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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Desktop and notebook computers – Measurement of energy consumption

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

IEC 62623:2012

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DESKTOP AND NOTEBOOK COMPUTERS – MEASUREMENT OF ENERGY CONSUMPTION

FOREWORD

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International Standard IEC 62623 has been prepared by IEC technical committee 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

This standard is based on ECMA-383.

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

FDIS	Report on voting
108/490/FDIS	108/500/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.

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**.

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

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INTRODUCTION

This standard is based on ECMA-383 and complements the guidance given in IEC 62075. It includes the 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 categorisation criteria that enable energy consumption comparisons of similar products.

DESKTOP AND NOTEBOOK COMPUTERS – MEASUREMENT OF ENERGY CONSUMPTION

1 Scope

This International Standard 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 standard 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 that should be used with this standard which enables conversion of average power into energy within the **TEC** formulas;

– a system of categorisation enabling like for like comparisons of energy consumption between EUTs;

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

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

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.

ECMA-389, *Procedure for the Registration of Categories for ECMA-383 2nd edition*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
active workload
simulated amount of productive or operative activity that the EUT performs as represented in the P_{work} (see 4.2.10) and $\boldsymbol{T_{work}}$ (see 3.1.13.6) attributes of the **TEC** equation (see 5.6)

3.1.2
category
grouping of EUT configurations

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 then 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 d.c. 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 a.c. 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 in the same physical enclosure to the computer casing and designed to convert mains power supply to lower d.c. 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: 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
computer network located on a user's premises within a limited geographical area

[SOURCE : IEC 60050-732:2010, 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
red green blue
RGB
primary colours that make up a pixel on a computer display

Note 1 to entry: The **RGB** values represent the intensity settings of each colour of that pixel to specify an exact colour.

3.1.10
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.

3.1.11
actual energy consumption
TEC measured using P_{work}

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

3.1.12
estimated energy consumption
TEC estimated by substituting P_{sidle} for P_{work}

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

Note 2 to entry: P_{sidle} is defined in detail in 4.2.

Note 3 to entry: P_{work} is defined in detail in 4.2.

3.1.13
duty cycle attributes
the 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 3.1.13.1 to 3.1.13.6.

3.1.13.1
off component of duty cycle
$\boldsymbol{T_{off}}$
percentage of time the EUT is in the off mode

3.1.13.2
sleep component of duty cycle
$\boldsymbol{T_{sleep}}$ **and** $\boldsymbol{T_{sleepWoL}}$
percentage of time the EUT is in the sleep modes

3.1.13.3
on components of duty cycle
$\boldsymbol{T_{on}}$
percentage of time the EUT is in the on mode

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

3.1.13.4
short idle component of duty cycle
$\boldsymbol{T_{sidle}}$
percentage of time the EUT is in the short idle mode

3.1.13.5
long idle component of duty cycle
$\boldsymbol{T_{idle}}$
percentage of time the EUT is in the long idle mode

3.1.13.6
active component of duty cycle
T_{work}
percentage of time the EUT is in the active (work) mode

3.1.14
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.

3.1.15
wake on LAN
WoL
functionality that allows a computer to wake from sleep or off when directed by a network request via Ethernet

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

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

ACPI Advanced Configuration and Power Interface

NOTE 1 ACPI specification can be found here: http://www.acpi.info/.

CF Crest Factor

CFR Crest Factor Ratio

CPU Central Processing Unit

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

HDD Hard Disk Drive

IPS Internal Power Supply

LAN Local Area Network

MCF Meter Crest Factor

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

RGB red green blue

RMS Root Mean Square

SSD Solid State Drive

TEC Typical Energy Consumption

THD Total Harmonic Distortion

ULE Ultra Low Energy

UPS Uninterruptible Power Supply

WoL Wake on LAN

4 Specifications for EUT

4.1 Computer descriptions

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 a 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 a.c. brick and have an integrated keyboard 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 standard, docking stations are considered accessories and therefore, should not be considered as part of the EUT. Tablet computers, which may use touch-sensitive screens along with, or instead of, other input devices, are considered notebook computers in this standard. Netbook computers which are typically identified by a smaller screen size (constrained) and base memory size are also considered notebook computers in this standard.

4.1.3 Integrated desktop computer

An integrated desktop computer is a desktop computer where the computer and computer display function as a single unit receiving its a.c. 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 d.c. 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 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.

NOTE Some international regulations also refer to this mode as standby mode.

4.2.2 P_{off}

P_{off} represents the average power measured in the off mode.

4.2.3 Sleep mode

Sleep mode is the lowest power mode that the EUT is capable of entering automatically after a period of inactivity or by manual selection. An EUT with sleep capability can quickly wake in response to network connections or user interface devices with a latency of ≤ 5 s from initiation of wake event to product becoming fully usable including rendering of display. For products where ACPI standards are applicable, sleep mode most commonly correlates to ACPI system level S3 (suspend to RAM) state. When the EUT is tested with the **WoL** capability disabled in the sleep state, it is referred to as sleep mode. When the EUT is tested with the **WoL** capability enabled in the sleep state, it is referred to as **WoL** sleep mode.

4.2.4 P_{sleep}

P_{sleep} represents the average power measured in the sleep mode with the **WoL** capability disabled.

4.2.5 $P_{sleepWoL}$

$P_{sleepWoL}$ represents the average power measured in the sleep mode with the **WoL** capability enabled.

4.2.6 On mode

The on mode represents the mode the EUT is in when not in the sleep or off modes. The on mode has several sub-modes that include the long idle mode, the short idle mode and the active (work) mode.

4.2.7 P_{on}

P_{on} represents the average power measured when in the on mode.

4.2.8 Idle modes

4.2.8.1 General

The idle modes are modes in which the operating system and other software have completed loading, the product is not in sleep mode, and activity is limited to those basic applications that the product starts by default. There are two forms of idle that comprise the idle modes: short idle mode (see 4.2.8.2) and long idle mode (see 4.2.8.4).

4.2.8.2 Short idle mode

Short idle is the mode where the EUT has reached an idle condition (for example, 5 min after OS boot or after completing an **active workload** or after resuming from sleep, one can also use 15 min in order to conform to legacy testing procedures), the screen is on for at least 30 min to allow it to warm up, and set to at least a brightness level detailed in test procedure 5.3, and long idle power management features should not have engaged (for example, HDD (if available) is spinning and the EUT is prevented from entering sleep mode).

4.2.8.3 P_{sidle}

P_{sidle} represents the average power measured when in the short idle mode.

4.2.8.4 Long idle mode

Long idle mode is the mode where the EUT has reached an idle condition (for example, 15 min after OS boot or after completing an **active workload** or after resuming from sleep), the screen of the primary display has just blanked but EUT remains in the working mode (ACPI G0/S0). Power management features, if configured as shipped, should have engaged (for example, primary display is on, HDD may have spun-down) but the EUT is prevented from entering sleep mode.

NOTE The screen has just blanked" refers to the main computer display (integrated panel or external display) having entered a low power state where the screen contents cannot be observed (for example, backlight has been turned off turning the screen black).

4.2.8.5 P_{idle}

P_{idle} represents the average power measured when in the long idle mode.

4.2.9 Active (work) mode

Active mode is the mode in which the EUT is carrying out work in response to

– prior or concurrent user input; or

– prior or concurrent instruction over the network.

This mode includes active processing, seeking data from storage, memory, or cache, while awaiting further user input and before entering other power modes. In this mode, the screen is on and set to as-shipped brightness.

4.2.10 P_{work}

P_{work} represents the average power measured when in the active mode.

4.3 Profile attributes

4.3.1 Profile

A profile is a combination of **duty cycle attributes** and a given use case (for example, office users, home users, gamers).

NOTE Refer to Annex A, Annex B and Annex C for further information on profiles.

4.3.2 Majority profile

The majority profile is the most common profile of users for desktop and notebook computers.

The majority profile should be used with this standard and is documented in Annex B. It provides the **duty cycle attributes** and the profile **TEC** error that is used to determine the **TEC** equation to be used in 5.6.

4.3.3 Minority profile

The minority profiles represent less common profiles of users of desktop and notebook computers that are not represented in the majority profile. As an example, extreme gamers represent a very specific profile but are a very small percentage of computer users.

4.3.4 Profile study

A profile study is a study performed to create a new profile for this standard. The study shall generate, together with supporting data, the following:

– all the **duty cycle attributes**;