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**Environmental Engineering (EE);**
**Measurement method for energy consumption of Customer Premises Equipment (CPE)**

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REN/EE-EEPS67

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# Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI EN Approval Procedure.



| Proposed national transposition dates | |
|---|---|
| Date of latest announcement of this EN (doa): | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 6 months after doa |
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# Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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# Introduction

The present document defines the energy consumption measurement methods for Customer Premises Equipment (CPE).

# 1 Scope

The present document defines the methodology and the tests conditions to measure the power consumption of CPE power source within the scope of Commission Regulation 2023/826 [i.1]:

Moreover, these different modes of operation are defined.

- Disconnect mode.
- Off mode (as defined in Commission Regulation 2023/826 [i.1]).
- Idle states.
- Low Power states.
- On mode.
- Ready mode.

The methods of measurement are applicable to customer premises equipment which can be directly connected to the mains.

Equipment drawing electricity via the network connection (indirectly connected to the mains) or via local Personal Computer (i.e. via USB) is out of scope:

- Networked standby mode and stand by mode defined in Commission Regulation (EU) 2023/826 [i.1] is out of the scope of the present document and it is covered by ETSI EN 303 423 [i.4].



# 2 References

## 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.



Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] EN 50160: "Voltage characteristics of electricity supplied by public electricity networks", (produced by CENELEC).

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.


[i.1] Commission Regulation (EU) 2023/826 of 17 April 2023 laying down ecodesign requirements for off mode, standby mode, and networked standby energy consumption of electrical and electronic household and office equipment pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulations (EC) No 1275/2008 and (EC) No 107/2009.

[i.2] European Commission Directorate-General, Joint Research Centre: "EU Code Of Conduct on Energy Consumption of Broadband Communication Equipment".

[i.3] Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast).

[i.4] ETSI EN 303 423: "Environmental Engineering (EE); Electrical and electronic household and office equipment; Measurement of networked standby power consumption of Interconnecting equipment".

[i.5] Cablelabs®: "Data-Over-Cable Service Interface Specifications- DOCSIS® 3.0 Interface".

[i.6] Cablelabs®: "Data-Over-Cable Service Interface Specifications- DOCSIS® 3.1 Interface".

[i.7] IEEE 802.3-2005™: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[i.8] Commission accompanying (EU) No 801/2013 amending Regulation (EC) N° 1275/2008 with regard to ecodesign requirements for standby, off mode electric power consumption of electrical and electronic household and office equipment, and amending Regulation (EC) N° 642/2009 with regard to ecodesign requirements for televisions.

[i.9] Guidelines accompanying Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off-mode electric power consumption of electrical and electronic household equipment.

[i.10] IEEE 802.11-2021™: "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[i.11] Recommendation ITU-T G.993.2 (02/2019): "Very high speed digital subscriber line transceivers 2 (VDSL2)".

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the following terms apply:

**AI Processor:** specialized computing unit capable of performing accelerated matrix calculation using dedicated hardware not normally found in a general purpose processor

**broadband telecommunication network equipment:** equipment comprising broadband technology that is part of a telecommunication network

**broadband terminal equipment:** equipment comprising broadband technology that is connected to a telecommunication network at a point beyond the Network Termination Point

**Customer-Premises Equipment (CPE):** any terminal and associated equipment located at a subscriber's premises and connected with a carrier's telecommunication channel(s) at the Network Termination Points (NTPs)

**directly connected to the mains power source:** equipment that could draw electricity from mains power outlet itself via its internal or external power supply

**g.fin:** fibre-based in-premises network consisted of a main FTTR unit and one/multiple sub FTTR unit

NOTE: The G.fin network enables network functionalities, including data backhauling, Wi-Fi® coordination, network management, etc.

**indirectly connected to the mains power source:** not directly connected to the mains power source e.g. the equipment could draw electricity via the network connection from a linked equipment that draws power from mains

NOTE: Examples include Power over Ethernet (PoE) and Power over USB.

**logical network port:** network technology running over a physical network port

**network port:** wired or wireless physical interface of the network connection located on the equipment through which the equipment is able to be remotely activated

**Network Termination Point (NTP):** point established in a building or complex to separate customer equipment from communications providers equipment

**networked equipment:** equipment that has the ability to connect to a network and has one or more network ports

**networked equipment with high network availability or 'HiNA equipment':** equipment with one or more of the following functionalities, but no other, as the main function(s):

- those of a router
- network switch
- wireless network
- access point
- hub
- modem
- VoIP telephone
- video phone

n**etworked equipment with high network availability functionality or 'equipment with HiNA functionality':** equipment with the functionality of a router, network switch, wireless network access point or combination thereof included, but not being HiNA equipment

**physical network port:** physical (hardware) medium of a network port

NOTE: A physical network port can host two or more network technologies.

**power consumption:** power used by a device to achieve an intended application performance

**reactivation function:** function facilitating the activation of other modes, including active mode, by remote switch including remote control, internal sensor, timer to a condition providing additional functions, including the main function

**readiness:** configuration (e.g. of VLANs) that allows user traffic to pass (between WAN and LAN interfaces, wired or wireless) without the need for any reconfiguration or manual intervention to enable its forwarding

**telecommunication network:** network operated under a license granted by a national telecommunications authority, which provides telecommunications between Network Termination Points (NTPs) (i.e. excluding terminal equipment and/or CPE's beyond the NTPs)

**user traffic:** service-related traffic between (any of) WAN interfaces and (any of) LAN interfaces, wired or wireless

NOTE: Traffic across any interface or port that is not (a result or cause of) providing the intended services (such as device management, keepalive, etc.) is not considered service-related and therefore is not "user traffic".

## 3.2 Symbols

Void.

## 3.3 Abbreviations



For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| 4G | 4th Generation (mobile networks) also known as LTE |
| 5G | 5th Generation (mobile networks) |
| AC | Alternating Current |
| ADSL | Asymmetric Digital Subscriber Line |
| ADSL2plus | Second generation ADSL with extended bandwidth |
| BW | Band Width |
| CF | Cable Frequency |
| CPE | Customer Premises Equipment |
| CRC | Cyclic Redundancy Check |
| DECT | Digital Enhanced Cordless Technology |
| DSL | Digital Subscriber Line |
| DSLAM | Digital Subscriber Line Access Multiplexer |
| EPON | Ethernet Passive Optical Network |
| FE | Fast Ethernet |
| FFT | Fast Fourier Transform |
| FTTR | Fiber To The Room |
| FXO | Foreign eXchange Office |
| FXS | Foreign eXchange Station |
| G.fast | Fast Access to Subscriber Terminal |
| GE | Gigabit Ethernet |
| GPON | Gigabit Passive Optic Network |
| HG | Home Gateway |
| HiNA | High Network Availability |
| HPNA | Home Phoneline Network Alliance |
| LAN | Local Area Network |
| LTE | 3GPP Long Term Evolution |
| MFU | Main FTTR Unit |
| MoCA | Multimedia over Coax Alliance |
| Ms/s | Mega symbols per second |
| NB-IoT | NarrowBand Internet of Things |
| NDR | Non Drop Rate |

| | |
|---|---|
| NTP | Network Termination Point |
| OFDM | Orthogonal Frequency Division Multiplex |
| OFDMA | Orthogonal Frequency Division Multiple access |
| PLC | Power Line Communication |
| PoE | Power other Ethernet |
| POF | Plastic Optical Fiber |
| PON | Passive Optical Network |
| PSD | Power Spectral Density |
| PtP | Point to Point |
| QAM | Quadrature Amplitude Modulation |
| SC-QAM | Single Carrier Quadrature Amplitude Modulation |
| SFU | Subordinate FTTR Unit |
| USB | Universal Serial Bus |
| VAC | Volts Alternating Current |
| VDSL | Very high speed Digital Subscriber Line |
| VDSL2 | Second generation VDSL |
| VLAN | Virtual Local Area Networ |
| VoIP | Voice over Internet Protocol |
| WAN | Wide Area Network |
| WLAN | Wireless Local Area Network |
| XG-PON1 | 10 Gigabit Passive Optical Network |
| XGS-PON | 10-Gigabit-capable Symmetric Passive Optical Network |

# 4 Operating modes



This clause reports a detailed explanation of the different operating mode applicable to CPE.

The different operating mode possible in a CPE are:

- Disconnected mode: the CPE is disconnected from all external power sources.
  - Off mode (from Commission Regulation (EU) 2023/826 [i.1]): means a condition in which the equipment is connected to the mains power source and is not providing any function, or it is in a condition providing only:



    a) an indication of off mode condition;

    b) functionalities intended to ensure electromagnetic compatibility pursuant to Directive 2014/30/EU [i.3].

    The vendor may determine that support of off-mode is inappropriate for the intended use of HiNA equipment (e.g. if intended use requires a permanent network connection or disallows end-user to switch off). See the Commission Regulation (EU) 2023/826 [i.1] and EC accompanying guidelines [i.8] and [i.9].

- Idle-state: in this state the device is not processing or transmitting a significant amount of traffic, but is ready to detect activity. All the components are in their individual Idle states.

- Low Power states: these are energy saving modes where settings should be adjustable by the user /operator and designed in a way that it is likely to be adjusted if necessary to an alternative or custom setting, more suitable to their typical use (e.g. ADSL2plus L2 mode). Other innovative solutions shall be considered.

- ON mode: The equipment is connected to the mains power source and all the main function(s) providing the intended service has been activated. All the components are in their individual On states.

- Ready mode The equipment is connected to mains power sources and configured to be ready to provide the intended services without any reconfiguration or manual intervention and a number of components are in their individual On states.

# 5 General requirements for measurement conditions

## 5.1 Measurement conditions

This clause describes the methods to measure the power consumption of broadband CPE equipment and also gives the conditions under which these measurements shall be performed.

The power measurements shall be performed in a laboratory environment under the following conditions:

- Room Temperature: 25 ± 2 °C.
- Room Relative Humidity: 30 % to 75 %.
- Supply voltage:
  - AC Powered Equipment: According to EN 50160 [1], 230 V ± 1 % for nominal voltage of 230 VAC and at ±1 % of rated frequency.
- Power measurement point:
  - AC Powered Equipment: Power consumption of broadband CPE with an external power supply shall be measured at AC input in all modes.
- Minimum Measurement Duration:
  - Equipment shall be allowed to stabilize. Wait at least 60 seconds before measurements. In case the WAN interface requires extended time to stabilize wait until final trimmed power level is achieved before measurements are taken.
  - The power levels provided as a result of measurement for all modes are mean values based on sufficiently long measurement periods (at least 10 minutes), during which the equipment remains continuously in that same mode.



## 5.2 Measurement instruments requirements



All measurement instruments used shall be calibrated by a certified calibration provider and be within calibration, and the measurement resolution shall be within ±1 %:

- Power Source: Power sources used to provide power to the equipment under test shall be capable of providing a minimum of 3 times the power rating of the equipment under test.

Power Measurement Instrument: Power measurement instrument (such as voltmeter and ammeter or power analyser) shall have a resolution of 0,5 % or better. Real Power, Apparent Power and Power Factor shall be accurately measured:

- AC power measurement instruments shall have the following minimum characteristics:
  1) A minimum digitizing sample rate of 40 kHz.
  2) Input circuitry with a minimum bandwidth of 80 kHz.

# 6 Measurement configurations

## 6.1 Off mode

In off mode the CPE is not fulfilling any main function. Maximum power consumption are defined in Commission Regulation (EU) 2023/826 [i.1].