



**Application Note AN024**

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**A Universal 13W/30W  
802.3af/at PD Reference  
Design using AS1135**

**Rev 1.1**

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## ABOUT APPLICATION NOTE AN024

Application Note AN024 describes the general framework for using the AS1135 PD / PWM Controller in a single standard reference design which accommodates all current and future Power-Over-Ethernet (PoE) PD design requirements.

Refer to [www.akrossilicon.com](http://www.akrossilicon.com) for further details on these and other Akros Silicon components. For any further assistance, please contact your Akros sales representation or contact us at [support@akrossilicon.com](mailto:support@akrossilicon.com).

## INTRODUCTION

### MOTIVATION

This Universal Reference Design provides the general framework for using the AS1135 PD / PWM Controller in a single standard reference design which accommodates all current and future Power-Over-Ethernet (PoE) PD design requirements, covering IEEE802.3af (13W), IEEE802.3at (25W) and semi-proprietary designs like IEEE802.3af-based 30W designs.

Standard IEEE802.3af PD designs have been well adopted in today's market. End applications include IP Phones, IP Cameras, AP routers, RFID terminals etc., where 12.95Watts of input power is sufficient. However, as system vendors expand their product lines to include more sophisticated features, higher input power becomes necessary.

Higher power can be provisioned via the upcoming IEEE802.3at standard. However, in the interim, many customers have been designing semi-proprietary solutions to work with PSEs/mid-spans which deliver up to 30Watts of power using the IEEE802.3af-based handshake mechanism. Such a requirement change often leads to a complete redesign or platform change that demands significant engineering resources. It results in higher development cost, longer development cycles, potentially missed production windows and (most importantly) an increased risk of introducing new design bugs.

Akros Silicon's AS1135 is a highly-integrated, fully-featured PD / PWM Controller device which simplifies the development of a single universal PD platform that can be used across the full range of the 13W-30W 802.3af / 802.3at based PD products. It solves the power requirement for today's systems and makes the platform ready for high-power IEEE 802.3at in the next generation.

This universal design minimizes the component change to only three (3) components, with no additional design effort, when switching from the 13W 802.3af to the 25W/30W 802.3at/af standard, or vice-versa. All different power schemes using this universal reference design are mapped to the same pinout, PCB layout and solution size – making design development, validation and the production process extremely simple.

### CUSTOMER BENEFITS

Key benefits for customers using the universal reference design:

- Same base PD & DC-DC design is used across complete product line, from 13W to 30W systems.
- Customers don't need to wait for IEEE802.3at-based PSEs to design higher power PD systems. 30W PDs can be designed to work with legacy 802.3af-based 30W power injectors, PSEs or mid-spans, and can be seamlessly migrated to 802.3at-compliant designs as 802.3at PSEs become available.
- Use of one common design across platforms reduces engineering development and validation time.
- Common BOM simplifies production logistics and delivers cost savings.
- Same EMC signature and performance across all platforms reduces compliance engineering and testing, delivering significant cost savings.
- Faster time to market for product releases.

### REFERENCE DESIGN

A PD & DC-DC reference design with flyback configuration and 12V output is used to illustrate the concept of the Universal Reference Design. Below, sections highlight different usage modes of the common design and their associated stuffing options. A detailed schematic of the design is available in the Universal Reference Design Schematic section of this document (page 9 and 10).

### UNIVERSAL PD OPERATION WITH 13W 802.3AF-BASED PSE

**AS1135-ASYNC-FL12V 13W-AF** – Use this design configuration when an 802.3af standard PSE is employed as the power source and a standard 13W PD is connected. The AS1135 is set for 400mA of current limiting. Resistor R7 and RCLASS are set at 0 – 3 classification, following the IEEE 802.3af specification (see Table 2). ATDET stays low, since 2-event detection from the PSE is not presented.

This design has been widely implemented in today's end products, such as standard PoE IP security cameras and standard desktop IP phones.

**Figure 1 - 13Watt PD "af" Examples**



### UNIVERSAL PD OPERATION WITH 30W 802.3AF-BASED PSE

**AS1135-ASYNC-FL12V 30W-AF** – Use this design when a high-power 802.3af PSE / mid-span will be used as the power source for high-power PDs requiring more than 13W. The AS1135 is set for 800mA input current limit. RCLASS is set at class 4 to request high power from the PSE. ATDET stays low since 2-event detection from the PSE is not presented. This design is often used for high-power IP cameras and video-capable IP phones where higher power is required but the PSE is not IEEE 802.3at-ready.

**Figure 2 - 30Watt PD "af" Examples**



### UNIVERSAL PD OPERATION WITH 802.3AT-BASED PSE

In this case, the 802.3at PSE is available but depending on the power requirement of the PD, there are two different solutions:

- If 13Watt maximum is required, set the RCLASS resistor to Class 0-3 (Type1 PD recognition).
- If >13Watt maximum is required, set the RCLASS resistor to Class 4 (Type2 PD recognition).

### Type1 (<13W) Configuration

**AS1135-ASYNC-FL12V Type1-AT** – Use this design when the 802.3at PSE is employed as the power source, but the PD itself does not require high power (less than 13W). The AS1135 is design-limited to 13Watts of input power by selecting the current-limiting resistor R7 to 400mA mode. The proper RCLASS resistor can be selected to set the classification between 0 – 3 for different power levels to be supplied by the PSE. ATDET stays low because IEEE802.3at PSE detects low power classification and only a single-event classification signal is presented to the AS1135.

This configuration is often used when an upgrade to the application, from 13W maximum to 30W maximum is planned, or simply to generate different product SKUs from the same base design, such as a PoE-ready 802.11a/b/g AP designs for future 802.11n upgrade.

**Figure 3 - Type1 PD "at" Examples**



### Type2 (>13W) Configuration

**AS1135-ASYNC-FL12V Type2-AT** - In this design, an 802.3at PSE is used as the power source for this high-power PD. Typical applications are PTZ surveillance cameras, enterprise wireless AP routers, video-conferencing IP phones, high-resolution CCD IP cameras, Thin Client Computers, etc. The AS1135 is set for 800mA current limit and RCLASS is set to Class 4 for maximum power request from the PSE. ATDET will then trigger high since AT PSE 2-event classification is presented.

This design is targeted for the newly-developed IEEE 802.3at Draft 3.0 specification for next generation PoE+ applications. The AS1135 offers the industry's first IEEE802.3at-compliant PD solution in production.

Note that although the AS1135 current limit is set to handle up to 30W of incoming power, an 802.3at-compliant PSE will only provision a maximum of 24.5W of power at the PD input. A standards compliant system should be designed with the PSE power limit in mind.

**Figure 4 - Type2 PD "at" Examples**

## SUMMARY

The different power scenarios described above can be solved using this AS1135 Universal Reference Design. The AS1135 is the only 802.3at Draft 3.0 pre-standard PD / PWM production-ready solution on the market as of July 2008. It offers the designer an easy-to-design, lower-BOM and smaller-area solution for today's 802.3af POE standard and is designed with the next-generation 802.3at PoE+ pre-standard in mind.

## CONFIGURATIONS SUMMARY

### CURRENT LIMIT RESISTOR AND TRANSFORMER SELECTION

Only three (3) components need to be changed from the universal design to support the entire range of power options. The following table shows the components selections:

Table 1 - Current Limit Resistor and Transformer Selection

Design Configuration	Component Loading Options		
	R7	R11	Transformer
AS1135-ASYNC-FL12V 13W-AF	0Ω	0.24Ω	TGSP-P042EFD15LF
AS1135-ASYNC-FL12V 30W-AF	NL	0.18Ω	TGSP-P028EFD20LF
AS1135-ASYNC-FL12V 13W-AT	0Ω	0.24Ω	TGSP-P042EFD15LF
AS1135-ASYNC-FL12V 30W-AT	NL	0.18Ω	TGSP-P028EFD20LF

Note: For input current limiting resistor R7, leave open to set the input current limit to 800mA or short to GND to set at 400mA. R11 is the internal DC/DC current-sense resistor that needs to be populated differently between 13W and 30W operation.

### RCLASS RESISTOR SELECTION

The following table shows the different classification setting with proper RCLASS resistor value (Table 2). This Class setting is independent of the reference design and follows the standard PoE Classification Mode definitions.

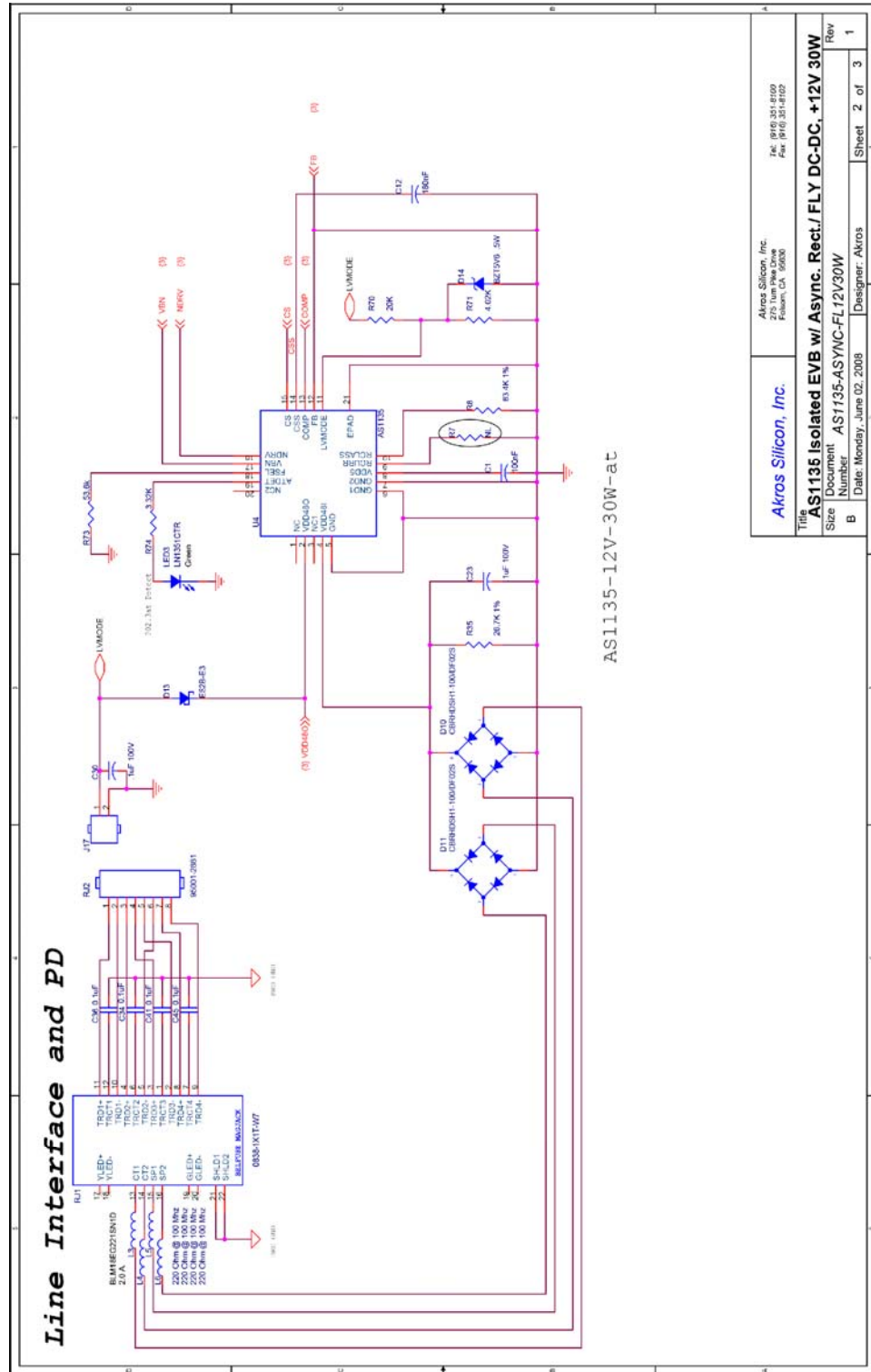
Table 2 - RCLASS Resistor Selection

Design Configuration	RCLASS Resistor R8				
	Class 0	Class 1	Class 2	Class 3	Class 4
AS1135-ASYNC-FL12V 13W-AF	Pull Up	280K Ω	143K Ω	90.9K Ω	
AS1135-ASYNC-FL12V 30W-AF					63.4K Ω
AS1135-ASYNC-FL12V 13W-AT	Pull Up	280K Ω	143K Ω	90.9K Ω	
AS1135-ASYNC-FL12V 30W-AT					63.4K Ω

Note: For details on Classification Mode operation and the power and current classification corresponding to the RCLASS resistor value, please refer to the AS1135 Datasheet, "Classification Mode" on page 18.

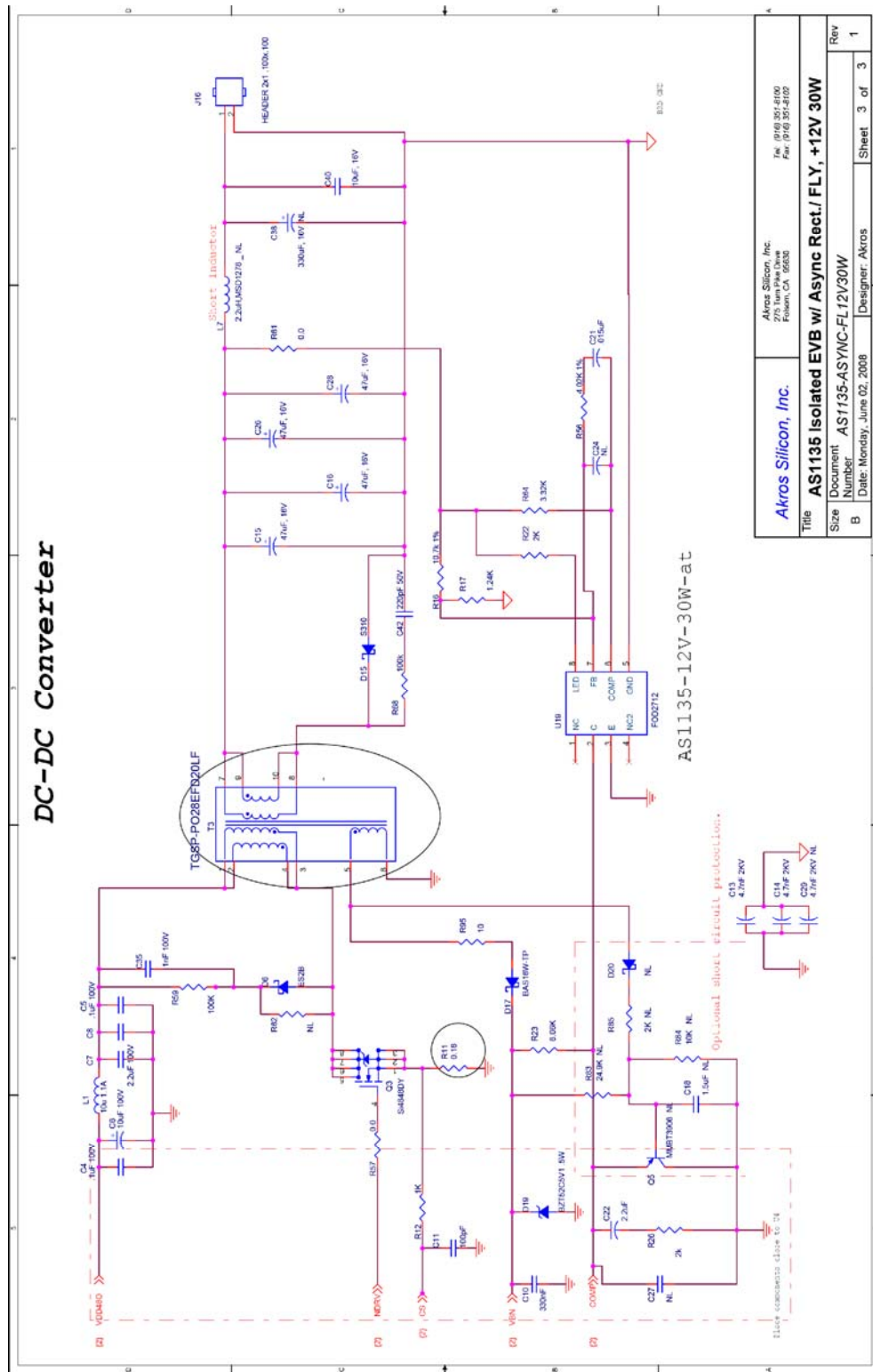
UNIVERSAL REFERENCE DESIGN SCHEMATIC

Figure 5 - Line Interface and PD



Akros Silicon, Inc.		Akros Silicon, Inc. 270 Tully Park Drive Farmingdale, NY 11735	
Title		AS1135 Isolated EVB w/ Async. Rect./ FLY DC-DC, +12V 30W	
Size		Document	
Number		AS1135-ASYNC-FL12V30W	
B		Date: Monday, June 02, 2008	
		Designer: Akros	
		Sheet 2 of 3	
		Rev 1	

Figure 6 - DC-DC Converter



Akros Silicon, Inc.		Akros Silicon, Inc. 275 Turnpike Drive Folsom, CA 95630	
Title	AS1135 Isolated EVB w/ Async Rect./ FLY, +12V 30W		
Size	Document Number AS1135-ASYNC-FLY12V30W		
B	Date: Monday, June 02, 2008	Designer: Akros	Rev
	Sheet 3 of 3		1

Note: This reference design shows standard PoE to 12V conversion. For reference design and BOM information for different output voltages and/or with use of an auxiliary power supply using the LVMODE feature, please contact Akros Silicon.



## CONCLUSION

Akros Silicon is committed to providing industry-leading technology to help customers improve their design cycle for next-generation 802.3at standard applications. By designing with the AS1135 for IEEE 802.3af standard applications today, it will become effortless to migrate designs to the next-generation IEEE 802.3at standard in the future. The component loading options between different power configurations are very simple to manage, with no major redesign, layout or validation effort required.

The AS1135 integrates the PD and PWM total PoE solution into a small 5x5 QFN thermal-enhanced package, further shrinking the solution area dramatically. Akros Silicon has already performed extensive validation of the reference design in various configurations to reduce customer design cycles.

## REFERENCE MATERIALS

- AS1135 Datasheet

