



ATIS STANDARD

ATIS-0100502-2005(S2020)

**System M-NTSC Television Signals –  
Network Interface Specifications and Performance  
Parameters**

**AMERICAN NATIONAL STANDARD FOR TELECOMMUNICATIONS**



As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, 5G, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit [www.atis.org](http://www.atis.org).

---

## AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretary or sponsor whose name appears on the title page of this standard.

**CAUTION NOTICE:** This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

---

## Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES THAT ANY AND ALL USE OF OR RELIANCE UPON THE INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith. Please refer to [<http://www.atis.org/legal/patentinfo.asp>] to determine if any statement has been filed by a patent holder indicating a willingness to grant a license either without compensation or on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain a license.

---

## ATIS-0100502.2005(S2020), *System M-NTSC Television Signals – Network Interface Specifications and Performance Parameters*

Is an American National Standard developed by the ATIS **Network Performance, Reliability, and Quality of Service Committee (PRQC)**.

*Published by*

**Alliance for Telecommunications Industry Solutions  
1200 G Street, NW, Suite 500  
Washington, DC 20005**

Copyright © 2020 by Alliance for Telecommunications Industry Solutions  
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

**ATIS-0100502.2005(S2020)**

(Revision of T1.502-1998)

American National Standard for Telecommunications

**SYSTEM M-NTSC TELEVISION SIGNALS –  
NETWORK INTERFACE SPECIFICATIONS AND  
PERFORMANCE PARAMETERS**

Secretariat

**Alliance for Telecommunications Industry Solutions**

Approved November 3, 2005

**American National Standards Institute, Inc.**

**Abstract**

This standard defines network interface specifications and performance parameters and values for television transmission service channels supporting 525-line, system M-NTSC color or monochrome video signals and the associated audio signals.

**FOREWORD**

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The Network Performance, Reliability, and Quality of Service Committee (PRQC) -- formerly T1A1 -- develops and recommends standards, requirements, and technical reports related to the performance, reliability, and associated security aspects of communications networks, as well as the processing of voice, audio, data, image, and video signals, and their multimedia integration. PRQC also develops and recommends positions on, and fosters consistency with, standards and related subjects under consideration in other North American and international standards bodies.

ANSI guidelines specify two categories of requirements: mandatory and recommendation. The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, PRQC Secretariat, 1200 G Street, NW, Suite 500, Washington, DC 20005.

At the time it approved this document, PRQC, which is responsible for the development of this Standard, had the following members:

- R. Wohlert, PRQC Chair
- N. Seitz, PRQC Vice-Chair
- S. Carioti, ATIS Disciplines
- S. Barclay, ATIS Secretariat
- C. Underkoffler, ATIS Chief Editor
- Pierre Costa, PRQC Technical Editors

Organization Represented	Name of Representative	Organization Represented	Name of Representative
Alcatel USA Inc.	Ken Biholar	National Communications System	An Nguyen
ASTRI	Jacky Chow		Jean Trakinat (Alt.)
AT&T	Percy Tarapore	NTIA	Neal B. Seitz
	Charles A. Dvorak (Alt.)	Nortel Networks	Oscar Avellaneda
BellSouth Telecommunications	Archie McCain		Joseph A. Zebarth (Alt.)
	David M. Brady (Alt.)	Qwest	Debra Showell
C.S.I Telecommunications	Michael S. Newman		Thomas J. Fargano (Alt.)
	Thomas G. Croda (Alt.)	SBC Communications, Inc.	Randolph Wohlert
Cingular Wireless LLC	Don Zelmer		Pierre Costa (Alt.)
	Marc Grant (Alt.)	Siemens Info & Comm Ntwks, Inc.	Suhas S. Gandhi
Defense Info. Systems Agency	Chris Fitzgerald		David E. Francisco (Alt.)
Ericsson Incorporated	Mustafa Kocaturk	Sprint Corporation	Mark L. Jones
	Susana Sabater-Maroto (Alt.)	Telcordia Technologies	Spilios Makris
Harris Corporation	Marlis Humphrey		Cliff Halevi (Alt.)
Intelsat	Mark T. Neibert	Tellabs Operations, Inc.	William A. Walker
Lucent Technologies	Stuart O. Goldman		Kevin Stodola (Alt.)
MCI	J. Martin Carroll	Verizon Communications	John Colombo
	Robert Schafer (Alt.)		Wendy Pugh (Alt.)

The PRQC Quality of Service (QoS) Task Force was responsible for the development of this document.

**TABLE OF CONTENTS**

<b>FOREWORD</b> .....	<b>II</b>
<b>TABLE OF CONTENTS</b> .....	<b>III</b>
<b>TABLE OF FIGURES</b> .....	<b>IV</b>
<b>TABLE OF TABLES</b> .....	<b>V</b>
<b>1 SCOPE, PURPOSE, &amp; APPLICATION</b> .....	<b>1</b>
1.1 SCOPE.....	1
1.2 PURPOSE.....	1
1.3 APPLICATION.....	1
<b>2 NORMATIVE REFERENCES</b> .....	<b>2</b>
<b>3 DEFINITIONS</b> .....	<b>2</b>
3.1 SPECIAL WORD/PHRASE USAGE.....	2
3.2 VIDEO SIGNALS.....	3
3.2.1 Video signal description.....	3
3.2.2 Test signal description .....	3
3.2.2.1 Composite test signal .....	3
3.2.2.2 Combination test signal.....	3
3.2.2.3 Multipulse test signal .....	3
3.2.2.4 Field-bar test signal.....	4
3.2.2.5 Flat-field test signal with variable APL .....	4
3.2.3 Method of measurement.....	4
3.3 Acronyms & Abbreviations List .....	4
<b>4 BASEBAND TELEVISION INTERFACE AND PERFORMANCE SPECIFICATIONS FOR ANALOG TRANSMISSION</b> .....	<b>5</b>
4.1 VIDEO SIGNAL ELECTRICAL INTERFACE SPECIFICATIONS .....	5
4.1.1 Impedance.....	5
4.1.1.1 Source impedance .....	5
4.1.1.2 Input impedance.....	6
4.1.1.3 Output impedance.....	6
4.1.1.4 Load impedance.....	6
4.1.2 Video signal.....	6
4.1.2.1 Input signal level.....	6
4.1.2.2 Output signal level .....	7
4.1.2.3 Polarity of the picture signal.....	7
4.1.2.4 Non-useful DC component .....	7
4.2 AUDIO SIGNAL ELECTRICAL INTERFACE SPECIFICATIONS .....	7
4.2.1 Impedance.....	7
4.2.1.1 Source impedance .....	7
4.2.1.2 Input Impedance.....	8
4.2.1.3 Output impedance.....	8
4.2.1.4 Load impedance.....	8
4.2.2 Audio signal.....	9
4.2.2.1 Input signal level.....	9
4.2.2.2 Output signal level .....	9
4.2.2.3 Polarity of the audio signal.....	9
4.3 VIDEO SIGNAL PERFORMANCE CHARACTERISTICS .....	10
4.3.1 Video signal linear distortions .....	10
4.3.1.1 Amplitude response versus frequency characteristic.....	10
4.3.1.2 Chrominance-to-luminance gain inequality.....	10
4.3.1.3 Chrominance-to-luminance delay inequality (CLDI).....	11
4.3.1.4 Field-time waveform distortion (FD).....	12
4.3.1.5 Line-Time waveform distortion .....	12
4.3.1.6 Short-time waveform distortion.....	13
4.3.1.7 Long-time waveform distortion (bounce) .....	13

4.3.1.8	Insertion gain and insertion gain variation.....	13
4.3.2	Video signal nonlinear distortions.....	14
4.3.2.1	Luminance nonlinearity.....	14
4.3.2.2	Differential gain.....	15
4.3.2.3	Differential phase.....	16
4.3.2.4	Chrominance-to-luminance intermodulation.....	16
4.3.2.5	Chrominance nonlinear gain.....	17
4.3.2.6	Chrominance nonlinear phase.....	17
4.3.2.7	Dynamic gain of the picture signal.....	18
4.3.2.8	Dynamic gain of the synchronizing signal.....	19
4.3.2.9	Transient synchronizing signal nonlinearity.....	19
4.3.2.10	Signal-to-weighted-random-noise ratio (10 kHz-4.2 MHz).....	20
4.3.2.11	Signal-to-low-frequency noise ratio (0-10 kHz).....	21
4.3.2.12	Signal-to-peak-to-peak-noise ratio (300 Hz-4.2 MHz).....	22
4.3.2.13	Availability of video service.....	22
4.4	AUDIO SIGNAL PERFORMANCE CHARACTERISTICS.....	23
4.4.1	Amplitude response versus frequency.....	23
4.4.2	Total harmonic distortion plus noise.....	23
4.4.3	Signal-to-noise ratio.....	24
4.4.4	Insertion gain.....	24
4.4.5	Stereo gain difference - A to B channel.....	25
4.4.6	Stereo phase difference - A to B channel.....	25
4.4.7	Crosstalk plus noise.....	25
4.4.8	Availability of audio service.....	26
4.4.9	Audio to video time differential.....	26
<b>5</b>	<b>BASEBAND TELEVISION INTERFACE AND PERFORMANCE SPECIFICATIONS FOR MIXED ANALOG AND DIGITAL TRANSMISSION.....</b>	<b>26</b>
<b>6</b>	<b>HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNELS.....</b>	<b>27</b>
6.1	TERRESTRIAL HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNEL.....	27
6.2	SATELLITE HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNEL.....	27
6.3	TRANSMISSION SERVICE CHANNELS - INTRA-LATA AND INTER-LATA.....	27
6.3.1	Intra-LATA access transmission service channel.....	27
6.3.2	Intra-LATA local transmission service channel.....	27
6.3.3	Inter-LATA transmission service channel.....	28
6.4	HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNELS VERSUS TRANSMISSION PERFORMANCE.....	28
6.4.1	Short haul.....	28
6.4.2	Medium haul.....	28
6.4.3	Long haul.....	28
6.4.4	Satellite.....	29
6.4.5	End-to-end.....	29
<b>A</b>	<b>BIBLIOGRAPHY.....</b>	<b>57</b>
<b>B</b>	<b>AUDIO LEVELS ON TELEVISION TRANSMISSION CHANNELS.....</b>	<b>58</b>
B.1	SUBCARRIER DEVIATION.....	58
B.2	MAXIMUM PERMITTED TEST-TONE LEVELS.....	58
<b>C</b>	<b>GOOD ENGINEERING PRACTICE FOR AUDIO AND VIDEO.....</b>	<b>60</b>
<b>D</b>	<b>TESTING VIDEO TRANSPORT EQUIPMENT FOR IMMUNITY TO GROUND POTENTIAL INTERFERENCE.....</b>	<b>61</b>
D.1	BACKGROUND.....	61
D.2	DIFFERENTIAL VIDEO INPUT CIRCUIT CHARACTERISTICS.....	61
D.3	CIRCUIT DESCRIPTION.....	61
<b>E</b>	<b>ACCESS SERVICE CHANNEL AND INTERFACE CODES.....</b>	<b>63</b>

**TABLE OF FIGURES**

FIGURE 1 - STANDARD VIDEO SIGNAL GENERAL WAVEFORM TERMINOLOGY □ VIDEO.....	39
--	----

FIGURE 2 - IRE UNIT SCALE.....	40
FIGURE 3 - COMPOSITE TEST SIGNAL -- VIDEO.....	40
FIGURE 4 - COMBINATION TEST SIGNAL -- VIDEO.....	41
FIGURE 5 - MULTIPULSE TEST SIGNAL -- VIDEO.....	41
FIGURE 6 - FIELD-BAR TEST SIGNAL -- VIDEO.....	42
FIGURE 7 - FLAT-FIELD TEST SIGNAL WITH VARIABLE APL -- VIDEO.....	42
FIGURE 8 - IMPEDANCE REFERENCE.....	43
FIGURE 9 - POLARITY TEST SIGNAL -- AUDIO.....	43
FIGURE 10 - SHORT-HAUL AMPLITUDE RESPONSE VERSUS FREQUENCY CHARACTERISTIC -- VIDEO.....	44
FIGURE 11 - MEDIUM-HAUL AND SATELLITE AMPLITUDE RESPONSE VERSUS FREQUENCY CHARACTERISTIC -- VIDEO.....	44
FIGURE 12 - LONG-HAUL AND END-TO-END AMPLITUDE RESPONSE VERSUS FREQUENCY CHARACTERISTIC -- VIDEO.....	45
FIGURE 13 - CHROMINANCE-TO-LUMINANCE DELAY INEQUALITY NOMOGRAM -- VIDEO.....	46
FIGURE 14 - SHORT-TIME WAVEFORM DISTORTION MEASUREMENT (SD) GRATICULE -- VIDEO.....	47
FIGURE 15 - LONG-TIME WAVEFORM DISTORTION EXAMPLE -- VIDEO.....	47
FIGURE 16 - DIFFERENTIATING NETWORK CIRCUIT DIAGRAM -- VIDEO.....	48
FIGURE 17 - LUMINANCE NONLINEARITY DISTORTION EXAMPLE -- VIDEO.....	48
FIGURE 18 - VECTORSCOPE DISPLAYS OF DIFFERENTIAL PHASE -- VIDEO.....	49
FIGURE 19 - CHROMINANCE-TO-LUMINANCE INTERMODULATION -- VIDEO.....	50
FIGURE 20 - VECTORSCOPE DISPLAY OF CHROMINANCE NONLINEAR PHASE.....	51
FIGURE 21 - DYNAMIC GAIN DISTORTION OF THE PICTURE SIGNAL COMPOSITE TEST SIGNAL WITH FLAT-FIELD OVERLAY -- VIDEO.....	51
FIGURE 22 - NOISE MEASUREMENT FILTERS.....	52
FIGURE 23 - SIGNAL-TO-PERIODIC NOISE EXAMPLES -- VIDEO.....	53
FIGURE 24 - AMPLITUDE RESPONSE VERSUS FREQUENCY CHARACTERISTIC -- AUDIO.....	54
FIGURE 25 - STEREO PHASE DIFFERENCE -- A TO B CHANNEL AUDIO.....	54
FIGURE 26 - TERRESTRIAL HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNEL.....	55
FIGURE 27 - SATELLITE HYPOTHETICAL REFERENCE TRANSMISSION SERVICE CHANNEL.....	55
FIGURE 28 - INTRA-LATA LOCAL TRANSMISSION SERVICE CHANNEL.....	55
FIGURE 29 - SATELLITE INTRA-LATA TRANSMISSION CHANNEL.....	56
FIGURE B.1 - STANDARD AUDIO PRE/DE-EMPHASIS (TIME CONSTANT = 75 $\mu$ S).....	59
FIGURE D.1 - HUM MEASUREMENT TEST CONFIGURATION.....	62

## TABLE OF TABLES

TABLE 1 - SHORT-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATIONS – VIDEO.....	30
TABLE 2 - MEDIUM-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATIONS – VIDEO.....	31
TABLE 3 - SATELLITE TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATIONS – VIDEO.....	32
TABLE 4 - LONG-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATIONS – VIDEO.....	33
TABLE 5 - END-TO-END TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATIONS – VIDEO.....	34
TABLE 6 - SELECTED FREQUENCY VALUES FOR A 50-IRE-UNIT SINE WAVE.....	35
TABLE 7 - SHORT-TIME WAVEFORM DISTORTION GRATICULE LIMITS.....	35
TABLE 8 - SHORT-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATION ANALOG, DIPLEXED DUAL-CHANNEL AUDIO.....	36
TABLE 9 - MEDIUM-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATION ANALOG, DIPLEXED DUAL-CHANNEL AUDIO.....	37
TABLE 10 - SATELLITE TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATION ANALOG, DIPLEXED DUAL-CHANNEL AUDIO.....	37
TABLE 11 - LONG-HAUL TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATION ANALOG, DIPLEXED DUAL-CHANNEL AUDIO.....	38
TABLE 12 - END-TO-END TRANSMISSION SERVICE CHANNEL PERFORMANCE SPECIFICATION ANALOG, DIPLEXED DUAL-CHANNEL AUDIO.....	38

American National Standard for Telecommunications –

# System M-NTSC Television Signals – Network Interface Specifications and Performance Parameters

## 1 SCOPE, PURPOSE, & APPLICATION

### 1.1 Scope

This standard covers interface and performance specifications of television transmission service channels. Hypothetical reference channels have been defined and utilized to apportion performance parameters. Television signals created or transmitted in accordance with other standards or make-ups may not necessarily be compatible with the specifications of this standard.

This standard specifies the performance of transmission service channels provided to convey 525-line, System M-National Television Systems Committee (NTSC) color or monochrome video signals and their associated audio signals only. This specification for television transmission service channels applies to both interface and performance parameters. The performance parameters are expressed as a function of the length between the endpoints of a channel or as a function of the facility type utilized. Performance definitions and measurement methods are provided if appropriate. Interface specifications are provided to facilitate compatibility between end users, service providers, and carriers.

The performance characteristics identified within this standard apply to the transmission quality between the defined interfaces. Those interfaces are: (1) between transmission service providers and end users; and (2) between the jurisdictions of one transmission service provider and another. This standard defines neither the interconnection nor the performance characteristics of specific apparatus or equipment.

### 1.2 Purpose

The purpose of this standard is to assure the uniform application of standard values of transmission parameters for television signals transported by portions of the telecommunications network. It is intended to provide a common understanding by both suppliers and their customers.

### 1.3 Application

The primary applications of this standard are for specifying and evaluating the performance of a transmission service provided by common carriers. These services are used to transport the audio and video portions of broadcast-quality television signals.