

# **AES information document for digital audio engineering – Transmission of AES3 formatted data by unbalanced coaxial cable**

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## **Abstract**

This document contains information regarding cables, cable equalizers, and receiver circuits including adapters to or from standard AES3 equipment and cabling where it is required to transmit AES3 formatted signals over long distances (up to 1000 m), or in a video installation using analog video distribution equipment. It is not intended to be an alternative electrical specification to AES3, which is based on balanced, shielded, twisted-pair cable transmission over distances of up to 100 m. The information is based on studies and laboratory experiments discussed in a series of technical reports that have been partly summarized and included.

*[This document was WITHDRAWN on 2010-07-09. The reason for this withdrawal is that the content of AES-3id has been superseded by AES3-4-2009, Annex D (Normative) "Coaxial transmission", and by AES-2id Annex C "Coaxial cable adapters and equalizer characterization", and so this Information Document has become redundant.]*

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This document is subject to periodic review and users are cautioned to obtain the latest edition and printing.

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## Foreword

[This foreword is not a part of *AES information document for digital audio engineering — Transmission of AES3 formatted data by unbalanced coaxial cable*, AES-3id-2001.]

### Foreword to original edition

Since its introduction in 1985, AES3 has become a well-accepted standard for the transmission of two channels of linearly represented digital audio data over a distance of 100 m in a professional audio environment. Equipment such as recorders, mixers, and signal processors in many installations worldwide conform to the AES3 standard. From time to time requests have been made to the AESSC SC-02 Subcommittee on Digital Audio to consider documenting an electrical specification for the transmission of AES3 formatted data which addresses applications of a professional nature but outside the original scope of AES3, or which would provide greater convenience in certain specialized environments. Some of these suggestions have come from individuals and organizations such as the Society of Motion Picture and Television Engineers (SMPTE) wishing to operate primarily in a video environment that is already based on unbalanced coaxial cable. Hence, the AESSC is providing this document for information purposes for the above applications and does not intend that it replace, or be viewed as an equal alternative, to the balanced, shielded, twisted-pair electrical specification already standardized in AES3.

The AESSC SC-02-02 Working Group on Digital Input/Output Interfacing commissioned a study voluntarily performed by the Sony Corporation. The results of this effort were provided to the working group in a series of three reports presented at three separate consecutive meetings. Each covered different aspects of transmitting AES3 formatted data over coaxial cable with special attention to operation in a video environment. The overall study provided both theoretical and experimental information which was thoroughly discussed by the working group and then used to draft the present document. In addition to the efforts of Sony, other companies provided important commentary on the draft to help provide further practical guidance.

The chairman wishes to thank the entire working group, but especially T. Setogawa of Sony Corporation, Probel, Graham-Patten, Grass Valley, and NVISION who have materially contributed to this information document.

Robert A. Finger  
Chairman, SC-02-02 Working Group on Digital Input/Output Interfacing  
1993-09-02

### Foreword to second edition

The revision of AES-3id was prepared under project AES-3id-R by a writing group headed by R. Caine.

R. A. Finger, chair  
J. Dunn, vice-chair  
SC-02-02 Working Group on Digital Input/Output Interfacing  
2001-01-08

### Note to 2006 printing

This document was written in the context of basic-rate sampling frequencies (see AES5-2003). No provision is made in this document to handle signals carrying stereo audio at double and quadruple sampling frequencies. It should be possible to expand the parameters quoted to handle such signals using common-place engineering techniques, and much modern video equipment will handle such signals in coaxial form.

R. Caine, chair SC-02 Subcommittee on Digital Audio

NOTE AES standards documents follow the practices of the International Electrotechnical Commission *Directives, Part 3*, in which the verb “shall” in a sentence designates a requirement, the verb “should” designates a recommendation, the verb “may” designates a permission, the verb “can” designates a possibility, and the decimal point is a comma.

**AES-3id-2001 (r2006)**  
Revision of AES-3id-1995**AES information document  
for digital audio engineering —  
Transmission of AES3 formatted data  
by unbalanced coaxial cable****1 Scope**

Where transmission of AES3 formatted signals over long distances (up to 1000 m) is required, or in a video installation using analog video distribution equipment, the electrical scheme described in this document, based on an unbalanced coaxial cable line, may be suitable. The document also provides some information regarding cables, cable equalizers, and receiver circuits, including adapters to or from standard AES3 equipment and cabling. Although the line driver characteristics can be fully specified, cables and receiver characteristics cannot because there are many combinations which are capable of achieving equivalent results over a broad set of applications.

This document is not intended to be an alternative electrical specification to AES3, which is based on balanced, shielded, twisted-pair cable transmission over distances of up to 100 m. The specification and information in the document are based on studies and laboratory experiments discussed in a series of technical reports that the document partly summarizes. Because a goal of the document is a description of a digital-audio transmission method appropriate for conventional professional analog-video environments, while being also adaptable to existing AES3 equipment, the description of the electrical characteristics is different from that in AES3. Similarly, it is also different from the coaxial-transmission method for digital audio in consumer applications that is described in IEC 60958-3 and the method for use of video-style equipment for professional users that is described in SMPTE 276M-1995.

Note that the three coaxial transmission methods specify different characteristics for many parameters such as return loss and minimum signal amplitude.

In an informative annex to this document, one popular type of coaxial cable and one cable length are assumed in order to describe cable equalizer characteristics. However, this document does not intend to specify any particular cable and length. Some equalizer characteristics for different coaxial cable lengths or different cable loss are also shown in annex A. For many applications and where the cable length is less than 300 m, no equalization may be necessary, and indeed no cable equalization is preferred. Whether or not the equalizer will be used, the choice of both cable length and type of equalizer design is dependent on system implementation requirements.

## 2 Normative references

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

- 1) AES3-1992, *AES Recommended practice for digital audio engineering – Serial transmission format for two-channel linearly represented digital audio data*. New York: Audio Engineering Society.
- 2) IEC 60169-8 (1978-01), *Radio-frequency connectors. Part 8: R.F. coaxial connectors with inner diameter of outer conductor 6.5 mm (0.256 in) with bayonet lock - Characteristic impedance 50 ohms (Type BNC)*. Geneva, Switzerland: International Electrotechnical Commission.

## 3 Definitions and abbreviations

### 3.1

#### transmission format

subframe and frame format, channel coding, preambles, and data organization, including validity (V), user data (U), channel status (C), and parity (P) bits, that shall be used as specified in AES3

### 3.2

#### bit width

unit interval (UI) as defined in AES3

### 3.3

$T_B$

$T_{NOM}$

1 UI

## 4 Line driver characteristics

All values specified herein (output voltage, d.c. offset, rise time, and fall time) were first determined by theoretical calculation. Experiments were performed to measure crosstalk to analog-video signals, distortion through an analog-video line amplifier, and EMI radiation noise. The specification for the line driver (also known as generator) is totally different from the AES3 electrical specification and is based on unbalanced coaxial-cable transmission consistent with conventional professional analog-video practice.

Although equalization may be used at the receiver, no equalization before transmission shall be permitted.

### 4.1 Impedance

The line driver shall have an unbalanced output circuit having a source impedance of 75  $\Omega$  and a return loss better than 15 dB over the frequency band from 0,1 MHz to 6,0 MHz.

### 4.2 Signal characteristics

The output signal characteristic shall be as shown in figure 1 and table 1 when measured across a resistor connected to the output terminals. The resistor shall have a value of 75  $\Omega$  with a relative tolerance of  $\pm 1$  %.