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Desktop and notebook computers – Measurement of energy consumption

Ordinateurs de bureau et ordinateurs portables – Mesurage de la consommation d'énergie

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

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

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DESKTOP AND NOTEBOOK COMPUTERS – MEASUREMENT OF ENERGY CONSUMPTION

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IEC 62623 has been prepared by technical area 19: Environmental and energy aspects for multimedia systems and equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

The first edition of this standard was originally based on ECMA-383.

This edition includes the following significant technical changes with respect to the previous edition:

a) Additions to terms & definitions and modification to short & long idle descriptions.
b) Test setup modifications for notebooks where battery pack cannot be removed for testing.
c) Categorisation procedure based on ECMA-389 removed.
d) Replace majority profile with new duty cycle study including new duty cycle attributes for desktop and notebook in a residential and enterprise application.
e) Removal of any reference and test methodology to ENERGY STAR V5.

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

Draft	Report on voting
100/3583/CDV	100/3669/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

In this standard, the following print types or formats are used:

– requirements proper and normative annexes: in roman type;
– notes/explanatory matter: in smaller roman type;
– terms that are defined in 3.1: **bold**.

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- withdrawn,
- replaced by a revised edition, or
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IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document provides definitions of energy saving modes and generic energy saving guidance for designers of desktop and notebook computers, by defining a methodology on how to measure the energy consumption of a product whilst providing key categorisation attributes that enable energy consumption comparisons of similar products.

This document is originally based on ECMA-383 and complements the guidance given in IEC 62075.

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DESKTOP AND NOTEBOOK COMPUTERS – MEASUREMENT OF ENERGY CONSUMPTION

1 Scope

This document covers personal computing products. It applies to desktop and notebook computers as defined in 4.1 that are marketed as final products and that are hereafter referred to as the equipment under test (EUT) or product.

This document specifies:

– a test procedure to enable the measurement of the power and/or energy consumption in each of the EUT's power modes;

– formulas for calculating the **typical energy consumption** (**TEC**) for a given period (normally annual);

– a majority profile to be used with this document which enables conversion of average power into energy within the **TEC** formulas;

– a pre-defined format for the presentation of results.

This document does not set any pass/fail criteria for the EUTs. Users of the test results define such criteria.

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2 Normative references

There are no normative references in this document.

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3 Terms, definitions and abbreviations

For the purposes of this document, the following terms and definitions 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
active workload
simulated amount of productive or operative activity that the EUT performs as represented in the P_{work} (see 4.2.12) and $\boldsymbol{T}_{\textbf{work}}$ (see 3.1.11.6) attributes of the **TEC** equation (see 5.6)

3.1.2
category
classification within a product type that is based on product features and installed components

3.1.3
duty cycle
divisions of time the EUT spends in each of its individual power modes

Note 1 to entry: A duty cycle is expressed as a percentage totalling 1.

3.1.4
energy use
energy used by a product when measured from the mains power supply over a given period of time

Note 1 to entry: Energy is measured in kilowatt hour.

3.1.5
external power supply
EPS
equipment contained in a separate physical enclosure external to the computer casing and designed to convert mains power supply to lower DC voltage(s) for the purpose of powering the computer

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: The **EPS** is sometimes referred to as an AC brick.

Note 3 to entry: A reference to a document which outlines the testing procedures for measuring **EPS** efficiencies (External Power Supply Efficiency Test Method) can be found in the Bibliography.

3.1.6
internal power supply
IPS
component contained inside the computer casing and designed to convert AC voltage from the mains power supply to lower DC voltage(s) for the purpose of powering the computer components

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Note 1 to entry: This note applies to the French language only.

Note 2 to entry: A reference to a document which outlines the testing procedures for measuring **IPS** efficiencies (Generalized Internal Power Supply Efficiency Test Protocol) can be found in the Bibliography.

3.1.7
local area network
LAN

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computer network located on a user's premises within a limited geographical area

[SOURCE: IEC 60050-732-01-04]

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: Currently the two primary technologies used in computers are IEEE 802.3 Ethernet or Wired **LAN**, and IEEE 802.11 WiFi or Wireless **LAN.**

3.1.8
manufacturer
organization responsible for the design, development and production of a product in view of its being placed on the market, regardless of whether these operations are carried out by that organization itself or on its behalf

3.1.9
typical energy consumption
TEC
number for the consumption of energy of a computer that is used to compare the energy performance of like computers, which focuses on the typical energy consumed by an EUT for a given profile while in normal operation during a representative period of time

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: For desktops and notebook computers, the key criterion of the **TEC** approach is a value for typical annual **energy use**, measured in kilowatt-hours (kWh), using measurements of average operational mode power levels scaled by an assumed typical **duty cycle** that represent annualized use for a profile.

3.1.10
actual energy consumption
TEC measured using P_{work}

Note 1 to entry: The **actual energy consumption** is referenced as $\mathbf{TEC}_{actual}$.

3.1.11
duty cycle attributes
percentage of time the EUT spends in each of its individual power modes

Note 1 to entry: Examples of **duty cycle attributes** are defined in 3.1.12.1 to 3.1.12.7.

3.1.11.1
off component of duty cycle
T_{off}
percentage of time the EUT is in the off mode

3.1.11.2
sleep component of duty cycle
T_{sleep} and $T_{sleepWoL}$
percentage of time the EUT is in the sleep modes

3.1.11.3
on components of duty cycle
T_{on}
percentage of time the EUT is in the on mode

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Note 1 to entry: The T_{on} **duty cycle** is equal to the sum of the T_{work} + T_{sidle} + T_{lidle}.

3.1.11.4
short idle component of duty cycle
T_{sidle}
percentage of time the EUT is in the short idle mode

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3.1.11.5
long idle component of duty cycle
T_{lidle}
percentage of time the EUT is in the long idle mode

3.1.11.6
alternative low power component of duty cycle
T_{alpm}
percentage of time the EUT is in the alternative low power mode

3.1.11.7
active component of duty cycle
T_{work}
percentage of time the EUT is in the active (work) mode

3.1.12
user of the test results
entity that will utilise the test results to apply to their needs

Note 1 to entry: Examples of such an entity are voluntary agreement owners, regulators, private companies, etc.

3.1.13
wake on LAN
WoL
functionality that allows a computer to wake from sleep or off to an active state when directed by a network wake request via Ethernet

Note 1 to entry: This note applies to the French language only.

3.1.14
graphics processor unit
GPU
integrated circuit, separate from the CPU, designed to accelerate the rendering of either 2D and/or 3D content to displays

Note 1 to entry: GPU may be paired with a CPU, on the system board of the computer or elsewhere to offload display capabilities from the CPU

3.1.15
discrete graphics
graphics processor (GPU) which must contain a local memory controller interface and local graphics-specific memory

3.1.16
integrated graphics
graphics solution that does not contain **discrete graphics**

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3.1.17
switchable graphics
functionality that allows **discrete graphics** to be disabled when not required in favour of **integrated graphics**

Note 1 to entry: This functionality allows lower power and lower capability integrated GPUs to render the display while on battery or when the output graphics are not overly complex while then allowing the more power consumptive but more capable discrete GPU to provide rendering capability when the user requires it.

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3.1.18
system memory bandwidth
rate at which data can be read or stored into computer system's memory

Note 1 to entry: System memory bandwidth is measured in gigabytes per second (GB/s).

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

ACPI advanced configuration and power interface

NOTE 1 ACPI specification can be found here: http://www.uefi.org/acpi/specs

ALPM alternative low power mode

CF crest factor

CFR crest factor ratio

CPU central processing unit

DVI Digital Visual Interface

EPS external power supply

EUT equipment under test

NOTE 2 Also referred to as product in this standard and sometimes referred to as UUT (unit under test) in other specifications.

FB_BW frame buffer bandwidth

GPU	graphic processing unit
HDD	hard disk drive
HDMI®[1]	High Definition Multimedia Interface
IPS	internal power supply
LAN	local area network
LPM	low power mode
MCR	maximum current ratio
OS	operating system
PAPR	profile active power ratio
PAWR	profile active workload ratio
PCF	product crest factor
PF	power factor
RAM	random access memory
RMS	root mean square
TEC	typical energy consumption
THD	total harmonic distortion
UPS	uninterruptible power supply
VGA	Video Graphics Array
WoL	wake on LAN

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4 Specifications for EUT

4.1 Computer descriptions

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4.1.1 Desktop computer

A desktop computer is a computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external computer display, keyboard, and mouse. Desktops are designed for a broad range of home and office applications.

4.1.2 Notebook computer

A notebook computer is a computer designed specifically for portability and intended to be operated for extended periods of time either with or without a direct connection to an AC mains power supply. Notebooks utilize an integrated computer display and are capable of operation from an integrated battery. In addition, most notebooks use an EPS or AC brick and have a non-detachable mechanical keyboard (using physical, moveable keys) and pointing device. Notebook computers are typically designed to provide similar functionality to desktops, including operation of software similar in functionality as that used in desktops. For the purposes of this document, docking stations are considered accessories and, therefore, should not be considered as part of the EUT.

4.1.3 Two-in-one notebook

A computer which resembles a traditional notebook computer with a clam shell form factor, but has a detachable display which can act as an independent slate/tablet when disconnected. The keyboard and display portions of the product must be shipped as an integrated unit. Two-in-one

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notebooks are considered notebooks in the remainder of this standard and are therefore not referenced explicitly.

4.1.4 Multiscreen notebook

A computer which resembles a traditional notebook computer with a clam shell form factor but has a secondary display with touch and/or pen capability that can be used as a touch screen keyboard in place of a traditional mechanical keyboard. These products are considered to be notebook computers for purposes of this standard.

4.1.5 Slate/Tablet

A computing device designed for portability that meets all of the following criteria:

a) Includes an integrated display with a diagonal size greater than 6,5 inches and less than 17,4 inches;

b) lacking an integrated, physical attached keyboard in its as-shipped configuration;

c) includes and primarily relies on touchscreen input; (with optional keyboard);

d) includes and primarily relies on a wireless network connection (e.g., Wi-Fi, 3G, etc.); and

e) includes and is primarily powered by an internal battery (with connection to the mains for battery charging, not primary powering of the device).

4.1.6 Portable all-in-one computer

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A computing device designed for limited portability that meets all of the following criteria:

a) Includes an integrated display with a diagonal size greater than or equal to 17,4 inches;

b) lacking keyboard integrated into the physical housing of the product in its as-shipped configuration;

c) includes and primarily relies on touchscreen input; (with optional keyboard);

d) includes wireless network connection (e.g. Wi-Fi, 3G, etc.); and

e) includes an internal battery, but is primarily powered by connection to the ac mains.

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4.1.7 Integrated desktop computer

An integrated desktop computer is a desktop computer where the computer and computer display function as a single unit and which is connected to AC mains power through a single mains cable. Integrated desktop computers come in one of two possible forms:

– a product where the computer display and computer are physically combined into a single unit; or

– a product packaged as a single product where the computer display is separate but is connected to the main chassis by a DC power cord and both the computer and computer display are powered from a single power supply.

As a subset of desktop computers, integrated desktop computers are typically designed to provide similar functionality as desktop computers.

NOTE 1 An integrated desktop computer can also be referred to as an all-in-one computer.

4.2 Power modes

4.2.1 Off mode

Off mode is the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the EUT is connected to the main electricity supply and used in accordance with the **manufacturer**'s instructions. For products where ACPI standards are applicable, off mode correlates to ACPI system level S5 state.