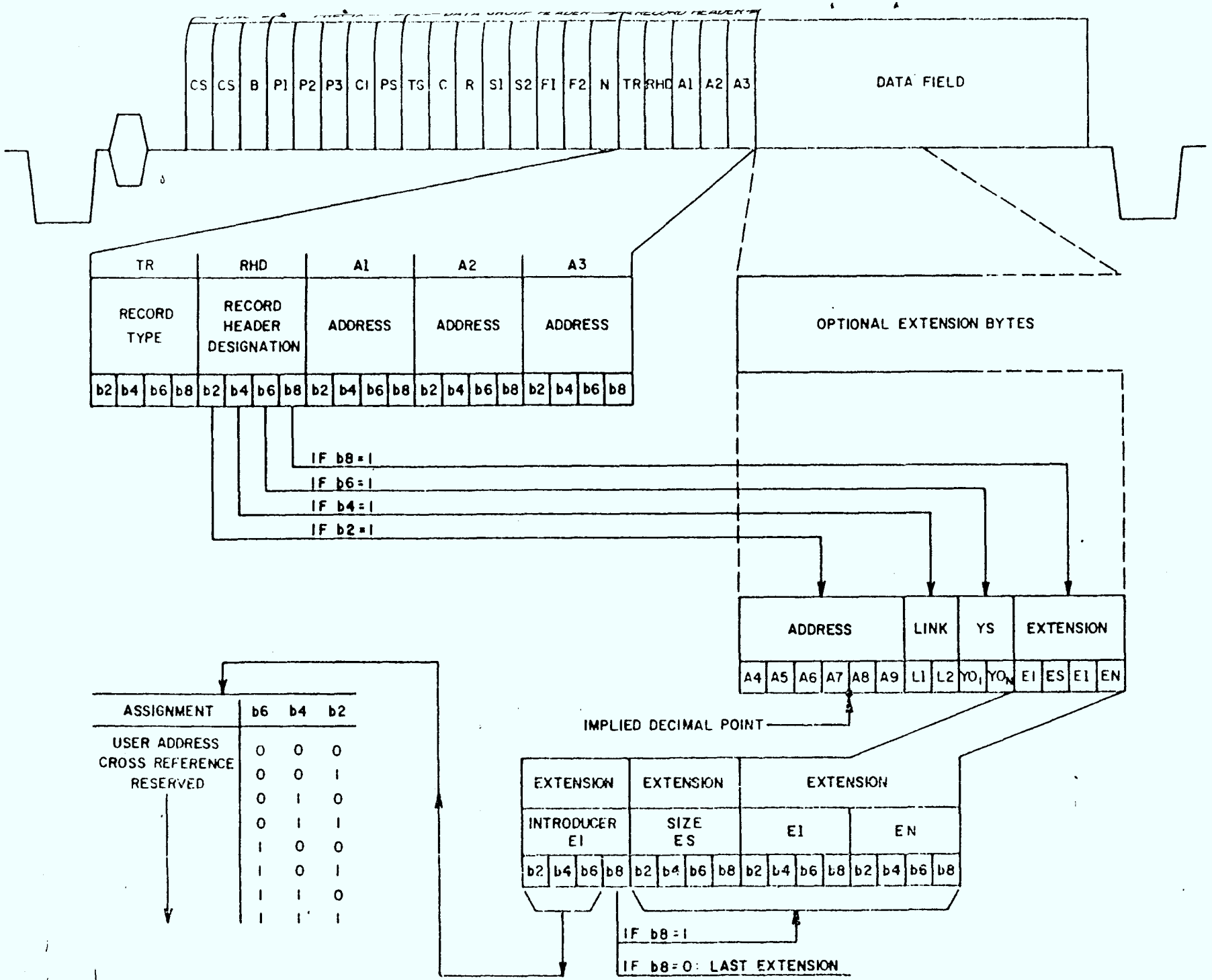
$b7 = b8 \oplus b6 \oplus b4$
$b5 = b6 \oplus b4 \oplus \overline{b2}$
$b3 = b4 \oplus \overline{b2} \oplus b8$
$b1 = \overline{b2} \oplus b8 \oplus b6$

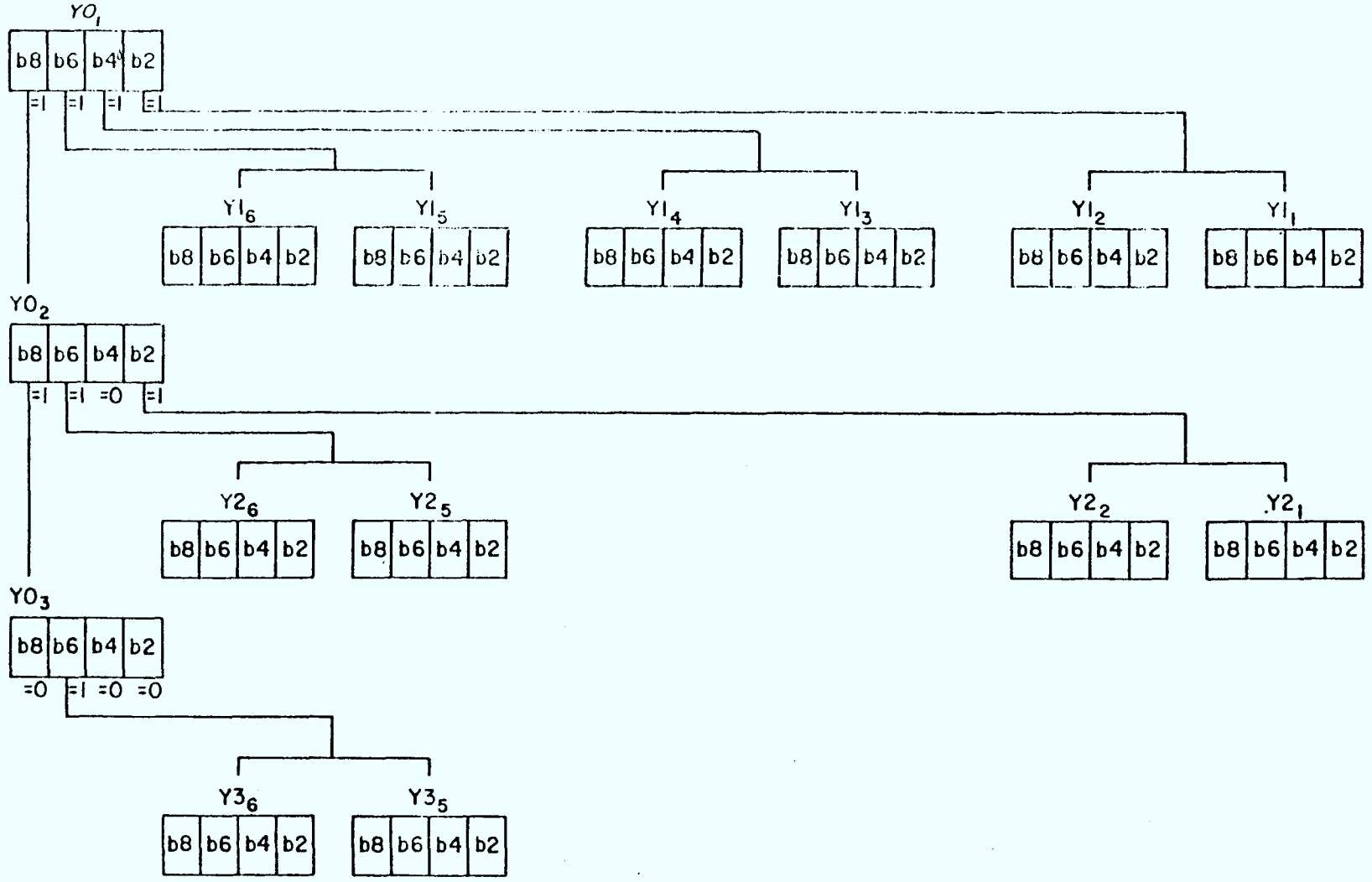
DECODING

X1	X2	X3	X4	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
$X1 \cdot X2 \cdot X3 = 0$			1	MULTIPLE ERRORS	REJECTED

where

$X1 = b8 \oplus b6 \oplus b2 \oplus b1$
$X2 = b8 \oplus b4 \oplus b3 \oplus b2$
$X3 = b6 \oplus b5 \oplus b4 \oplus b2$
$X4 = b8 \oplus b7 \oplus b6 \oplus b5 \oplus b4 \oplus b3 \oplus b2 \oplus b1$


CS CS B P1 P2 P3 CI PS TS C R S1 S2 F1 F2 N TR RHD A1 A2 A3
DATA FIELD
TR
RHD
A1
A2
A3
RECORD TYPE
RECORD HEADER DESIGNATION
ADDRESS
ADDRESS
ADDRESS
b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8
OPTIONAL EXTENSION BYTES
IF b8 = 1
IF b6 = 1
IF b4 = 1
IF b2 = 1
ADDRESS
LINK
YS
EXTENSION
A4 A5 A6 A7 A8 A9 L1 L2 YO1 YON E1 ES E1 EN
IMPLIED DECIMAL POINT
ASSIGNMENT
b6 b4 b2
USER ADDRESS
CROSS REFERENCE
RESERVED
0 0 0
0 0 1
0 1 0
0 1 1
1 0 0
1 0 1
1 1 0
1 1 1
EXTENSION
EXTENSION
EXTENSION
INTRODUCER E1
SIZE ES
E1
EN
b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8 b2 b4 b6 b8
IF b8 = 1
IF b8 = 0: LAST EXTENSION



Order of transmission: YO_1 YI_1 YI_2 YI_3 YI_4 YI_5 YI_6 YO_2 $Y2_1$ $Y2_2$ $Y2_5$ $Y2_6$ YO_3 $Y3_5$ $Y3_6$

APPENDIX D

APPENDIX E

INTERPRETATION OF THE COMPLEMENTARY CLASSIFICATION BYTES ($Y1_1$ - $Y1_6$, ... YN_1 - YN_6) AND HEADER EXTENSION FIELD BYTE (EI).

This Appendix describes the recommended interpretation of the broadcast videotex standards. The specific assignments are chosen as working designations which will be adhered to indefinitely unless operating experience dictates otherwise.

Interpretation of Classification Bytes Associated with Byte $Y0_1$

Byte $Y1_1$

b8,b6 Error Protection Levels: these bits are used to indicate the type of presentation level or error protection.

b8	b6	Four levels of message coding
0	0	Level 0 or no error protection being used
0	1	Level 1 or error protection being used
1	0	Reserved for future extension
1	1	Reserved for future extension

b4 = 1 Index message: This bit indicates that the message is an index message. Different index messages are possible which are numbered by byte $Y1_2$.

b2 = 1 Sub-index: This bit indicates that the message is a submessage. Different sub-indexes are possible which are numbered by byte $Y1_2$.

Byte $Y1_2$

This byte is used to number index messages or sub-index messages depending on the status of the bits in $Y1_1$.

Byte $Y1_3$

b8 = 1 Boxed message: This bit indicates that the message is related to the television program carrying the data signal. This bit indicates that the message is program related, and is to be displayed over the television program video with boxing. This may reset some options in the presentation layer to alternate values.

b6 = 1 Delayed message: The interpretation of the message and its presentation are delayed until the user manually requires its interpretation or until a specific 'reveal' message is sent. This bit indicates that the message should not be revealed until a 'reveal' message is sent, or until the user manually reveals the message.

b4,b2 Partial message: This indicates that the message contained in the Record cannot be interpreted alone. The terminal must first select a starting message which the partial message complements.

b4	b2	
0	0	Not partial message
0	1	First partial message
1	0	Last partial message
1	1	Intermediate partial message

Byte $Y1_4$

b8 = 1 Document Chain: This bit identifies a page which is part of a multi-page Document (not last).

b6 = 1 Cyclic Marker: This bit identifies the first occurrence of any channel number in a cyclic information retrieval data base. This may be used by a decoder to abort a search for a requested page which is not present in the cycle.

b4 = 1 Auto Read: This bit indicates that a "Target Page" whose number is contained in the Extension Field which has its Header Extension code equal to '1', is to be captured immediately following the current one. This, however, requires user input (depression of 'proceed' key or equivalent) for display.

b2 = 1 Complementary Information: This bit indicates that complementary information is needed to properly interpret this message. The complementary information is to be found immediately following on the same Data Channel.

Byte $Y1_5$

b8 = 1 Program related message: This message is related to the television program carrying the data signal. When this bit is raised and the decoder is in the television mode, the message should be displayed over the television program.

b6 = 1 Alarm message: This bit indicates that the associated message has a priority function which can be interpreted by the decoder to override all other display functions.

b4 = 1 Update message: This is a flag indicating that the message contained in the Record replaces a previous message with the same address.

b2 = 1 New: This bit is used as an indicator to identify material not previously included in the information retrieval index. This permits decoders to be programmed to capture all new pages, or alternatively only those within a specific channel.

Byte $Y1_6$

Version: This byte, with four usage bits, is used to specify a version number of an information retrieval page.

Interpretation of Classification Bytes Associated with Byte YO_2

Bytes $Y2_1$

Terminal: This byte, with four usage bits, is used to specify terminal functions.

Bytes $Y2_2$ - $Y2_6$ ... YN_1 - YN_6

These bytes are not defined in this specification and are reserved for future extension.

Interpretation of Header Extension Field Byte (EI)

The first byte of the Header Extension Field is an extension field introducer byte (EI), with bit designations as follows:

b8 = 0 indicates last Extension Field

= 1 indicates further Header Extension Field(s) to follow (E_1 ... E_N)

b6,b4,b2 indicate Header Extension Code assignments as follows:

= 0 reserved

= 1 cross reference;
identifies a Record to be
captured immediately following the current one.

= 2-7 reserved for future extension.

The second byte (ES) of the Header Extension Field indicates the number of bytes of Extension Field information in the current Extension Field.

ANNEX E

SCMO Technique

E.1 Introduction

E.1.1 Transmitted signal (see Fig. E.1, a)

At the broadcast studio, two microphones generate a left-hand audio signal L(t) and a right-hand signal R(t). These signals are added and subtracted to generate L(t)+R(t) and L(t)-R(t). These sum and difference signals are each bandlimited to 15 KHz by filters. An oscillator makes available a sinusoidal waveform referred to as a pilot carrier at a frequency f_p=19 KHz. The pilot carrier is applied to a frequency doubler which generates a sinusoidal subcarrier at the frequency $f_{sc}=2xf_p$=38 KHz.

The subcarrier and the difference signal are applied to a balanced modulator, the output of which is $[L(t)-R(t)]\cos 2\pi f_{sc}t$.

By combining the modulator output, the sum signal, and the oscillator output, a composite signal M(t) is formed, where:

$$M(t)=[L(t)+R(t)] + [L(t)-R(t)]\cos 2\pi f_{sc}t + K\cos 2\pi f_p t$$

K is a constant which determines the level of the pilot carrier in comparison with the other components of the composite signal. The sum signal L(t)+R(t) occupies the frequency range between 0 and 15 KHz. The balanced modulator output, which is the DSB-SC signal $[L(t)-R(t)]\cos 2\pi f_{sc}t$ has a lower sideband which extends from 23 KHz to 38 KHz, and an upper sideband which extends from 38 KHz to 53 KHz. The pilot carrier at 19 KHz is present, as shown in Fig. E.1 below. This composite-signal M(t) frequency modulates a carrier, and this modulated carrier is delivered to a transmitting antenna.

E.1.2 Received signal (see Fig. E.1, b)

At a stereo receiver, the composite signal M(t) is recovered from the frequency-modulated carrier. The pilot carrier regenerates the subcarrier. The availability of this subcarrier permits synchronous demodulation of the DSB-SC waveform. The output of the synchronous demodulator is proportional to the difference waveform L(t)-R(t), while the output of the baseband filter is proportional to L(t)+R(t). The transmission of the pilot carrier allows one to regenerate, at the receiver, the required subcarrier waveform. Such a subcarrier is not separated by any appreciable frequency interval from the spectral components of its accompanying sidebands. Hence, to extract such a subcarrier would require a very narrow and sharply turned filter. The pilot carrier occupies an isolated place in the spectrum, there being no other spectral components present over a range of 4 kHz on either side.

Now having available the sum signal L(t) + R(t), and the difference signal L(t) - R(t), then the individual signals L(t) and R(t) respectively, are recovered by addition and substraction.

E.1.3 Effect of the Pilot Carrier (see Fig. E.2)

Unlike the DSB-SC signal, the pilot carrier, when added to the other components of the composite modulating signal, does produce an increase in peak excursion. Hence the addition of the pilot carrier calls for a reduction in the sound signal modulation level.

(a) a high-level pilot carrier eases the burden of extracting the pilot carrier at the receiver.

(b) a low-level pilot carrier allows greater sound signal modulation.

The FCC standards call for a pilot carrier of such a level that the peak sound modulation amplitude has to be reduced to about 90% of what would be allowed in the absence of a carrier. This 10% reduction corresponds to a loss in signal level of less than 1 dB.

E.2 SCA technique by National Public Radio (NPR)

In 1981 a series of laboratory and field tests were conducted to evaluate several FM/SCA (subsidiary communication authorization) frequencies . It is believed that one of these frequencies would permit the addition of a second SCA service on a stereo FM station, or would reduce potential interference to the station's stereo service. The tests were designed to try these assertions and document their performance relative to the 67 KHz subcarrier.

Introduction of new signals into the modulating baseband of an FM station requires attention to its possible interactions with existing baseband signals, as well as its chosen performance characteristics. The baseband spectrum of the combined stereo and SCA signals 67 KHz and 92 KHz is shown in Fig. E.3 below.

Fig. E.3 shows the modulation spectrum of an FM-stereo transmitter. The sum (L+R) of the two audio channels occupies spectrum space from 30 Hz to 15 KHz (the highest audio frequency permitted on FM). The stereo pilot signal is found at 19 KHz, and the sidebands of the supressed carrier 38 KHz AM subcarrier signal containing the difference (L-R stereo information) occupy the space from 23 KHz to 53 KHz. The first practical subcarrier will have a frequency of around 57 KHz. Stations transmitting in stereo and also providing an SCA (or SCMO) service generally select 67 KHz as their subcarrier frequency. Another subcarrier frequency 92 KHz has been introduced by NPR, Washington, D.C., as

the best choice for a new SCA service relative to the 67 KHz subcarrier.

The basic findings are that 92 KHz is the best choice for a new SCA service; that it's performance is similar to 67 KHz SCA; that it produces lower interference levels to main channel stereo service than 67 KHz, and that it can be successfully operated in addition to stereo and existing SCA services.

In Fig. E.3, the modulating frequency is shown on the horizontal axis; the modulation level as a percentage of 75 kHz peak deviation is shown on the vertical axis. In the main channel (direct modulation by the L+R signal), the maximum deviation may not exceed 80 percent of the total deviation, assuming identical amplitude and phase on the L and R signals. Otherwise, the modulating signal is divided between the L+R and L-R channels. The Pilot signal at 19 kHz deviates the main channel within the limits of 8 to 10 percent. The SCA subcarrier at 67 kHz contributes up to 10 percent of the total modulation. A nominal value of 9 percent has been shown. The arithmetic sum of the three deviations approaches 100 percent which is $\pm$75 kHz deviation.

The 92 kHz subcarrier used in the field tests is shown in Figure E.3. This results in a peak deviation of 110 percent (40+10+40+10+10=110).

Adding the test subcarrier to the existing baseband signals had the advantages of comparing performance of both subcarriers with "normal" modulation (up to 10 percent injection for each) and avoided problems of shifting the main channel modulation up or down while maintaining stereo Pilot injection. It also created a slightly greater chance for interference to stereo listeners, which would make identification easier.

E.3.1 Conclusion

Several conclusions may be drawn from the test results which may be useful to stations operating or considering new SCA services:

- The principal source of SCA/Stereo interference in older FM receivers is caused by the beat-note between two times the 38 kHz subcarrier and the instantaneous SCA frequency, and occurs only within the stereo decoder:

- Modern (less than 10 years old) FM receivers inherently have low amounts of SCA/Stereo interference at all subcarrier frequencies between 53 and 99 kHz, due to the use of Phase Locked Loop stereo decoders and improved intermodulation distortion performance;

- Non-linearities in the RF domain (such as inadequate exciter, transmitter and antenna bandwidth or symmetry,

standing waves in transmission lines, multipath reception, receiver misalignment and user mistuning) contribute to second order IM distortion of the baseband signals, the products of which may cause small amounts of audible beat-notes from the stereo decoder; main-to-SCA crosstalk will also increase;

- FM modulation monitors approved for station use with a baseband of 75 kHz may be inaccurate for measuring higher subcarriers (amplitude rolloffs of up to 10% at 100 kHz were noticed on a sampling of current units);

- A new SCA subcarrier should be placed between 92 and 95 kHz because it will not produce noticeable beat-notes in either old or new stereo decoders;

- 92 kHz is preferred as a new subcarrier frequency because it allows a higher modulation index (peak deviation/audio bandwidth) than possible at 95 kHz, which makes overall performance similar to that at 67 kHz;

- There is sufficient bandwidth between 53 and 99 kHz to permit the simultaneous operation of two SCA subcarriers;

- Operation of SCA subcarriers at 67 and 95 kHz created no complaints or comments of interference from WETA-FM staff or listeners during the two month duration of the tests, despite many programs of wide dynamic range on the main channel.

E.4 Programme Identification (PI) system by Sweden

A Programme Idintification (PI) system has been developed by the Swedish Telecommunications administration for transmission of new services in addition to the normal stereophonic sound broadcasting via FM transmitters.

E.4.1 Characteristics of the PI system

- the PI system makes it possible to transmit supplementary information from FM transmitters.

- The PI syatem can be used for various applications simultaneously, e.g., programme identification, paging, and transmission of text.

- the capacity of the PI system makes it possible to introduce new applications in the future.

- the PI system does not require better reception conditions than the main programme.

- The PI system can be utilized in many transmitter networks simultaneously.

- The PI system can transmit information that is not related to the main programme material.

E.4.2 **Modulation method**

The information is binary coded and is made to phase modulate a square wave signal of 1187.5 Hz frequency (1/16 of the pilot tone frequency) so that a binary "one" causes a phase shift of 180 while a "zero" does not change the phase. The bit rate is 1187.5 bit/sec (i.e., one bit corresponds to one period of the square wave signal).

After filtering, the phase modulated signal is made to product modulate a 57 KHz sub-carrier, which should be locked to the pilot tone during stereophonic transmission according to the pilot tone system. The two sidebands generated in the modulation process are added to the multiplex stereophonic signal. Then this combined signal frequency modulates the main carrier of the FM transmitter, where the PI signal accounts for $\pm$3KHz of the total deviation (see Fig. E.4).

The system was designed with great care to avoid interference in already existing receivers.

E.4.3 **Error control**

There is a tendency for errors to appear in short bursts. Therefore a shortened cyclic block code is used in the PI system that corrects these error bursts. The information is arranged in blocks of 26 bits length, 10 of which are error control bits. This makes it possible to correct an error burst of up to 5 bits length in a block.

E.4.4. **Capacity**

The modulation rate is about 1200 baud. Some of this capacity has to be used for synchronization and error control purposes. The information rate would be in the order of 600 bit/sec.

E.4.5 **Organization of data**

A message is formed by one or more data blocks. The first block in a message starts with a synchronization word of 8 bits length. This word has also an identification function, which makes it possible for the receiver to identify and separate messages for different applications or signals from different countries. Messages can also be fitted with prefixes, which separates various message types for one and the same application. This makes the system very flexible and easy to match to future needs.

The above technique can be used for the transmission of paging signals over FM radio stations. Before retransmission, the

paging signal is corrected and regenerated at every transmitter station, which greatly reduces the risk of bit errors.

Each transmitter station has two alternative relay reception paths. In the event of a fault in a transmitter the paging signal is automatically switched to a fault-free reception path.

ANNEX F

F.1 CCIR and North America TV Standards

Two basic standards have been adopted for the international exchange of TV programs (see CCIR, Rec. 472-1 and 470-1, Ref.12 and 13):

	Standard in North America	CCIR standard
Lines/picture.....	525	625
Fields/s	60	50
Colour system.....	NTSC	PAL/SECAM
Video bandwidth.....	4.2 MHz	5/5.5/6 MHz
Colour subcarrier.....	3.58 MHz	4.43 MHz

Where:

NTSC is the National Television System Committee
PAL is the Phase Alternating Line
SECAM is the Sequentiel a memoire

The different video bandwidths of the CCIR standard are not so much due to field and line scanning procedures, but rather to the bandwidth available in the TV transmitter channels.

The main problem of standards conversion is the conversion of field frequency from 50 Hz to 60 Hz and vice versa. For this purpose, the picture information must be stored and then scanned at the new frequency. A digital standards converter converts the picture signal information from analog into digital form, reads it into a digital store, reads it out with a new scanning rate and reconverts it into analog form.

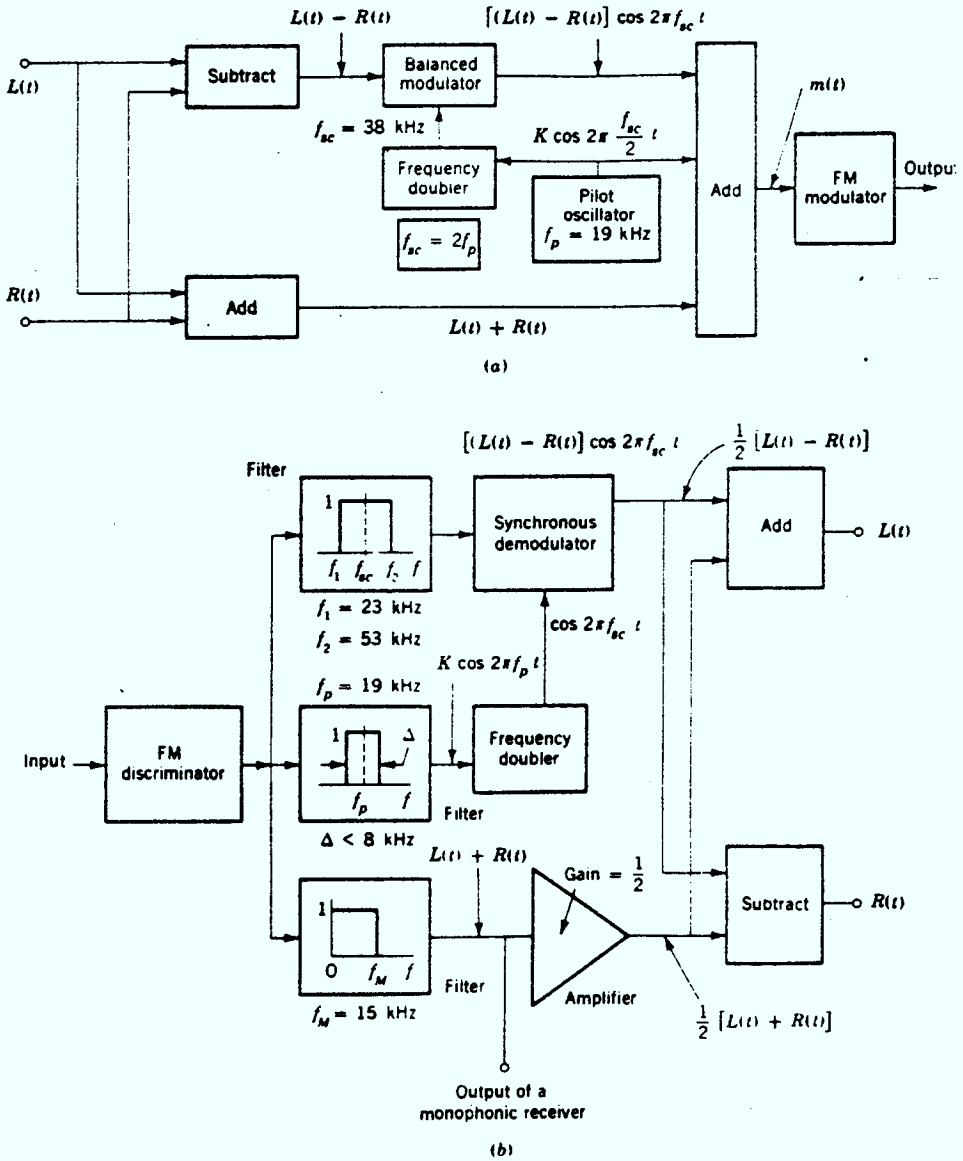


Fig. E-1 Stereophonic broadcasting system. (*a*) Transmitter. (*b*) Receiver.

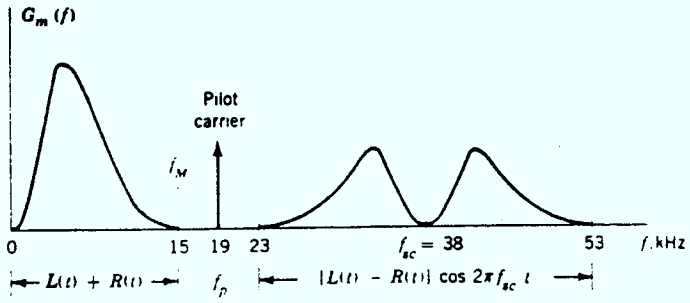
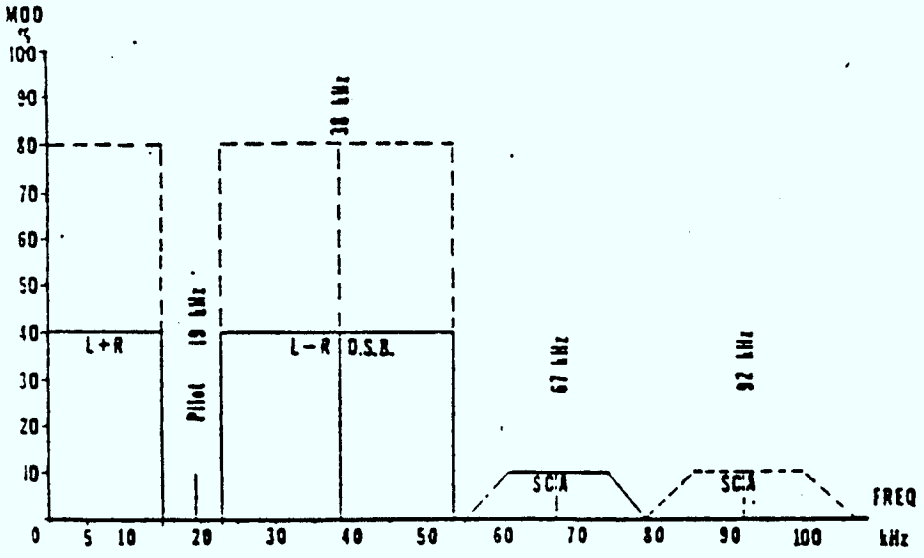


Fig. E-2 Spectral density of a typical composite stereo baseband signal.

Figure E-3

FM Stereo and Subcarrier Baseband



THE MULTIPLEX STEREOPHONIC SIGNAL WITH PI SIGNAL ADDED

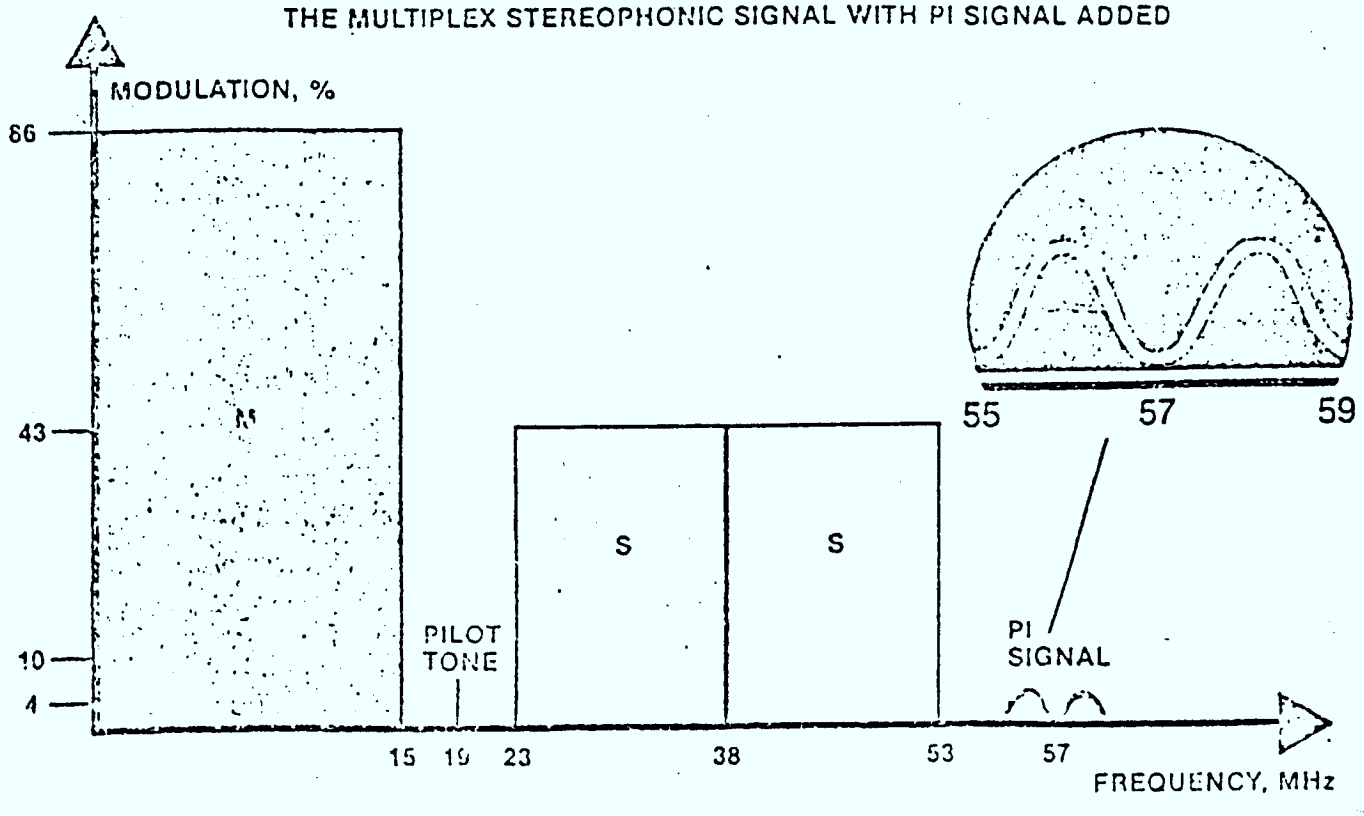


Fig. E.4