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Measurement method for energy consumption of Customer
Premises Equipment (CPE)**

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Environmental Engineering (EE).

National transposition dates	
Date of adoption of this EN:	28 March 2012
Date of latest announcement of this EN (doa):	30 June 2012
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 December 2012
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Introduction

The present document defines the energy consumption measurement methods for Broadband CPE telecommunication equipment.

1 Scope

The present document defines the methodology and the tests conditions to measure the power consumption of end-user broadband equipment (CPE) within the scope of EU regulation 1275/2008 [1] in:

- Disconnected mode
- Off mode (as defined in Commission Regulation 1275/2008)
- Standby (as defined in Commission Regulation 1275/2008)
- Idle states
- Low Power states
- On mode

Moreover, these different modes of operation are defined.

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.

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

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

2.1 Normative references

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

- [1] 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 and office equipment.

2.2 Informative references

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] "Code Of Conduct on Energy Consumption of Broadband Communication Equipment" European Commission Directorate-General, Joint Research Centre; Final v4: 10 February 2011.
- [i.2] IEEE 802.16: "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems".

- [i.3] Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
- [i.4] CENELEC EN 50160: "Voltage characteristics of electricity supplied by public electricity networks".
- [i.5] Cablelabs: "Data-Over-Cable Service Interface Specifications - DOCSIS[®] 2.0 Interface".
- [i.6] Cablelabs: "Data-Over-Cable Service Interface Specifications- DOCSIS[®] 3.0 Interface".

3 Definitions and abbreviations

3.1 Definitions

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

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: equipment that could draw electricity from mains power outlet itself via its internal or external power supply

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.

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

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

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)

3.2 Abbreviations

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

AC	Alternating Current
ADSL	Asymmetric Digital Subscriber Line
ADSL2plus	Second generation ADSL with extended bandwidth
AP	Access Point
CoC	Code of Conduct
CPE	Customer Premises Equipment
DECT	Digital Enhanced Cordless Technology
DSLAM	Digital Subscriber Line Access Multiplexer
FE	Fast Ethernet
FXO	Foreign eXchange Office

FXS	Foreign eXchange Station
GE	Gigabit Ethernet
HG	Home Gateway
LAN	Local Area Network
Ms/s	Mega symbols per second
NDR	Non Drop Rate
PSD	Power Spectral Density
QAM	Quadrature Amplitude Modulation
USB	Universal Serial Bus
VAC	Volts Alternating Current
VDSL	Very high speed Digital Subscriber Line
VDSL2	Second generation VDSL
WAN	Wide Area Network
WLAN	Wireless Local Area Network

4 Operating modes

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

- Disconnected mode: the CPE is disconnected from all external power sources.
- Off mode (from Regulation 1275/2008 [1]): means a condition in which the equipment is connected to the mains power source and is not providing any function; the following shall also be considered as off mode:
 - a) conditions providing only an indication of off mode condition;
 - b) conditions providing only functionalities intended to ensure electromagnetic compatibility pursuant to Directive 2004/108/EC [i.3].
- Standby mode (from Regulation 1275/2008 [1]): means a condition where the equipment is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time:
 - a) reactivation function, or reactivation function and only an indication of enabled reactivation function; and/or
 - b) information or status display.
- 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.
- Other 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: equipment is connected to the mains power source and at least one of the main function(s) providing the intended service has been activated.

5 General requirements for 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.

5.1 Measurement conditions

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 [i.4], $230V \pm 1$ % for nominal voltage of 230 VAC and at ± 1 % of rated frequency.
- Minimum Measurement Duration: Equipment shall be allowed to stabilize. E.g. Wait at least 1 minute to allow bitswap to settle. In ADSL2plus L2 mode wait until final trimmed power level is achieved before measurements are taken.

5.2 Measurement instruments requirements

All measurement instruments used must be calibrated by a certified calibration provider and be within calibration, and the measurement tolerance must 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 analyzer) shall have a resolution of 0,5 % or better. Real Power, Apparent Power and Power Factor must 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.

Setup:

- The external power supply is connected to the mains.

The on/off switch is put in the Off position Traffic flows:

- No voice call in progress (on-hook).
- No traffic on WAN, WLAN and LAN ports.

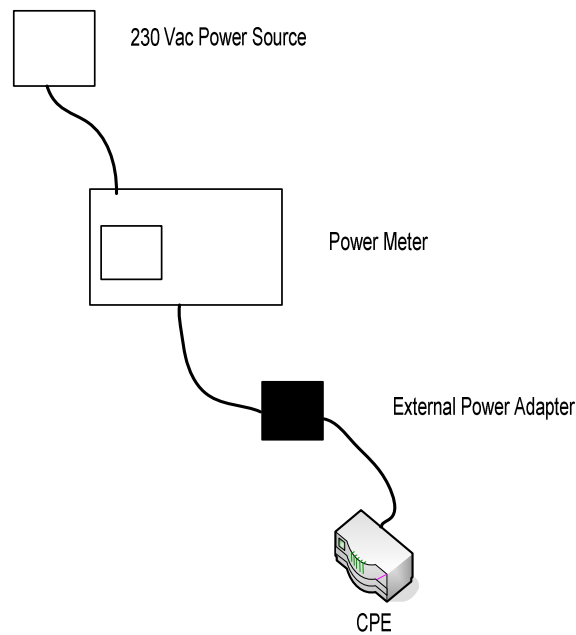


Figure 1: Power measurement setup

6.2 Standby mode

Setup:

- The external power supply is connected to the mains
- The CPE is put into the Standby state
- Traffic flows:
 - no voice call in progress (on-hook)
 - no traffic on WAN, WLAN and LAN ports

6.3 Idle state

Setup (apply when applicable):

- Central functions: Not processing user traffic
- WAN connected and synchronized, but no user traffic transmission
- LAN Ethernet ports: Ports not connected (or no Ethernet link) but with Ethernet link detection active
- Wi-Fi active, no clients associated
- FXS: 1 phone connected to 1 of the FXS ports, phone is on hook
- FXO: No active call, incoming call detection enabled
- DECT: No active call, incoming call detection enabled
- USB inactive
- Simulator: Generating no traffic

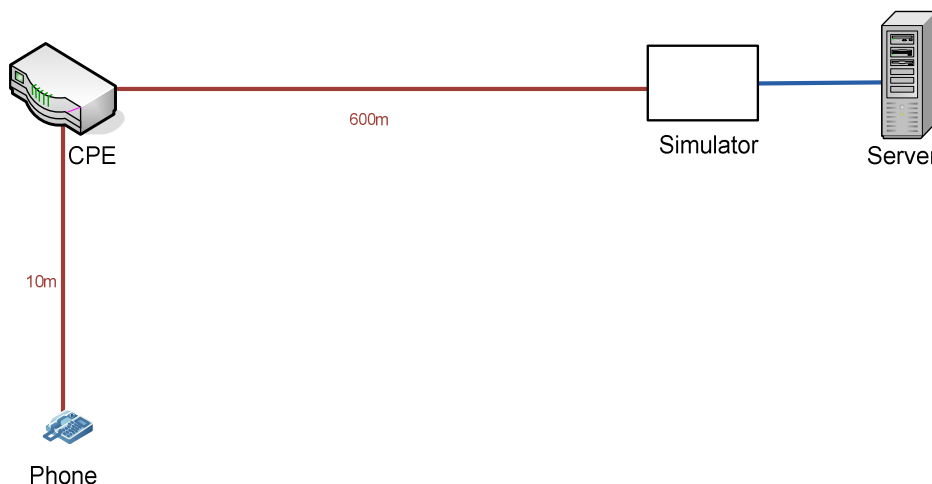


Figure 2: Example of Idle mode setup

6.4 On mode

Remark:

Measurement conditions for the on mode of broadband CPE equipment are also given into the Broadband Code of Conduct V4 of 10 February 2011 [i.1]. When one wants to check if a product meets the targets of Version 4 of the Code of Conduct, then he should measure according to those methods described therein.

1) Setup (apply when applicable):

- WAN connected and synchronized.
- ADSL2plus: Select a valid ADSL2plus specific test profile, configured in rate adaptive mode. Use a test loop of 1,250 m.
- VDSL2: Select a valid VDSL2 profile line combination, for the governing profile bandwidth (namely 8 MHz, 12 MHz or 17 MHz), configured in rate adaptive mode. Use a test loop of 300 m for the 8 MHz profile and 150 m for each of the 12 MHz and 17 MHz profiles.
- VDSL2 (30a): VDSL2 Band Profile shall be: Profile 30a, using a valid Annex B PSD mask, configured in rate adaptive mode. Use a test loop of 100 m.
- DOCSIS[®] 2.0 [i.5]: Active with a downstream channel with a modulation type of 256 QAM and an upstream channel with a modulation type of 64 QAM and a symbol rate of 5,12 Ms/s.
- DOCSIS[®] 3.0 [i.6]: Active with an NxM configuration with N downstream channels with a modulation type of 256 QAM and M upstream channels with a modulation type of 64 QAM and a symbol rate of 5,12 Ms/s.
- Ethernet cable length: 10 m.
- Wifi radio distance: 1 m to 5 m away from Access Point.
- Run traffic generator at all wired and wireless 802.11 interfaces at the calculated traffic (see tables 1 and 2).
- FXS: 1 phone connected (200 Ohm / loop current of 20 mA / 5 m max cable length), off hook, 1 active call.
- DECT: 1 active call.
- FXO: 1 active call.
- USB host active: No USB device connected.

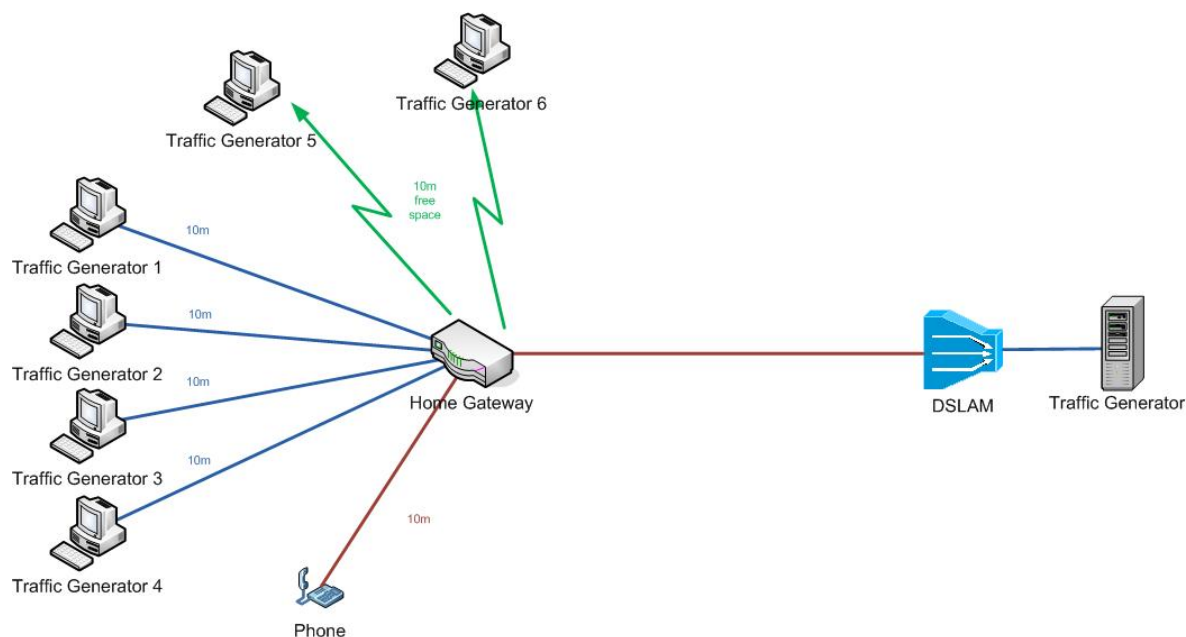


Figure 3: Example of an on mode setup

2) Qualification:

- The goal of the first step in the measurement procedure is to determine the maximum lossless throughput rate that the CPE can handle:
 - As the WAN provides an asymmetrical technology (ADSL, VDSL or cable), the upload speed shall be taken into account.
Traffic over the demarcation point (from WAN to LAN) is increased step by step just until a maximum Non Drop Rate (NDR) is achieved and sustained for 5 minutes.
This maximum NDR shall be noted.

3) Calculation of individual throughput:

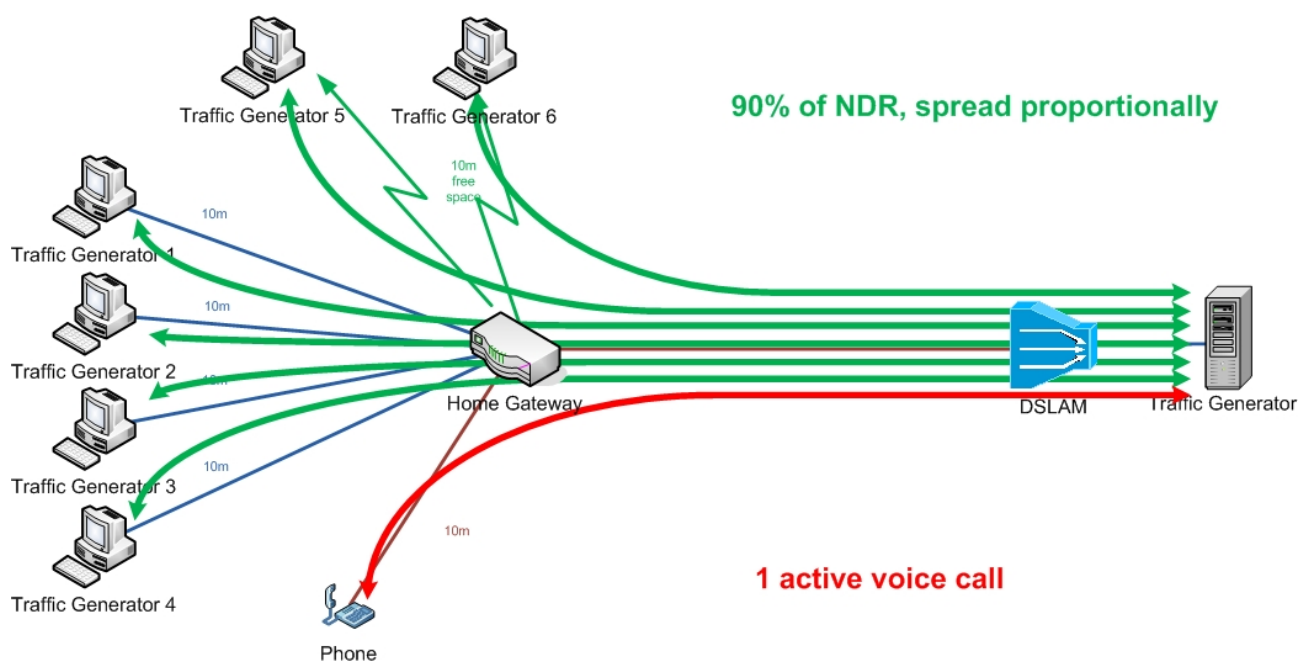
- 90 % of the NDR shall be divided proportionally over the different wired and wireless 802.11 interfaces, depending upon their theoretical maximum line rate.
- One Wi-Fi client per wireless frequency band 2,4 GHz to 5 GHz associated shall be used with highest available throughput.

Table 1: CPE with 10 Mbps NDR upload speed, 4 Fast Ethernet Ports

CPE1	Measured NDR (Mbps)	10,0	
	90 % NDR (Mbps)	9,0	
	Line Rate (Mbps)		Throughput (Mbps)
FE port 1	100	25,0 %	2,3
FE port 2	100	25,0 %	2,3
FE port 3	100	25,0 %	2,3
FE port 4	100	25,0 %	2,3
Sum	400	100,0 %	9,0

Table 2: CPE with 30 Mbps NDR upload speed, 1 GEthernet and 4 Fast Ethernet ports, 1 802.11b/g and 1 802.11a wifi radio

CPE2	Measured NDR (Mbps)	30,0	
	90 % NDR (Mbps)	27,0	
	Line Rate (Mbps)		Throughput (Mbps)
GE port 0	1 000	66,3 %	17,9
FE port 1	100	6,6 %	1,8
FE port 2	100	6,6 %	1,8
FE port 3	100	6,6 %	1,8
FE port 4	100	6,6 %	1,8
wifi 1	54	3,6 %	1,0
wifi 2	54	3,6 %	1,0
Sum	1 508	100,0 %	27,0



NOTE: Traffic generator 1 to N can be ports on the same traffic generator.

Figure 4: Example of On mode traffic flows

Annex A (informative): Bibliography

HGI RWD009-R3: "Requirements for an energy efficient HG".

ITU-T Recommendation G.993.2: "Very high speed digital subscriber line transceivers 2 (VDSL2)".

History

Document history		
V1.1.1	November 2011	One-step Approval Procedure OAP 20120328: 2011-11-29 to 2012-03-28
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