IEC 62813

Edition 1.0 2015-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Lithium ion capacitors for use in electric and electronic equipment – Test methods for electrical characteristics

Condensateurs au lithium-ion destinés à être utilisés dans les équipements électriques et électroniques – Méthodes d'essai relatives aux caractéristiques électriques

IEC 62813:2015-01(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l’édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue
Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d’études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org
Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
Plus de 60 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 62813

Edition 1.0 2015-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Lithium ion capacitors for use in electric and electronic equipment – Test methods for electrical characteristics

Condensateurs au lithium-ion destinés à être utilisés dans les équipements électriques et électroniques – Méthodes d'essai relatives aux caractéristiques électriques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.060.99 ISBN 978-2-8322-2196-9

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

LITHIUM ION CAPACITORS FOR USE IN ELECTRIC AND ELECTRONIC EQUIPMENT – TEST METHODS FOR ELECTRICAL CHARACTERISTICS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62813 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
40/2322/FDIS	40/2341/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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

LITHIUM ION CAPACITORS FOR USE IN ELECTRIC AND ELECTRONIC EQUIPMENT – TEST METHODS FOR ELECTRICAL CHARACTERISTICS

1 Scope

This International Standard specifies the electrical characteristics (capacitance, internal resistance, discharge accumulated electric energy, and voltage maintenance rate) test methods of lithium ion capacitors (LIC) for use in electric and electronic equipment.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The terms printed in italics are those which are defined in this Clause 3.

3.1
upper category temperature
highest ambient temperature that a LIC is designed to operate continuously

[SOURCE: IEC 62576:2009, 3.3, modified]

3.2
rated voltage
U_R
maximum direct current (d.c.) voltage that may be applied continuously for a certain time under the *upper category temperature* (3.1) to a LIC so that it can exhibit specified demand characteristics

Note 1 to entry: This voltage is the setting voltage in LIC design.

Note 2 to entry: The endurance test using the rated voltage is described in Annex A.

[SOURCE: IEC 62576:2009, 3.6, modified]

3.3
rated lower limit voltage
U_L
minimum d.c. voltage such that a LIC can exhibit specified demand characteristics

Note 1 to entry: The rated lower limit voltage is designated by manufacturer.

3.4
charging current
current required to charge a LIC

3.5
discharging current
current required to discharge a LIC

3.6
discharge accumulated electric energy
amount of discharged energy of a LIC accumulated from the *discharge start time* (3.7) to the *time to reach rated lower limit voltage* (3.10)

3.7
discharge start time
T_0
time when discharge of a LIC starts

Note 1 to entry: It is the basis time for the *calculation start time* (3.8) and the *time to reach rated lower limit voltage* (3.10).

3.8
calculation start time
T_1
time at a selected start point used to calculate the *capacitance* (3.12) and the *internal resistance* (3.14) during discharge of a LIC

Note 1 to entry: The calculation start time is expressed as elapsed time since the *discharge start time* (3.7).

3.9
calculation end time
T_2
time at a selected end point used to calculate the *capacitance* (3.12) and the *internal resistance* (3.14) during discharge of a LIC

Note 1 to entry: The calculation end time is expressed as elapsed time since the *discharge start time* (3.7).

3.10
time to reach rated lower limit voltage
T_L
time when the voltage reaches the *rated lower limit voltage* (3.3) during discharge of a LIC

Note 1 to entry: The time to reach rated lower limit voltage is expressed as elapsed time since the *discharge start time* (3.7).

3.11
instant drop voltage at discharge
U_0
voltage at the *discharge start time* (3.7) of a least-squares regression line over the time period from the *calculation start time* (3.8) to the *calculation end time* (3.9) for the voltage drop characteristic of a LIC during discharge

3.12
capacitance
ability of a LIC to store electrical charge

[SOURCE: IEC 62576:2009, 3.14, modified]

3.13
nominal capacitance
C_N
capacitance value designated by manufacturer, usually indicated on a LIC

[SOURCE: IEC 62576:2009, 3.15, modified]

3.14
internal resistance
resistance component expressed in the equivalent series circuit of capacitance and resistance of a LIC

[SOURCE: IEC 62391-1:2006, 2.2.20, modified]

3.15
nominal internal resistance
R_N
internal resistance value designated by manufacturer, usually indicated on a LIC

[SOURCE: IEC 62576:2009, 3.17, modified]

3.16
constant voltage charging
method of charging a LIC at specified constant voltage

[SOURCE: IEC 62576:2009, 3.18, modified]

3.17
constant current charging
method of charging a LIC with specified constant current

3.18
constant current discharging
method of discharging a LIC with specified constant current

3.19
pre-conditioning
charge, discharge, and storage of a LIC under specified atmospheric conditions (temperature, humidity, and air pressure) before tests

Note 1 to entry: Generally, pre-conditioning implies that the LIC is stored until its inner temperature attains thermal equilibrium with the surrounding temperature, before its electrical characteristics are measured.

[SOURCE: IEC 62576:2009, 3.19, modified]

3.20
voltage maintenance rate
A
ratio of the voltage at the open-ended terminals to the charging voltage after a specified time period subsequent to the charging of a LIC

[SOURCE: IEC 62576:2009, 3.26, modified]

4 Test methods

4.1 Test requirements

4.1.1 Standard atmospheric conditions for tests

Unless otherwise specified in the detail specification, all tests shall be made under standard atmospheric conditions for tests as given in IEC 60068-1:2013, 4.3:

– temperature: 15 °C to 35 °C;
– relative humidity: 25% to 75 %;

– air pressure: 86 kPa to 106 kPa.

If any question about determining measurement value arises under the atmospheric conditions or if it is requested, 4.1.2 is applied.

If it is difficult to perform measurements under the standard atmospheric conditions and if no question about determining measurement value arises, tests and measurements may be performed under other conditions than the standard atmospheric conditions.

4.1.2 Standard atmospheric conditions for measurements

Unless otherwise specified in the detail specification, all measurements shall be made under standard atmospheric conditions for measurements as given in IEC 60068-1:2013, 4.2, with the following details:

– temperature: 25 °C ± 2 °C;
– relative humidity: 45 % to 55 %;
– air pressure: 86 kPa to 106 kPa.

4.1.3 Pre-conditioning

Unless otherwise specified in the detail specification, the LIC shall be charged with a constant current and constant voltage power supply, the voltage of which is set to the rated voltage, for 30 min then discharged to the lower limit voltage with a proper discharging device.

4.2 Measurement

4.2.1 Capacitance, discharge accumulated electric energy, and internal resistance

4.2.1.1 Test equipment

The test equipment shall be capable of constant current charging, constant voltage charging, and constant current discharging with current specified in 4.2.1.2, and continuous measurement of current and voltage at specified sampling interval. The basic circuit is shown in Figure 1.

a) D.C. power supply

The d.c. power supply shall be capable of charging the LIC at specified constant current and specified constant voltage for specified duration.

b) Constant current load

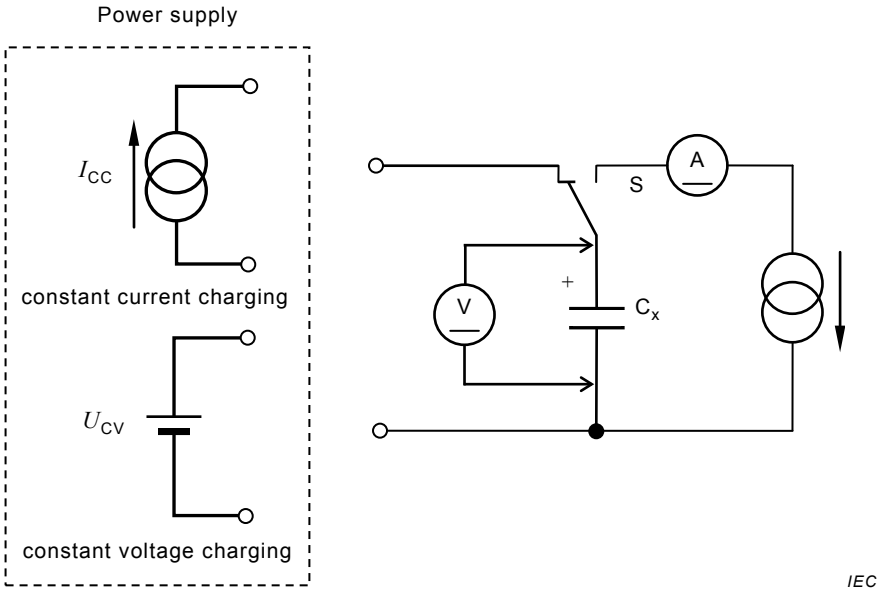
The constant current load shall be capable of discharging the LIC at specified constant current and its current rise time at discharge start shall be 50 ms or less.

c) D.C. voltage recorder

The d.c. voltage recorder shall be capable of conducting measurements and recording with 1 mV resolution and sampling interval of 100 ms.

d) Changeover switch

The changeover switch shall not cause chattering which may affect the result of voltage-time recording.



Key

I_{CC}	constant-current
U_{CV}	constant-voltage
A	D.C. ammeter
V	D.C. voltage recorder
S	changeover switch
C_x	LIC under test
	constant current power supply
	constant voltage power supply
	constant current load

Figure 1 – Basic circuit for measuring capacitance, discharge accumulated electric energy, and internal resistance

4.2.1.2 Measurement procedure and conditions

The measurement procedure and conditions shall be as follows. The voltage profile between the LIC terminals in the measurement shall be as shown in Figure 2.

a) Before setting sample

The LIC shall be left in the standard atmospheric condition as defined in 4.1.1 for 2 h to 6 h.

b) Sample setting

Connect the LIC terminals to the circuit.

c) Constant current charging

Charge the LIC to the rated voltage U_R with d.c. power supply specified in 4.2.1.1 and with specified current I calculated by Formula (1).

$$I = \frac{1}{30R_N}\sqrt{1+\frac{27}{5C_NR_N+1}-\frac{26}{10C_NR_N+1}} \quad (1)$$

where

I is the charging current (A). It is also used to specify the discharging current;

R_N is the nominal internal resistance of the LIC under test (Ω);

C_N is the nominal capacitance of the LIC under test (F).

NOTE The current calculated by Formula (1) is assumed as the current by which the resultant measurement error of the internal resistance is limited within ± 3 % (see Annex B). When the nominal value of internal resistance is uncertain, the current for the measurement can be set according to the advisable procedures described in Annex C.

d) Constant voltage charging

When voltage between the LIC terminals is reached to the rated voltage U_R, switch to constant voltage charging then apply the rated voltage U_R for 30 min.

e) Constant current discharging

Turn changeover switch from the power supply to the constant current load and discharge with the specified constant current as follows:

1) For internal resistance measurement, set the discharge current: I calculated by Formula (1);

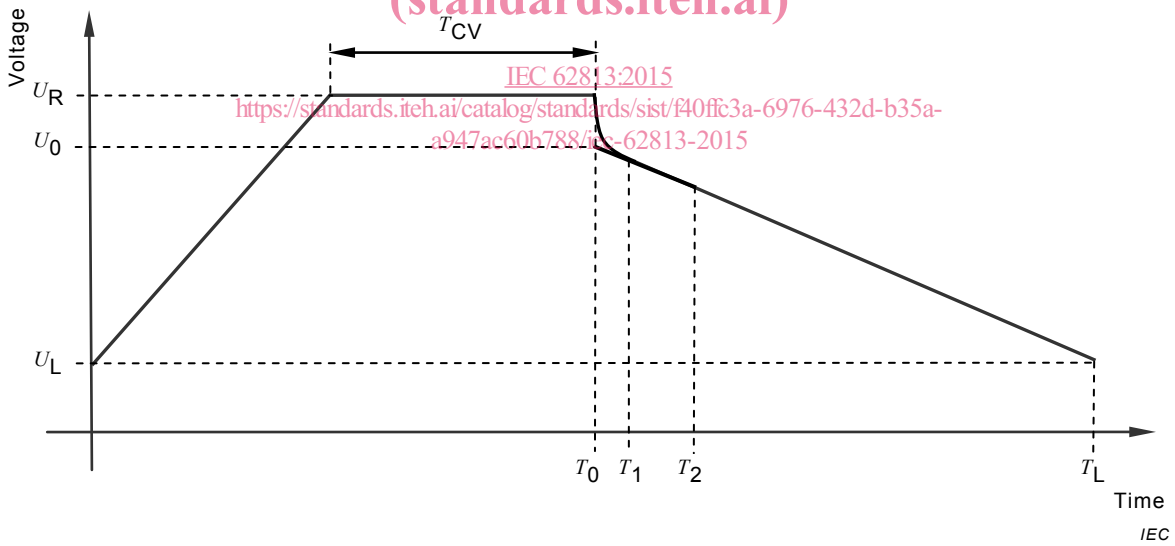
2) For discharge accumulated electric energy and capacitance measurement, set the discharge current: tenth of I calculated by Formula (1).

f) Test, measurement and recording

Measure and record the voltage-time characteristics between the LIC terminals

1) Sampling and recording interval shall be set to 100 ms.

2) Sampling and recording shall be conducted continuously from charge start time to the time to reach rated lower limit voltage U_L.



Key

T_0 discharge start time (s)

T_1 calculation start time, which is set to $C_N R_N$ (s)

T_2 calculation end time, which is set to 2 $C_N R_N$ (s)

T_L time to reach rated lower limit voltage (s)

T_{CV} duration of constant voltage charging (s)

U_R rated voltage (V)

U_L rated lower limit voltage (V)

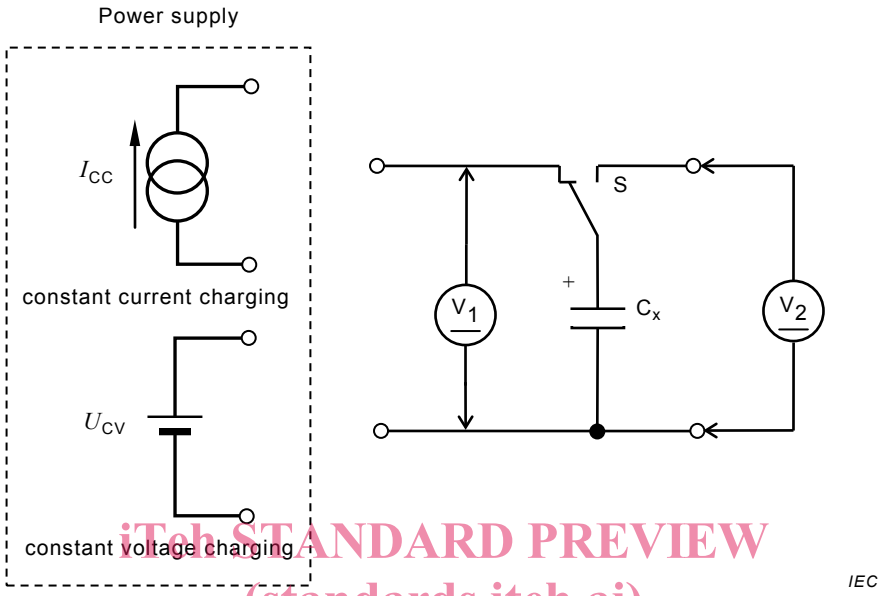
U_0 instant drop voltage at discharge (V)

Figure 2 – Voltage profile for measuring capacitance, discharge accumulated electric energy, and internal resistance

4.2.2 Measurement for voltage maintenance rate

4.2.2.1 Test equipment

The basic circuit is shown in Figure 3. The d.c. voltmeters V_1 and V_2 shall have a resolution of 5 mV or less for voltage measurement. The input impedance shall be sufficiently high so that measurement errors are negligible.



Key

V_1 V_2 D.C. voltmeter

Figure 3 – Basic circuit for measuring the voltage maintenance rate

4.2.2.2 Measurement procedure and conditions

The measurement procedure and conditions shall be as follows. The voltage profile between the LIC terminals in the measurement shall be as shown in Figure 4.

a) Before setting sample

The LIC shall be left in the standard atmospheric condition as defined in 4.1.1 for 2 h to 6 h.

b) Sample setting

Connect the LIC terminals to the circuit.

c) Constant current charging

Charge the LIC to the rated voltage U_R with d.c. power supply specified in 4.2.1.1 and with specified current I calculated by Formula (1).

d) Constant voltage charging

When voltage between the LIC terminals is reached to the rated voltage U_R, switch to the constant voltage charging then apply the rated voltage U_R for 24 h.

e) Terminal opening

Disconnect the LIC terminals from the circuit.

f) Measurement

Measure voltage between the LIC terminals when T_{OC} is 72 h (see Figure 4).