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# Auxiliary Power Extends PoE Applications

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Power-over-Ethernet (PoE) has found utility in hundreds of applications from Voice over Internet Protocol (VoIP) telephony and wireless routers to security equipment. Many PoE applications employ auxiliary power sources, typically an AC "wall wart" power supply at the Powered Device (PD) or an Uninterruptible Power Supply (UPS) at the Power Sourcing Equipment (PSE). Integrating auxiliary power can be a challenging design task and the PoE designer must understand the various methods and inherent tradeoffs that exist with each.

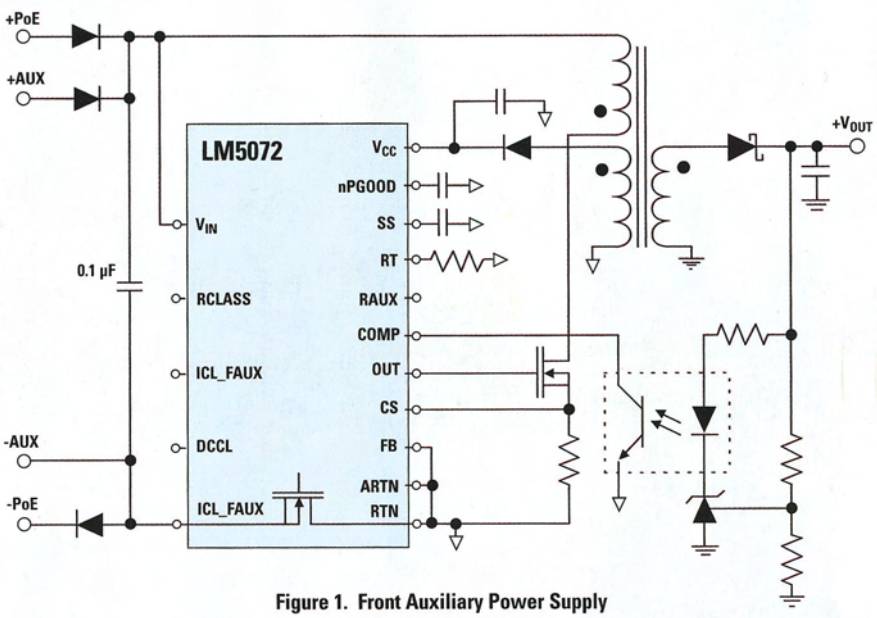


**Figure 1. Front Auxiliary Power Supply**

Three configurations are commonly used to add auxiliary power to PoE systems, and the possible combinations are to multiplex auxiliary power with PoE power (1) through the PD's front end hot-swap section, (2) directly to the input of the PD power supply controller, and (3) directly to the PD power supply's isolated output voltage.

In the first case, power is multiplexed into the PD's front end and delivered through the hot swap section. This is sometimes referred to as "front aux", and is illustrated in *Figure 1.*

Front aux has the advantage of hot swap protection, as power is delivered through the PD's PoE interface controller. If the front aux potential is lower than normal PoE levels, the first power source applied will deliver power indefinitely. This occurs because insertion of aux before PoE eliminates the ability of the PSE to detect the PD signature resistance; this will be the case whenever front aux is implemented. However, if PoE is supplied first, the lower potential aux supply will be blocked by the reverse biased aux power diode. One additional drawback to low voltage front aux is the potential for power draw limiting. This can occur when the hot swap current limit function restricts the current drawn from the aux supply.

If the front aux potential is comparable or higher than PoE, it further complicates the situation as the two supplies may share the PD load proportional to their regulation voltages and inversely proportional to their output impedances. Another serious complication exists when a higher

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potential aux source is applied because it presents a new hot swap condition to the controller. The sudden increase in the input voltage of the PD controller may force the hot swap transistor into current limit as the MOSFET charges the input capacitor of the power supply. This will momentarily negate the system's input "Power Good" status which must be filtered in order to maintain continuous power delivery. The hot-swap controller should have its current limit set well in excess of the DC current being delivered to the load. If the DC current limit is set too low, there will be insufficient surplus current in the hot-swap controller to charge the load capacitors before an error occurs.

Power disconnection must also be carefully considered. If PoE power is not present, which is the case if front aux power was applied first, power delivery will not be maintained when aux power is removed because the module capacitors must completely discharge before the PSE will be able to detect a valid signature and reapply power. Continuity of power is guaranteed if front aux is present and PoE power is removed at any time.

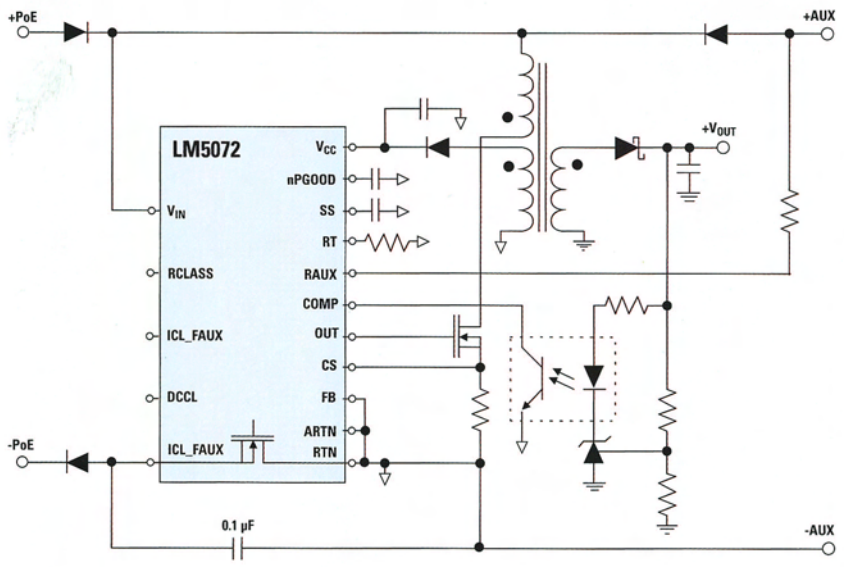


**Figure 2. Rear Auxiliary Power Supply**

Application of front aux power can be a difficult and confusing proposition. Many of the complications are alleviated if auxiliary power is supplied directly to the power supply section of the module (sometimes referred to as rear aux), as shown in *Figure 2.*

Rear aux will also be dominant if it is applied to the module first as it reverse biases the input diode bridges preventing the PSE from detecting a valid signature. Depending on the PD controller IC selected, the user may have the option of disabling the PoE interface upon application of the rear aux supply. When PoE power is disabled while aux power is available, the configuration is referred to as "aux dominant". The aux-dominant mode disables the hot-swap controller's power MOSFET switch, thereby preventing PoE power delivery. If DC Maintain Power Signature detection is performed by the PSE, as outlined in the IEEE 802.3 standard, the PSE will remove PoE power as it will consider the PD to be disconnected. This is a major advantage of the rear aux method because it offloads the PSE supply thus allowing power to be reallocated to other ports.

If the rear aux method is configured for non-dominance and PoE power is applied first, then the aux supply will not deliver power until PoE power is removed. Just as in the front aux case, power delivery to the load will be maintained in dominant or non-dominant mode so long as the rear aux supply is present. If aux power is removed and PoE power is not enabled (because of aux dominance or aux being applied first), continuity of power delivery will not be maintained.

The final option, where auxiliary power is OR'd directly to the output of the PD power supply, is a simple solution but offers few advantages. It requires an aux power supply that is designed to deliver the current and regulated voltages required by the PD load. In addition, this configuration usually requires additional components and some duplication of functions, possibly even a second isolated switching regulator or a linear post regulator.

The addition of auxiliary power to PoE-powered devices can be a complex and daunting task. Only by understanding the costs, benefits, and constraints of each configuration can the designer of PoE-enabled equipment select the appropriate scheme and deliver the desired system performance. ■

For more information on power supply design for PoE applications, read Power Designer #104 at power.national.com/designer