Energy efficiency of power supplies (PS) in ICT-equipment

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Overview

1. 1990s
2. Today
3. This study: objectives and approaches
4. Results Lab
5. Results PC in different modes
6. More insights
7. Technical measures
8. Recommendations
1990s

1. Using switched power supplies improves efficiency from (30-50)% to (60-90)%

2. Heavy power distortion by PS of ICT-equipment

3. Low distortion paid by lower efficiency

4. Efficiency and power factor are strongly dependent on the workload
Today

• PS in ICT-equipment are of the “switched” type
• Power factor corrected in most of the equipment
• Nominal power (nameplate wattage) can not be used for dimensioning the infrastructure
• Detailed study of efficiency in small/external PS (Calwell et al.)
• 1st policy measures for external PS
  – EU (code of conduct; session 2)
  – EnergyStar (session 2)
  – California (draft declaration)
This study

• Objectives
  – Determine efficiency and power factor of PS for ICT in function of workload
  – Determine typical workload of PCs
  – Potentials and measures to foster energy efficiency

• Approaches
  – Measurement of PS in laboratory conditions
  – Measurement of PS-efficiency and workload of PC in use
  – Analysis, synthesis
Results (lab-conditions 1)

Summary: Table 1 in paper submitted to EEDAL’03

Example: Minebea 200 W
Results (lab-conditions 2)

Example: modern HP power supply, 200 W
Results (PC in different modes 1)

Modes
• off
• standby
• on 1 (low processor activity)
• on 2 (high processor activity)
Results (PC in different modes 2)

![Graph showing efficiency vs. workload for different models of PC: Octec, PowerMan, Fujitsu/Siemens, HP_1, and HP_2. The x-axis represents workload in % of nominal power, and the y-axis represents efficiency in %. The graph compares the performance of these models across various workloads.]

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More insights

1. Efficiency depends not only on the workload, but also on the split of outgoing power over the different DC-levels.

2. The DC-output after the power supply unit has to be further transformed (DC/DC) in order to reach the DC-level of the processor (typically 1.5 V today)

3. The overall efficiency (220/110 VAC -> 1.5 VDC) is of the order of 50%
Measures and potential savings

1. Using power supply units with an adequate nominal power in order to reach operating points of 50% or more

2. Using power supply with a separate power supply system from 230 V AC to 1.5 V DC for low power modes of the ICT equipments

3. ... for high capacity load (booster)?

4. With these two measures energy savings of 30% are possible. For PC users the electricity cost savings are of the order of 2 EU/year (for typical private use) and 10 EU/year (for heavy users)
Recommendations

1. Work out an energy declaration for power supply units on an international/global level.

2. Strengthen Energy Labels in two directions:
   • reinforce the requirements regarding power loads in the standby/sleep mode and
   • initiate requirements regarding power loads in the on mode

3. Consider to edict (or to reach a voluntary agreement on) a maximum value for no load losses
Recommnedations (Intel)


- **General recommendations**: The efficiency of the power supply unit should be at least **68 % under maximum rated load**.

- **Energy Star**: The “Energy Star” efficiency requirements of the power supply depend on the intended system configuration. In the low-power / sleep state (S1 or S3) the system should consume power in accordance with the values listed in Table 8. **Note**: To help meet the “Energy Star” system requirements, it is recommended that the power supply have **> 50% efficiency at light load and in standby mode**.
Definitions (1)

workload is defined as the ratio of power out to nominal or maximal power out.