

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



Specification for the testing of balanced and coaxial information technology cabling –

Part 1-1: Additional requirements for the measurement of transverse conversion loss and equal level transverse conversion transfer loss

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Spécification relative aux essais des câblages symétriques et coaxiaux des technologies de l'information –

Partie 1-1: Exigences supplémentaires pour le mesurage de l'affaiblissement de conversion transversale et de l'affaiblissement de transfert de conversion transversale de niveau égal



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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**SPECIFICATION FOR THE TESTING OF BALANCED  
AND COAXIAL INFORMATION TECHNOLOGY CABLING –**
**Part 1-1: Additional requirements for the measurement of transverse  
conversion loss and equal level transverse conversion transfer loss**

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
46/724/FDIS	46/729/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61935 series, published under the general title *Specification for the testing of balanced and coaxial information technology cabling*, can be found on the IEC website.

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## INTRODUCTION

Measurement of TCL and ELTCTL is not required by IEC 61935-1. However, these parameters are specified requirements of unscreened cabling for class D up to  $F_A$  according to ISO/IEC 11801-1. The installation can experience delivery of non-compliant components which cannot assure ISO/IEC 11801-1 system compliance. Other installation factors can also affect TCL and ELTCTL performance.

For screened cabling, TCL and ELTCTL are not specified requirements for class D up to  $F_A$  according to ISO/IEC 11801-1.

Observation of the minimum requirements of IEC 61935-1 would not identify non-compliant cabling. However, field test instrumentation can provide reference tests for TCL and ELTCTL that can be optionally applied to the minimum requirements of IEC 61935-1.

This document describes the practice of such testing and provides a reference level of accuracy for such field testers.

In addition, those wishing to use field test instrumentation for the laboratory evaluation of systems or components according to ISO/IEC 11801-1 could also use this document to ensure a consistent level of understood accuracy.

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# SPECIFICATION FOR THE TESTING OF BALANCED AND COAXIAL INFORMATION TECHNOLOGY CABLING –

## Part 1-1: Additional requirements for the measurement of transverse conversion loss and equal level transverse conversion transfer loss

### 1 Scope

This part of IEC 61935 specifies additional reference measurement procedures for level V field testers, transverse conversion loss (TCL) and equal level transverse conversion transfer loss (ELTCTL). The requirements for field tester accuracy to measure these parameters according to the requirements of ISO/IEC 11801-1 are specified in this document.

### 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.

IEC 61935-1:2019, *Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

### 3 Terms definitions and acronyms

For the purposes of this document, the terms and definitions given in IEC 61935-1 and ISO/IEC 11801 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1 Terms and definitions

##### 3.1.1

##### **transverse conversion loss**

ratio, expressed in dB, of the measured common mode voltage on a pair relative to the differential mode voltage on the same pair applied at the same end

##### 3.1.2

##### **transverse conversion transfer loss**

ratio, expressed in dB, of the measured common mode voltage on a pair relative to the differential mode voltage applied at the opposite end of the same pair

##### 3.1.3

##### **equal level transverse conversion transfer loss**

difference, in dB, between the transverse conversion transfer loss and the differential mode insertion loss of a pair



### 3.2 Acronyms

TCL	Transverse conversion loss
TCTL	Transverse conversion transfer loss
ELTCTL	Equal level transverse conversion transfer loss

## 4 Reference measurement procedures

### 4.1 Cabling configurations

The cabling configurations that are tested in the field are described by IEC 61935-1.

### 4.2 Transverse conversion loss

The reference measurement procedure for TCL is provided by IEC 61935-1.

### 4.3 Equal level transverse conversion transfer loss

The reference measurement procedure for ELTCTL is provided by IEC 61935-1.

## 5 Field test measurement requirements for TCL and ELTCTL

### 5.1 General

This document specifies additional reference measurement procedures for level V field test transverse conversion loss (TCL) and equal level transverse conversions transfer loss (ELTCTL) and the requirements for field tester accuracy to measure these parameters.

Measurement of TCL and ELTCTL is not required by IEC 61935-1; however, these parameters are specified requirements of unscreened cabling for class D up to  $F_A$  according to ISO/IEC 11801-1.

For screened cabling, TCL and ETCTL are not specified requirements for class D up to  $F_A$  according to ISO/IEC 11801-1.

### 5.2 Field test parameters

The following field test measurement parameters and related requirements are specified in this document:

- TCL;
- ELTCTL.

### 5.3 Data reporting and accuracy

#### 5.3.1 General

See IEC 61935-1.

#### 5.3.2 Detailed results

The field test equipment shall be capable of recording all connectivity information, as well as the measured values of every parameter at every frequency data point. In addition, the detailed results shall include a PASS/FAIL result for TCL and ELTCTL, as applicable for the selected performance level.

### 5.3.3 Summary results

A summary of the reporting requirements for field test equipment are provided by Table 1.

**Table 1 – Summary reporting requirements for field test equipment**

Function	Measured from local end or remote end (if measurements from both directions are not required)	Measured from remote end (if measurement from remote end is required)
TCL	Worst case TCL margin (1 of 4 possible) Test limit at worst case TCL margin TCL at worst case TCL margin Frequency at which worst case margin occurs PASS/FAIL	Worst case TCL margin (1 of 4 possible) Test limit at worst case TCL margin TCL at worst case TCL margin Frequency at which worst case margin occurs PASS/FAIL
ELTCTL	Worst case ELTCTL margin (1 of 4 possible) Test limit at worst case ELTCTL margin ELTCTL at worst case ELTCTL margin Frequency at which worst case margin occurs PASS/FAIL	Worst case ELTCTL margin (1 of 4 possible) Test limit at worst case ELTCTL margin ELTCTL at worst case ELTCTL margin Frequency at which worst case margin occurs PASS/FAIL

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## 6 Field tester measurement accuracy requirements

### 6.1 General

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A summary of the accuracy of TCL and ELTCTL measurements for level V testers is provided by Table 2.

**Table 2 – Summary of TCL and ELTCTL accuracy for level V testers**

Test parameter	Baseline accuracy at permanent link limit			Link accuracy at permanent link limit			Channel accuracy at channel limit		
	dB			dB			dB		
Level V	1 ≤ f < 50 MHz	50 ≤ f < 100 MHz	100 ≤ f ≤ 1 000 MHz	1 ≤ f < 50 MHz	50 ≤ f < 100 MHz	100 ≤ f ≤ 1 000 MHz	1 ≤ f < 50 MHz	50 ≤ f < 100 MHz	100 ≤ f ≤ 1 000 MHz
Frequency									
TCL	5,0	7,0 – $\frac{f}{25}$	3,0	5,0	7,0 – $\frac{f}{25}$	3,0	5,0	7,0 – $\frac{f}{25}$	3,0
ELTCTL	4,0	5,0 – $\frac{f}{50}$	3,0	4,0	5,0 – $\frac{f}{50}$	3,0	4,0	5,0 – $\frac{f}{50}$	3,0

Table 3 provides an informative summary of TCL and ELTCTL accuracy values for level V testers.

**Table 3 – Informative summary of TCL and ELTCTL accuracy values for level V testers**

Frequency MHz	TCL			ELTCTL		
	Baseline accuracy at permanent link limit dB	Link accuracy at permanent link limit dB	Channel accuracy at channel limit dB	Baseline accuracy at permanent link limit dB	Link accuracy at permanent link limit dB	Channel accuracy at channel limit dB
1	5,0	5,0	5,0	4,0	4,0	4,0
50	5,0	5,0	5,0	4,0	4,0	4,0
100	3,0	3,0	3,0	3,0	3,0	3,0
1 000	3,0	3,0	3,0	3,0	3,0	3,0

NOTE For Class D up to  $F_A$ , ISO/IEC 11801-1 limits for TCL are specified to a maximum frequency of 250 MHz, and ELTCTL to a maximum frequency of 30 MHz. IEC 61935-1 (all parts) documents specify accuracy as referenced at the limit line, and for the purposes of IEC 61935-1-1 accuracy requirements, extrapolations (or highest frequency requirement) of ISO/IEC 11801-1 TCL and ELTCTL requirements have been assumed to apply up to 1 000 MHz with a plateau of 3 dB applied.

## 6.2 Comparison methods to reference procedures

When comparing TCL and ELTCTL results to reference measurement procedures provided by IEC 61935-1, the full frequency comparison method given by IEC 61935-1:2019 6.12.2.2 shall be used. Annex A provides informative error models for TCL and ELTCTL.

## 6.3 Accuracy performance requirements for level V field testers

The tester performance requirements for TCL measurements for level V testers are provided by Table 4.

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**Table 4 – Summary of tester requirements for TCL measurements**

Parameter	Baseline field tester dB	Field tester with level V permanent link adapter dB	Field tester with level V channel adapter dB
Dynamic accuracy for TCL ( $E_{TCL}$ )	±0,75	±0,75	±0,75
Differential mode return loss of the tester ( $E_{DMRL, \text{tester}}$ )	1 MHz to 300 MHz: $20 - 12,5 \log(f/100)$ 20 max 300 MHz to 600 MHz: 14 600 MHz to 1 000 MHz: $21 - 9 \log(f/100)$	1 MHz to 300 MHz: $18 - 12,5 \log(f/100)$ 20 max 300 MHz to 600 MHz: 12 600 MHz to 1 000 MHz: $19 - 9 \log(f/100)$	1 MHz to 300 MHz: $18 - 12,5 \log(f/100)$ 20 max 300 MHz to 600 MHz: 12 600 MHz to 1 000 MHz: $19 - 9 \log(f/100)$
Common mode return loss of the tester ( $E_{CMRL, \text{tester}}$ )	6	6	$10 - 10 \log(f/100)$ 6 max 3 min
Residual TCL of the tester ( $E_{RTCL}$ )	$55 - 20 \log(f/100)$ 55 max	$55 - 20 \log(f/100)$ 55 max	$45 - 20 \log(f/100)$ 55 max
TCL random noise floor of the tester ( $E_{RTCL}$ )	85	80	80

The tester performance requirements for ELTCTL measurements for level V testers are provided by Table 5.

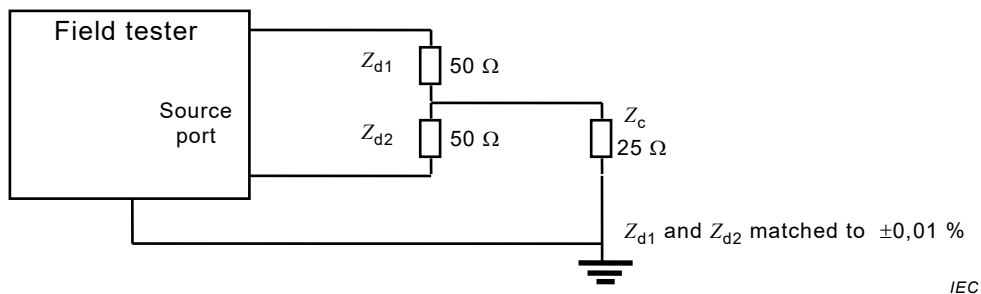
**Table 5 – Summary of tester requirements for ELTCTL measurements**

Parameter	Baseline field tester	Field tester with level V permanent link adapter	Field tester with level V channel adapter
	dB		
Dynamic accuracy for TCTL	± 0,75	± 0,75	± 0,75
Dynamic accuracy for IL	± 0,75	± 0,75	± 0,75
Differential mode return loss of the tester	1 MHz to 300 MHz: 20 – 12,5 log( <i>f</i> /100) 20 max 300 MHz to 600 MHz: 14 600 MHz to 1 000 MHz: 21 – 9 log( <i>f</i> /100)	1 MHz to 300 MHz: 18 – 12,5 log( <i>f</i> /100) 20 max 300 MHz to 600 MHz: 12 600 MHz to 1 000 MHz: 19 – 9 log( <i>f</i> /100)	1 MHz to 300 MHz: 18 – 12,5 log( <i>f</i> /100) 20 max 300 MHz to 600 MHz: 12 600 MHz to 1 000 MHz: 19 – 9 log( <i>f</i> /100)
Common mode return loss of the tester	6	6	10 – 10 log( <i>f</i> /100) 6 max 3 min
Residual TCTL of the tester	42 – 20 log( <i>f</i> /100) 50 max	42 – 20 log( <i>f</i> /100) 50 max	30 – 20 log( <i>f</i> /100) 45 max
TCTL random noise floor of the tester	85	80	80
Dynamic accuracy for TCTL	±0,75	± 0,75	± 0,75

**6.4 Procedures for determining field tester parameters**

**6.4.1 Residual TCL of the tester ( $E_{RTCL}$ )**

The measurement of residual TCL shall be according the measurement setup shown in Figure 1.



**Figure 1 – Diagram of the measurement of residual TCL**

**6.4.2 Residual TCTL of the tester ( $E_{RTCTL}$ )**

The measurement of residual TCTL shall be according to Figure 2.