

**Information technology equipment — Computers
— Minimum Energy Performance Standards
(MEPS)**

Part 1:

Specification

DKS 2880-1:2019

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**Information technology equipment —
Computers — Minimum Energy Performance
Standards (MEPS)**

Part 1:

Specification

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Foreword

This Standard was prepared by the Technical Committee 98 WG on Sustainability for and by ICT, under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

This standard provides designers, manufacturers, exporters, test laboratories, regulators and users of computers with a test method to assess the energy efficiency of computer monitors.

This series consists of two parts under the general title, **Information Technology — Minimum Energy Performance Standards (MEPS) — Computers**

Part 1 — Performance Requirements

Part 2 — Test Methods

During the preparation of this standard, reference was made to the following documents:

- i) ENERGY STAR® Program Requirements Product Specification for Computers-Eligibility Criteria Version 7.0 ENERGY STAR Computer Specification
- ii) ENERGY STAR Program Requirements for Displays (Sep 2015)
- iii) EU 75 Ecodesign (2010) Ecodesign requirements for computers and computer servers

Acknowledgement is hereby made for the assistance derived from these sources.

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Information technology equipment — Minimum Energy Performance Standards (MEPS) — Computers— Part 1: Specification

1. Scope and application

1.1 This Kenya standard specifies minimum energy performance standards (MEPS) requirements for computers.

1.2 This standard applies to the following products that can be powered directly from the mains alternating current (AC) including via an external or internal power supply:

- i) Desktop Computers and Integrated Desktop Computers;
- ii) Notebook Computers and tablet computers;
- iii) Workstations;
- iv) Slate/Tablets;
- v) Small-scale Servers that are marketed and sold for non-data center use;
- vi) Thin Clients

1.3 This standard shall not apply to the following product groups:

- i) Game Consoles;
- ii) Handheld Computers (including eReaders);
- iii) Handheld gaming devices, typically battery powered and intended for use with an integral
- iv) display as the primary display;
- v) Mobile Thin Clients not meeting the definition of Notebook Computer;
- vi) Personal Digital Assistant devices (PDAs);
- vii) Point of Sale (POS) products that do not use internal components common to Desktop
- viii) Computers, including a processor, motherboard, and memory, or that do not run a standard Desktop Computer operating system;
- ix) Small-scale Servers that are marketed and sold for use in data centers;
- x) Smart Phones; and
- xi) Ultra-thin Clients.

2. Normative references

The following referenced documents are indispensable for the application of this Kenya Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

KS 2880, Information technology equipment — Computers, Part 2 — Methods of measurement of energy performance
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3. Terms and definitions.

For the purposes of this standard, the following definitions shall apply:

Additionally, 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

Computer

A device which performs logical operations and processes data

Note 1 to entry For the purposes of this specification, computers include both stationary and portable units, including Desktop Computers, Integrated Desktop Computers, Notebook Computers, Small-Scale Servers, Thin Clients, and Workstations.

Note 2 to entry Although computers are capable of using input devices and displays, such devices are not required to be included with the computer upon shipment. Computers are composed of, at a minimum:

- i) A central processing unit (CPU) to perform operations. If no CPU is present, then the device must function as a client gateway to a server which acts as a computational CPU;
- ii) User input devices such as a keyboard, mouse, or touchpad; and
- iii) An Integrated Display screen and/or the ability to support an external display screen to output information.

3.1.1

Desktop Computer

A computer whose main unit is designed to be located in a permanent location, often on a desk or on the floor.

Note 1 to entry Desktop computers are not designed for portability and are designed for use with an external display, keyboard, and mouse.

Note 2 to entry Desktop computers are intended for a broad range of home and office applications, including point of sale applications.

3.1.2

Integrated Desktop Computer

A Desktop Computer in which the computing hardware and display are integrated into a single housing, and which is connected to ac mains power through a single cable.

Note 1 to entry Integrated Desktop Computers come in one of two possible forms:

- i) a system where the display and computer are physically combined into a single unit; or
- ii) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and 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 systems.

3.1.3

Notebook Computer

A computer designed specifically for portability and to be operated for extended periods of time both with and without a direct connection to an ac mains power source. Notebook Computers include an Integrated Display, a non-detachable, mechanical keyboard (using physical, moveable keys), and pointing device.

Note 1 to entry Notebook computers are typically designed to provide similar functionality to Desktops, including operation of software similar in functionality as that used in Desktops.

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Note 2 to entry For purposes of this specification, Notebook Computers include models with touch-sensitive screens.

a) Mobile Thin Client: A computer meeting the definition of a Thin Client, designed specifically for portability, and also meeting the definition of a Notebook Computer. These products are considered to be Notebook Computers for the purposes of this specification.

3.1.4

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.

Note 1 to entry The keyboard and display portions of the product must be shipped as an integrated unit.

Note 2 to entry Two-In-One Notebooks are considered Notebooks in the remainder of this specification and are therefore not referenced explicitly.

3.1.5

slate/Tablet

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

- i) Includes an integrated display with a diagonal size greater than 6.5 inches and less than 17.4 inches;
- ii) Lacking an integrated, physical attached keyboard in its as-shipped configuration;
- iii) Includes and primarily relies on touchscreen input; (with optional keyboard);
- iv) Includes and primarily relies on a wireless network connection (e.g., Wi-Fi, 3G, etc.); and
- v) Includes and is primarily powered by an internal battery (with connection to the mains for battery charging, not primary powering of the device).

3.1.6

Portable All-In-One Computer

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.

3.1.7

E-Reader

A device designed for display and consumption of static images. The display is characterized by a low refresh rate and a display made of bistable materials where no energy is needed to maintain a visible image, only to alter the image.

3.1.8

Small-scale Server:

A computer that typically uses desktop components in a desktop form factor, but is designed primarily to be a storage host for other computers.

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Note 1 to entry Small-scale Servers are designed to perform functions such as providing network infrastructure services (e.g., archiving) and hosting data/media. These products are not designed to process information for other systems or run web servers as a primary function.

Note 2 to entry A Small-scale Server has the following characteristics:

- i) Designed in a pedestal, tower, or other form factor similar to those of desktop computers such that all data processing, storage, and network interfacing is contained within one box/product;
- ii) Designed to operate 24 hours/day, 7 days/week, with minimal unscheduled downtime (on the order of hours/year);
- iii) Capable of operating in a simultaneous multi-user environment serving several users through networked client units; and
- iv) Designed for an industry accepted operating system for home or low-end server applications (e.g., Windows Home Server, Mac OS X Server, Linux, UNIX, Solaris).

3.1.9

Thin Client

An independently-powered computer that relies on a connection to remote computing resources (e.g., computer server, remote workstation) to obtain primary functionality.

Note 1 to entry Main computing functions (e.g., program execution, data storage, interaction with other Internet resources) are provided by the remote computing resources.

Note 2 to entry Thin Clients covered by this specification are

- i) limited to devices with no rotational storage media integral to the computer and
- ii) designed for use in a permanent location (e.g. on a desk) and not for portability.

3.1.10

Integrated Thin Client

A Thin Client in which computing hardware and display are connected to ac mains power through a single cable. Integrated Thin Client computers come in one of two possible forms: (1) a system where the display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and display are powered from a single power supply. As a subset of Thin Clients, Integrated Thin Clients are typically designed to provide similar functionality as Thin Client systems.

3.1.11

Ultra-thin Client

A computer with lesser local resources than a standard Thin Client that sends raw mouse and keyboard input to a remote computing resource and receives back raw video from the remote computing resource. Ultra-thin clients cannot interface with multiple devices simultaneously nor run windowed remote applications due to the lack of a user-discernible client operating system on the device (i.e., beneath firmware, user inaccessible).

3.1.12

Workstation

A high-performance, single-user computer typically used for graphics, CAD, software development, financial and scientific applications among other compute intensive tasks.

Note 1 to entry a) Workstations covered by this specification are marketed as a workstation; b) provide mean time between failures (MTBF) of at least 15,000 hours (based on field collected data); and (c) support error-correcting code (ECC) and/or buffered memory.

Note 2 to entry In addition, a workstation meets three or more of the following criteria:

- i) Provide supplemental power support for high-end graphics (e.g., PCI-E 6-pin 12V supplemental power feed);
- ii) Wired for greater than x4 PCI-E on the motherboard in addition to the graphics slot(s) and/or PCI-X support;
- iii) Do not provide support for Uniform Memory Access (UMA) graphics;
- iv) Provide 5 or more PCI, PCI-E, or PCI-X slots;
- v) Provide multi-processor support for 2 or more processors (shall support physically separate processor packages/sockets, i.e., requirement cannot be met with support for a single multi-core processor); and/or
- vi) Qualification by 2 or more Independent Software Vendor (ISV) product certifications; these certifications can be in process, but shall be completed within 3 months of qualification.

3.2

Product Category

A second-order classification or sub-type within a product type that is based on product features and installed components. Product categories are used in this specification to determine qualification and test requirements.

3.3

Graphics Processing Unit GPU

An integrated circuit, separate from the CPU, designed to accelerate the rendering of either 2D and/or 3D content to displays. A GPU may be mated with a CPU, on the system board of the computer or elsewhere to offload display capabilities from the CPU.

3.3.1

Discrete Graphics (dGfx)

A graphics processor (GPU) with a local memory controller interface and local graphics-specific memory.

3.3.2

Integrated Graphics (iGfx)

A graphics solution that does not contain Discrete Graphics.

3.4

Display

A commercially-available product with a display screen and associated electronics, often encased in a single housing, that as its primary function displays visual information from

- i) a computer, workstation or server via one or more inputs (e.g., VGA, DVI, HDMI, Display Port, IEEE 1394, USB),
- ii) external storage (e.g., USB flash drive, memory card), or
- iii) a network connection.

3.4.1

Enhanced-performance Integrated Display

An integrated Computer Display that has all of the following features and functionalities:

- i) A contrast ratio of at least 60:1 at a horizontal viewing angle of at least 85°, with or without a screen cover glass;

- ii) A native resolution greater than or equal to 2.3 megapixels (MP); and
- iii) A color gamut of at least sRGB as defined by IEC 61966-2-1. Shifts in color space are allowable as long as 99% or more of defined sRGB colors are supported.

3.5

Power supply

Electrical energy converter which draws electric energy from a source and supplies it in a specified form to a load

External Power Supply

(EPS)

external power adapter also referred to as an circuit that is used to convert household electric current into dc current or lower-voltage ac current to operate a consumer product.

3.6

Internal Power Supply

A component internal to the computer casing and designed to convert ac voltage from the mains to dc voltage(s) for the purpose of powering the computer components.

Note 1 to clause For the purposes of this specification, an internal power supply shall be contained within the computer casing but be separate from the main computer board.

Note 2 to clause the power supply shall connect to the mains through a single cable with no intermediate circuitry between the power supply and the mains power. in addition, all power connections from the power supply to the computer components, with the exception of a dc connection to a display in an integrated desktop computer, shall be internal to the computer casing (i.e., no external cables running from the power supply to the computer or individual components).

Note 2 to clause internal dc-to-dc converters used to convert a single dc voltage from an external power supply into multiple voltages for use by the computer are not considered internal power supplies.

3.7

Operational mode

3.7.1

Active State:

The power state in which the computer is carrying out useful work in response to a) prior or concurrent user input or b) prior or concurrent instruction over the network. Active State includes active processing, seeking data from storage, memory, or cache, including Idle State time while awaiting further user input and before entering low power modes.

3.7.2

Idle State

The power state in which the operating system and other software have completed loading, a user profile has been created, activity is limited to those basic applications that the system starts by default, and the computer is not in Sleep Mode. Idle State is composed of two sub-states: Short Idle and Long Idle.

3.7.2.1

Long Idle

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The mode where the Computer has reached an Idle condition (i.e., 15 minutes after OS boot or after completing an active workload or after resuming from Sleep Mode) and the main Computer Display has entered a low-power state where screen contents cannot be observed (i.e., backlight has been turned off) but remains in the working mode (ACPI G0/S0).

Note to entry If power management features are enabled as-shipped in the scenario described in this definition, such features shall engage prior to evaluation of Long Idle (e.g., display is in a low power state, HDD may have spun-down), but the Computer is prevented from entering Sleep Mode. PLONG_IDLE represents the average power measured when in the Long Idle Mode.

3.7.3

Short Idle

The mode where the Computer has reached an Idle condition (i.e., 5 minutes after OS boot or after completing an active workload or after resuming from Sleep Mode), the screen is on, and Long Idle power management features have not engaged (e.g. HDD is spinning and the Computer is prevented from entering sleep mode). PSHORT_IDLE represents the average power measured when in the Short Idle mode.

3.8

Off Mode

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

3.9

Sleep Mode

A low power mode that the computer enters automatically after a period of inactivity or by manual selection.

Note 1 to entry A computer with Sleep capability can quickly "wake" in response to network connections or user interface devices with a latency of less than or equal to 5 seconds from initiation of wake event to system becoming fully usable including rendering of display.

Note 2 to entry For systems where ACPI standards are applicable, Sleep Mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state.

3.10

Additional Internal Storage

Any and all internal hard disk drives (HDD) or solid state drives (SSD) shipping with a computer beyond the first. This definition does not include external drives.

3.11

Energy Efficient Ethernet (EEE)

A technology which enables reduced power consumption of Ethernet interfaces during times of low data throughput. Specified by IEEE 802.3az.

3.12

Full Network Connectivity

The ability of the computer to maintain network presence while in Sleep Mode or an alternative low power mode (LPM) with power less than or equal to 10 watts and intelligently wake when further processing is required (including occasional processing required to maintain network presence).

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Note 1 to entry Presence of the computer, its network services and applications, is maintained even though the computer is in a LPM.

Note 2 to entry From the vantage point of the network, a computer with full network connectivity that is in LPM is functionally equivalent to an idle computer with respect to common applications and usage models.

Note 3 to entry Full network connectivity in LPM is not limited to a specific set of protocols but can cover applications installed after initial installation. Also referred to as “network proxy” functionality and as described in the *Ecma-393* standard.

i Network Proxy - Base Capability:

To maintain addresses and presence on the network while in LPM, the system handles IPv4 ARP and IPv6 NS/ND.

ii Network Proxy - Full Capability:

While in LPM, the system supports Base Capability, Remote Wake, and Service Discovery/Name Services.

iii Network Proxy - Remote Wake

While in LPM, the system is capable of remotely waking upon request from outside the local network. Includes Base Capability.

iv Network Proxy

Service Discovery/Name Services: While in LPM, the system allows for advertising host services and network name. Includes Base Capability.

3.13

Network Interface:

The components (hardware and software) whose primary function is to make the computer capable of communicating over one or more network technologies.

Examples of Network Interfaces are IEEE 802.3 (Ethernet) and IEEE 802.11 (Wi-Fi).

3.14

Wake Event:

A user, scheduled, or external event or stimulus that causes the computer to transition from Sleep Mode or Off Mode to an active state of operation. Examples of wake events include, but are not limited to: movement of the mouse, keyboard activity, controller input, real-time clock event, or a button press on the chassis, and in the case of external events, stimulus conveyed via a remote control, network, modem, etc.

3.15

Wake On LAN (WOL)

Functionality which allows a computer to transition from Sleep Mode or Off Mode to an Active State of operation when directed by a network Wake Event via Ethernet.

3.16

Switchable Graphics

Functionality that allows Discrete Graphics to be disabled when not required in favor of Integrated Graphics.

Note 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.

3.17

Enterprise Channels

Sales channels typically used by large and medium-sized business, government, educational, or other organizations to purchase computers for use in managed client/server environments.

3.18

Model Name

A marketing name that includes reference to the computer model number, product description, or other branding references.

3.19

Model Number:

A unique marketing name or identification reference that applies to a specific hardware and software configuration (e.g., operating system, processor type, memory, GPU), and is either pre-defined or selected by a customer.

3.20

Product Family

A high-level description referring to a group of computers sharing one chassis/motherboard combination that often contains hundreds of possible hardware and software configurations. Product models within a family differ from each other according to one or more characteristics or features that either

- i) have no impact on product performance with regard to MEPS qualification criteria, or
- ii) are specified herein as acceptable variations within a product family. For Computers, acceptable variations within a product family include: Color; Housing; and Electronic components other than the chassis/motherboard, such as the processor, memory, GPU, etc.

4. Requirements

4.1. Power supply

Power supply test data and test reports from testing entities recognized by relevant government authority to perform power supply testing shall be accepted for the purpose of certifying the product.

4.2. Internal Power Supply (IPS) Requirements

IPSs used in Computers eligible under this specification must meet the following requirements when tested using the *Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6* (available at http://www.plugload solutions.com/docs/collatrl/print/Generalized_Internal_Power_Supply_Efficiency_Test_Protocol_R6.6.pdf).

- i) IPS with maximum rated output power less than 75 watts shall meet minimum efficiency requirements as specified in Table 1.
- ii) IPS with maximum rated output power greater than or equal to 75 watts shall meet both minimum efficiency requirements and minimum power factor requirements, as specified in Table 1.

Table 1 — Requirements for Internal Power Supplies

Loading Condition(Percentage of Name- plate Output Current)	Minimum Efficiency	Minimum Power Factor
20%	0.82	
50%	0.85	
100%	0.82	0.90

4.3. External Power Supply (EPS) Requirements:

Single- and Multiple-voltage EPSs shall meet the Level V or higher performance requirements under the International Efficiency Marking Protocol when tested according to the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.

- i) Single-voltage EPSs shall include the Level V or higher marking.
- ii) Multiple-voltage EPSs meeting Level VI or higher shall include the Level VI or higher marking.
- iii) Additional information on the Marking Protocol shall be as specified in the relevant Kenya Standard for marking

4.4. Power Management Requirements

3.3.1 Products shall include power management features in their “as-shipped” condition as specified in Table 2, subject to the following conditions:

- i) For Thin Clients, the Wake-on-LAN (WOL) requirement shall apply for products designed to receive software updates from a centrally managed network while in Sleep Mode or in Off Mode. Thin Clients whose standard software upgrade framework does not require off-hours scheduling are exempt from the WOL requirement.
- ii) For Notebooks, WOL may be automatically disabled when the product is disconnected from ac mains power.
- iii) For all products with WOL, directed packet filters shall be enabled and set to an industry standard default configuration.
- iv) Products that do not support Sleep Mode by default are only subject to the Display Sleep Mode requirement.

Table 2 — Power Management Requirements

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Portable All-In- Ones	Notebooks	Small- scale Servers	Slates/ Tablets	Thin Clients	Workstations
System Sleep mode	Sleep Mode shall be set to activate after no more than 30 System minutes of user inactivity. The speed of any active 1 Gb/s Ethernet network links shall be reduced when transitioning to Sleep Mode or Off Mode.	Yes	Yes	Yes	Yes	No	N/A	Yes	Yes
Display Sleep Mode	(1) Display Sleep Mode shall be set to Sleep activate after no more than 15 minutes of user inactivity.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wake on LAN (WOL)	Computers with Ethernet capability shall provide users with an option to enable and disable WOL for Sleep Mode (2) Computers with Ethernet capability that are shipped through Wake on enterprise channels shall either: (a) be shipped with WOL (WOL) by default for Sleep Mode, when the computer is operating on a mains power; or (b) provide users with the ability to enable WOL that is accessible from both the client operating system user interface and over the network.	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Portable All-In- Ones	Notebooks	Small- scale Servers	Slates/ Tablets	Thin Clients	Workstations
Wake Management	(1) Computers with Ethernet capability that are shipped through enterprise channels shall: (a) be capable of both remote (via network) and scheduled (via Real-Wake time clock) wake events from Sleep Management - Mode, (b) provide clients with the ability to centrally manage (via vendor tools) any wake management settings that are configured through hardware settings if the manufacturer has control over such features.	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes

4.5. User Information Requirements

4.5.1. Products shall be shipped with informational materials to notify customers of the following:

- i) A description of power management settings that have been enabled by default,
- ii) A description of the timing settings for various power management features, and
- iii) Instructions for properly waking the product from Sleep Mode.

4.5.2. Products shall be shipped with one or more of the following:

- i) A list of default power management settings.
- ii) A note stating that default power management settings have been selected for compliance with This standards (within 15 min of user inactivity for the display, within 30 min for the computer, if applicable per Table 2), and are recommended for optimal energy savings.
- iii) Information about benefits of power management, to be located at or near the beginning of the hard copy or electronic user manual, or in a package or box insert.

4.5.3. Provisions 4.5.1 and 3.5.2 may be met through use of either electronic or printed product documentation, provided the documentation is shipped with the product (e.g., in a printed manual or insert, on included optical media, in a file installed with the software load shipped to the customer)

4.6. Requirements for Desktop, Integrated Desktop, and Notebook Computers

4.6.1. Calculated Typical Energy Consumption (E_{TEC}) for Desktop, Integrated Desktop, and Notebook Computers per Equation 1 shall be less than or equal to the maximum TEC requirement (E_{TEC_MAX}) per Equation 2, subject to the following requirements:

- i) The Additional Internal Storage adder allowance ($TEC_{STORAGE}$) shall be applied if there are more than one internal storage devices present in the product, in which case it shall only be applied once.
- ii) The Integrated Display adder allowance ($TEC_{INT_DISPLAY}$) applies only for Integrated Desktops and Notebooks and may be applied for each display. For Enhanced-performance Integrated Displays, the adder is calculated as presented in Table 7 and Equation 3.
- iii) For a product to qualify for the Full Network Connectivity mode weightings, the following criteria shall be satisfied:
 - Products shall meet a non-proprietary Full Network Connectivity standard such as ECMA 393 or another standard that has been approved by NEMA as meeting the goals of this standard. Such approval must be in place prior to submittal of product data for qualification.
 - Products shall have the applied level of functionality enabled and configured by default upon shipment. If Full Network Connectivity features are not enabled by default, the system shall be tested and reported with Conventional TEC weightings.
 - Products shall be capable of Sleep Mode or alternative low power modes with power less than or equal to 10 watts.
- iv) For Notebooks, Desktops, and Integrated Desktops that use an alternative low power mode in place of System Sleep Mode, power in Long Idle (P_{LONG_IDLE}) may be used in place of power in Sleep (P_{SLEEP}) in Equation 1 if the alternative low power mode is less than or equal to 10 watts. In such instances, (\times), is replaced by ($_ \times$); Equation 1 remains otherwise unchanged.
- v) Notebooks, Desktops, and Integrated Desktops with switchable graphics may not apply the Discrete Graphics allowance, $TEC_{GRAPHICS}$, from Table 7 in Equation 2. However, for Desktop and Integrated Desktop systems providing Switchable Graphics and enabling it by default, an allowance equal to 50% of the G1 graphics allowance for the platform type (Desktop or Integrated Desktop) may be applied. The switchable graphics incentive only applies to automated switching that is enabled by default. This capability is manufacturer-declared

Equation 1 — TEC Calculation (E_{TEC}) for Desktop, Integrated Desktop, Thin Client and Notebook Computers

$$E_{TEC} = \frac{8760}{1000} \times (P_{OFF} \times T_{OFF}) + (P_{SLEEP} \times T_{SLEEP}) + (P_{LONG_IDLE} \times T_{LONG_IDLE}) + (P_{SHORT_IDLE} \times T_{SHORT_IDLE})$$

Where:

P_{OFF} = Measured power consumption in Off Mode (W);

P_{SLEEP} = Measured power consumption in Sleep Mode (W);

P_{LONG_IDLE} = Measured power consumption in Long Idle Mode (W);

P_{SHORT_IDLE} = Measured power consumption in Short Idle Mode (W); and

T_{OFF} , T_{SLEEP} , T_{LONG_IDLE} , and T_{SHORT_IDLE} are mode weightings as specified in Table 3 (for Desktops, Integrated Desktops, and

Thin Clients) or Table 4 (for Notebooks).

Table 3 — Mode Weightings for Desktop, Thin Clients, and Integrated Desktop Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Capability Base	Remote Wake	Service Discovery /Name Services	Full Capability
T _{OFF}	45%	40%	30%	25%	20%
T _{SLEEP}	5%	15%	28%	36%	45%
T _{LONG_IDLE}	15%	12%	10%	8%	5%
T _{SHORT_IDLE}	35%	33%	32%	31%	30%

Table 4 — Mode Weightings for Notebook Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Base Capability	Remote Wake	Service Discovery/ Name Services	Full Capability
T _{OFF}	25%	25%	25%	25%	25%
T _{SLEEP}	35%	39%	41%	43%	45%
T _{LONG_IDLE}	10%	8%	7%	6%	5%
T _{SHORT_IDLE}	30%	28%	27%	26%	25%

Equation 2 — E_{TEC_MAX} Calculation for Desktop, Integrated Desktop, and Notebook Computers

$$E_{TEC_MAX} = (1 + ALLOWANCE_{PSU}) \times (TEC_{BASE} + TEC_{MEMORY} + TEC_{GRAPHICS} + TEC_{STORAGE} + TEC_{INT_DISPLAY} + TEC_{SWITCHABLE} + TEC_{EEE})$$

Where:

- *ALLOWANCE_{PSU} is an allowance provided to power supplies that meet the optional more stringent efficiency levels specified in Table 5; power supplies that do not meet the requirements receive an allowance of 0;*
- *TEC_{BASE} is the Base allowance specified in Table 6; and,*
- *TEC_{GRAPHICS} is the discrete graphics allowance as specified in Table 7, with the exception of systems with integrated graphics, which do not receive an allowance, or Desktops and Integrated Desktops with switchable graphics enabled by default, which receive an allowance through TEC_{SWITCHABLE}; and*
- *TEC_{MEMORY}, TEC_{STORAGE}, TEC_{INT_DISPLAY}, TEC_{SWITCHABLE}, and TEC_{EEE} are adder allowances as specified in Table 7.*

Table 5 — Power Supply Efficiency Allowance

Power Supply Type	Computer Type	Minimum Efficiency at Specified Proportion of Rated Output Current ⁱ⁾				Minimum Average Efficiency ⁱⁱ⁾	Allowance _{PSU}
		10%	20%	50%	100%		
IPS	Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87		0.03
	Integrated Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87		0.04
EPS	Notebook or Desktop	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.03
	Integrated Desktop	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.04

i) EPSs shall meet the specified requirements when tested using the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430. IPSs shall meet the specified requirements when tested using the EPRI 306 Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6.

ii) Average efficiency is the arithmetic mean of efficiencies tested at 25%, 50%, 75%, and 100% of rated output current. EPSs shall meet the specified requirements when tested using the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.

Table 6 — BASE TEC (TEC_{BASE}) Allowances

Category Name	Graphics Capability ⁱ⁾	Desktop or Integrated Desktop		Notebook	
		Performance Score, $P^{ii)}$	Base Allowance	Performance Score, $P^{ii)}$	Base Allowance
0	Any Graphics dGfx \leq G7	$P \leq 3$	69.0	$P \leq 2$	14.0
I1	Integrated or Switchable Graphics	$3 < P \leq 6$	112.0	$2 < P \leq 5.2$	22.0
I2		$6 < P \leq 7$	120.0	$5.2 < P \leq 8$	24.0
I3		$P > 7$	135.0	$P > 8$	28.0
D1	Discrete Graphics dGfx \leq G7	$3 < P \leq 9$	115.0	$2 < P \leq 9$	16.0
D2		$P > 9$	135.0	$P > 9$	18.0

i) Discrete Graphics capability is categorized based on frame buffer bandwidth, as shown in Table 7.

ii) $P = [\# \text{ of CPU cores}] \times [\text{CPU clock speed (GHz)}]$, where # of cores represents the number of physical CPU cores and CPU clock speed represents the Max TDP core frequency, not the turbo boost frequency.

Table 7— Functional Adder Allowances for Desktop, Integrated Desktop, Thin Client, and Notebook Computers

FUNCTION			Desktop	Integrated Desktop	Notebook
TEC _{MEMORY} (kWh) ⁱ⁾			0.8		
TEC _{GRAPHICS} (kWh) ⁱⁱ⁾	Graphics Category ⁱⁱⁱ⁾	G1 (FB_BW ≤ 16)	36	14	
		G2 (16< FB_BW ≤ 32)	51	20	
		G3 (32 < FB_BW ≤ 64)	64	26	
		G4 (64 < FB_BW ≤ 96)	83	32	
		G5 (96 < FB_BW ≤ 128)	105	42	
		G6 (FB_BW > 128; Frame Buffer Data Width < 192 bits)	115	48	
		G7 (FB_BW > 128; Frame Buffer Data Width ≥ 192 bits)	130	60	
TEC _{SWITCHABLE} (kWh) ^{iv)}			0.5 x G1	N/A	
TEC _{EEE} (kWh) ^{v)}			8.76 × 0.2 × (0.15 + 0.35)	8.76 × 0.2 × (0.10 + 0.30)	
TEC _{STORAGE} (kWh) ^{vi)}			26	26	
TEC _{INT_DISPLAY} (kWh) ^{vii)}			N/A	$\frac{8.76 \times 0.35 \times (1+EP)}{\times (4 \times r + 0.05 \times A)}$ $\frac{8.76 \times 0.30 \times (1+EP)}{\times (2 \times r + 0.02 \times A)}$	
<p>i) TEC_{MEMORY} Adder: Applies per GB installed in the system.</p> <p>ii) TEC_{GRAPHICS} Adder: Applies to only the first dGfx installed in the system, but not Switchable Graphics.</p> <p>iii) FB_BW: Is the display frame buffer bandwidth in gigabytes per second (GB/s). This is a manufacturer declared parameter and should be calculated as follows: (Data Rate [MHz] × Frame Buffer Data Width [bits]) / (8 × 100)</p> <p>iv) TEC_{SWITCHABLE} Incentive: Applies to automated switching that is enabled by default in Desktops and Integrated Desktops.</p> <p>v) TE_{CEEE}: Applies per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.</p> <p>vi) TEC_{STORAGE} Adder: Applies once if system has more than one Additional Internal Storage element.</p> <p>vii) TEC_{INT_DISPLAY} Adder: EP is the Enhanced Performance Display allowance calculated per Equation 3; r is the Screen resolution in megapixels; and A is viewable screen area in square inches.</p>					

$$EP = \begin{cases} 0, \text{ No enhanced performance Display} \\ 0.3, \text{ enhanced performance display } d < 27 \\ 0.75, \text{ Enhanced performance display, } d \geq 27 \end{cases}$$

Equation 3 — Calculation of Allowance for Enhanced-performance Integrated Displays

4.7. Requirements for Slates/Tablets and Portable All-In-One Computers

4.7.1 Slates/Tablets shall follow **all** of the requirements for Notebook Computers in Section 3.5 above, including calculations of the following:

- i. Calculated Typical Energy Consumption (E_{TEC}), using Equation 1 with the Notebook Computer Mode Weightings from Table 4.
- ii. Calculated Maximum Allowed Typical Energy Consumption (E_{TEC_MAX}), using Equation 2 with the appropriate base Notebook Computer allowance from Table 6, and applicable Notebook Computer functional adder allowances from Table 7.

4.7.2 Portable All-In-One Computers shall follow all of the requirements for Integrated Desktop Computers in Section 3.5 above, including calculation of the following:

- i. Calculated Typical Energy Consumption (E_{TEC}), using Equation 1 with the Integrated Desktop Computer Mode Weightings from Table 3.
- ii. Calculated Maximum Allowed Typical Energy Consumption (E_{TEC_MAX}), using Equation 2 with the appropriate base Integrated Desktop Computer allowance from Table 6, and applicable Integrated Desktop Computer functional adder allowances from Table 7.

Note: EPA intends to further evaluate Slate/Tablet and Portable All-In-One Computer product data to inform the development of future energy consumption requirements in Version 7.0.

4.8. Requirements for Workstations

4.8.1. Weighted power consumption (P_{TEC}) as calculated per Equation 4 shall be less than or equal to the maximum weighted power consumption requirement (P_{TEC_MAX}) as calculated per Equation 5.

Equation 4: — P_{TEC} Calculation for Workstations

$$P_{TEC} = P_{OFF} \times T_{OFF} + P_{SLEEP} \times T_{SLEEP} + P_{LONG_IDLE} \times T_{LONG_IDLE} + P_{SHORT_IDLE} \times T_{SHORT_IDLE}$$

Where:

P_{OFF} = Measured power consumption in Off Mode (W);

P_{SLEEP} = Measured power consumption in Sleep Mode (W);

P_{LONG_IDLE} = Measured power consumption in Long Idle Mode (W);

P_{SHORT_IDLE} = Measured power consumption in Short Idle Mode (W); and

T_{OFF} , T_{SLEEP} , T_{LONG_IDLE} , and T_{SHORT_IDLE} are mode weightings as specified in Table 8

Table 8 — Mode Weightings for Workstations

T _{OFF}	T _{SLEEP}	T _{LONG_IDLE}	T _{SHORT_IDLE}
35%	10%	15%	40%

Equation 5 — P_{TEC_MAX} Calculation for Workstations

$$P_{TEC_MAX} = 0.28 \times (P_{MAX} + N_{HDD} \times 5) + 8.76 \times P_{EEE} \times (T_{SLEEP} + T_{LONG_IDLE} + T_{SHORT_IDLE})$$

Where:

P_{MAX} = Measured maximum power consumption (W)

N_{HDD} = Number of installed hard disk drives (HDD) or solid state drives (SSD)

P_{EEE} is an EEE allowance of 0.2 W per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.

4.8.2. Active State Benchmark — To be certified, a Workstation must be submitted for qualification with the following information disclosed in full:

- Linpack benchmark test results, compiler optimizations, and total energy consumed over the duration of the test; and
- SPECviewperf benchmark test results, configuration options, total duration of the test, and total energy consumed over the duration of the test.

4.8.3. Desktop Workstations: — Products marketed as workstations may be certified under the Desktop requirements in Clause 4.6 instead of the Workstation requirements in Clause 4.7, at the Partner's option. EPA will identify Workstations certified as Desktops as "Desktops" in all marketing materials, on certified product lists, etc.

4.9. Requirements for Small-scale Servers

4.9.1. Measured Off Mode power (P_{OFF}) shall be less than or equal to the Maximum Off Mode Power Requirement(P_{OFF_MAX}), as calculated per Equation 6, subject to the following requirements:

- The Off Mode Wake-on-LAN (WOL) adder allowance (P_{OFF_WOL}) shall only be applied to products that offer WOL enabled by default upon shipment.

Equation 6 — Calculation of P_{OFF_MAX} for Small-scale Servers

$$P_{OFF_MAX} = P_{OFF_BASE} + P_{OFF_WOL}$$

Where:

- P_{OFF_BASE} is the base allowance as specified in Table 9; and
- P_{OFF_WOL} is the Wake-on-LAN allowance as specified in Table 9.

Table 9 — Off Mode Power Allowances for Small-scale Servers

P _{OFF_BASE} (watts)	P _{OFF_WOL} (watts)
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1.0		0.4
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4.9.2. Measured Long Idle State power ($P_{\text{LONG_IDLE}}$) shall be less than or equal to the Maximum Idle State Power Requirement ($P_{\text{IDLE_MAX}}$), as calculated per Equation 7.

Equation 7 — Calculation of $P_{\text{IDLE_MAX}}$ for Small-scale Servers

$$P_{\text{IDLE_MAX}} = P_{\text{IDLE_BASE}} + (N - 1) \times P_{\text{IDLE_HDD}} + P_{\text{EEE}}$$

Where:

- N is equal to the number of installed storage devices in the Small Scale Server (either hard disk drives or solid state drives);
- $P_{\text{IDLE_BASE}}$ is the base allowance as specified in Table 10;
- $P_{\text{IDLE_HDD}}$ is the hard drive allowance as specified in Table 10; and
- P_{EEE} is an EEE allowance of 0.2 W per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.

Table 10: Idle Mode Power Allowances for Small-scale Servers

$P_{\text{IDLE_BASE}}$ (watts)	$P_{\text{IDLE_HDD}}$ (watts)
24.0	8.0

4.10. Requirements for Thin Clients

4.10.1 Calculated Typical Energy Consumption (E_{TEC}) per Equation 1 shall be less than or equal to the Maximum TEC Requirement ($E_{\text{TEC_MAX}}$), as calculated per Equation 8, subject to the following requirements.

- i. Allowances can only be applied if the corresponding adders are enabled by default.
- ii. Thin Clients can utilize the proxy weightings in Table 3 when calculating E_{TEC} .
- iii. For Thin Clients that lack a discrete System Sleep Mode, Long Idle State power ($P_{\text{LONG_IDLE}}$) may be used in place of Sleep Mode Power (P_{SLEEP}) in Equation 1 so long as the system meets the Thin Client TEC allowance. In such instances, (\times), is replaced by ($_ \times$); Equation 1 remains otherwise unchanged.

Equation 8: Calculation of $E_{\text{TEC_MAX}}$ for Thin Client

$$E_{\text{TEC_MAX}} = TEC_{\text{BASE}} + TEC_{\text{GRAPHICS}} + TEC_{\text{WOL}} + TEC_{\text{INT_DISPLAY}} + TEC_{\text{EEE}}$$

Where:

- *TEC_{BASE} is the Base Allowance specified in Table 11;*
- *TEC_{GRAPHICS} is the Discrete Graphics allowance specified in Table 11 if applicable;*
- *TEC_{WOL} is the Wake-on-LAN allowance specified in Table 11 if applicable;*
- *TEC_{INT_DISPLAY} is the Integrated Display allowance for Integrated Desktops specified in Table 7 if applicable; and*
- *TEC_{EEE} is the Energy Efficiency Ethernet incentive for Desktops specified in Table 7 if applicable, per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.*

Table 11 — Adder Allowances for Thin Clients

Adder	Allowance(kWh)
TEC _{BASE}	60
TEC _{GRAPHICS}	36
TEC _{WOL}	2

Note Products intended for sale in the US market are subject to minimum toxicity and recyclability requirements. Please see ENERGY STAR® Program Requirements for Computers: Partner Commitments for details.

5. Sampling and testing

5.1. Testing

When testing Computer products, the test methods identified in Part 2 of this standards shall be applied.

5.2. Sampling for tests

5.2.1. Representative Models shall be selected for testing per the following requirements:

- i. For qualification of an individual product configuration, the unique configuration that is intended to be marketed and labeled is considered the Representative Model.
- ii. For qualification of a Product Family of all product types, with the exception of Workstations, product configurations that represent the worst-case power consumption for each product category within the family are considered Representative Models. When submitting Product Families, manufacturers continue to be held accountable for any efficiency claims made about their products, including those not tested or for which data were not reported.
- iii. For systems that meet the definition for multiple categories depending on the specific configuration, manufacturers will have to submit the highest power configuration for each category under which they would like the system to be certified. For example, a system that could be configured as either a Category 0 or 1 Desktop, as defined in Table 6 would require submittal of the highest power configuration for both categories in order to be certified. If a product could be configured to meet all categories, it would then have to submit data for the highest power configuration in all categories.
- iv. For qualification of a Product Family of Workstations under the Workstation or Desktop product type, the product configuration that represents the worst-case power consumption with a single GPU within the family is considered the Representative Model.

Note Workstations that meet requirements for this standard with a single graphics device may also have a configuration with more than one graphics device be certified, provided the additional hardware configuration is identical with the exception of the additional graphics device(s). The use of multiple graphics includes, but is not limited to, driving multiple displays and ganging for high performance, multi-GPU configurations (e.g. ATI Crossfire, NVIDIA SLI). In such cases, and until such time as SPECviewperf® supports multiple graphics threads, manufacturers may submit the test data for the workstation with the single graphics device for both configurations without retesting the system.

5.2.2. A single unit of each Representative Model shall be selected for testing.

All units/configurations for which a Partner is seeking compliance, must meet the requirements of this standard.