



**Whitepaper:
System Solution for
Power over Ethernet
(PoE)**

Revision 1.0 May 2007

DESCRIPTION

The AS1113 and AS1124 provide single-chip, highly integrated CMOS system solutions for Power over Ethernet (PoE) applications. The devices incorporate surge protection and control common mode noise, for reduced electromagnetic emissions. Applications include Voice over IP (VoIP) Phones, Wireless LAN Access Point, Security and Web Cameras, Analog Telephone Adapters (ATA) and Point of Sales Terminals.

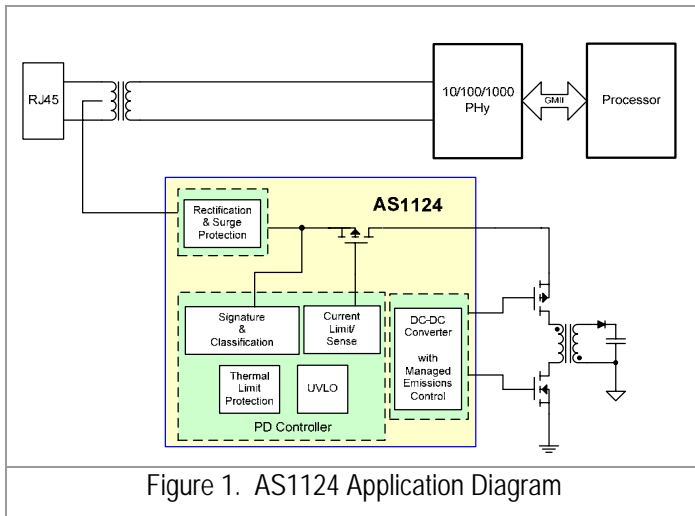


Figure 1. AS1124 Application Diagram

AS1113 and AS1124 have been designed to address both EMI concerns and surge protection in POE applications. The devices implement many design features that minimize transmission of common-mode noise on the UTP cable. They also provide high immunity to overvoltage and surge events. Any common mode noise that leaks onto the UTP cable will show up as Conducted or Radiated noise, depending on the frequency. Controlling the behavior of the integrated DC-DC converter is critical in the management of electromagnetic emissions

Both the AS1113 and AS1124 interface directly to the UTP media through Ethernet transformers. AS1113 is designed for use in IEEE® 802.3af applications while AS1124 is for pre-standard 802.3at. Each device offers PD compliance, through the integration of the bridge diodes, PD Controller and DC-DC controller. The devices minimize the number of components and greatly improve reliability. System designers benefit by using a PoE device that will meet all relevant EMC standards for EMI emissions, immunity and Surge and ESD protection

MAJOR FEATURES

The AS1113 / AS1124 are fully integrated and architected at a system level to provide the following features:

- Fully supports IEEE® Std. 802.3af-2003 and supports pre-standard IEEE® Std. 802.3at-2006 power needs
- Meet IEC 61000-4-2/3/4/5/6 and IEC 60950 requirements for Surge, EMI and Isolation

- Integrated rectification and protection for board level surge meets > 20kV air discharge (IEC61000-4-2), > 8kV contact discharge (IEC61000-4-2) and > 15kV Surge (IEC61000-4-5)
- Integrated DC-DC converter with reduced EM emission for CISPR22/FCC part 15 Class B applications
- Programmable DC current limit up to 800mA
- Provide extended classification levels for higher power PD applications (pre 802.3at compliant)
- Provides seamless support for local power
- Over temperature protection

REDUCING COMMON MODE NOISE IN POE SYSTEMS

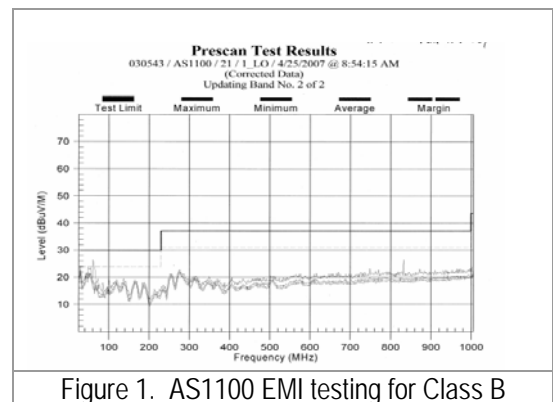


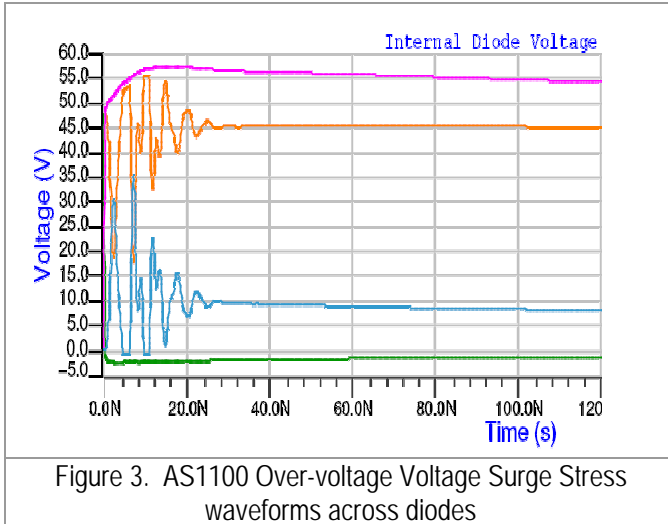
Figure 1. AS1100 EMI testing for Class B

The PoE network often allows for noise from the DC-DC switchers and downstream switchers to couple common mode noise through the PD device and onto the center tap of the Ethernet transformer. The secondary autoformer (part of Ethernet transformer) provides a direct low impedance common mode path from the center tap node to RJ45. The system can provide a very low impedance path from the switching DC-DC converters and UTP cable, creating a significant EMI issue. Using traditional methods, the only way to prevent this noise from getting onto the Ethernet cable is to add common-mode chokes in that path. Switchers typically operate in 100-500KHz freq range, and tend to have dV/dt based noise transients in 10-50MHz range. Typical magnetic chokes are not very effective in low frequency ranges and that necessitates use of multiple or bulkier chokes to meet the emission requirements.

The AS1113 and AS1124 designs take a system level approach to address the emission issues in POE PD systems. The DC-DC switching controller is optimized to reduce CM noise between High and Low Voltage ground planes, by using a power transformer that is optimized for low switching noise. As part of full system level solution for EMI, Akros has focused significant effort in reducing switching noise in the integrated power

converters through unique techniques of balancing the signaling of the FET drivers, managing the energy leakage in the transformer and reducing ground bounce by minimizing the dV/dt switching noise.

SURGE PROTECTION IN POE SYSTEMS



A key requirement of POE systems is immunity to overvoltage and surge events. These events can be caused by inductive coupling of external lightning events, creating surge voltages on power lines. Another discharge phenomenon can occur when Ethernet cables disconnect from high-current / high-power PoE circuits or when static electricity builds-up on the Ethernet cabling. These events can either have moderate energy, with very high peak currents and time constants as short as 1ns. IEC61000-4-2 defines a test for this condition. Another discharge characteristic occurs when the discharge pulse has a slower rise times and very high energy with moderate peak currents. IEC61000-4-5 is designed to test this condition. Typically, expensive and rugged external components, such as sidactors are added to shield sub-micron semiconductor devices from the stresses of external surge events that can easily become destructive. These components are often selected by trial and error to achieve the required performance and are very dependant on board parasitic and the CMOS components (e.g. PHYs etc.) that are connected to the cable.

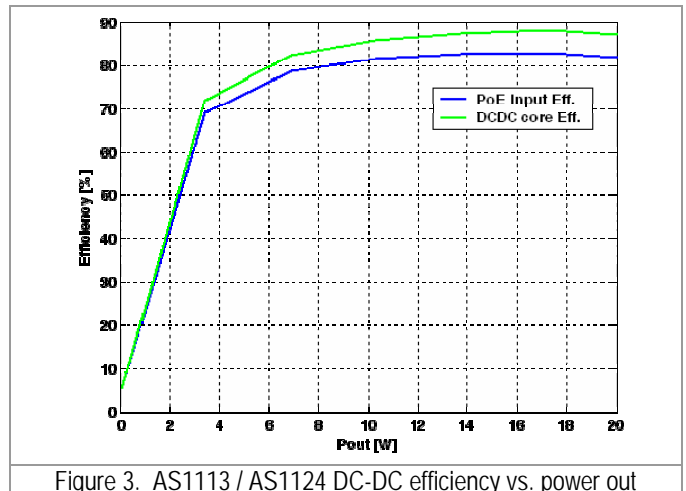
Akros Silicon's has integrated the diodes and protection circuitry that allows a much faster response to the surge event, substantially improving surge capability, and its dependence on external component variability. This design limits stray surge current from passing through sensitive circuits, such as the Ethernet PHY device and enables a low impedance safe discharge paths directly back to the earth ground. The protection circuit itself is carefully designed to ensure that during these surge events, where currents can sometime be as high as 30A, that voltages do not exceed critical breakdown and spark

gap limits so they themselves are not destroyed by the event. The Akros AS1113 and AS1124 have both passed these test conditions defined in IEC61000-4-2. 4.5

PD CONTROLLER AND DC-DC CONVERSION IN POE SYSTEMS

The AS1113 PD controller meets all the requirements of 802.3af (13W) requirements, while the AS1124 is designed to meet the pre-802.3at high power requirements of up to 30W. The AS1124 includes the current 802.3at working group recommendation of extended classification scheme using the 2 finger classification method to communicate and recognize an 802.3at PSE. Both devices feature an integrated power switch. The switch in the AS1124 has been designed to support 625ma of continuous current and a peak current of 800ma.

The integrated DC-DC converter is designed to work in a flyback, forward or buck configuration through the use of external FETs. Both the AS1113 and AS1124 are footprint compatible. By keeping the FETs external, the designer can configure the application for either 802.3af power levels of 13W or 802.3at power levels of 30W without changing his board layout, thus allowing forward design capability and improving time to market



The devices are available in a 20-pin QFN package that is compliant with Reduction of Hazardous Substance (RoHS) requirements. The package footprint is a 5x5mm and is the smallest foot print in the industry. In addition, higher integration results in reduced components and provides an overall reduced BOM. Customers can bring to market higher performance PoE devices with low cost and a small footprint.