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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Advanced Television Systems and Their Impact on the Existing Television Broadcast Service Review of Technical and Operational Requirements: Part 73-E, Television Broadcast Stations Reevaluation of the UHF Television Channel and Distance Separation Requirements of Part 73 of the Commission's Rules	MM Docket No. 87-268

To: The Commission

COMMENTS OF ATSC

The United States Advanced Television Systems Committee ("ATSC") submits these Comments on the Tentative Decision and Further Notice of Inquiry ("Further Notice") released by the Commission on September 1, 1988. Our purpose is to bring to the attention of the Commission the ATSC's ongoing interest in coordinating and developing voluntary national technical standards for advanced television systems. We believe the ATSC can continue to provide valuable assistance to the Commission in assessing the issues raised and achieving the goals described in the Further Notice, and we continue to offer the ATSC as a resource for the Commission's use.

I. Background Of The ATSC

In late 1982, the Joint Committee on Inter-Society Coordination ("JCIC") established the ATSC to coordinate and develop voluntary national technical standards for advanced television systems. The JCIC members -- the Electronic Industries Association (EIA), the Institute of Electrical and Electronics Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Television Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE) -- are Charter Members of the ATSC.

ATSC's 57 member and observer organizations represent all facets of the United States television industry. The membership is composed of television networks, terrestrial and satellite broadcasters, cable television operators, consumer and professional television equipment manufacturers, educational institutions and, through the Motion Picture Association of America ("MPAA"), the major U.S. motion picture producers. A list of these organizations is attached as Exhibit 1.

The ATSC is also charged with making recommendations for presentation to the United States Department of State for its use in developing United States positions on various standards issues as those issues are considered from time to time by the International Radio Consultative Committee ("CCIR") and other international organizations.

The work of the ATSC is currently divided among two Technology Groups having terms of reference as follows:

> Distribution. The ATSC Technology Group on Distribution, with due regard for existing standards organizations and activities, will develop and recommend voluntary national technical standards for the distribution of television programs to the public using advanced television technology. Technologies considered may be improvements to current systems or entirely new systems that are compatible or incompatible with current systems. All forms of distribution systems may be considered, such as terrestrial broadcasting, cable systems, direct satellite broadcasting and pre-recorded media. With respect to distribution systems, sound, vision, display, conditional access, and data sub-systems may be considered.
>
> Production. The ATSC Technology Group on Production, with due regard for existing standards organizations and activities, will develop and recommend voluntary national technical standards for production of television programs using advanced television technology. With respect to production systems, sound, vision, and display sub-systems may be considered.

The ATSC was previously organized with three Technology Groups, one each dealing with Improved NTSC, Enhanced 525-Line Systems, and High Definition Television (HDTV). Recognizing that advanced television systems do not divide neatly into the three separate technologies, in September 1988 the ATSC changed the terms of reference and names of its Technology Groups.

II. ATSC Activities To Date

During 1988 the Technology Group on Improved NTSC made two decisions regarding the NTSC specification. The first decision was that set-up should not be removed from the NTSC specification at this time. The second decision was that

addition of digital stereo sound to the NTSC specification should await further advanced television system developments. Both decisions reflect the belief of ATSC members that only complete system proposals should be considered at this time, that it would be inappropriate to make "fine-tuning" changes in the NTSC specification.

As was noted in the Comments filed by the ATSC on the Notice of Inquiry ("NOI") released by the Commission on August 20, 1987 the Technology Group on Enhanced 525-Line Systems issued a report in 1987 containing detailed descriptions of the "B-MAC" system. This report, "Multiplexed Analog Component Television Broadcast System Parameter Specifications," is a publicly available document (ATSC Report T2/62, April 1987).

The Technology Group on High Definition Television in 1985 and 1987 adopted recommended positions for the United States' participation in deliberations of the CCIR which, following approval by the U.S. CCIR National Committee, became the official United States position. Also in 1987 the HDTV group approved a document, "Signal Parameters of the 1125/60 High Definition Television Production System," specifying technical parameters for the 1125/60 high definition television production system as a proposed ATSC voluntary technical standard. The full ATSC Committee approved the standard in January 1988, a copy of which is attached as Exhibit 2 (ATSC Document A/27, January 1988).

III. ATSC Plans For The Future

In the Comments filed by the ATSC on the NOI, the ATSC outlined a program it had established for testing and evaluating transmission systems for the terrestrial broadcasting of HDTV in the United States. That program consisted of three phases:

Phase I - Signal propagation tests to evaluate spectrum characteristics,

Phase II - Evaluation of proposed transmission systems in the laboratory and under field conditions, and

Phase III - Subjective assessment of proposed transmission systems to provide a fair and broad-based comparative assessment of the actual operating characteristics of each system.

Subsequent to the formation of these plans, the Advisory Committee on Advanced Television Service was established. Various Working Parties of the Advisory Committee are making plans to accomplish very similar tests. The ATSC has decided to avoid needless and unproductive duplication of effort by foregoing its tests and cooperating in the tests of the Advisory Committee. The ATSC is pleased that the Further Notice notes that the Advisory Committee has benefited from the cooperation extended by the ATSC and that its earlier work has been of help to the Advisory Committee.

The ATSC plans to stay abreast of all related activities being undertaken by the Advisory Committee and to provide information on its continuing standards development and coordination activities to the Advisory Committee. The ATSC plans

to use relevant information obtained from the Advisory Committee, other organizations, and its own proceedings to reach decisions on ATSC advanced television system standards and to recommend such standards, when appropriate, to the FCC for regulatory consideration. Ultimately, it is expected that a standard or standards will be developed for systems delivering programs by terrestrial broadcast, cable, satellite, VCR and video disk.

The ATSC believes that a private sector organization encompassing all segments of the television industry is an essential part of the mechanism needed to achieve national technical standards for advanced television systems. The ATSC provides a funded mechanism for all interested parties to advocate their views and to have those views fairly considered in a one member-one vote procedure. The ATSC's use of a super-majority voting mechanism tends to assure adherence to high quality without sacrificing the need to achieve broad-based industry support.

The NTSC Committees formed in the 1940's and 1950's were private sector groups; their work products then became FCC standards. A similar approach may indeed come to pass in the field of advanced television systems.

IV. Conclusion

The ATSC was formed six years ago to coordinate and develop voluntary national technical standards for advanced television systems. Since then, the ATSC

has actively pursued its obligations as expressed in its Charter. The ATSC is now recognized here and internationally as the preeminent advanced television systems standards organization in the United States. It represents all facets of the television industry in the United States and has an organization in place actively involved in carrying out its designated tasks. The ATSC has been cooperating with the FCC's Advisory Committee on Advanced Television Service and plans to continue that support. Accordingly, we urge the Commission to use the ATSC as one of the resources available to it.

Respectfully submitted,
UNITED STATES ADVANCED
TELEVISION SYSTEMS COMMITTEE

By: _____
E. William Henry
Chairman

_____
Robert Hopkins
Executive Director

November 30, 1988

Exhibit 1

ATSC MEMBERSHIP

ATSC CHARTER MEMBERS

Electronic Industries Association (EIA)
Institute of Electrical and Electronics Engineers (IEEE)
National Association of Broadcasters (NAB)
National Cable Television Association (NCTA)
Society of Motion Picture and Television Engineers (SMPTE)

ATSC MEMBERS

American Television and Communications Corporation
Ampex Corporation
Association of Maximum Service Telecasters
AT&T Bell Laboratories
Baylor University
Bell Communications Research
Cable Television Laboratory
Capital Cities/ABC
CBS Broadcast Group
Comsat Video Enterprises
David Sarnoff Research Center
Dolby Laboratories
Eastman Kodak Company
Faroudja Laboratories
General Instrument Corporation
Hitachi Denshi America
Hoechst Celanese Corporation
Home Box Office
Ikegami Electronics USA
INTV
Jansky Telecommunications
Koichi Sadashige & Associates
Massachusetts Institute of Technology
Matsushita Electric Corporation of America
Mitsubishi Electric Sales America
Motion Picture Association of America (MPAA)
National Broadcasting Company
New York Institute of Technology
North American Philips Corporation
Northern Telecom
Panasonic Broadcast Systems Company
Panavision Electronics
Public Broadcasting Service

Sanyo Manufacturing Corporation
Satcorp
Scientific Atlanta
Sharp Electronics Corporation
Sony Communications Products Company
Sony Corporation of America
Thomson Consumer Electronics
Toko America
Toshiba America
Tribune Broadcasting Company
VISNEWS
Westinghouse Broadcasting Company
Zenith Electronics Corporation

ATSC OBSERVERS

Entertainment and Sports Programming Network (ESPN)
GTE Service Corporation
INTELSAT
Malarkey-Taylor Associates
Tektronix
Weston E. Vivian Associates

Exhibit 2

Doc. A/27
6 Jan. 1988

United States Advanced Television Systems Committee
Standard

SIGNAL PARAMETERS OF THE 1125/60 HIGH DEFINITION TELEVISION PRODUCTION SYSTEM

This document was prepared at the request of the ATSC by the Society of Motion Picture and Television Engineers, a charter member of the ATSC. SMPTE document DOC N15.040, 11 AUG 1987

1. Scope

This document defines the basic characteristics of the video signals associated with origination equipment operating in the 1125/60 High Definition Television production system.

As this document deals with basic system characteristics, all parameters are untoleranced. Tolerances will be developed in detailed system specification documents as appropriate.

2. Scanning Parameters

The video signals represent a scanned raster with the following characteristics:

Total scan lines per frame	1125
Active lines per frame	1035
Scanning Format	Interlaced 2:1
Aspect Ratio	16:9
Field repetition rate	60.00 Hz
Line repetition rate (derived)	33750 Hz

3. System Colorimetry

The system is intended to create a metameric reproduction (visual color match) of the original scene under conditions of equal color temperature and luminance between the original scene and its reproduction.

Camera and monitor design will accommodate this intent within the constraints imposed by the choice of reference primaries (see Appendix 1).

Colorimetric analysis and signal amplitude transfer function are defined as follows:

Chromaticity of reference primaries:	G:	$x = 0.310$	$y = 0.595$
	B:	$x = 0.155$	$y = 0.070$
	R:	$x = 0.630$	$y = 0.340$
Chromaticity for equal primary signals:	Illuminant D_{65}:	$x = 0.3127$	$y = 0.3291$

Electro-optical transfer characteristic of reference reproducer:	$L = ((V+0.1115)/1.1115)^{(1/0.45)}$	for $V \geq 0.0913$
	$L = V/4.0$	for $V < 0.0913$
Opto-electronic transfer characteristic of reference camera:	$V = 1.1115 \cdot L^{(.45)} - 0.1115$	for $L \geq 0.0228$
	$V = 4.0 \cdot L$	for $L < 0.0228$

where L = light output from reproducing primary
V = video signal driving the reproducing primary
(Ref. ARD Document Pflichtenheft Nr. 8/4, §4.1.8)

4. Reference Clock

Signal durations and timings are specified both in microseconds and in reference clock periods.

Reference clock periods in total line:	2200
Reference clock frequency (derived):	74.25 MHz

5. Video Signal Definitions

The video signals shall be appropriate to drive the reference reproducer. Picture sources shall incorporate colorimetric analysis and signal processing to achieve this end.

The image is represented by three parallel, time-coincident video signals. Each incorporates a synchronizing waveform.

The signals shall be either of the following sets:

Color Set	Color Difference Set
G - "green"	Y - "luminance"
B - "blue"	P_B- "blue color difference"
R - "red"	P_R- "red color difference"

where [G B R] are the signals appropriate to directly drive the primaries of the reference reproducer (having been pre-corrected for the reproducer's electro-optical transfer characteristic), and [Y P_B P_R] can be derived from [G B R] through a linear matrix.

More specifically,

$$Y = 0.701 \cdot G + 0.087 \cdot B + 0.212 \cdot R$$

P_B is amplitude-scaled (B-Y), according to:

$$P_B = (B-Y)/1.826$$

and P_R is amplitude-scaled (R-Y), according to:

$$P_R = (R-Y)/1.576$$

where the scaling factors are derived from the signal levels given in section 6.3 and the following transformation equations.

The derived transformation between the two sets is:

$$\begin{bmatrix} G \\ B \\ R \end{bmatrix} = \begin{bmatrix} 1.000 & -0.227 & -0.477 \\ 1.000 & 1.826 & 0.000 \\ 1.000 & 0.000 & 1.576 \end{bmatrix} \begin{bmatrix} Y \\ P_B \\ P_R \end{bmatrix}$$

$$\begin{bmatrix} Y \\ P_B \\ P_R \end{bmatrix} = \begin{bmatrix} 0.701 & 0.087 & 0.212 \\ -0.384 & 0.500 & -0.116 \\ -0.445 & -0.055 & 0.500 \end{bmatrix} \begin{bmatrix} G \\ B \\ R \end{bmatrix}$$

6. Video and Synchronizing Signal Waveforms

The combined video and synchronizing signal shall be as shown in Figure 1. For illustrative purposes, a video signal of the form Y, G, B, or R is shown. The details of the synchronizing signal are identical for the P_B and P_R color difference signals.

6.1 Timing

The timing of events within a horizontal line of video is illustrated in Figure 1(a) and summarized in the following table. All event times are specified at the midpoint of the indicated transition.

Rising edge of sync (timing reference)	0
Trailing edge of sync	44
Start of active video	192
End of active video	2112
Leading edge of sync	2156

The durations of the various portions of the video and sync waveforms are illustrated in Figure 1(b), (c), and (d), and summarized in the following table.

	reference clock periods	time (derived) (microsec.)
a	44	0.593
b	88	1.185
c	44	0.593
d	132	1.778
e	192	2.586
f (Sync rise time)	4	0.054
Total line	2200	29.63
Active line	1920	25.86

6.2 Bandwidth

The Color Set [G B R] comprises three equal-bandwidth signals whose nominal bandwidths are 30 MHz.

The Color Difference Set [Y P_B P_R] comprises a luminance signal Y whose nominal bandwidth is 30 MHz and color difference signals P_B and P_R whose nominal bandwidths are 30 MHz for analog originating equipment and 15 MHz for digital originating equipment.

6.3 Analog Representation

The video signals are represented in analog form as follows:

		Y,G,B,R Signals
Reference Black level	(mV)	0
Reference White level	(mV)	700
Synchronizing level	(mV)	±300

		P_B,P_R signals
Reference zero signal level	(mV)	0
Reference peak levels	(mV)	±350
Synchronizing level	(mV)	±300

6.4 Digital Representation

See Appendix 2.

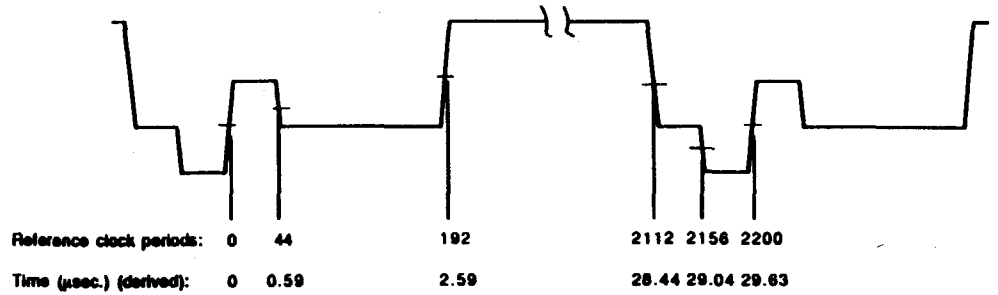

Figure 1(a). Timing of events within a video line.

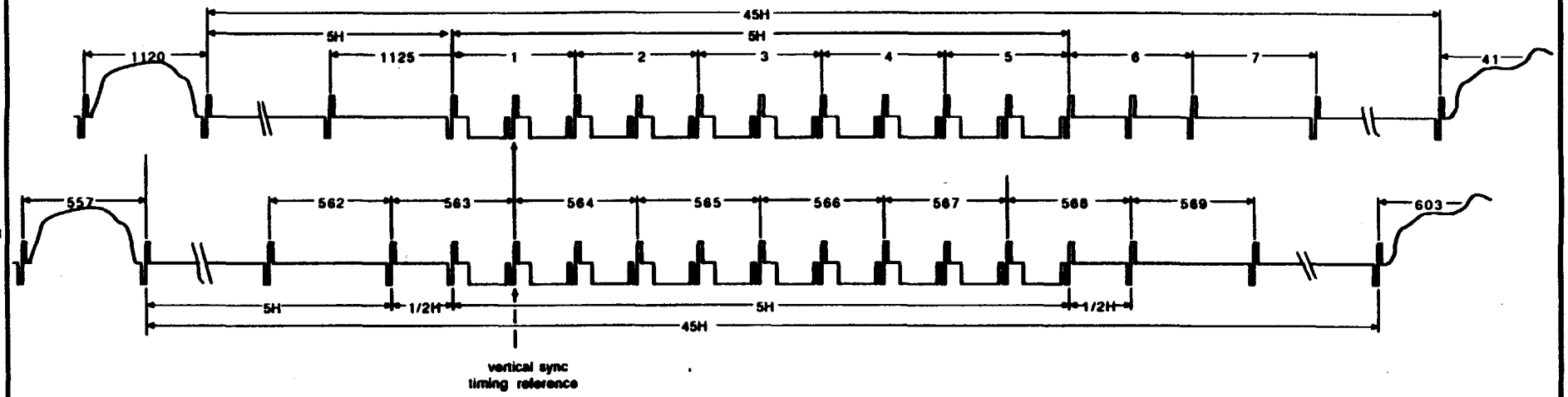

Figure 1(b). Detail of field blanking periods.

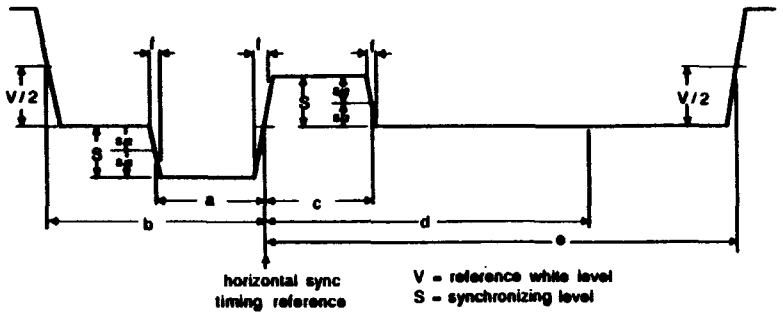

Figure 1(c). Detail of line blanking period

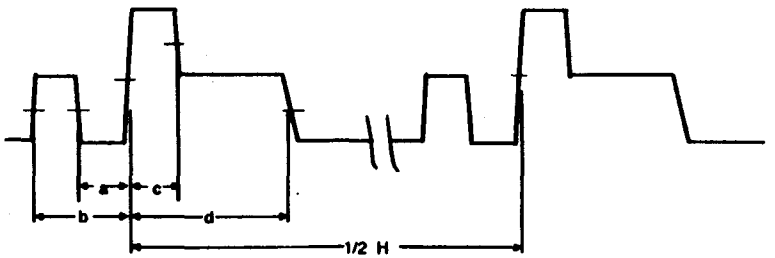

Figure 1(d). Detail of field synchronizing pulse.

Appendix 1

This appendix is not part of the standard, but is included for information only.

System Colorimetry

The parameters values in section 3 are based on current practice and technical constraints.

It is recognized that it would be desirable to implement a system embracing a wider color gamut, and embodying the principle of "constant luminance."

Before this can be done, further study is required, in particular of the feasibility of implementing non-linear signal processing at various points throughout the system.

With respect to color gamut, it is felt that the system should embrace a gamut at least as large as that represented by the following primaries:

G:	x = 0.210	y = 0.710
B:	x = 0.150	y = 0.060
R:	x = 0.670	y = 0.330

Appendix 2

This appendix is not part of the standard, but is included for information only.

Digital Representation

It is necessary to define the digital representation of the 1125/60 HDTV signal. Current practice and experience have not clarified the most suitable value for certain parameters, in particular the number of bits per sample and the coding law. An appropriate form for the specifications of section 6.4 would be the following:

		Y,G,B,R signals	P_B,P_R signals
Quantization	(bits)	[ ]	[ ]
Coding Law		[ ]	[ ]
Sampling frequency	(MHz)	74.25	37.125
Samples per active line		1920	960

The sampling structure is orthogonal: line, field and frame repetitive.

Appendix 3

This appendix is not part of the standard, but is included for information only.

Tolerances

The Ad-Hoc Group did not choose to affix tolerances to any of the parameters specified in this document. It was felt that this document specifies aim points for system design, rather than detailed system specifications. Furthermore, it was not possible to determine comprehensive tolerances for all parameters on the basis of information at the disposal of the Ad-Hoc Group. It was concluded that tolerancing should be left to future documents which give detailed specifications for specific components or equipment operating in the 1125/60 HDTV system.

However, in the course of debating the document, certain tolerances were discussed. These will be given in this appendix, in order that the information should not be lost.

Line Repetition Rate

The Ad-Hoc Group had initially attached a tolerance to this parameter, to serve as a fundamental tolerance on all system timing. This tolerance was removed as a consequence of the decision to leave the document untoleranced. The stated value, with tolerance, was:

Line Repetition Rate (derived)	33750.00 Hz ±10 ppm

Synchronizing Signal

The synchronizing signal adopted by the Ad-Hoc Group was that proposed by BTA (Japan). The BTA proposal was based on time durations, which were toleranced. The Ad-Hoc Group chose counts of reference clock periods as the primary time specification, giving time durations in microseconds as derived, and quoting no tolerances. For information, the BTA proposal, with tolerances, was:

a	0.593 ±0.040 microsec
b	1.185 ±0.040 microsec
c	0.593 ±0.040 microsec
d	1.778 ±0.040 microsec
e	2.586 ±0.040 microsec
f (sync rise time)	0.054 ±0.020 microsec
S sync pulse amplitude	300 ±6 mV
amplitude difference between positive and negative-going sync pulses	<6 mV

Appendix 4

This appendix is not part of the standard, but is included for information only.

Relationships between basic and derived parameters

In this document, certain parameters have been determined as basic and fundamental system parameters. The values of all other system parameters can be derived from those chosen as basic. The purpose of this appendix is to describe and define the derivations.

Line Repetition Rate (L):

$$L = S \cdot F/2$$

where F = field repetition rate (section 2),
and S = total scan lines per frame (section 2).

Reference Clock Frequency (C):

$$C = L \cdot R$$

where L = line repetition rate (section 2, derived above),
and R = reference clock periods in total line (section 4).

Transformation Matrices between component sets (section 5):

The transformation matrices can be calculated from the chromaticity coordinates of the reproducer primaries, and the chromaticity of reference white (ie. the color reproduced when the reference reproducer is driven by equal primary signals), according to well-known methods.

Stated briefly, the equation for Y can be found as follows:

$$Y = (G \cdot L_g \cdot y_g) + (B \cdot L_b \cdot y_b) + (R \cdot L_r \cdot y_r)$$

where L_g, L_b, and L_r are derived as follows:

$$\begin{bmatrix} L_r \\ L_g \\ L_b \end{bmatrix} = \begin{bmatrix} x_r & x_g & x_b \\ y_r & y_g & y_b \\ z_r & z_g & z_b \end{bmatrix}^{-1} \begin{bmatrix} x_w/y_w \\ 1 \\ z_w/z_w \end{bmatrix}$$

and: x_r, y_r, z_r are the chromaticity coordinates of the red primary,
x_g, y_g, z_g are the chromaticity coordinates of the green primary,
x_b, y_b, z_b are the chromaticity coordinates of the blue primary,
x_w, y_w, z_w are the chromaticity coordinates of reference white.