

Engineering Specification

XO Laptop Power AC Adapter

Scope

This is a specification for a high efficiency AC power adapter for a low cost children's laptop. It meets or exceeds Energy Star Level V efficiency specifications.

As large numbers of these adapters are likely to share an AC circuit, the power factor of the adapter is a concern. Unlike a traditional AC power adapter, which concentrates on providing a stable DC value, this adapter provides only the first stage (the PFC correction) of a two stage adapter, relying on the battery charger of the laptop to provide the second stage. For this reason, the ripple specification is abnormally large.

1 Input Characteristics

The following are defined at both nominal input voltages and both nominal input frequencies, with rated load, and at 25C ambient temperature, unless otherwise specified.

1.1 Nominal Voltage

The nominal input voltages are 110VAC and 220 VAC.

1.2 Nominal Frequency

The nominal input frequencies are 50 and 60 Hz, single phase.

1.3 Input Voltage Range

The adapter shall operate with an input voltage from 90 to 264 VAC

1.4 Input Frequency Range

The adapter shall operate with an input frequency from 47 to 63 Hz.

1.5 No Load and Light Load Power Consumption

Maximum no-load input power consumption shall be less than 0.3W across the entire input voltage and frequency range.

Maximum light load input power consumption shall be less than 0.4W across the entire input voltage and frequency range. Light load is defined as 0.1W drawn from the output of the adapter.

1.6 Efficiency

The average efficiency of the power adapter shall be higher than 83.25% at both of the nominal input voltages.

The average efficiency at a particular input voltage is determined by averaging the efficiency of the power adapters at 25%, 50%, 75% and 100% of the rated load, measured at the end of the DC output connector. A warm-up period of thirty minutes (at rated load) is allowed before measuring the efficiency.

1.7 AC In-rush current

Under both warm and cold start conditions, with an input voltage of 264V, there shall be no damage to power adapter components which might affect the reliability of the adapter.

1.8 Power Factor

The power factor of the adapter at 100% of rated load shall exceed 0.9 at each of the nominal input voltages.

The power factor of the adapter at 25% of rated load shall exceed 0.65 at each of the nominal input voltages.

2 Output Requirements

The following are defined at both nominal input voltages and both nominal input frequencies, with rated load, and at 25C ambient temperature, unless otherwise specified.

2.1 Output Voltage Static Regulation

The DC component of the output voltage shall be +13.5V, +/- 5%.

2.2 Output Current Range (Rated Load)

The output current may range from 0 to 1.85 Amps (at the nominal output voltage).

The rated load (maximum continuous output power) of the power adapter is 25W.

2.3 Output Ripple and Noise

The AC component of the output shall not exceed 1.50 V (peak-peak), across the entire range of input voltage and output current.

The ripple is measured by placing a 0.1 uF ceramic capacitor and a 10 uF electrolytic capacitor in parallel with the output load. The measurement may be band-limited to 20 MHz.

2.4 Turn-on Delay Time / Rise Time

The power adapter shall have a turn-on (start up) time of less than three seconds, when driving the rated load.

The rise time of the output shall be less than 100 mS when driving the rated load.

2.5 Dynamic Load Change Response

The output voltage shall stay within 1.50 V of the nominal output voltage while the output load is stepped from 10% to 50%, and 50% to 100% of rated load. The slew rate of the load changes shall not exceed 0.05A/uS, or be less than 0.01A/uS.

3 Protection

3.1 Output Over-Voltage Protection (OVP)

The output voltage shall not be allowed to exceed 26V under any conditions. If this voltage is exceeded, the adapter shall shut down the output.

The unit shall recover when the AC input is removed.

3.2 Output Over-Current Protection (OCP)

The adapter shall limit the current drawn from the output to 2.5 A. If this output current is exceeded, the adapter shall limit the current drawn to less than 2.5A.

The adapter may recover automatically if this fault condition is removed, or it may require that the AC input be removed to return to a normal state.

3.3 Short Circuit Protection

A resistance of less than 0.1 ohm between the output terminals shall be considered a short circuit. In this case, the adapter shall limit the output power to less than 0.1W, averaged over a one second period.

No damage to the adapter shall result from a continuous short circuit.

The adapter may automatically recover if the short condition is removed.

3.4 Over-Temperature Protection

The adapter shall contain circuitry to protect the adapter in the case that the internal case temperature becomes excessive. Excessive internal temperature is defined as one that results in component damage, a reduction in adapter reliability, or deformation/discoloration of the case.

The adapter may recover automatically if the overtemperature condition is removed, or it may require that the AC input be removed to return to a normal state.

4 Environmental Requirements

4.1 Temperature Range

The adapter shall operate over a temperature range of 0 to 45C, using free air convection cooling.

The adapter shall allow storage over a temperature range of -20 to 70C, without damage.

4.2 Humidity Range

The adapter shall operate at relative humidities between 10% and 90% (non-condensing).

The adapter shall allow storage at relative humidities of between 10% and 95% (non-condensing) without damage.

4.3 Altitude Range

The adapter shall operate properly at altitudes between 0 and 5000 meters, relative to mean sea level.

4.4 Reliability

The MTBF failures for the adapter shall exceed 100,000 hours at both of the nominal input voltages, driving the rated load at an ambient temperature of 25C.

5 International Compliance

5.1 Electromagnetic Emission

The power adapter shall meet the following standards:

- FCC part 15 class B
- EN55022 class B
- EN61000-3-2 class D

- EN61000-3-3

5.2 Electromagnetic and Electrostatic Immunity

The power adapter shall meet

- EN55024
- EN61000-6-2
- EN61000-4-2 Electrostatic discharge immunity, +/- 4KV contact, +/- 8KV Air discharge
- EN61000-4-3 Radiated electromagnetic field, 10 V/m with 80% AM
- EN61000-4-4
- EN61000-4-5, Line Transient (Surge), Line to line 1KV, Line to Ground 2KV
- EN61000-4-6, Conducted Disturbance, 10V with 80% AM
- EN61000-4-8, Power Frequency Magnetic Field, 30 A/m
- EN61000-4-11, Voltage Dips

5.3 Safety Compliance

The power adapter shall meet:

- UL 60950-1
- CSA 22.2 NO.60950-1
- TUV EN60950-1

5.3.1 Dielectric Withstand Voltage

For safety certification, 3KV AC or 4.25KV DC shall be applied between AC input and output terminals for 1 minute.

100% production testing of adaptor is required. 3KV AC or 4.25KV DC shall be applied for 2 seconds between AC input terminals and output terminals.

Cut off current 10mA.

5.3.2 Insulation Resistance

The resistance should be higher than 100 Mohm at apply 500Vdc between input terminals and output terminals.

5.3.3 Maximum Case Temperature

The temperature of the outside of the adapter case shall not exceed 65C at any location, when the adapter is operated at maximum load and maximum ambient temperature, over the entire input voltage and frequency ranges.