59/540/CDV

COMMITTEE DRAFT FOR VOTE (CDV)
PROJET DE COMITÉ POUR VOTE (CDV)

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Also of interest to the following committees Intéresse également les comités suivants TC108	Supersedes document Remplace le document 59/523/CD and 59/539/CC

Proposed horizontal standard
Norme horizontale suggérée

☒ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the TC/SC secretary
Les autres CE/SC sont requis d'indiquer leur intérêt, si nécessaire, dans ce CDV à l'intention du secrétaire du CE/SC

Functions concerned
Fonctions concernées

☐ Safety Sécurité	☐ EMC CEM	☒ Environment Environnement	☒ Quality assurance Assurance qualité

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Titre : CEI 62301 Ed 2.0: Appareils électrodomestiques - Mesure de l'alimentation générale

Title : IEC 62301 Ed 2.0: Household electrical appliances – Measurement of standby power

Note d'introduction

La version française sera diffusée ultérieurement.

Introductory note

The methods defined in this standard are intended to cover **low power modes**. They are not intended to be used to measure power consumption of appliances and equipment during **active mode** (also called "on mode"), as these are generally covered by IEC or other product standards

French version will be circulated later.

ATTENTION **VOTE PARALLÈLE** **CEI – CENELEC** L'attention des Comités nationaux de la CEI, membres du CENELEC, est attirée sur le fait que ce projet de comité pour vote (CDV) de Norme internationale est soumis au vote parallèle. Les membres du CENELEC sont invités à voter via le système de vote en ligne du CENELEC.	**ATTENTION** **IEC – CENELEC** **PARALLEL VOTING** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) for an International Standard is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOUSEHOLD ELECTRICAL APPLIANCES – MEASUREMENT OF STANDBY POWER

FOREWORD

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International Standard IEC 62301 has been prepared by IEC technical committee 59: Performance of household electrical appliances

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

FDIS	Report on voting
59/409A/FDIS	59/420/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 maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

The methods defined in this standard are intended to cover **low power modes**. They are not intended to be used to measure power consumption of appliances and equipment during **active mode** (also called “on mode“), as these are generally covered by IEC or other product standards (see Bibliography for some examples).

HOUSEHOLD ELECTRICAL APPLIANCES – MEASUREMENT OF STANDBY POWER

1 Scope

This International Standard specifies methods of measurement of electrical power consumption in **standby mode(s)** and other **low power modes** (**off mode** and **network mode**), as applicable. It is applicable to electrical appliances with a rated input voltage or voltage range that lies wholly or partly in the range 100V ac to 250 V ac for single phase equipment and 130 V ac to 480 V ac for other equipment.

The objective of this standard is to provide a method of test to determine the power consumption of a range of appliances and equipment in relevant **low power modes** (refer 3.4), generally where the product is not in **active mode** (i.e. not performing a primary function).

NOTE 1 The measurement of energy consumption and performance of appliances during intended use are generally specified in the relevant product standards and are not covered by this standard.

NOTE 2 The term "appliances" in this standard means energy using products such as household appliances or equipment within the scope of TC59, however the measurement methodology could be applied to other appliance or equipment types.

NOTE 3 Where this international standard is referenced by performance standards or procedures, these should define and name the relevant **low power modes** (refer 3.4) to which this test procedure is applied.

NOTE 4 The inclusion of DC powered equipment within the scope of this standard is under consideration.

This standard does not specify safety requirements. It does not specify minimum performance requirements nor does it set maximum limits on power or energy consumption.

2 Normative references

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

IEC 60050-131, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory*

IEC 60050-300, *International Electrotechnical Vocabulary (IEV) – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313: Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument*

3 Terms and definitions

For the purposes of this international standard the terms and definitions contained in IEC 60050-131 and IEC 60050-300 as well as the following definitions apply.

3.1
Function

a **function** is a predetermined operation undertaken by the energy using product. **Functions** may be controlled by an interaction of the user, of other technical systems, of the system itself, from measurable inputs from the environment and/or time

In this standard, functions are grouped into 4 main types:

- user oriented secondary **functions** (see 3.6 - **standby mode**)
- network related secondary **functions** (see 3.7 - **network mode**)
- primary **functions** (see 3.8 - **active mode**, which is not the focus of this standard)
- other **functions** (these **functions** do not affect the **mode** classification).

NOTE A list of typical **functions** that may be found in products is included in Annex A. Accurate recording and documentation of **functions** in the relevant **product mode** is a key element of documentation in this standard (refer 6.3). **Functions** types are generally classified as primary or secondary (remote, network, sensing and protective).

3.2
Mode

a state that has a particular set of **functions** (and may include no **function**)

NOTE 1 The **low power mode** categories in this standard are intended to provide guidance for the development of specific **mode** definitions for TC59 products by the relevant sub-committees.

NOTE 2 Annex A provides guidance on expected **modes** found in various appliance configurations and designs based, on their circuitry and layout, but it does not define these **modes**. Annex A also provides background and guidance to users of this international standard regarding the development of **mode** definitions for specific products.

NOTE 3 Refer to Annex C for examples of how to calculate total energy consumption from power measurements where the duration of each relevant **mode** is known.

3.3
Product Mode

the set of **functions** that are actually activated for a specified configuration for a particular product

NOTE The issue of devising appropriate names for **product modes** is a matter for the relevant product committees. While a **product mode** name should generally reflect the **functions** that are active, they need not contain the terms “standby” or “network” even where the **product mode** falls within these **mode** categories.

3.4
Low power mode

a **product mode** that falls into one of the following broad **mode** categories:

- **Off mode(s)**
- **Standby mode(s)**
- **Network mode(s)**

NOTE 1 **Low power modes** are classified into one of the **mode** categories above (where applicable) on the basis of the **functions** that are present and active in each relevant **mode**. Where other **functions** are present in a **product mode** (in addition to the ones required for the **mode** categories specified above), these **functions** do not affect the **mode** classification.

NOTE 2 **Low power mode** categories are defined in order to provide guidance to users of this international standard and to provide a consistent framework for the development of **low power modes**.

NOTE 3 Any limited duration transition that may occur should be separately documented where applicable.

NOTE 4 Not all **low power mode** categories are present on all products. Some products may have more than one **product mode** in each of the **low power mode** categories with different set of **functions** active. The power consumption in each **low power mode** depends on the product design and the **functions** which are active in the particular **product mode**.

3.5
Off mode(s)

this **mode** category includes any **product modes** where the energy using product is connected to a mains power source and is not providing any **standby mode**, **network mode** or **active mode function** and where the **mode** usually persists. An indicator that only shows the user that the product is in the off position is included within the classification of **off mode**

NOTE Guidance on **modes** and **functions** may be found in Annex A.

3.6
Standby Mode(s)

this **mode** category includes any **product modes** where the energy using product is connected to a mains power source and offers one or more of the following user oriented or protective **functions** which usually persist:

- To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, timer;
- Continuous function: information or status displays including clocks;
- Continuous function: sensor-based functions

NOTE Guidance on modes and functions may be found in Annex A. A timer is a continuous clock function (which may or may not be associated with a display) that provides regular scheduled tasks (e.g. switching) and that operates on a continuous basis.

3.7
Network Mode(s)

this **mode** category includes any **product modes** where the energy using product is connected to a mains power source and at least one network **function** is activated (such as reactivation via network command or network integrity communication) but where the primary function is not active

NOTE Where a network function is provided but is not active and/or not connected to a network, then this **mode** is not applicable. A network function could become active intermittently according to a fixed schedule or in response to a network requirement. A "network" in this context includes communication between two or more separate independently powered devices or pieces of equipment. A network does not include one or more controls which are dedicated to a single piece of equipment. **Network mode** may include one or more standby functions.

3.8
Active Mode(s)

this **mode** includes **product modes** where the energy using product is connected to a mains power source, has been activated and provides one or more primary **functions**

NOTE The common terms "on", "in-use" and "normal operation" also describe this **mode**.

3.9
Disconnected Mode

this **mode** defines the status in which all connections to mains power sources of the energy using product are removed or interrupted

NOTE Common terms "unplugged" or "cut off from mains" also describe this **mode**. This **mode** is not part of the **low power mode** category.

3.10
rated voltage

supply voltage (range) designated by the manufacturer

3.11
rated frequency
supply frequency (range) designated by the manufacturer

4 General conditions for measurements

4.1 General

Unless otherwise specified, measurements shall be made under test conditions and with equipment specified in 4.2 to 4.5.

4.2 Test room

The tests shall be carried out in a room that has an air speed close to the appliance under test of ≤0,5 m/s. The ambient temperature shall be maintained at (23 ± 5) °C throughout the test.

NOTE The measured power for some products and **modes** could be affected by the ambient conditions (e.g. illuminance, temperature).

4.3 Power supply

Where this standard is referenced by an external standard or regulation that specifies a test voltage and frequency, the test voltage and frequency so defined shall be used for all tests.

Where the test voltage and frequency are not defined by an external standard, the test voltage and the test frequency shall be the nominal voltage and the nominal frequency of the country for which the measurement is being determined ±1 % (refer to Table 1).

Table 1 – Typical nominal electricity supply details for some regions

Country/Region	Nominal voltage and frequency [a]
Europe	230 V, 50 Hz
North America	115 V, 60 Hz
Japan [b]	100 V, 50/60 Hz
China	220 V, 50 Hz
Australia and New Zealand	230 V, 50 Hz

[a] Values are for single phase only. Some single phase supply voltages can be double the nominal voltage above (centre transformer tap). The voltage between two phases of a three-phase system is 1,73 times single phase values. (e.g. 400 V for Europe). Thus these multiples of the listed nominal voltage are also the nominal voltage for some appliances (e.g. ovens and clothes dryers) in some markets.

[b] “50 Hz” is applicable for the Eastern part and “60 Hz” for the Western part, respectively.

4.4 Supply voltage waveform

The total harmonic content of the supply voltage when supplying the appliance under test in the specified **mode** shall not exceed 2 % (up to and including the 13th harmonic); harmonic content is defined as the root-mean-square (r.m.s.) summation of the individual components using the fundamental as 100 %.

The ratio of peak value to r.m.s. value of the test voltage (i.e. crest factor) shall be between 1,34 and 1,49.

4.5 Power measurement accuracy

Measurements of power of 0,5 W or greater shall be made with an uncertainty of less than or equal to 2 % at the 95 % confidence level. Measurements of power of less than 0,5 W shall be made with an uncertainty of less than or equal to 0,01 W at the 95 % confidence level. The power measurement instrument shall have a resolution of:

– 0,01 W or better for power measurements of 10 W or less;
– 0,1 W or better for power measurements of greater than 10 W up to 100 W;
– 1 W or better for power measurements of greater than 100 W.

For appliances connected to more than one phase, the power measurement instrument shall be equipped to measure total power of all phases connected.

Where the power is measured using the accumulated energy method (see 5.3.2) the calculated power measurement uncertainty shall meet the above requirements.

NOTE 1 See Annex D and the *Guide to the Expression of Uncertainty in Measurement (GUM)* for further details.

NOTE 2 Although an instrument specification for current waveform and crest factor is not included here, the available crest factor on the instrument for the measurement setting selected should exceed the crest factor of the load measured if the uncertainty requirements above are to be met. Refer to B.2, B.3, B.4 and B.6 for more information.

5 Measurements

5.1 General

The purpose of this test method is to determine the power consumption in the relevant **product mode**, which is either persistent or of a limited duration. A **mode** is considered to be persistent where the power level is constant or where there are several power levels that occur in a regular sequence for an indefinite period of time.

NOTE 1 During transition from one mode to another (either automatic or user initiated) some products could wait in a higher power state while transition tasks are performed or circuits are energized or de-energized, so they can take some time to enter a stable state.

NOTE 2 Where the **product mode** changes automatically it can sometimes be necessary to operate a product through the automatic sequence several times on a trial basis to ensure that sequence is fully understood and documented before test results are recorded and reported. A sequence of separate **product modes** could also exhibit a regular ongoing pattern of power levels. Refer to Annex B for further guidance.

NOTE 3 While limited duration **modes** may be documented using measurements to this standard, the results for such **modes** should be reported as an energy consumption (Wh) and duration. A **product mode** that is stable should persist without any user intervention.

5.2 Preparation of appliance or equipment

Tests in this standard are to be performed on a single appliance.

The appliance shall be prepared and set up in accordance with the manufacturer's instructions, except where these conflict with the requirements of this standard. If no instructions are given, then factory or "default" settings shall be used, or where there are no indications for such settings, the appliance is tested as supplied.

Once a product has been selected and is ready for testing, the following steps shall be followed and documented in the test report as applicable:

- Remove the product from packaging (where applicable).
- Read the user instructions (see note) supplied with the product and configure the product in accordance with these instructions.
- Refer to the relevant product test procedure, external requirement (e.g. regulation) or client instruction that specifies the **product mode(s)** to test (where applicable). The **product modes** tested should be consumer relevant and representative of expected normal use. Where user instructions provide configuration options, each relevant option

should be separately tested. **Active mode(s)** should be measured in accordance with the relevant performance standard for the product.

- Undertake testing on relevant **product modes** in accordance with Clause 5.3.
- Classify each of the **product modes** tested into one of the **low power mode** categories (refer Clause 3.4) or other **mode** as applicable.

NOTE User instructions mean information that is provided with the product in the form of a user manual, instruction sheet, information affixed to the product itself or information which is available on a public website specifically for the product model. User instructions does not include any special directions provided by the product supplier to the test laboratory especially for testing purposes.

5.3 Procedure

Under this standard, power consumption in the relevant **low power mode** shall be determined by:

– Sampling Method: by the use of equipment to record power measurements at regular intervals throughout the measurement period (refer 5.3.1). Sampling is the preferred method of measurement for all **modes** and equipment types under this standard. For **modes** where power varies in a cyclic fashion or limited duration **modes**, sampling is the only measurement method permitted under this standard; or

– Average Reading Method: where the power value is not stable but the **mode** is stable, by averaging the instrument power readings over a specified period or, alternatively by recording the energy consumption over a specified period and dividing by the time (refer 5.3.2 for details of when this method is valid); or

– Direct Meter Reading Method: where the power value is stable and the **mode** is stable, by recording the instrument power reading (refer 5.3.3 for details of when this method is valid).

NOTE Determination of an average power from accumulated energy over a time period is equivalent. Energy accumulators are more common than functions to average power over a user specified period.

5.3.1 Sampling Method

This methodology shall be used where either the power is not stable (cyclic or unstable) or the **mode** is of limited duration. However, it may also be used for all **modes** and is the recommended approach for all measurements under this international standard. It should be used if there is any doubt regarding the behaviour of the appliance or stability of the **mode**.

Connect the appliance (equipment) to the metering equipment. Select the **product mode** to be measured (this could require a sequence of operations, including waiting for the equipment to automatically enter the desired **mode**) and commence recording the power. Power readings, together with other key parameters such as voltage and current, shall be recorded at equal intervals of not more 1 second for the minimum period specified.

Note: Data collection at equal intervals of 0.25 sec or faster is recommended for loads that are unsteady or where there are any regular or irregular power fluctuations.

Power readings shall be collected until a period of stable power consumption is established of not less than 10 minutes duration. To establish that the period selected is stable, a linear regression through all power readings selected for the period of sampling shall have a slope of less than 0,01 (1%). The minimum total period for sampling to establish stability using this method is 15 minutes. The final 10 minutes of any sampling period should generally be used to establish stability.

Modes that are known to be of limited duration (based on product information or specifications) should be recorded for their whole duration. The results for such **modes** should be reported as an energy consumption (Wh) and duration together with a statement that the **mode** is of limited duration. For products where a series of separate **product modes** occur in a regular pattern, the power level for each **mode** shall be determined in accordance with this clause and the known sequence and duration of each **mode** in the pattern documented. Refer to Annex B for further guidance.

If the power consumption within a **mode** is cyclic (i.e. a regular sequence of power states that occur over several minutes or hours), the measurement period selected shall be not less than two complete cycles in order to get a representative average value. For cycling loads, the total duration of the period measured shall not be less than 20 minutes or 2 complete operating cycles (whichever is longer) and the average power for subsequent cycles shall not vary by more than 0,01 (1%) for the reading to be valid. Where cycles are not stable or are irregular, sufficient data shall be measured to adequately characterise the power consumption of the mode (a minimum of 10 cycles is recommended).

NOTE In all cases it is recommended that power for the period where data is recorded be represented in graphical form to assist in the establishment of any warm up period, cyclic pattern, instability and stability period.

5.3.2 Average Reading Method

The average reading method over a specified period is valid where the power value is not completely stable but the **mode** does not change. Average power readings or accumulated energy over a user-selected period are used in this case. This method is not permitted for cyclic loads or limited duration **modes**.

NOTE A shorter measurement period may be possible for stable **modes** using the sampling method – refer 5.3.1.

Connect the appliance (equipment) to the metering equipment. Select the **mode** to be measured (this may require a sequence of operations and it could be necessary to wait for the equipment to automatically enter the desired **mode**) and monitor the power. After the product has been allowed to stabilize for at least 30 min, determine the average power over the required period by using either the ***average power*** or ***accumulated energy*** approaches outlined below.

a) ***Average power approach***: where the instrument can record a true average power over a user selected period, the period selected shall not be less than 10 min.

b) ***Accumulated energy approach***: where the instrument can measure energy over a user selected period, the period selected shall not be less than 10 min. The integrating period shall be such that the total recorded value for energy and time is more than 200 times the resolution of the meter for energy and time. Determine the average power by dividing the measured energy by the time for the monitoring period.

NOTE 1 To ensure consistent units, it is recommended that watt-hours and hours be used above, to give watts.

NOTE 2 Example 1 – if an instrument has a time resolution of say 1 s, then a minimum of 200 s (3,33 min) is required for integration on such an instrument.

NOTE 3 Example 2 – if an instrument has an energy resolution of say 0,1 mWh, then a minimum of 20 mWh is required for the accumulation of energy on such an instrument (at a load of 0,1 W this would take about 12 min, at 1 W this would take 1,2 min). Note that both the time and energy resolution requirements should be satisfied by the reading, as well as the minimum recording period specified above (10 min).

5.3.3 Direct meter reading Method

The direct meter reading method may only be used where the **mode** does not change and the power reading displayed on the measurement instrument is stable. A variation of less than 1 % in the measured power over 10 min is considered stable for the purposes of this standard. Where there are some fluctuations in the power value displayed, only significant figures from the readout that do not fluctuate shall be recorded. Not less than 3 significant figures must be stable on the meter readout for this method to be valid. This method is not permitted for cyclic loads or limited duration **modes**.

NOTE A shorter measurement period may be possible for stable **modes** using the sampling method – refer 5.3.1.

Connect the product to be tested to the metering equipment, and select the **mode** to be measured. After the product has been allowed to stabilize for at least 30 min, monitor the power consumption for not less than an additional 10 min. If the power level does not drift by more than 1 % (from the value initially observed at the start of the 10 min period) during the 10 min, the load can be considered stable and the power can be recorded directly from the instrument readout at the end of the 10 min.

6 Test report

The following information shall be recorded in the test report:

6.1 Appliance (equipment) details

- Brand, model, type, and serial number
- Product description, *as appropriate*
- Rated voltage(s) and frequency(frequencies)
- Details of manufacturer marked on the product (if any)
- Source of information used to establish **product modes** (user instructions)

In the case of products with multiple functions or with options to include additional modules or attachments, the configuration of the appliance as tested shall be noted in the report.

6.2 Test parameters

- Ambient temperature (°C)
- Test voltage(s) (V) and frequency (frequencies) (Hz)
- Total harmonic distortion of the electricity supply system
- Information and documentation on the instrumentation, set-up and circuits used for electrical testing

6.3 Measured data, for each product mode as applicable

- Description of the **product mode** and documentation on the user oriented and other **functions** that are active and provide a description of how the **mode** was activated.
- Sequence of events to reach the **mode** where the equipment automatically changes modes.
- Average power in watts rounded to the second decimal place. For loads greater than or equal to 10 W, at least three significant figures shall be reported.
- Measurement method used (refer to 5.3.1, 5.3.2 or 5.3.3). In the case of 5.3.2, indicate whether average power or accumulated energy approach was used.
- Sampling interval, total duration of measurements and stability period (5.3.1 if applicable).
- Accumulated energy and period of measurement (seconds/minutes/hours) (5.3.2 if applicable).
- Energy and duration of any **modes** of limited duration. Documentation describing the pattern (or patterns) for **modes** that automatically repeat sequentially.
- Any notes regarding the operation of the appliance (equipment).
- Classification of the measured **product mode** into one of the relevant **mode** categories in Section 3, or other mode as applicable.

NOTE Apparent power (VA), real power factor and crest factor are also useful parameters and are recommended for inclusion in the test report. Presentation of data collected by sampling in graphical format is recommended.

6.4 Test and laboratory details

- Test report number/reference
- Date of test
- Laboratory name and address
- Test officer(s)

Annex A
(informative)

Guidance on modes and functions for selected appliance types

A.1 General

It is important for Sub-committees and other groups that reference this international standard to devise names for **product modes**, within the broad categories defined, that reflect the relevant **functions** that are present and working.

IEC62301 is a measurement procedure for **low power modes** and is not sufficient to provide an estimate for total energy consumption. Issues like user behaviour, as well as considerations concerning frequency and duration of each possible **low power mode** in addition to **active mode** and **disconnected mode**, are required to determine energy consumption and are not subjects of this standard.

A.2 Product Modes

A product may or may not have each of the **modes** defined and it may have more than one of each of the relevant **modes**. Information on **functions** is included in A.3.

Disconnected mode is included in definitions as many products are removed by users from mains power sources for substantial periods of time. The energy consumption (from the mains) in this state is of course zero and no measurements under this standard are specified. However, the prevalence of this **mode** is user dependent (habits and practices) and is only included as this will have some impact on total product energy consumption in cases where this is of interest.

A product may have several **off modes** or it may have no **off mode**. Switches on products that are labelled as power, on/off or standby may not reflect the **mode** classification based on the actual **functions** active in that **mode**.

The existence of a switch (of whichever technology) which is located on the product is not considered a (user oriented) **function** under **standby modes**. A remote switch (not located on the product) (e.g. remote control, low voltage remote switch) should be considered a remote operation function and would therefore normally be part of **standby mode**. The exception is where a remote switch operates at mains voltage by controlling the mains power supply to a product; in this case it should be considered as **disconnected mode.** EMC filters should not be considered a function under **standby modes**.

Functions regarding memory retention and history of use, user preferences etc are not considered as a function under **standby mode** as these should be retained in **off mode**, during power outages and in **disconnected mode** (e.g. stored in non volatile memory).

Functions that are not protective and/or which cannot be verified (e.g. in the user instructions or information) should not be considered a function under **standby mode**.

In **network mode** care is required to ensure that a properly configured network is available and connected to the product when testing to obtain an accurate measure of power consumption in this **mode**. Care is required in these **modes** as several power levels may be possible (e.g. power may be affected by network connection speed or the number and type of network connections). The power consumption may also cycle in these modes. For a wireless network, there may be a difference in power consumption between the wireless device looking for a connection (listening) and where the network connection is actually established. It is important to consider that in a network environment, the energy consumption of the energy using product may be affected by the product design and user interaction as well as network interaction.

In most cases, **active mode** energy consumption is complex and requires a detailed analysis of the duty cycle of the product together with the influence of any user interaction and the range of common tasks. In many cases there are specific product standards that cover the **active mode** energy consumption and these should be referenced where they are available. However, product committees may decide that the measurement methodologies defined in Clause 5 of this standard could be applicable to **active modes** which have low power and steady power consumption.

For portable appliances with rechargeable batteries, the relevant **low power modes** would be:

- with the charger or docking/base station connected to mains power but with the appliance detached (battery disconnected); and
- with the charger or docking/base station connected to mains power with the appliance attached and fully charged (also called float or maintenance).

Modes where batteries are being charged (apart from float or maintenance **modes**) are not defined in this standard.

The **low power mode** with the minimum power level (lowest power **mode**) for an individual product may be a useful benchmark for products with comparable functionality.

In Edition 1 of this standard, **standby mode** was defined as follows:

> *lowest power consumption mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when an appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions*

In Edition 2 of this standard, this definition is no longer used as **standby mode**. This definition above has no defined level of functionality and if used should be applied with great caution, as compared products may have different levels of functionality. The minimum power consumption mode is not a **mode** in this standard and does not relate to any one of the **low power mode** categories as defined in Edition 2.

A.3 Functions

A **function** is defined in Clause 3.1.

Functions can be generally classified as either primary **functions** or secondary **functions**. Secondary **functions** can include remote switching, network, sensing and protective type **functions**. Primary **functions** relate to the primary purpose of the product. For some products network **functions** or sensing **functions** can be a primary **function**. There may be more than one primary **function**.

The operating load (as illustrated in Figure A.1) is the primary **function** of the appliance. Thermostats or temperature control devices which control the operating load in order to maintain a constant condition are usually considered as part of the operating load (primary **function**) and not as a power switch or a secondary **function**.

Examples of secondary **functions** are:

- remote control of power to the operating load (effectively a remote power switch) – typically wireless or low voltage (dedicated to a product);

- secondary control of the load (auto off, delay start or delay off);
- sensors such as light, occupancy, heat, smoke, temperature, water flow (note that a thermostat which controls an operating load is not considered to be a sensor in this context);
- display (could be mode, status, program, state or clock etc.);
- memory and timer functions;
- electronic controls, locks and switches;
- network functions (wired, wireless, infrared);
- battery charging (where this is not a primary **function** of the device);
- electromagnetic compatibility (EMC) filters;
- sensors for protection of equipment and/or users.

Some examples of **functions** and their respective **mode** classifications are set out in Table A.1.

It is useful to consider secondary **function(s)** as separate modules to the primary load (or primary **function**) in order to understand why power consumption may occur in some **low power modes**. Secondary **functions** will consume small amounts of power under some design configurations. Some secondary **functions** may have a separate switch to disconnect them from the mains power supply under some **product modes**. A range of possible configurations for secondary **function** modules are shown in Figure A.1.

A.4 Power switch

A power switch allows the user to activate or deactivate a primary **function**. A power switch is usually located on the product. Some secondary **functions** may remain active or become activated once the primary **function** is deactivated. Some products may have more than one power switch (some switches may operate on secondary **functions** alone). Some products may not have a power switch. A power switch is not classified as a **function** in this standard. There are a number of possible variations of a power switch, such as:

- Mains power switch: power supply to the primary **function** is controlled by a user activated mains voltage switch. Some secondary **functions** may remain active or become activated when the primary **function** is deactivated;
- Low voltage or “soft” power switch: power supply to the primary **function** is controlled via a user activated secondary low voltage switch. Some secondary **functions** may remain active or become activated when the primary function is deactivated;
- Timer or automatic switch: a variation of a switch where the primary function is controlled within the appliance rather than by the user directly (can be automatic (e.g. at completion of a task) or user programmed to turn on of turn off at specified times or selected periods and can include power management);
- Remote control switch: a variation of a switch where the primary function is controlled remotely by the user or by another device;
- Power control switch: a power switch that incorporates some sort of power control device such as a dimmer or thyristor.

Table A.1 Table of Devices, their Functions and their Associated Modes – for guidance only

Device	Description	Secondary Function Type	Associated Mode	Comments/Issues
Remote switch	Remote switch that uses low voltage (wired) or radio or IR signals (wireless)	User oriented	Standby	Remote function has to be active. Does not includes mains voltage switch that may be mounted remote from the product. Includes normal remote controls that are common on consumer products and some appliances (e.g. heaters).
Local switch	Switch that places the product into a mode with no apparent user oriented function active	Other	Off	Switch located on the product. Overrides remote switches and network functions. Some switches do not deactivate all functions (e.g. clocks, remotes etc) – these would be **standby mode**.
Child lock	Device to stop accidental activation of an appliance by a child	User oriented	Off (1)	Typically an electrical lock (can also be mechanical) to ensure the product stays in **off mode**. Often associated with an LED. Variant of off but requires some power.
LED to signal Off-Mode	Light emitting diode (LED) to show the user that the product is off	Other	Off	A special case which should be considered as **off mode** (see Clause 3.5). Does not include cases where remote switch is still active (see remote switch above).
Safety switches	Earth leakage, residual current devices or Ground Fault Circuit Interrupter or Arc Fault Circuit Interrupters	Other	See note (3)	Protective device which disconnects power in case of an electrical fault to protect the user or equipment – user not aware of presence.
EMC filters	Electromagnetic compatibility filters	Other	Off	EMC filters are required to limit interference with other devices.
Flood protector	Detection systems to ensure that flooding does not occur from faulty solenoids (e.g. washing products)	Other	Off (2)	Once solenoids are properly closed, they are unlikely to open again – should be required to ensure solenoids are closed and not leaking at end of cycle (designs vary).
Back-siphonage protector	Stops backflow of water into the mains water supply from an appliance (e.g. washing products)	Other	Off	Many products are required to have this and almost always this is a mechanical device (no power). Protects other users connected to the water supply.
No movement deactivation switch	Turns the product off if there is no movement in a defined period of time (e.g. iron)	Other	Active	An automatic change of mode from active to **off** or **standby mode** – not a normal operating state, protects property in case of (accidental) misuse of the product, not common in normal use. This function is by definition associated with use in **active mode**. Should not be relevant to energy consumption. Device protects property.
Delayed off switch	After a certain (user selectable) period the appliance is switched to a lower state	User oriented	Standby	Once powered to a lower state, the resulting mode would depend on the **functions** that are active (e.g. is remote control active or not). Relevant to energy consumption.

Notes: The final product mode will depend on the set of functions (devices) that are present and activated.

1. Should be off mode as the product is clearly off and is considered to be off by the user. However, power may be required to keep electronic locks active so may need to be considered as a special kind of off. Some options for this **function** are mechanical and may not require power consumption.
2. Some designs provide additional protection by detecting leakages ahead of the solenoid, e.g. leakage of tube & connections. However, all of these **functions** are not obvious to users and it can be argued that the user could not differentiate this from normal **off mode**. However, these are real **functions** and may require some power. This is an area where there are different views and product committees need to consider specific cases. This device protects property.
3. Safety switches should be ignored when determining the **mode category**, but if it was noted in the user manual, it could be classified as **standby mode**. This device protects users.

A.5 Appliance types

This section sets out in diagrammatic form some common appliance configurations and whether these are likely to have some power consumption in **low power modes**. The major components in the appliance that affect power consumption are described below together with some examples and descriptions for each type (A to G) (see Figure A.1) A brief description of each type and some examples are given below. The example products listed are to illustrate those typical products that are configured in a particular way and their inclusion is not necessarily an accurate classification for possible product variations.

NOTE Letters allocated to each appliance type are arbitrary.

Type A: The appliance has no secondary **function** load and no power switch. The appliance operates whenever plugged in. There may be some internal regulation of the load (e.g. thermostat or temperature control device). There is no low power mode.

Examples of Type A appliances: electric kettles (with no cut-out), some small kitchen appliances, electric storage water heaters, room heaters, refrigerators and freezers.

Type B: The appliance has a power switch. The primary **function** of the appliance operates when it is manually turned on by the power switch and stops when turned off. Power switches can be the auto-off type (automatically turns off at the completion of the operation). As there is no secondary **function**, the **low power mode** usually consumes little or no power.

Examples of Type B appliances: electric heaters (with no thermostat), hair dryers, toasters, electric kettles (with boil cut-out), some major appliances (some dishwashers, clothes washers and clothes dryers), many small kitchen appliances, cooktops, some ovens.

Type C: The appliance has no mains power switch but has a secondary **function** that controls the primary **function** or performs some related **function**. There may be a remote control or low voltage power switch. **Low power mode** energy may be associated with the secondary function.

Examples of Type C appliances: bread makers, some small kitchen appliances, some major appliances (some dishwashers, clothes washers and clothes dryers), some microwave ovens, any appliance with a remote control and no hard off switch, any appliance with a “soft” (electronic) power switch.

Type D: The appliance has a power switch that disconnects the primary **function** and has a secondary **function** that is permanently connected to the power. **Low power mode** energy may be associated with the secondary **function**.

Examples of Type D appliances: conventional ovens, some types of heaters, microwave oven, any appliance that requires some power for a secondary function (clock, display, timer etc.).

Type E: The appliance has a power switch that disconnects the primary **function.** It may have a secondary **function** that is permanently connected to the power and/or one that is disconnected with the power switch. **Low power mode** energy may be associated with the permanently connected secondary **function**. Other **low power modes** may be associated with the switched secondary function.

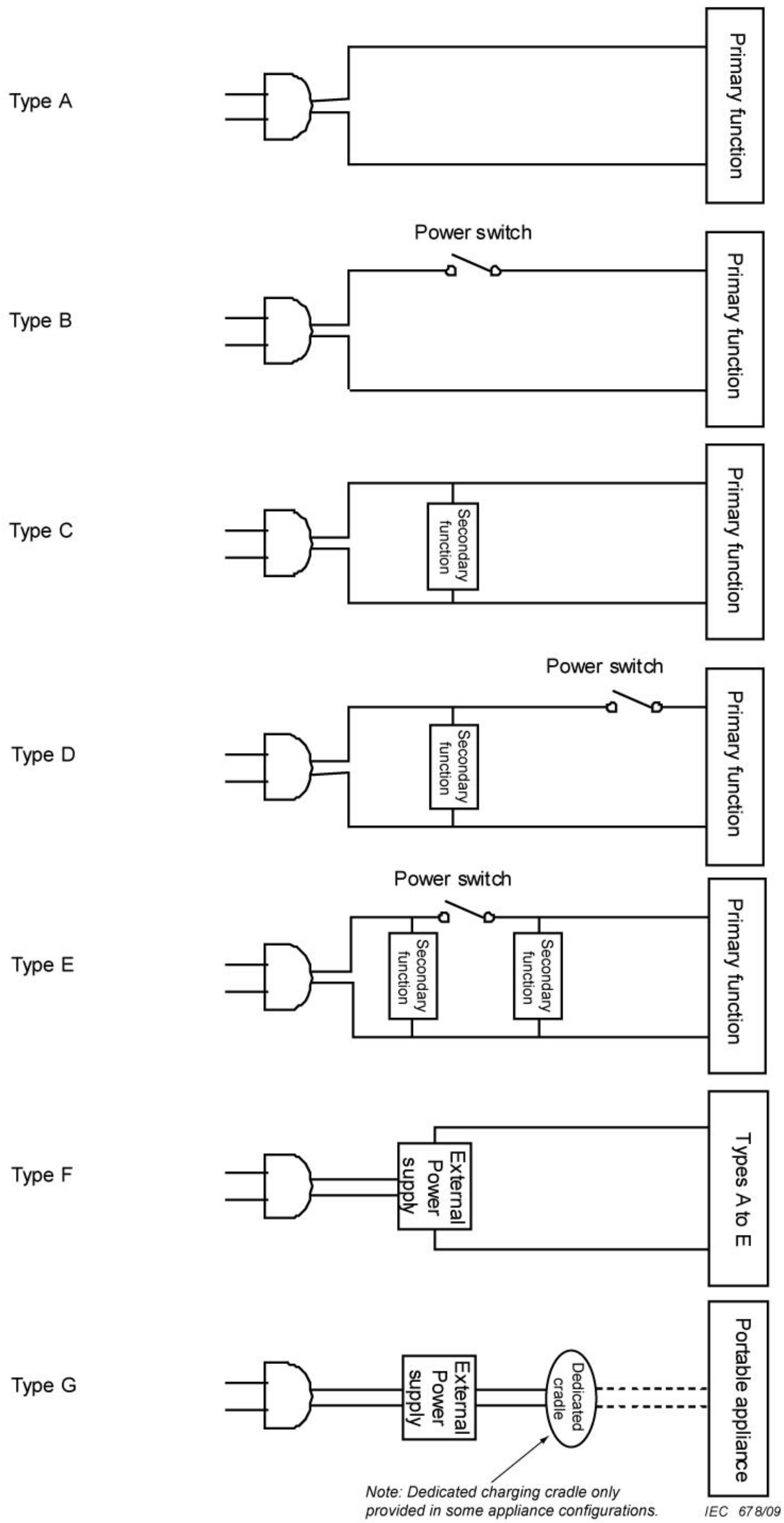
Examples of Type E appliances: some microwave ovens, some major appliances (some dishwashers, clothes washers and clothes dryers), some types of heaters, any appliance that requires some power for a secondary function (clock, display, timer etc.), any appliance with permanently connected electronics or EMC filters, low voltage switches and controls or wired remote controls.

Type F: The appliance has an external power supply that provides the appliance with power. Supply is usually extra low voltage (<50 V), may be a.c. or d.c. and may be connected via a plug. Internal appliance configurations may be A to E above. All **functions** require the external power supply to be connected to mains power. Energy consumption is associated with the power supply and there may be numerous **low power modes**.

Examples of Type F appliances: some small personal care products, some small kitchen appliances, any appliance that is normally connected to mains power via an external power supply.

Type G: The appliance has an external power supply that provides the appliance with power, mainly for battery charging. The appliance's primary **function** is normally performed with key part of the appliance disconnected from the power supply (battery operated and portable appliances), but some appliances may be used with the power supply connected. Supply is usually extra low voltage (<50 V) and may be a.c. or d.c. and is usually connected via a detachable plug. For these types of appliances the battery may be either charged while remaining inside or connected to the appliance (in this case the power supply may be attached to the product itself via a plug, or the product may sit in a dedicated cradle which charges the product when placed in the cradle while not in use) or the battery may be disconnected from the appliance for charging purposes (may require a dedicated or generic battery charging device). Energy consumption is usually associated with the power supply (even when the appliance is disconnected) and there can be **low power modes** and/or **active modes** associated with battery charging and equipment use (refer Paragraph A.2).

Examples of Type G appliances: portable battery operated appliances such as battery shavers, electric toothbrushes, portable vacuum cleaners.



657
658 **Figure A.1 – Circuit diagram images by type**

Annex B
(informative)

Notes on the measurement of low power modes

There are a number of problems associated with power measurement of very small loads that are typically found in **low power modes** (typically less than 10 W). These mostly relate to the ability of the measurement instrument to respond correctly to non sinusoidal current waveforms that are often presented in low power modes. Key points for consideration are discussed briefly below.

B.1 Low power measurement issues

The intent of this standard is to measure power of the device in each relevant **product mode**. However in many **low power modes**, the current waveform is unlikely to be sinusoidal, so it is necessary to ensure that the meter has a scanning frequency that is sufficiently fast to capture the unusual current waveforms that are common (such as pulses or spikes). To determine the power, the meter has to multiply the instantaneous current and voltage values several hundred times per cycle (roughly 15 ms). Most digital instruments accumulate these values and display an average power once or twice a second. It is important to note that the power of many products in **low power modes** will be less than 10 W (some will be very small). This is partly due to low current levels, but also, in some cases, due to the current waveform being largely unrelated to the voltage waveform.

B.2 Crest factor

The crest factor is defined as the ratio of peak current to r.m.s. current (or peak voltage to r.m.s. voltage). For a pure sinusoidal waveshape the crest factor is 1,414, while for a pure constant d.c. load the crest factor is 1,0. In normal circumstances it is assumed that the voltage supply impedance will be such that the voltage waveform will remain generally sinusoidal in shape when supplying small **low power mode** loads (noting the allowable harmonic requirements for the electricity supply in 4.4), so the parameter of particular concern from a metering perspective is usually current and its waveform. During the measurement, it is critical that the crest factor capability of the meter is greater than the actual crest factor of the load, otherwise the peak value of the current will be “lopped off” and the integration for power will be incorrect. Most meters will have a rated crest factor stated for the rated input within each “range”. Usually, the available crest factor will increase as the actual load becomes smaller relative to the rated input range selected. However, if the range selected is too large, the accuracy resolution of the measurement will become poor. Good meters will give an “out of range” reading if the available crest factor is exceeded. Note that crest factors for standby loads are typically 3 and can, in some circumstances, be as high as 10. Good instruments will provide guidance on how to deal with high crest factor loads while retaining measurement accuracy.

B.3 Instruments for power measurements

Generally, a digital power analyser with a fundamental power accuracy of 0,5 % or better will comfortably meet the instrument specification and measurement uncertainty required in this standard. It is not usually possible to meet these requirements (either the required accuracy or the measurement method) using traditional rotating disk kilowatt-hour meters. **Low power mode** loads (less than 10 W) are often unable to overcome the starting torque required for the operation of a rotating disk meter and such loads may therefore appear as 0 W. This is unsatisfactory. See also Clause B.6.

The following broad recommendations are made regarding power measurement instruments:

- power resolution of 1 mW or better;
- an available current crest factor of 3 (or more) at its rated range value;
- minimum current range of 10 mA (or less).

It is also desirable for measurement instruments to be able to average power accurately over any user selected time interval (this is usually done with an internal mathematical calculation dividing accumulated energy by time within the meter, which is the most accurate approach). As an alternative, the measurement instrument would have to be capable of integrating energy over any user selected time interval with an energy resolution of less than or equal to 0,1 mWh and integrating time displayed with a resolution of 1 s or less. A data recording capability (sampling) is the most desirable capability – refer B.7.

B.4 Harmonic components of the current waveform

Where the current waveform is a smooth sine wave in phase with the voltage waveform (e.g. in a resistive heating load), there is no harmonic content in the current waveform. However, some current waveforms associated with low power modes are highly distorted and the current may appear as a series of short spikes or a series of pulses over a typical a.c. cycle. This effectively means that the current waveform is made up of a number of higher order harmonics which are multiples of the fundamental frequency (50 Hz or 60 Hz). Most digital power analysers will have no problem with the accurate measurement of higher order current harmonics presented by **low power modes**. However, it is recommended that a power instrument should have the ability to measure harmonic components up to at least 2,5 kHz. Note that harmonic components greater than the 49th harmonic (2 450 Hz) generally have little power associated with them. As a rule, the scanning frequency of a power measurement instrument should be at least twice the frequency of the highest order harmonic that has significant power associated with it.

B.5 Cyclic or pulsing loads, sequence of modes

Some **low power mode** loads will be cyclic or pulsing in nature. Such loads make it impossible to use normal power readouts from a power meter to determine **low power mode** power. In these cases it is necessary to use a meter that can sample and record data at 1 sec or faster as specified in 5.3.1 (refer also B.7). Other products may exhibit a sequence of distinct **product modes** that occur in a regular pattern.

Some **product modes** may be cyclical in nature in that they may be stable for a period (often many minutes) and may then go into a higher or lower energy state for a short period. Some products may draw a power pulse at infrequent intervals. In these cases, it is important to understand the behaviour of the product before measurements are commenced. Where there is a “regular” cycle of differing energy states, then a whole number of cycles should be examined when determining average power. To gain a better understanding of the product behaviour it can be useful to examine the load profile with an oscilloscope that is set to trigger on a significant change of load.

Some products may exhibit a sequence of different **product modes** that automatically occur in a regular pattern. In these cases, each of the separate **product modes** should be separately identified, measured and their duration documented.

In some cases, judgement may be required to determine whether a single **product mode** exhibits cyclic power patterns or whether the product in fact has a sequence of different **product modes** that occur in a regular pattern. The key determinant is whether there are different **functions** that become active or inactive during the different power levels – if this occurs then these should be treated as separate **product modes**.

As a general guide, cyclic loads within a **mode** would normally change power levels for seconds or perhaps minutes over a period of seconds to tens to minutes, whereas a pattern of **modes** would normally change power state for minutes or hours over a period of hours to days. However, it may not always be easy for a third party to differentiate these cases without further product documentation.

Examples of cyclic power patterns *within a product **mode*** include

- a heater that operates periodically to maintain an operating condition; and
- the short power draw required to recharge capacitors that maintain functions within a particular operating state.

An example of a product that exhibits *a sequence of **modes*** is one having a low power mode most of the time which wakes once or twice a day for a short period (e.g. in the order of 2 to 30 minutes) in order to connect to a network to download operating information. In this case, the product clearly enters a different limited duration mode as it has activated network related functions which were not present in the low power mode.

B.6 Asymmetric current waveforms (DC components)

Depending on the power supply configuration and design, some small loads (such as those associated with **low power modes)** can draw asymmetric current, i.e. drawing current only on either the positive or negative part of the a.c. voltage cycle. This is effectively a d.c. power load component supplied by an a.c. voltage supply. Most digital power analysers can adequately handle low frequency and d.c. components during a power measurement. However, it is not possible to undertake accurate measurements of this type of current waveform using any type of transformer input such as a current transformer – d.c. components are not visible through a transformer input. It is therefore critical that any power instrument use a direct shunt input to measure current. Rotating disk meters are unsuitable for any size load of this type because d.c. loads also exert a braking torque on the meter which creates further inaccuracies.

B.7 Sampling of power readings

Sampling of power readings can be done using a data logger (i.e. a “device that can read various types of electrical signals and retains the data in internal memory for later download to a computer”) or by direct connections between a power measurement instrument and a computer which can record data directly at regular intervals. The latter configuration is probably the most common setup in modern laboratories, although there are many possible configurations. Most digital power analysers have an interface (e.g. GPIB or serial interface) that can allow regular recording of all key parameters directly to a computer or other laboratory data collection device.

While most laboratory instruments are now very flexible in their operation, the operator needs to have a good understanding of their behaviour and how they interface with logging equipment or computers. One common issue in particular relates to the use of digital power analysers when they are controlled externally. For many types, once an external interface with a data logger or computer is engaged/active and data collection has commenced, the auto-ranging function is usually disabled. This means that the laboratory technician needs to anticipate the likely power range and crest factor required for the monitoring period and to manually set the meter up in the correct range prior to recording data (for both power and current). So a trial run to set the meter correctly (to avoid out of range readings) is usually recommended.

A related point is that during changes of mode on an appliance (e.g. switch to passive or active standby from off) or during significant changes in supply voltage (e.g. from 115V to 230V) spikes or severe fluctuations in power levels often occur for a short time (large spikes associated with an on switch are common). Care is required to set the correct range if tracking these spikes is of interest (otherwise they can usually be ignored as these are not usually of direct importance for measurement to this standard).

B.8 Application of this standard

This standard specifies tests to be performed on a single product to assess the relevant low power modes. It does not provide any indication of production variability which would require specified sampling for a range of products. For the purposes of compliance and conformity assessment, a properly devised sampling plan should be developed.

B.9 Connection of Electrical Instruments

In order to minimise variability in measurement results it is important that electrical instruments are connected in a consistent manner. The connection arrangement for end use equipment powered directly from an ac source is shown in Figure B.9.1 and the connection arrangement for end use equipment powered via an external power supply is shown in Figure B.9.2. The voltage should be measured on the equipment side of the current sensor of a power meter.

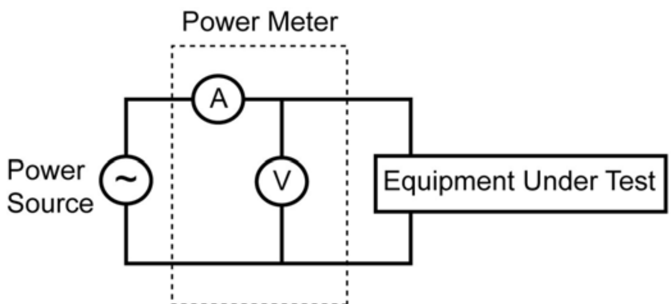


Figure B.1 – Connection arrangement for equipment powered directly from the ac main supply

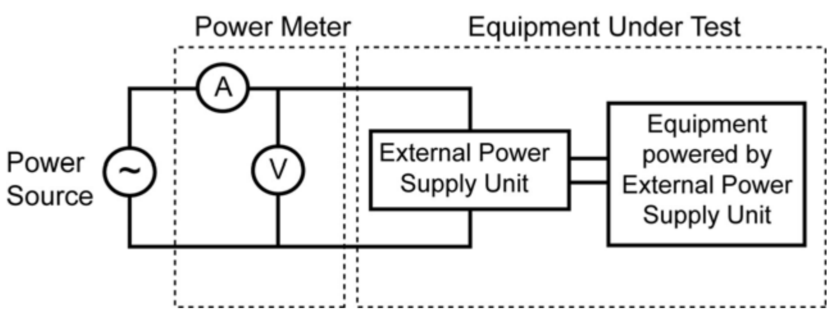


Figure B.2 – Connection arrangement for equipment powered via an external power supply

Key:

‘A’ indicates the current measuring part of the power meter

‘V’ indicates the voltage measuring part of the power meter

When measuring input powers of 1W or less, care should be taken to ensure that the connection arrangements do not give false readings due to interference. To minimise such effects, all leads should be kept as short as possible and the leads to the ammeter (shown as ‘A’ in Figures B.1 and B.2) should be twisted together.

Annex C
(informative)

Converting power values to energy

This annex provides some guidance regarding the conversion of power measurements determined under this standard to energy consumption values.

Energy is the average power multiplied by the time. Electrical energy is generally expressed in watt-hours or kilowatt-hours. Energy can also be expressed in joules. One watt is the rate of energy consumption of 1 J/s. 1 kWh is equivalent to 3,6 MJ.

To convert power to energy (e.g. an annual energy consumption), the number of hours of operation in each **mode** must be assumed for a given period and the average power for each **mode** must also be known. As most appliances can operate in a number of **modes** and the usage patterns and profiles may vary considerably between countries, converting power values determined under this standard to energy values is potentially fraught with difficulty.

In the simplest case, an appliance that has only a single **mode** of operation can be converted to an annual energy value by assuming a constant power for a whole year. A year has 8 760 h (this ignores leap years), so an appliance that has say a constant standby power of 5 W (assuming that there is no use in other **modes**) would consume 43 800 Wh per year or 43,8 kWh per year.

Annual energy consumption can be determined for more complex user patterns by the sum of power × hours of use for each **mode** during one year (i.e. hours 1 to 8 760).

When total energy consumption for a large appliance is being considered, it is necessary to know as a minimum the “on” or **active mode** time and energy consumption per cycle. For some appliances, an assumed number of uses (cycles) per year and the **low power mode** (typically **off mode**) power may be sufficient. For more complex products where the **active mode** can vary considerably (e.g. heaters and air conditioners), more detailed data is required. For some products, consumers may disconnect the appliance from the power supply while not in use. There may also be several possible **low power modes** which may depend on consumer preferences or usage patterns and behaviour.

NOTE Since usage patterns and products may vary considerably, the number of uses and power levels in both examples below should be considered as hypothetical figures for the sole purpose of illustrating the calculation.

- **Example 1**: Say a clothes washer has a program time of 85 min and an energy consumption of 0,95 kWh per cycle (**active mode**) and an **off mode** power consumption of 1,30 W. The annual energy consumption for 300 uses per year would be (assuming no use of delay start and assuming end of program power is equal to the **off mode** power consumption):

  time in use = 85 × 300 ÷ 60 = 425 h per year;

  time in **off mode** = 8 760 – 425 = 8 335 h per year;

  energy consumption in **active mode** = 300 × 0,95 = 285 kWh per year;

  energy consumption in **off mode** = 8 335 × 1,30 ÷ 1 000 = 10,836 kWh per year;

  energy consumption total = 285 + 10,836 = 295,836 kWh per year

  = 296 kWh per year (rounded to the near whole kWh for illustrative purposes).

- **Example 2**: Say a breadmaker takes 4 h to bake a standard 700 g loaf of bread and uses 0,33 kWh in the process. It is used to bake three loaves a week. The rest of the time it is left plugged in. It has a **standby mode** power consumption of 2 W. The annual energy consumption for 156 uses per year would be:

time in **active mode** = 4 × 3 × 52 = 624 h per year; (whole weeks used for simplicity)

time in **standby mode** = 8 760 – 624 = 8 136 h per year;

energy consumption in **active mode** = 0,33 × 52 × 3 = 51,48 kWh per year;

energy consumption in **standby mode** = 8 136 × 2,0 ÷ 1 000 = 16,272 kWh per year;

energy consumption total = 51,48 + 16,272 = 67,752 kWh per year

= 68 kWh per year (rounded to the near whole kWh).

Annex D
(informative)

Determination of uncertainty of measurement

NOTE The following text has been adapted from "Assessment of Uncertainties of Measurement" by RR Cook, published by NATA Australia, 1999, ISBN 0-909307-46-6 (see Bibliography). Further detail should be obtained from this reference or from the *Guide to the Expression of Uncertainty in Measurement (GUM)* (hereafter referred to as "GUM").

Any measurand (the subject of a measurement) will have a true value that will be approximated by the measurement value. The error of the measurement is the difference between the measured value and the true value. In general, the measured value cannot be repeated exactly, so we need a parameter that describes not only the range of the error but also how "fuzzy" or dispersed the range is. This parameter is called the uncertainty of the measured value. It gives a range, centred on the measured value, within which, to a stated probability, the true value lies. It is usual (but not universal) that the range has equal positive and negative limits.

To be meaningful, the uncertainty statement must have an associated confidence level: i.e. it is necessary to state the probability that the true value lies within the range given.

The reasons for choosing a 95 % confidence level in this standard are as follows.

- It is established practice throughout much of Europe, North America and Asia.
- The GUM assumes that the combined uncertainty has a distribution that is a close approximation to a normal distribution. A 95 % confidence level approximates to a range of 2 standard deviations. It is a widely held view that, for most measurement systems, the approximation to a normal distribution for the distribution of the combined uncertainty is reliable out to 2 standard deviations, but beyond that the approximation is less reliable.
- An approximate 95 % confidence interval can be simply obtained by multiplying the combined standard uncertainty by 2.

The steps to assess an uncertainty of measurement are:

- ensure that all corrections and calibrations are correctly applied to readings;
- construct a model of the measurement system listing all the factors that contribute error to the final result;
- decide whether each component is to be evaluated by a Type A or Type B analysis (see the GUM for details). Type A analysis uses repeat measurements and statistical means to minimise the effect of random errors and noise. Type B analysis uses an engineering approach (non-statistical methods) to estimate the worst case limits or measurement errors (based on instrument accuracy, calibration data, specifications etc. – typically data from third party sources); and
- combine all the standard uncertainty components to give an overall measurement uncertainty.

Further detail should be obtained from the *Guide to the Expression of Uncertainty in Measurement (GUM)*.

Bibliography

NOTE This bibliography lists standards and other reports relevant to the measurement of energy and performance of household electrical appliances. Not all products covered below necessarily have a **low power mode**.

IEC 60299, *Household electric blankets – Methods for measuring performance*

IEC 60311, *Electric irons for household or similar use – Methods for measuring performance*

IEC 60312, *Vacuum cleaners for household use – Methods of measuring the performance*

IEC 60350, *Electric cooking ranges, hobs, ovens and grills for household use – Methods for measuring performance*

IEC 60369, *Methods for measuring performance of floor polishers for household and similar purposes*

IEC 60379, *Methods for measuring the performance of electric storage water-heaters for household purposes*

IEC 60436, *Electric dishwashers for household use – Methods for measuring the performance*

IEC 60442, *Electric toasters for household and similar purposes – Methods for measuring the performance*

IEC 60456, *Clothes washing machines for household use – Methods for measuring the performance*

IEC 60508, *Methods for measuring the performance of electric ironing machines for household and similar purposes*

IEC 60530, *Methods for measuring the performance of electric kettles and jugs for household and similar use*

IEC 60531, *Household electric thermal storage room heaters – Methods for measuring the performance*

IEC 60535, *Jet fans and regulators*

IEC 60619, *Electrically operated food preparation appliances – Measuring methods*

IEC 60661, *Methods for measuring the performance of electric household coffee makers*

IEC 60665, *AC electric ventilating fans and regulators for household and similar purposes*

IEC 60675, *Household electric direct-acting room heaters – Methods for measuring performance*

IEC 60705, *Household microwave ovens – Methods for measuring performance*

IEC 60879, *Performance and construction of electric circulating fans and regulators*

IEC 61121, *Tumble dryers for household use – Methods for measuring the performance*

IEC 61176, *Hand-held electric mains voltage operated circular saws – Methods for measuring the performance*

IEC 61254, *Electric shavers for household use – Methods for measuring the performance*

IEC 61591, *Household range hoods – Methods for measuring performance*

IEC 62087, *Methods of measurement for the power consumption of audio, video and related equipment*

IEC 62252, *Household refrigerating appliances - Characteristics and test methods*

Guide to the Expression of Uncertainty in Measurement (GUM) [ISO/IEC/BIPM/IFCC/IUPAC/ IUPAP/OIML:1995]

EN 50229, *Electric clothes washer-dryers for household use – Methods of measuring the performance*

COOK, RR. *Assessment of uncertainties of measurement for calibration and testing laboratories.* National Association of Testing Authorities (NATA), Australia, 1999

NOTE The following standard provides information that may be of value to appliance and equipment designers regarding the product design power control user interface.

IEEE 1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments

Refer to http://eetd.lbl.gov/controls/1621/1621index.html

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