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Road vehicles — Media Oriented Systems Transport (MOST) —

Part 13: 50-Mbit/s balanced media physical layer conformance test plan

Véhicules routiers — Système de transport axé sur les médias —

Partie 13: Plan d'essais de conformité de la couche physique en milieu équilibré à 50-Mbit/s

Reference number
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Foreword

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

A list of all parts in the ISO 21806 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The Media Oriented Systems Transport (MOST) communication technology was initially developed at the end of the 1990s in order to support complex audio applications in cars. The MOST Cooperation was founded in 1998 with the goal to develop and enable the technology for the automotive industry. Today, MOST[1)] enables the transport of high Quality of Service (QoS) audio and video together with packet data and real-time control to support modern automotive multimedia and similar applications. MOST is a function-oriented communication technology to network a variety of multimedia devices comprising one or more MOST nodes.

Figure 1 shows a MOST network example.

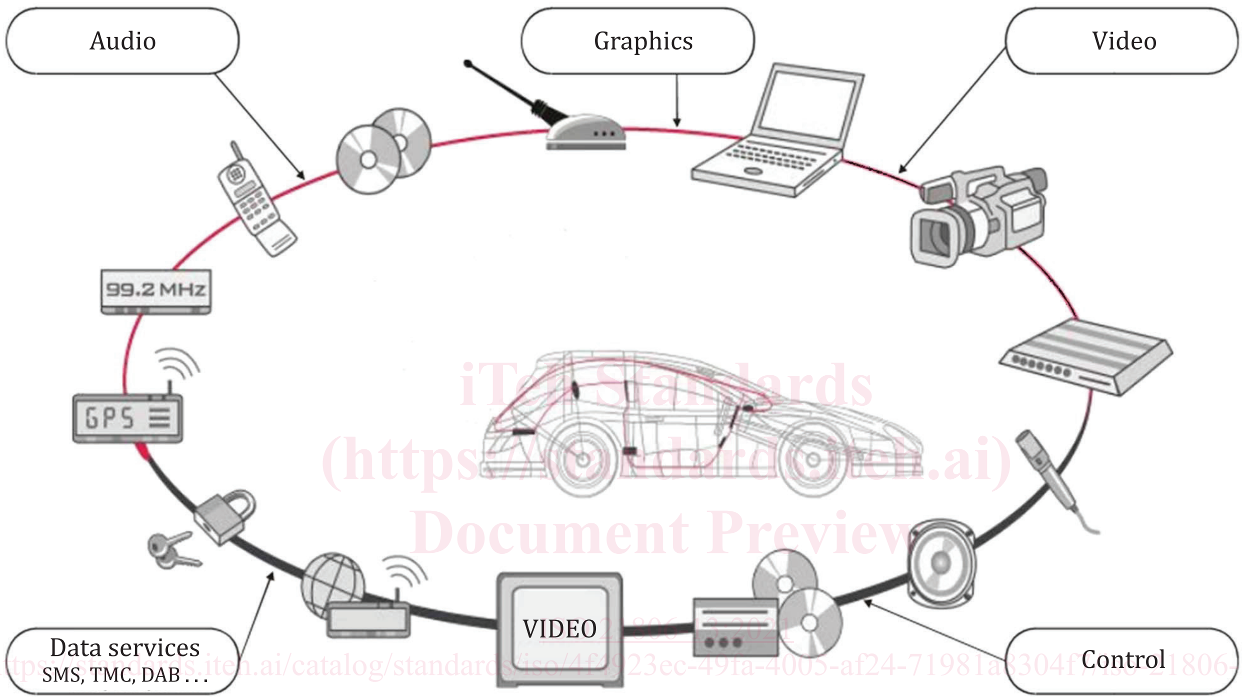

Figure 1 — MOST network example

The MOST communication technology provides:

— synchronous and isochronous streaming,

— small overhead for administrative communication control,

— a functional and hierarchical system model,

— API standardization through a function block (FBlock) framework,

— free partitioning of functionality to real devices,

— service discovery and notification, and

— flexibly scalable automotive-ready Ethernet communication according to ISO/IEC/IEEE 8802-3[2].

MOST is a synchronous time-division-multiplexing (TDM) network that transports different data types on separate channels at low latency. MOST supports different bit rates and physical layers. The network clock is provided with a continuous data signal.

1) MOST® is the registered trademark of Microchip Technology Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO.

Within the synchronous base data signal, the content of multiple streaming connections and control data is transported. For streaming data connections, bandwidth is reserved to avoid interruptions, collisions, or delays in the transport of the data stream.

MOST specifies mechanisms for sending anisochronous, packet-based data in addition to control data and streaming data. The transmission of packet-based data is separated from the transmission of control data and streaming data. None of them interfere with each other.

A MOST network consists of devices that are connected to one common control channel and packet channel.

In summary, MOST is a network that has mechanisms to transport the various signals and data streams that occur in multimedia and infotainment systems.

The ISO standards maintenance portal (https://standards.iso.org/iso/) provides references to MOST specifications implemented in today's road vehicles because easy access via hyperlinks to these specifications is necessary. It references documents that are normative or informative for the MOST versions 4V0, 3V1, 3V0, and 2V5.

The ISO 21806 series has been established in order to specify requirements and recommendations for implementing the MOST communication technology into multimedia devices and to provide conformance test plans for implementing related test tools and test procedures.

To achieve this, the ISO 21806 series is based on the open systems interconnection (OSI) basic reference model in accordance with ISO/IEC 7498-1[1] and ISO/IEC 10731[3], which structures communication systems into seven layers as shown in Figure 2. Stream transmission applications use a direct stream data interface (transparent) to the data link layer.

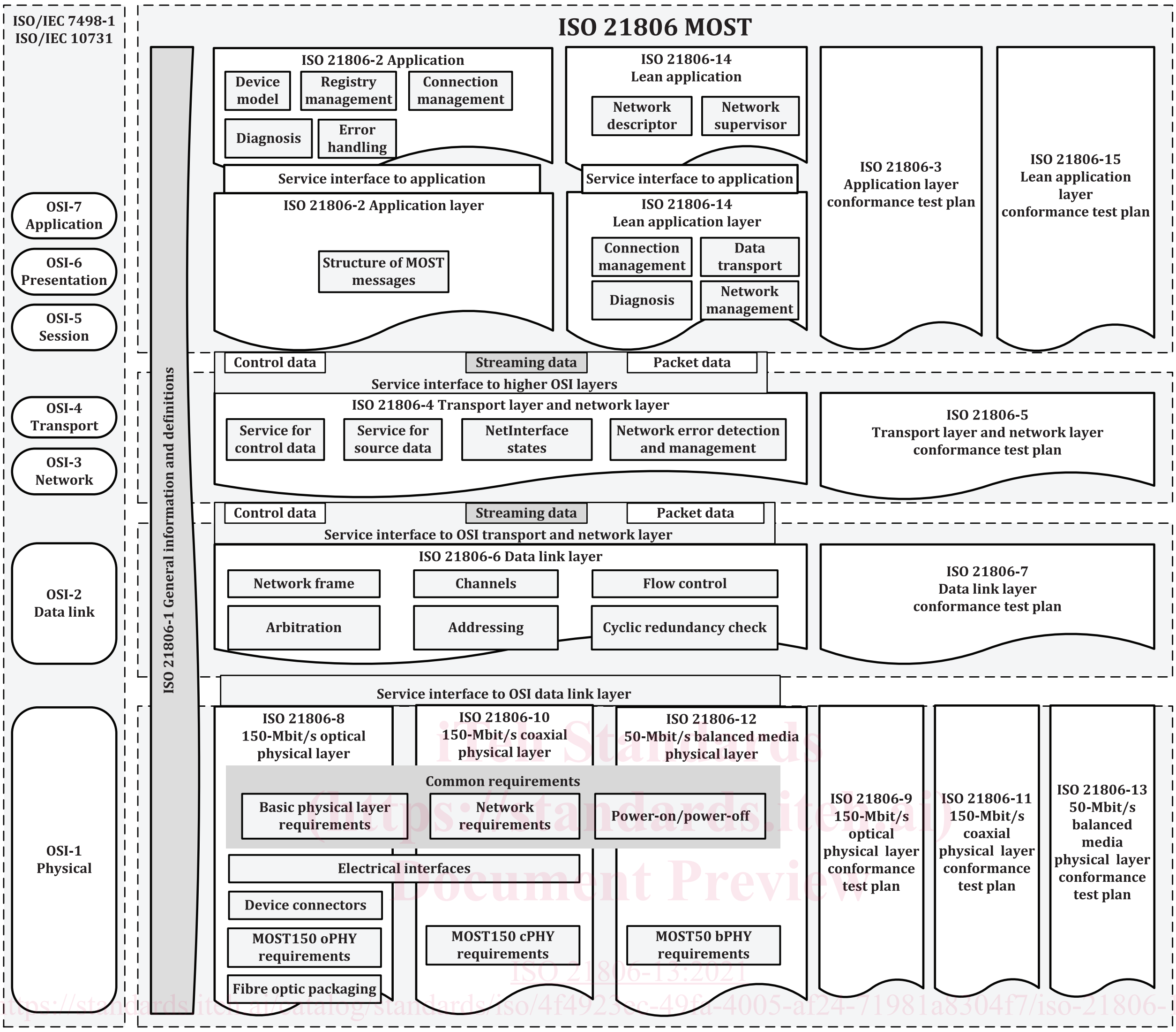

Figure 2 — The ISO 21806 series reference according to the OSI model

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Road vehicles — Media Oriented Systems Transport (MOST) —

Part 13: 50-Mbit/s balanced media physical layer conformance test plan

1 Scope

This document specifies the conformance test plan for the 50-Mbit/s balanced media physical layer for MOST (MOST50 bPHY), a synchronous time-division-multiplexing network.

This document specifies the basic conformance test measurement methods, relevant for verifying compatibility of networks, nodes, and MOST components with the requirements specified in ISO 21806-12.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 21806-1, *Road vehicles — Media Oriented Systems Transport (MOST) — Part 1: General information and definitions*

ISO 21806-12, *Road vehicles — Media Oriented Systems Transport (MOST) — Part 12: 50-Mbit/s balanced media physical layer*

EN 50289-1-8, *Communication cables — Specifications for lest methods — Part 1-8: Electrical test methods — Attenuation*

EN 50289-1-11, *Communication cables — Specifications for lest methods — Part 1-11: Electrical test methods — Characteristic impedance, input impedance, return loss*

No JEDEC JESD8C.01,[2] *interface Standard for Nominal 3 V/3.3 V Supply Digital Integrated Circuits*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21806-1, ISO 21806-12 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

2) Available at https://www.jedec.org/.

3.1
intersymbol interference
disturbance due to the overflowing into the signal element representing a wanted digit of signal elements representing preceding or following digits

[SOURCE: IEC Electropedia, 702-08-33]

4 Symbols and abbreviated terms

4.1 Symbols

---	empty table cell or feature undefined
ε_r	relative permittivity
F	frequency
ρ_{BR}	bit rate
ρ_{Fs}	network frame rate
t	time
T	temperature
T_A	ambient temperature
T_{Typ}	typical temperature

4.2 Abbreviated terms

AFE	analogue frontend
AJ	alignment jitter
BALUN	balanced-unbalanced
BEC	balanced media to electrical converter
BR	bitrate
BTR	balanced media transceiver
BW	bandwidth
Cfg	configuration
CH	channel
DC	direct current
DSO	digital sampling oscilloscope
EBC	electrical to balanced media converter
FFT	fast Fourier transformation
IUT	implementation under test

MNC MOST network controller

PG pattern generator

PLL phase lock loop

PSD power spectral density

RBW resolution bandwidth

RMS root mean square

SP specification point

TDR time-domain reflectometer

TJ transferred jitter

UI unit interval

VNA vector network analyser

5 Conventions

This document is based on OSI service conventions as specified in ISO/IEC 10731[3].

6 Operating conditions and measurement tools, requested accuracy

6.1 Operating conditions

Temperature range for MOST components: T_A = -40 °C to +105 °C according to ISO 21806-12:2021, 11.3.

Voltage range for MOST components: V_{CCCN} and V_{CCSW}, with an operating range of 3,3 V ± 0,165 V according to ISO 21806-12:2021, Clause 10.

NOTE There are functional requirements for the EBC within an extended voltage supply range according to ISO 21806-12.

6.2 Apparatus — Measurement tools, requested accuracy

Apart from the measurement tools listed in this subclause, depending on the chosen test method and method to generate stimuli for the test, further equipment is necessary (e.g. electrical attenuator, discrete filter module to emulate cable transfer function). Performance requirements of such equipment depend on the use case.

The following list provides the measurement tools.

6.2.1 Oscilloscope

— digital sampling oscilloscope;

— sampling rate ≥5 gigasample/s;

— bandwidth ≥1 GHz;

— sampling memory ≥10 megasample;

— active probe (single-ended, differential).

6.2.2 VNA or TDR (TDR bandwidth ≥3,5 GHz).

6.2.3 Ampere meter

— accuracy ≤2 µA;

— trigger input (for timing measurements).

6.2.4 Pattern generator for generating MOST50 bPHY stress pattern

— bandwidth 100 Mbit/s;

— trigger output (for timing measurements).

7 Electrical characteristics

LVTTL testing of MOST devices or MOST components shall be performed according to JEDEC No. JESD8C.01.

8 Balanced media characteristics

8.1 Threshold for detection of alignment and transferred jitter

All jitter measurements are based on detection of edges in the data stream. The threshold for detecting edges is set to 0 V of the differential signal (zero-crossing). DC offset in the measurements shall be minimized as it may indirectly compromise timing-parameter results, see 10.2 and 10.3.

8.2 RMS signal amplitude

In ISO 21806-12:2021, 9.2, output signal power boundaries for SP2 and minimum input signal power at SP3 are defined as RMS voltage.

A waveform, signal voltage over time, is acquired on an oscilloscope. The RMS voltage V_{RMS} is calculated according to Formula (1).

$$V_{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} V(i)^2} \quad (1)$$

where

V_{RMS} is the root-mean-square signal voltage;

N is the number of time steps with equidistant time interval;

V is the voltage amplitude at a specific time step;

i is the index of summation.

RMS signal voltage amplitude gives a representation of the average signal power P_{av} as specified in Formula (2).

$$P_{av} = \frac{V_{RMS}^2}{R} \quad (2)$$

where

P_{av} is the average signal power in [W];

V_{RMS} is the root-mean-square signal voltage.

R resistance of 100 Ω.

In order to get to a representative average value, it requires a long-term observation. Depending on the chosen SP2 and applied channel losses, intersymbol interference impact affects the signal to be measured. It may lead to locally distributed RMS minima and maxima when choosing only short snippets of the signal. The acquired waveform shall have a minimum length of 125 µs (125 µs equals six frames with a frame rate of 48 kHz).

DC offset in the measurements shall be minimized as it may indirectly compromise RMS signal voltage amplitude results, see 10.2 and 10.3.

8.3 PSD of SP2 output signal

PSD as specified in ISO 21806-12:2021, 9.2 is used as a link quality criterion at SP2. The main purpose is to limit pulse shape variations and inherently limit the transmitted signal bandwidth.

Several measurement options are available to perform spectral signal analysis. A method using time-domain data acquisition followed by FFT post-processing is given for reference. Other measurement methods are permitted. In the case of discrepancies, the reference method shall be used.

PSD shall be measured with an RMS detector and using an effective RBW of 500 kHz. Besides directly measuring PSD with 500 kHz resolution bandwidth, this can be achieved by using lower RBW setting and averaging spectral results in the amount *n* of overlapping groups of the lower RBW bands to produce the effect of 500 kHz RBW sliding window (linear scale), (i.e. measurement with RBW 10 kHz, averaged in overlapping groups of fifty bands, therefore $n = 50$). To achieve statistical representation, the spectral density results of multiple trace segments are averaged to form the final result. The number of trace segments contributing to the averaged spectrum equals the sweep time.

The following is an example procedure for measuring PSD.

— The IUT transmitter sends multiple MOST50 bPHY PSD patterns.

— Differential signal at terminated SP2 is measured with a differential probe. Other methods to measure a single ended representation of the differential signal are acceptable (e.g. use BALUN or use test fixture with matched length 50 Ω coaxial cables, measured with 2 channels and mathematical combination).

— An oscilloscope acquires the SP2 signal. To reduce noise in the measurement channel, it is recommended to use an averaging technique for time domain data acquisition. Selecting oscilloscope sampling rate and acquisition length leads to the inherent RBW for the acquisition, which is the reciprocal of the acquired duration time. The appropriate duration can be achieved by adjusting horizontal oscilloscope settings accordingly or by acquiring longer traces and slice the trace into appropriate trace segments for the further processing.

— For further post-processing, FFT algorithm can be applied on the oscilloscope or via processing per external script on a PC. In frequency domain, PSD is then formed as a moving average (linear scale) of *n* consecutive samples of the inherent RBW bands.

— To achieve statistical representation, the spectral density results of multiple trace segments are averaged to form the final result. The number of trace segments contributing to the averaged spectrum equals the sweep time.

— Described procedure provides spectral density for consecutive 500 kHz bands in the relevant frequency range and can be directly compared with the limit lines.

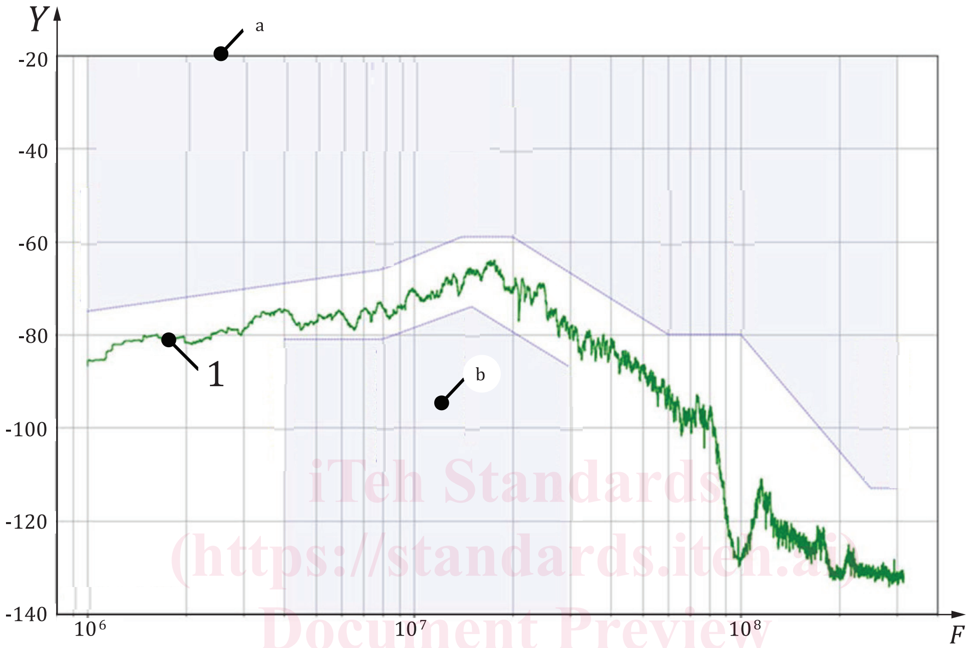
Configuration for a measurement example:

— acquisition length of 1 megasample with sampling rate 10 GHz results in a duration of 100 µs or inherent RBW of 10 kHz,

— this results in an overlap of n = 50 inherent RBW bands to form effective RBW of 500 kHz,

— 100 iterations lead to a sweep time of 10 ms.

Figure 3 shows the example measurement for PSD.



Key

Y PSD [dBm/Hz]

F frequency [Hz]

1 example PSD

[a] This is the upper limit of the PSD mask.

[b] This is the lower limit of the PSD mask.

Figure 3 — Example measurement for PSD

PSD analysis may also be performed with a spectral analyser. The number of data points can also be lower and not produce gapless data in the specified frequency range. Settings are applied that fit the above described processing.

Figure 4 shows the test set-up for measuring PSD with an oscilloscope.