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BSI Standards Publication

ESL measuring method —
Part 1: Capacitors with lead terminal for use
in electronic equipment

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**ESL measuring method -
Part 1: Capacitors with lead terminal for use in electronic equipment
(IEC 62490-1:2010)**

Méthode de mesure de l'ESL -
Partie 1: Condensateurs à bornes
de sortie utilisés dans les équipements
électroniques
(CEI 62490-1:2010)

ESL-Messverfahren -
Teil 1: Kondensatoren
mit Anschlussdrähten zur Verwendung
in Geräten der Elektrotechnik
und Elektronik
(IEC 62490-1:2010)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 40/2044/FDIS, future edition 1 of IEC 62490-1, prepared by IEC TC 40, Capacitors and resistors for electronic equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62490-1 on 2010-09-01.

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The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2011-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2013-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62490-1:2010 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60384-1	2008	Fixed capacitors for use in electronic equipment - Part 1: Generic specification	EN 60384-1	2009

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ESL MEASURING METHOD –

**Part 1: Capacitors with lead terminal
for use in electronic equipment**

FOREWORD

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International Standard IEC 62490-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

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

FDIS	Report on voting
40/2044/FDIS	40/2056/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 2.

A list of all the parts in the IEC 62490 series, under the general title *ESL measuring method*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

ESL MEASURING METHOD –

Part 1: Cap with lead terminal for use in electronic equipment

1 Scope

This part of IEC 62490 provides the equivalent series inductance L (ESL) measuring method for capacitors with lead terminal type for use in electronic equipment.

The inductance values of capacitors provided for this document are within the range of 1 nH to 10 nH.

2 Normative references

The following referenced documents are indispensable for the application 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 60384-1:2008, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 60384-1 and the following apply.

3.1

equivalent series inductance L ESL

inductive part of the impedance of capacitors

NOTE 1 The unit of ESL is Henry (H).

4 Measurement jig, short compensation jig, and spacer

4.1 Measurement jig (test fixture)

The measurement jig shall have the following features:

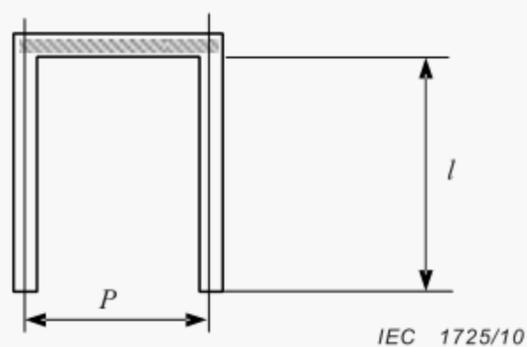
- a) the lead terminal holding method shall be screw up;
- b) the measurement jig has two pairs of screw-fixation electrodes for fixing the lead terminals of the capacitor to be measured. In pairs, one of the electrodes is fixed to the measurement jig and the other is adjustable for fixing the lead wire. The adjustable electrode shall move only in a direction to hold the lead terminal and shall not rotate around the electrode fixing screw.

4.2 Short compensation jig

The short compensation jig shall be the lead wire rod which has the following features of the materials and dimensions, which includes the diameter or the cross-section area:

- a) materials shall be the same materials as the lead wire of the capacitor to be measured;
- b) shape shall be as shown in Figure 1;

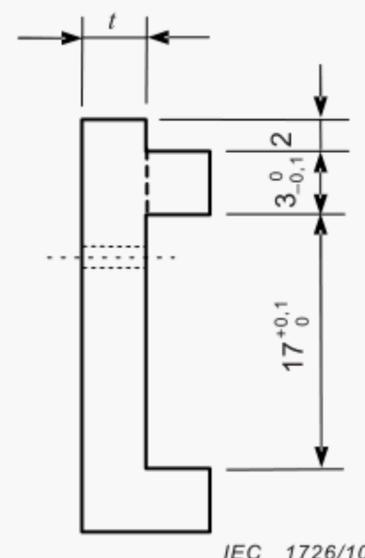
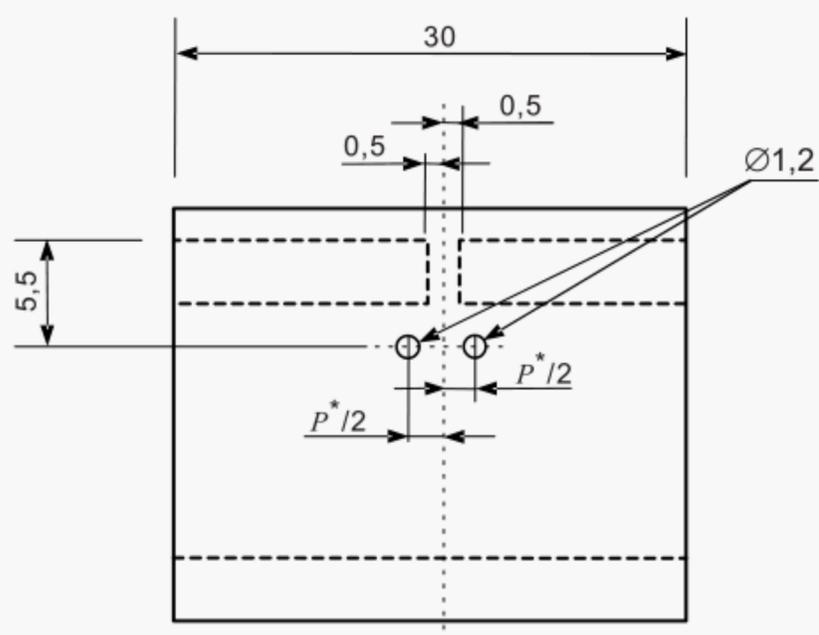
- c) spacing section (pitch) shall be the same lead spacing as the capacitor to be measured. The tolerance on the lead spacing of a short compensation jig shall be $\pm 0,25$ mm;
- d) the straight section (shank) of the jig length shall be 5 mm to 10 mm, depending on what the measurement jig is able to hold. The straight section of the jig shall be kept from bending.

**Key**

- P spacing section (pitch) (shaded section)
- l straight section (shank)

Figure 1 – Short compensation jig**4.3 Spacer**

These spacers shall be firmly fixed onto the measurement jig. The spacer material shall be nonmagnetic. An example is shown in Figure 2.



Dimensions in millimetres

Key for Figure 2a

P lead spacing

* Lead spacing shall be the same as the capacitor to be measured.

Key for Figure 2b

t thickness of the spacer

Figure 2a – Front view of the spacer

Figure 2b – Side view of the spacer

P	t	Remarks
$3,5 \pm 0,3$	$1,5 \pm 0,1$	Short compensation spacer
	$3,25 \pm 0,1$	Measurement spacer
$5,0 \pm 0,3$	$1,5 \pm 0,1$	Short compensation spacer
	$4,0 \pm 0,1$	Measurement spacer

NOTE The basic method for measuring ESL when using these types of spacer is shown in Annex A.

Figure 2 – Constructional example of the short compensation spacer and the measurement spacer

5 Measuring method

5.1 Measuring instrument

The impedance analyser (balance bridge method) with the following specification or equivalent shall be used:

- inductance value (ESL) can be measured at a frequency of 40 MHz or higher;
- basic impedance accuracy shall be $\pm 0,08\%$ or better;
- impedance value of 3 m Ω or less can be measured.

5.2 Measurement conditions

The measurements shall be made under the standard atmospheric conditions for testing, as specified in IEC 60384-1:2008, 4.2.1. In addition, if there is any doubt as to the validity of measurement, the recovery conditions, as specified in IEC 60384-1:2008, 4.2.2, shall be implemented.

5.3 Preparation of sample

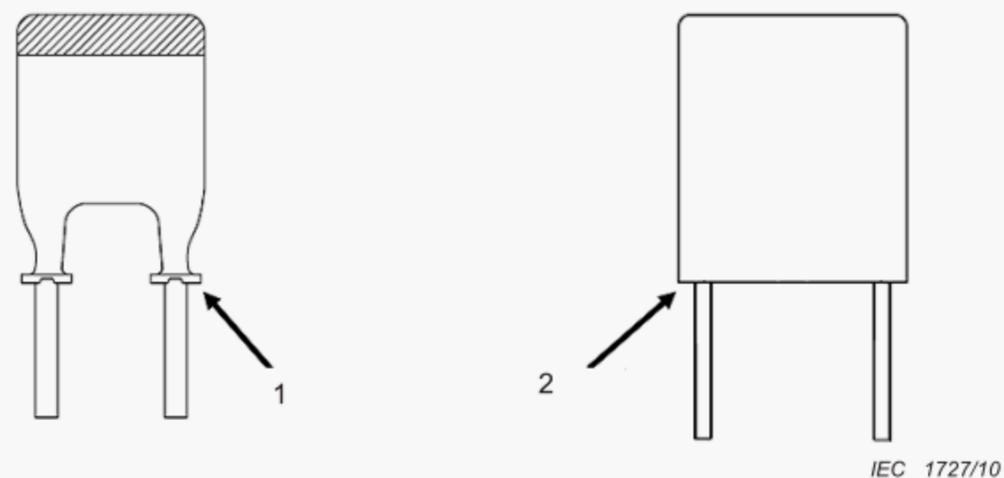
The lead terminals of a capacitor to be measured shall be cut at a length of 5 mm to 10 mm. When cutting the lead terminals, the lead terminal shall be kept from bending.

NOTE By cutting the leads shorter, they make stable contact with the measurement electrodes and provide highly repeatability and reproducibility.

5.4 Measurement points

The measurement points of ESL shall be the places of the seating plane or flange of the capacitor to be measured. An example is shown in Figure 3.

NOTE Although during measurement the spacer is used, the measured value is equivalent to the value that would be measured at the seating plane of the lead terminals of capacitors as shown in Annex A.



Key

- 1 flange
- 2 seating plane

Figure 3 – Measure points: seating plane or flange of capacitor on the printed circuit board

5.5 Frequency and signal level

Unless otherwise specified in the product specification, the frequency and signal shall be as follows;

- a) the measurement frequency shall be 40 MHz;
- b) the signal level of an oscillation of a measuring instrument shall be 0,5 V to 1,0 V in r.m.s.

5.6 Measurement procedure

5.6.1 General

The measurement shall be performed in the order of open compensation, short compensation, and ESL measurement of the capacitor. Before beginning the procedure, the number of times to average and integration time shall be set so that measurement accuracy is less than 2 %.

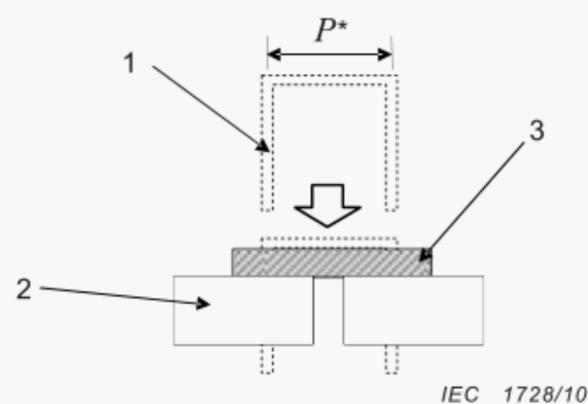
NOTE Increasing the number of times to average and integration time increases repeatability and reproducibility.

5.6.2 Open compensation

Connect the measurement jig specified in 4.1 to the measuring instrument and tighten the screw for adjustable electrode with nothing in between the electrodes. Perform open compensation according to the instructions for the measuring instrument.

5.6.3 Short compensation

The test fixture specified in 4.1 shall be connected to the measuring instrument and the short compensation jig specified in 4.2 with the short compensation spacer shall be fixed in between the electrodes by tightening the screws. Then the short compensation shall be performed according to the instruction of the measurement instrument. Example of short compensation shall be as shown in Figure 4.



Key

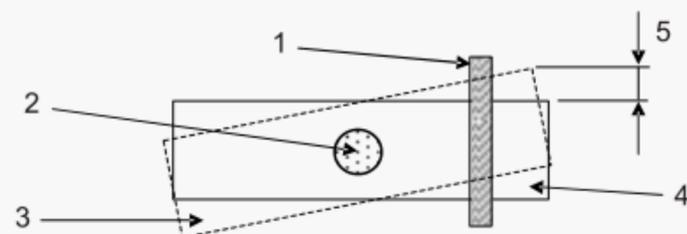
- 1 short compensation jig (dashed lines)
- 2 electrode of measurement jig (solid lines)
- 3 short compensation spacer (shaded section)
- P lead spacing
- * lead spacing shall be the same as the capacitor to be measured.

Figure 4 – Method of short compensation

5.6.4 ESL measurement

After performing the compensation specified in 5.6.2 and 5.6.3, replace short compensation spacer with the measurement spacer specified in 4.3 and tighten the screw for adjustable electrode with the lead terminal of the capacitor to be measured which is prepared according to 5.3 through the spacer in between the electrodes. Then measure the ESL of the capacitor.

Care shall be taken so that the electrode of the measurement jig does not rotate and prevent shifting as shown in Figure 5, when insert lead terminal of the capacitor to be measured.



Electrode fixing screw of a measurement jig

IEC 1729/10

Key

- 1 lead wire (shaded section)
- 2 fixation screw (shaded section)
- 3 adjustable electrode (dashed lines)
- 4 fixed electrode (solid lines)
- 5 shifting (measuring point deviation)

Figure 5 – Example in state where electrode of measurement jig shifted**6 Items to be indicated in test result report**

The test report shall include at least the following information:

- a) test date *;
- b) test site (name and place) *;
- c) detail description of capacitor under test *;
- d) measuring instrument (manufacturer and type);
- e) test fixture (manufacturer and type);
- f) measurement frequency and a measurement signal level;
- g) measurement point, if other than seating plane; and
- h) measured ESL value.

* optional

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