INTERNATIONAL STANDARD

IEC 60728-9

First edition
2000-11

Cabled distribution systems for television and sound signals –

Part 9: Interfaces of cabled distribution systems for digitally modulated signals

Systèmes de distribution par câbles destinés aux signaux de radiodiffusion sonore et de télévision –

Partie 9: Interfaces des systèmes de distribution par câbles utilisant des signaux modulés numériques

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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CABLED DISTRIBUTION SYSTEMS FOR TELEVISION AND SOUND SIGNALS –

Part 9: Interfaces of cabled distribution systems for digitally modulated signals

FOREWORD

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International Standard IEC 60728-9 has been prepared by subcommittee 100D: Cabled distribution systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/158/FDIS	100/180/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A and B form an integral part of this standard.

Annexes C, D, E and F are for information only.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

INTRODUCTION

Standards of the IEC 60728 series deal with cable networks for television signals, sound signals and interactive services including equipment, systems and installations

– for headend reception, processing and distribution of television and sound signals and their associated data signals, and
– for processing, interfacing and transmitting all kinds of signals for interactive services using all applicable transmission media.

All kinds of networks like

– CATV-networks,
– MATV-networks and SMATV-networks,
– individual receiving networks

and all kinds of equipment, systems and installations installed in such networks, are within the scope of this series.

The extent of this standardization work goes from the antennas, special signal source inputs to the head-end, or other interface points to the network, up to the system outlet or the terminal input, where no system outlet exists.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals, etc.) as well as of any coaxial and optical cables and accessories therefore is excluded.

CABLED DISTRIBUTION SYSTEMS FOR TELEVISION AND SOUND SIGNALS –

Part 9: Interfaces of cabled distribution systems for digitally modulated signals

1 Scope

This part of IEC 60728 describes physical interfaces for the interconnection of signal processing devices for professional CATV/SMATV headend equipment or for similar systems, such as in up-link stations. This standard, in particular, specifies the transfer of MPEG-2 data signals in the standardized transport layer format between devices of different signal processing functions.

RF interfaces and interfaces to telecom networks are not covered by this standard.

In addition references are made to all other parts of the IEC 60728 series and, in particular, for RF, video and audio interfaces, to IEC 60728-5.

For connections to telecom networks, special Data Communication Equipment (DCE) is necessary to adapt the serial or parallel interfaces specified in this document to the bitrates and transmission formats of the public Plesiochronic Digital Hierarchy (PDH) networks. Other emerging technologies such as Connectionless Broadband Data Services (CBDS), Synchronous Digital Hierarchy (SDH), Asynchronous Transfer Mode (ATM), etc. can be used for transmitting MPEG-2 Transport Streams (TS) between remote locations. ATM is particularly suitable for providing bandwidth on demand and it allows for high data rates.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60728. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60728 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60169-8:1978, *Radio-frequency connectors – Part 8: RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock – Characteristic impedance 50 ohms (type BNC)*

IEC 60728 (all parts), *Cabled distribution systems for television and sound signals*

IEC 60728-5,— *Cabled distribution systems for television and sound signals – Part 5: Head-end equipment* [1)]

IEC 60728-6,— *Cabled distribution systems for television and sound signals – Part 6: Optical equipment* [1)]

IEC 60793-2:1998, *Optical fibres – Part 2: Product specifications*

[1)] To be published.

IEC 60874-14:1993, *Connectors for optical fibres and cables – Part 14: Sectional specification for fibre optic connector – Type SC*

ISO/IEC 13818-1:1996, *Information technology – Generic coding of moving pictures and associated audio information – Part 1: Systems*

ISO/IEC 13818-9:1996, *Information technology – Generic coding of moving pictures and associated audio information – Part 9: Extension for real time interface for systems decoders*

ISO/IEC 14165-111, *Information technology – Fibre Channel – Part 1: Physical and signalling interface (FC-PH)*[1)]

ISO 2110:1989, *Information technology – Data communication – 25-pole DTE/DCE interface connector and contact number assignments*

ITU-R Recommendation BT.656-4:1994, *Interfaces for digital component video signals in 525-line and 625-line television systems operating at the 4:2:2 level of Recommendation ITU-R BT.601 (Part A)*

ITU-T Recommendation G.654:1997, *Characteristics of a cut-off shifted single-mode optical fibre cable (Rev 1)*

ITU-T Recommendation G.703:1998, *Physical/electrical characteristics of hierarchical digital interfaces (Rev 1)*

ETS 300421:1994, *Digital broadcasting for television, sound and data services – Framing structure, channel coding and modulation for 11/12 GHz satellite services*

ETS 300429:1994, *Digital broadcasting for television, sound and data services – Framing structure, channel coding and modulation for cable systems*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this part of IEC 60728, the following definitions apply.

3.1.1
head-end
equipment connected between receiving antennas or other signal sources and the remainder of the cable distribution system to process the signals to be distributed

NOTE The head-end may, for example, comprise antenna amplifiers, frequency converters, combiners, selectors and generators.

3.1.2
Satellite Master Antenna Television system (SMATV)
system designed to provide sound and television signals to the households of a building or group of buildings

NOTE Two system configurations are defined in ETS 300 473 as follows:

- SMATV system A, based on transparent transmodulation of QPSK satellite signals into QAM signals to be distributed to the user;
- SMATV system B, based on direct distribution of QPSK signals to the user, with two options:
  - SMATV-IF distribution in the satellite IF band (above 950 MHz);
  - SMATV-S distribution in the VHF/UHF band, for example in the extended S-band (230-470 MHz).

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1) To be published.

3.1.3
biphase mark
line code which ensures DC balance, easy clock recovery and polarity freedom

3.1.4
transport stream
includes one or more programs with one or more independent time bases into a single stream. The transport stream is designed for use in environments where errors are likely, such as storage or transmission in lossy or noisy media

3.1.5
transport packet
packetized element of the transport stream. The packets are either 188 bytes or, in the case where Reed Solomon FEC is used, 204 bytes in length

3.1.6
DVALID
signal which indicates in the 204-byte mode of a Transport Stream that the empty space is filled with dummy bytes

3.1.7
PSYNC
flag which indicates the beginning of a packet

3.2 Abbreviations

8B/10B	eight-to-ten bit conversion
ACCP	Accumulated Phase
ACCT	Accumulated Time
ASI	Asynchronous Serial Interface
ASI-C	Asynchronous Serial Interface on coaxial cable
ASI-O	Asynchronous Serial Interface on optical fibre
ATM	Asynchronous Transfer Mode
BER	Bit Error Rate
CBDS	Connectionless Broadband Data Services
DFB	Distributed Feedback
DJ	Deterministic Jitter
DVALID	data valid
DVB	Digital Video Broadcast
EN	European Norm
FC	Fibre Channel
FIFO	First In First Out
FEC	Forward Error Correction
FWHM	Full Width Half Max
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITU-R	International Telecommunication Union – Radiocommunication
ITU-T	International Telecommunication Union – Telecommunication
LVDS	Low-Voltage Differential Signalling
MPEG	Moving Picture Experts Group
MSB	Most Significant Bit
MUX	Multiplex
NA	not applicable
NRZ	Non-Return-to-Zero
PDH	Plesiosynchronic Digital Hierarchy
PLL	Phase Lock Loop
PMD	Physical Medium Dependent
PSYNC	Packet Synchron
QAM	Quadrature Amplitude Modulation
QPSK	Quarternary Phase Shift Keying
RD	Running Disparity
RIN	Relative Intrinsic Noise
RJ	Random Jitter
RS	Reed Solomon
SDH	Synchronous Digital Hierarchy
SMPT	Society of Motion Picture and Television Engineers
SPI	Synchronous Parallel Interface
SSI	Synchronous Serial Interface
SSI-C	Synchronous Serial Interface on coaxial cable
SSI-O	Synchronous Serial Interface on optical fibre
Tr	Rise-time
TS	Transport Stream
UNC	Unified National Coarse Thread

4 Interfaces for MPEG-2 data signals

4.1 Introduction

This subclause describes possible interfaces for devices transmitting or receiving MPEG-2 data as transport packets, such as QPSK demodulators, QAM modulators, multiplexers, demultiplexers, or telecom network adapters.

This specification is similar to ETS 300429 and ETS 300421.

NOTE Both standards describe a first functional block representing the MPEG2 source coding and multiplexing as standardized in ISO/IEC 13818-1, a second functional block representing the channel adaptation, whereas an interface in between shall be based on MPEG2 transport stream specification according to ISO/IEC 13818-1.

The function of the channel modulator/demodulator is to adapt the signal to the characteristics of the transmission channel: satellite, terrestrial or cable as specified in the DVB base line documents.

Also the case where data signals are transmitted to or from a headend via a telecom network, or if a headend serves to insert data signals into such networks, is considered to be covered by the generic channel modulator/demodulator functional block. The interface parameters valid for this network have to be met. For the latter, reference is made to ITU-T G.703 for Plesiochronic Digital Hierarchy (PDH) networks.

4.1.1 Application requirements

In order to avoid any unnecessary processing at the transmitting or receiving station of an interface in certain applications, it is considered an application requirement that the interface supports 204-byte packet length in such cases, in addition to or instead of the 188-byte packet length specified in ISO/IEC 13818-1. These two cases are identified in the protocol diagrams of figures 1 and 2, where also the scope of this specification is delineated. The relevant associated packet structures are illustrated in figures 3 and 4.

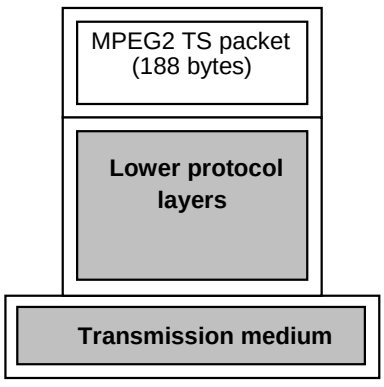


Figure 1 – Protocol stack for 188-byte packets

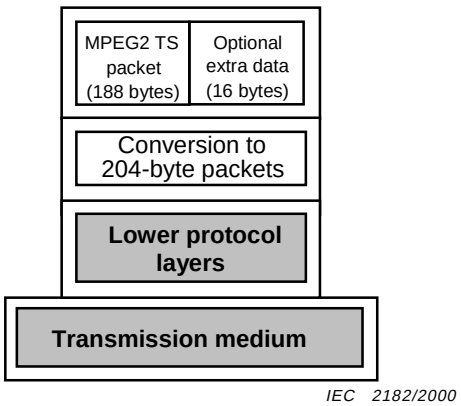
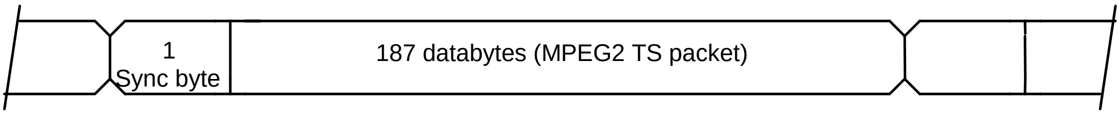


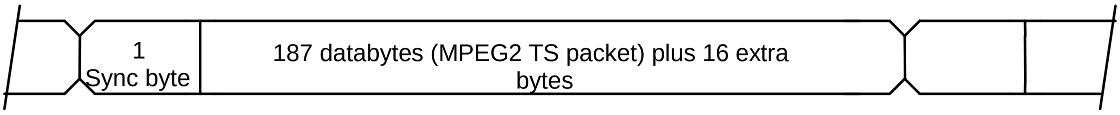
Figure 2 – Protocol stack for 204-byte packets

NOTE Shaded areas identify the scope of this standard.



IEC 2183/2000

Figure 3 – Packet structure of 188-byte packet



IEC 2184/2000

Figure 4 – Packet structure of 204-byte packet

4.1.2 Interfaces

Three interfaces and two serial transmission media are specified as follows:

- SPI (Synchronous Parallel Interface);
- SSI-C (Synchronous Serial Interface on coaxial cable);
- SSI-O (Synchronous Serial Interface on optical fibre);
- ASI-C (Asynchronous Serial Interface on coaxial cable);
- ASI-O (Asynchronous Serial Interface on optical fibre).

Each of these interfaces feature a BER such that FEC is not required for reliable data transport.

The synchronous parallel interface is specified to cover short or medium distances, i.e. for devices arranged near each other. Subclause 4.2 describes the definitions for such a parallel interface derived from ITU-R Recommendation BT.656-4. Flags are provided to distinguish 188-byte packets from 204-byte packets and to signal the existence of valid RS bytes. Note that the interface, as such, is transparent to the RS bytes.

The synchronous serial interface (SSI) which can be seen as an extension of the parallel interface, is briefly introduced in 4.3 and described in detail in annexes A and D. The packet length and the existence of valid RS bytes are conveyed through suitable coding mechanisms.

Subclause 4.4 introduces the Asynchronous Serial Interface (ASI). Details of the ASI are provided in annexes B and E. The ASI is configurable to either convey 188-byte packets (which is mandatory) or optionally 204-byte packets.

4.1.3 Packet length and contents

Each of the interface specifications can be used to convey either 188-byte packets or 204-byte packets in order to enable selection of the appropriate interface characteristics dependent on the kind of equipment to be interconnected. Mandatory and optional packet sizes are specified in table 1.

Table 1 – Mandatory and optional packet lengths

Interface		Data packet carrying capability		
		188 bytes	204 bytes (with 16 dummy bytes)	204 bytes (with 16 RS bytes)
SPI	transmitter	O	M	O
	receiver	M	M	M
SSI	transmitter	O	M	O
	receiver	M	M	M
ASI	transmitter	M	O	O
	receiver	M	O	O
M = mandatory O = optional				

In case the data stream is packetized in 188-byte packets and the interface is configured to convey 204-byte packets, the extra packet length can be used for additional data. The contents of the 16 bytes in this extra packet length are not specified in this standard. One application could be the transmission of 16 RS bytes associated with the preceding transport package.

4.1.4 Compliance

For an equipment to be compliant to this standard it is sufficient for the equipment to show at least one instance of at least one of the interface specifications as described in 4.1.2 and specified in detail in subsequent subclauses of this standard, while at least the mandatory packet sizes as indicated in 4.1.3 shall be supported.

4.1.5 System integration

The interfaces specified in this standard define physical connections between various pieces of equipment. It is important to notice that various parameters which are important for interoperation are not specified in this standard. This is intentional as it leaves maximum implementation flexibility for different applications. In order to facilitate system integration, equipment suppliers shall provide the following information about the characteristics of the interfaces in their equipment:

- interface type (SPI, SSI-C, SSI-O, ASI-C, ASI-O);
- supported packet length (188 bytes, 204 bytes, both);
- maximum input jitter (jitter measured as specified in ISO/IEC 13818-9);
- output jitter (jitter measured as specified in ISO/IEC 13818-9);
- minimum input data rate (rate measured as specified in ISO/IEC 13818-1);
- maximum input data rate (rate measured as specified in ISO/IEC 13818-1).

Some of these parameters may not be applicable to certain types of equipment. If all relevant parameters are provided by equipment suppliers, the proper functioning of the complete system can be ensured.

4.2 Synchronous parallel interface (SPI)

This subclause describes an interface for a system for parallel transmission of variable data rates. The data transfer is synchronized to the byte clock of the data stream, which is the MPEG Transport Stream. Transmission links use LVDS technology [2][1)] and 25-pin connections.

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1) Figures in brackets refer to items in the bibliography.

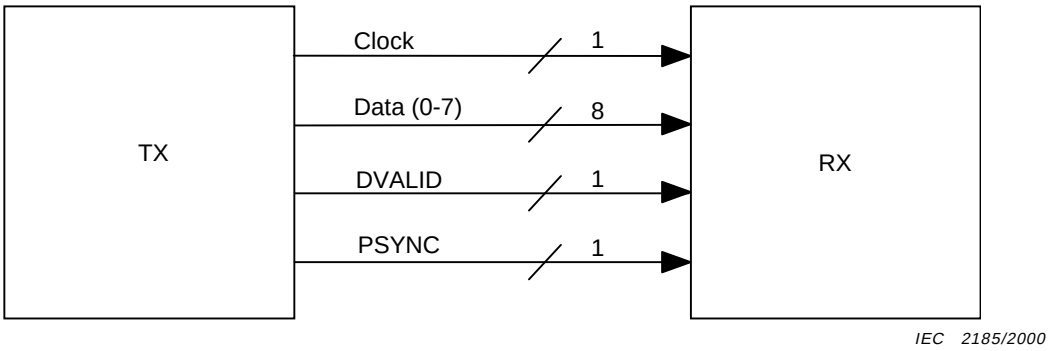

Figure 5 – System for parallel transmission

The data to be transmitted are MPEG-2 Transport Packets with 188 or 204 bytes. In the case of the 204-byte packet format, packets may contain a 16-byte "empty space"; a DVALID signal serves to identify these dummy bytes. A PSYNC flag labels the beginning of a packet. The data are synchronized to the clock depending on the transmission rate.

Equipment which implements the parallel interface shall support the three transmission formats as shown in figures 6, 7 and 8.

4.2.1 Signal format

The clock, data, and synchronization signals shall be transmitted in parallel: 8 data bits together with one (MPEG-2) PSYNC signal and a DVALID signal which indicates in the 204-byte mode that the empty space is filled with dummy bytes. All signals are synchronous to the clock signal. The signals are coded in NRZ form.

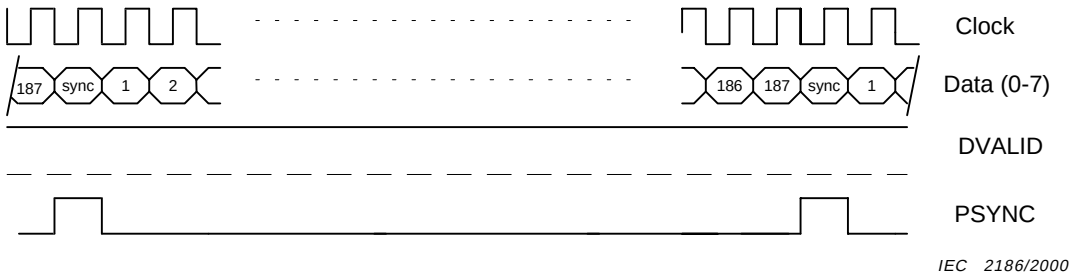

Figure 6 – Transmission format with 188-byte packets

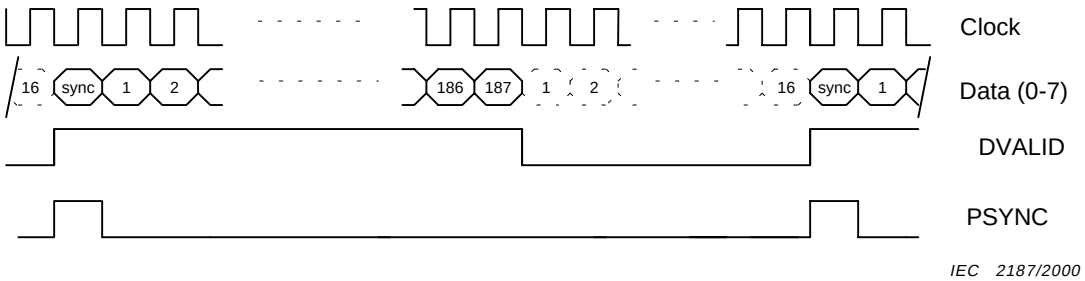

Figure 7 – Transmission format with 204-byte packets (188 data bytes and 16 dummy bytes)