SLOVENSKI STANDARD
SIST EN 300 462-5-1 V1.1.2:2003

01-december-2003

Prenos in multipleksiranje (TM) ï Generiļ ne zahteve za sinhronizacijska omreģja ï 5-1. del: Ļasovne znaļ ilnosti podrejenih ur, primernih za obratovanje v opremi sinhrone digitalne hierarhije (SDH)

Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 5-1: Timing characteristics of slave clocks suitable for operation in Synchronous Digital Hierarchy (SDH) equipment

Ta slovenski standard je istoveten z: **EN 300 462-5-1 Version 1.1.2**

ICS:

33.040.20 Prenosni sistem Transmission systems

SIST EN 300 462-5-1 V1.1.2:2003 **en**

EN 300 462-5-1 V1.1.2 (1998-05)

European Standard (Telecommunications series)

Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 5-1: Timing characteristics of slave clocks suitable for operation in Synchronous Digital Hierarchy (SDH) equipment

Reference

REN/TM-03017-5-1 (4a199idc.PDF)

Keywords

synchronization, timing, transmission

ETSI

Postal address

F-06921 Sophia Antipolis Cedex - FRANCE

Office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Internet

secretariat@etsi.fr
http://www.etsi.fr
http://www.etsi.org

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Foreword

This European Standard (Telecommunications series) has been produced by the Transmission and Multiplexing (TM) Technical Committee.

The present document has been produced to provide requirements for synchronization networks that are compatible with the performance requirements of digital networks. It is one of a family of documents covering various aspects of synchronization networks:

Part 1-1: "Definitions and terminology for synchronization networks";

Part 2-1: "Synchronization network architecture";

Part 3-1: "The control of jitter and wander within synchronization networks";

Part 4-1: "Timing characteristics of slave clocks suitable for synchronization supply to Synchronous Digital Hierarchy (SDH) and Plesiochronous Digital Hierarchy (PDH) equipment";

Part 4-2: "Timing characteristics of slave clocks suitable for synchronization supply to Synchronous Digital Hierarchy (SDH) and Plesiochronous Digital Hierarchy (PDH) equipment Implementation Conformance (ICS) Statement";

Part 5-1: "Timing characteristics of slave clocks suitable for operation in Synchronous Digital Hierarchy (SDH) equipment";

Part 6-1: "Timing characteristics of primary reference clocks";

Part 6-2: "Timing characteristics of primary reference clocks Implementation Conformance (ICS) Statement";

Part 7-1: "Timing characteristics of slave clocks suitable for synchronization supply to equipment in local node applications".

Parts 1-1, 2-1, 3-1 and 5-1 have previously been published as ETS 300 462 Parts 1, 2, 3 and 5, respectively.

Additionally, parts 4-1 and 6-1 completed the Voting phase of the Two Step Approval procedure as ETS 300 462 Parts 4 and 6, respectively.

It was decided to prepare ICS proformas for several of the parts and this necessitated a re-numbering of the individual document parts. It was also decided to create a new part 7-1.

This in turn led to a need to re-publish new versions of all six parts of the original ETS. At the same time, the opportunity was taken to convert the document type to EN.

This has involved no technical change to any of the documents. However part 5-1 has been modified, due to editorial errors which appeared in ETS 300 462-5.

Transposition dates	
Date of adoption of this ETS:	16 August 1996
Date of latest announcement of this ETS (doa):	31 December 1996
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	30 June 1997
Date of withdrawal of any conflicting National Standard (dow):	30 June 1997

NOTE: The above transposition table is the original table from ETS 300 462-5 (September 1996, see History).

1 Scope

This European Standard (Telecommunications series) outlines requirements for timing devices used in synchronising network equipment that operates according to the principles governed by the Synchronous Digital Hierarchy (SDH). These requirements apply under the normal environmental conditions specified for SDH equipment. Typical SDH equipment contains a slave clock linked to a master, or a primary reference clock. The logical function of the SEC is described in figure 2 of EN 300 462-2-1 [3]. In general the SDH Equipment Clock (SEC) will have multiple reference inputs. In the event that all links between the master and the slave clock fail, the equipment should be capable of maintaining operation (holdover) within the prescribed performance limits contained within the present document.

Slave clocks used in SDH equipment shall meet specific requirements in order to comply with the jitter specifications given in ETS 300 417-1-1 [9] for plesiochronous tributaries.

The case where clock performance is required in SDH equipment is outside the scope of the present document, see EN 300 462-4-1 [10].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[2] EN 300 462-1-1: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 1-1: Definitions and terminology for synchronization networks".

[3] EN 300 462-2-1: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 2-1: Synchronisation network architecture".

[4] ITU-T Recommendation G.823: "The control of jitter and wander within digital networks which are based on the 2 048 kbit/s hierarchy".

[5] EN 300 462-6-1: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 6-1: Timing characteristics of primary reference clocks".

[6] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

[7] ITU-T Recommendation G.825: "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".

[8] ITU-T Recommendation Q.551: "Transmission characteristics of digital exchanges".

[9] ETS 300 417-1-1 (1996): "Transmission and Multiplexing (TM); Generic functional requirements for Synchronous Digital Hierarchy (SDH) equipment; Part 1-1: Generic processes and performance".

[10] EN 300 462-4-1: "Transmission and Multiplexing (TM); Generic requirements for synchronization networks; Part 4-1: Timing characteristics of slave clocks suitable for synchronization supply to Synchronous Digital Hierarchy (SDH) and Plesiochronous Digital Hierarchy (PDH) equipment".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the definitions given in EN 300 462-1-1 [2] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in EN 300 462-1-1 [2], together with the following, apply:

MTIE	Maximum Time Interval Error
NE	Network Element
PDH	Plesiochronous Digital Hierarchy
PLL	Phase Locked Loop
ppm	parts per million
PRC	Primary Reference Clock
SDH	Synchronous Digital Hierarchy
SEC	SDH Equipment Clock
SSU	Synchronisation Supply Unit
STM-N	Synchronous Transport Module N
TDEV	Time Deviation
UI	Unit Interval
UIpp	Unit Interval peak to peak
VCO	Voltage Controlled Oscillator

4 Frequency accuracy

Under free-running conditions, the SEC output frequency accuracy shall be within 4,6 ppm with regard to a reference traceable to a clock as specified in EN 300 462-6-1 [5].

NOTE: The time interval for this accuracy specification is for further study.

5 Pull-in and pull-out ranges

The minimum pull-in range shall be ± 4,6 ppm, whatever the internal oscillator frequency offset may be. The Pull-out range is for further study. A value of ± 4,6 ppm has been proposed.

6 Noise generation

The noise generation of a SEC represents the amount of phase noise produced at the output when there is an ideal input reference signal or the clock is in holdover state. A suitable reference, for practical testing purposes, implies a performance level at least 10 times more stable than the output requirements. The ability of the clock to limit this noise is described by its frequency stability. The measures Maximum Time Interval Error (MTIE) and Time Deviation (TDEV) are useful for characterization of noise generation performance.

MTIE and TDEV are measured through an equivalent 10 Hz, first order, low-pass measurement filter, at a maximum sampling time t_0 of 1/30 second. The minimum measurement period for TDEV is twelve times the integration period ($T = 12\tau$).

6.1 Wander in locked mode

When the SEC is in the locked mode of operation, the MTIE and TDEV measured using the synchronised clock configuration defined in figure 1a of EN 300 462-1-1 [2] shall have the limits in tables 1 and 2, if the temperature is constant (± 1 K).

Table 1: Wander in locked mode for constant temperature specified in MTIE

Requirement	Observation interval
40 ns	$0,1 < \tau \leq 1$ s
$40\ \tau^{0,1}$ ns	$1 < \tau \leq 100$ s
$25\ \tau^{0,2}$ ns	$100 < \tau \leq 1\ 000$ s

Table 2: Wander in locked mode for constant temperature specified in TDEV

Requirement	Observation interval
3,2 ns	$0,1 < \tau \leq 25$ s
$0,64\ \tau^{0,5}$ ns	$25 < \tau \leq 100$ s
6,4 ns	$100 < \tau \leq 1\ 000$ s

The model used to derive these numbers is described in (informative) annex C. The resultant requirements are shown by the thick solid lines in figures 1 and 2.

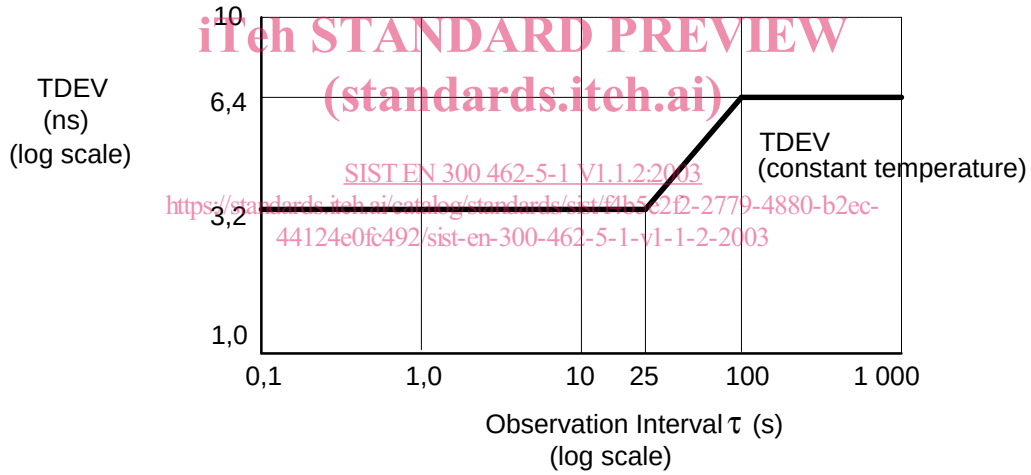

Figure 1: TDEV as a function of an observation period τ