

## Toshiba

According to the test method, DC voltage shall be measured at the end of DC cord. For Notebook PC, AC adapter's cord length is usually 1.8m regarding user's convenience. If the output wattage gets higher, power loss due to cord length (cord's impedance) has effect on power efficiency.

In case of 120W AC adapter, 2m length DC cord's total impedance is nearly 75 [mohm]. Power loss becomes  $8A * 8A * 0.075ohm = 4.8W$ . ( $8A = 120W/15V$ )  
4.8 loss is corresponded to 4% ( $4\% = 4.8W/120W$ )

For 150W AC adapter, the DC cord impedance should be decreased to half. Even though the total impedance is decreased to half (35[mohm]), power loss is  $10A * 10A * 0.035ohm = 3.8W$ . ( $10A = 150W/15V$ )  
3.8W loss is corresponded to 2.5%. ( $2.5\% = 3.8W/150W$ )

To improve power efficiency, the DC cord length should be shortened, or the cord diameter should be increased. But these solutions make user's inconvenience worse.

Please check the statistical data about the high power AC adapters (over 100W) DC cord length, wattage, and efficiency.

According to Toshiba's measurement data, there is a tendency that if output wattage is over 60W, the lower output voltage adapters efficiency is critical to the specification. Especially 25% load efficiency gets worse.

For Notebook PC, there are usually two types of AC adapter's output voltage. One is 15-16V, the other one is 19V.

The AC adapter's output voltage is usually decided according to the series number of battery cells.

Battery Series Cell	AC Adapter Output Voltage
3 cells (9V-12.6V)	15-16V
4 cells (12V-16.8V)	19V

Li-Ion battery cell's voltage changes from 4.2V (full charge) to 3V (empty).

For example, 6 cells battery is configured as following: 3 series x 2 parallel; 8 cells battery is as following: 4 series x 2 parallel.

The combination between the battery series cells and the AC adapter output voltage is very important with regard to the charge and the safety.

To charge the battery, the AC adapter's output voltage must be higher enough to the battery's full charged voltage.

On the other hand, the safety must be considered in case of the abnormal conditions. For example, even though the power circuit line between AC adapter and battery is shortened, the voltage difference between AC adapter and battery should be within a certain level. Each PC vendor has their own policy to the safety, but this is a basic approach.

There are pros and cons to both AC adapter's output voltage.

1.) Output voltage =15-16V

Pros – Battery voltage can be lower (3 series cells), so DC/DC converter's efficiency gets better when the input power is battery. If battery running time is important, 15V AC adapter and 3 series cell battery combination should be chosen.

To design the light notebook PC, 3 series cell battery type should also be chosen.

Above items (battery running time, and light weight) should be regarded as an environment matter.

Cons – If output wattage gets higher, the output current also gets higher. So the external power supply efficiency (especially 25% load) get critical.

2.) Output voltage=19V

Above pros and cons are reversed in case of 19V.

Please check the statistical data about the relation between the output voltage, wattage, and efficiency. As Draft 2 said, lower output voltage type is the subset in the total market. But for the mobile products, lower output voltage may have environmental pros (battery running time etc.)