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## Application Note Dual USB High-Side Power Switch AP1212

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### 1. Power Protection Switch Reasoning

Proliferation of cell-phones, PDAs and digital cameras, along with various PC peripherals such as printer and scanner makes communication between these electronic devices an important task. Fortunately, a USB (Universal Serial Bus) featured Plug-and-Play (PnP) eliminates the troublesome system-reboot requirement to plug-in device. USB makes connections between these electronic devices easy.

However, use of PnP feature can cause some problems: the plug-in or plug-out action induces large inrush current that can damage other relating electronic devices. Therefore, a current limit protection is necessary for the system. Three fundamental practices can be performed to provide such protection: (1) Metal fuse, (2) Poly Switch, and (3) Power Switch IC.

### 2. Poly Switch

Metal fuse is similar to fuses used in household's master power switch that over-current can easily burn and break the fuse, ending its usability. This limitation does not meet USB's reusability requirements.

Poly switch is substantially a positive temperature-sensitive resistor, made of conductor-doped polymer. A temperature increase, due to over-current, increases its resistance and eventually cuts off the circuitry. It returns to functional state only after current decreased and temperature dropped to designated condition. Poly switch meets USB's reusability requirement but has four major shortcomings: high impedance, slow response, low reliability, and larger size.

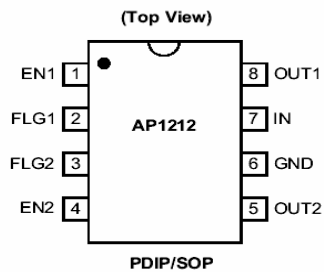
High impedance of poly switch consumes more power to operate even in regular condition circuitry. For battery-powered portable electronic devices, energy-waste during stand-by cannot be disregarded. Poly switch's time-response is as slow as one second and it requires longer time to react after USB plugged-in. In addition, poly switch ages easily and thermal resistance changes gradually after some period of usage that is not feasible to electronic devices requiring high reliability. Lastly, poly switch tends to be larger in size comparing to metal fuse and power switch IC.

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### 3. Power Switch IC

Figure 1. AP1212 Front View



Power switch IC overcomes every shortcoming of metal fuse

and poly switch and provides additional intelligent functions. Figure 1

shows the front view of Anachip's AP1212. AP1212 is a dual channel

integrated high-side power switch with independent ENABLE and FLAG

functions. AP1212 supports each USB port at least 500mA output current

for down stream electronic devices. It cuts off current flow to protect

electronic devices when transient current exceeds 1.1A limit. AP1212 is a million times faster than poly switch

with one microsecond response time. Soft-start mode to restart system prevents USB's transient voltage drop in

1 millisecond (1ms). It consumes 110 $\mu$ A during standby and consumes 1 $\mu$ A during cut off. The Thermal

Shutdown feature protects the device to prevent catastrophic switch failure from high-current loads. Under

Voltage Lockout (UVLO) and

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3.3V/5V logic compatible enable inputs ensure a USB interface working with 5V logic.

USB specification specifies USB power supply system to contain current limit and power switch internally. AP1212 receives logic signals to control its CMOS power switches. The switch is “closed” for passing current when receiving ON logic signal while the switch is “open” for cutting current when receiving OFF logic signal. AP1212 also sends signal to inform USB controller it is in ready state to operate and reports any abnormal conditions such as current-overload, high temperature, insufficient voltage supply, to provide faster response time and better current limit ability. All these integrated features enable designer to use a compact device for switch power control.

Many operations such as Plug-and-Play (PnP), RAID system, replacing hard-drive (HDD) and battery in a portable computer, often damage portable PC's hard-drives. Inrush current may damage components in circuitry when power is plugged in. The change on power source may also change the supply current and damage the capacitor due to improper polarization resulting short circuit.

AP1212 is the best solution to protect HDD components and certain CD-ROM, CD-R, CD-RW and DVD's starter from damage cause by current overload. AP1212 power switch protects circuitry when detecting system failures and it returns to normal after failure conditions and high power surge are cleared.

### **4. AP1212 Operation Description**

Figure 2 shows a typical application circuitry for the power switch AP1212. AP1212 cuts off OUT output and sends FLG signal to inform USB controller when USB based device incorporated with AP1212 encounters circuit-short and abnormal power consumption. AP1212 provides two channels power switches. IN is USB's power source. FLG1 and FLG2 are two FLAG signals with active low, open-drain output. EN1 and EN2 control AP1212's ENABLE. Anachip provides two types of choices: AP1212H – active-HIGH and AP1212L – active-LOW. OUT1 and OUT2 are power output to USB ports down stream devices.

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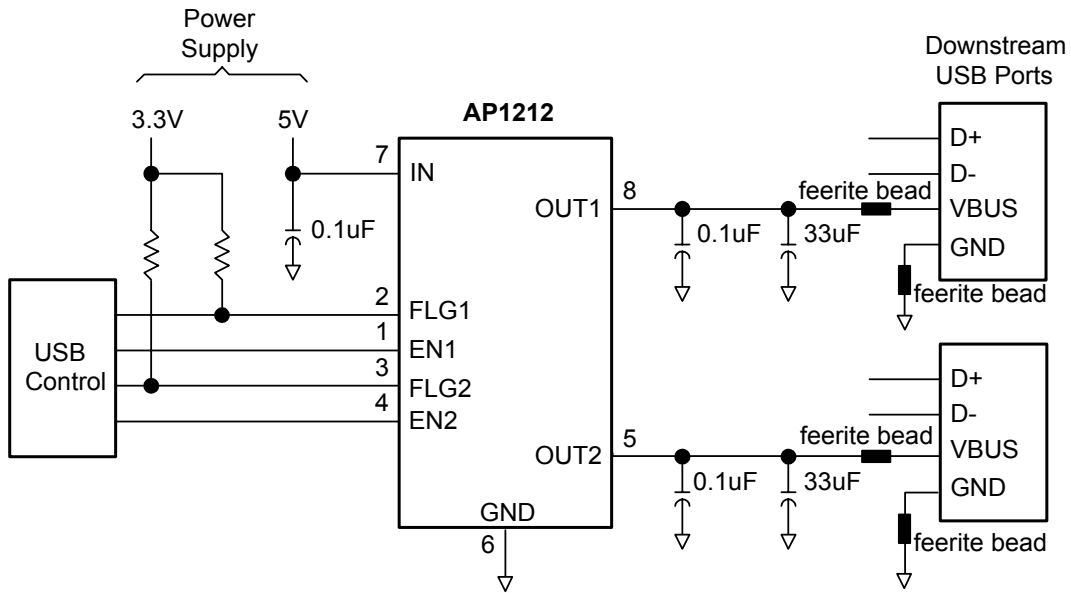


Figure 2. Power Switch Application

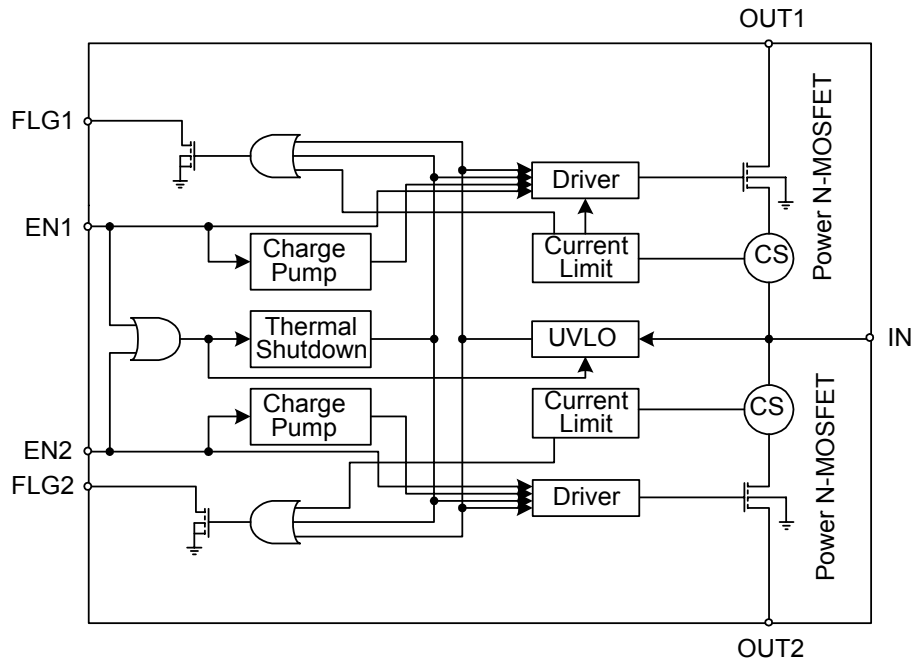


Figure 3. AP1212 Block Diagram

Figure 3 shows AP1212 block diagram. Current Sensor (CS) senses OUT current flow. Current Limit limits

output current to about 1A. If this limit continues and internal temperature increases, Thermal Shutdown cuts off



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circuit until temperature drops to normal. Any adverse condition of either Current Limit or Thermal Shutdown, AP1212 sends FLAG signal to USB controller port through OR Gate. The function for Charge Pump is to reduce resistance of the Driver so that output voltage will not decrease when USB device connects to AP1212.

For more detail AP1212 data sheet, please visit Anachip USA at [www.anachip.com](http://www.anachip.com) or Anachip Taiwan at [www.anachip.com.tw](http://www.anachip.com.tw)