+12V Power-Over-Ethernet Application Kit

Hardware Reference

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Contents

1 Overview

This document defines the characteristics of the PoE application kit board. This application kit provides a reference design for PoE on the Power Device side using National LM5070 device.

The POE_12V_JS board is an extra-power module which can be plugged on the Digi JumpStart development boards, providing +12V power supply to the JumpStart boards.

1.1 Introduction to PoE

Ethernet is becoming the standard communication interface of peripheral devices beyond networked computers. In a PoE environment the Ethernet not only transports data between computers and devices, but also provides power so that connected PoE capable devices do not need separate power supplies.

Power over Ethernet gradually has became an industry standard and is covered by IEEE 802.3af. The proposed standard can accommodate power over either the data transmission pairs or the spare pairs of the Ethernet cable.

There are two sides to the Power over Ethernet system. The side that provides power is called power Source Equipment (PSE) side, and the side that consumes power is called Power Device (PD) side. A detection scheme is designed to detect if there is PD connected at the destination. This prevents applying power to a non PoE system.

After a PD is detected the PoE sides has to match the power delivering capability of the PSE and the power consumption of the PD. This is called power classification stage.

After a valid classification is determined and a match between PSE and PD is found, the PSE applies a nominal 48V DC across the power delivering lines. The PD regulates the power down to its needs.

2 Detailed description

2.1 POE_12V_JS_0

The POE_12V_JS application kit is designed to provide an IEEE802.3af compliant, Power over Ethernet (PoE) 12V power supply. This application kit is based on the National Semiconductor LM5070 device.

The LM5070 is a power interface port and pulse width modulation(PWM) controller used in Powered Devices (PD) that connect into Power over Ethernet (PoE) systems. This device complies to the power detection, level classification, and does the power regulation for the end system. For the LM5070 specific information and functional description please refer to the datasheet.

General performance features of the application kit are:

- Fully compliant 802.3af Power Interface Port

- Fully isolated +12V output

- Input range: 32 to 57V

- Output current: 0 to 1A

- Output frequency: 20KHz

2.1.1 Mechanical

The module is connected to the JumpStart Kits through two one row, right angle, SMD, RM2.54 connectors. The first one (P1) is a four pin connector that provides access to the PoE signals coming from the Ethernet interface. The second one (P2) is a six pin connector that provides the output power supply from the PoE module. The module makes a right-angle with the development board.
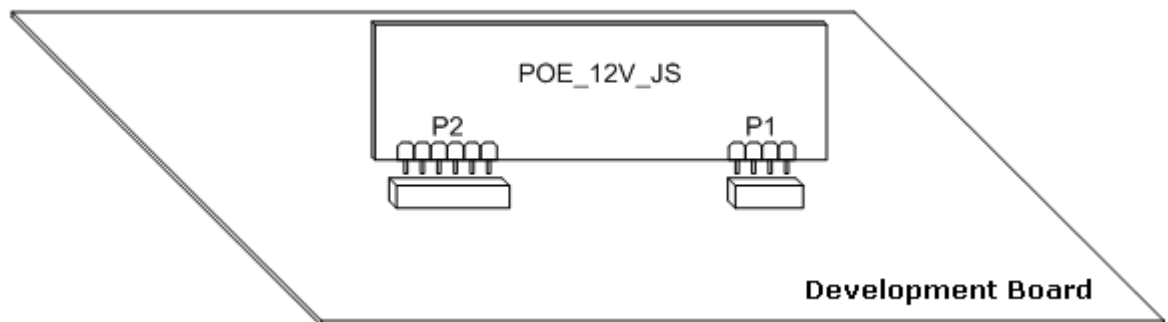
The size of the POE_12V_JS board is 65.88 x 25 mm.

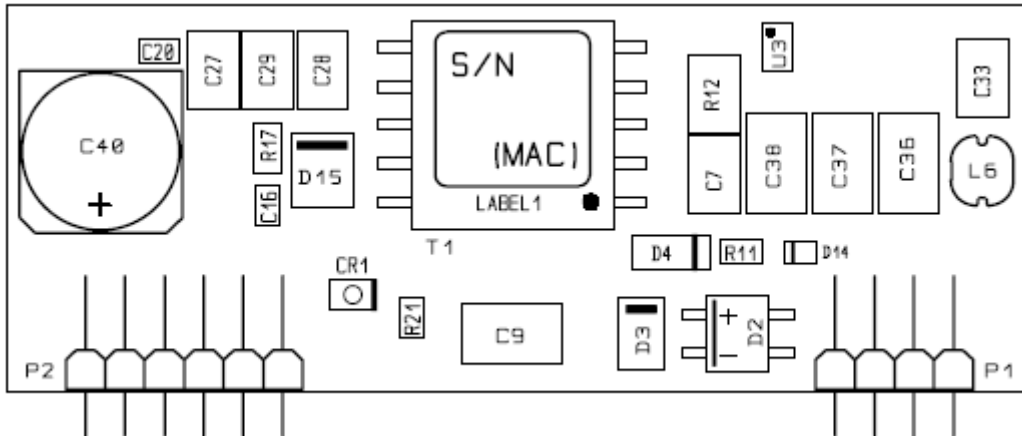The following figure shows the placement of the POE_12V_JS board.
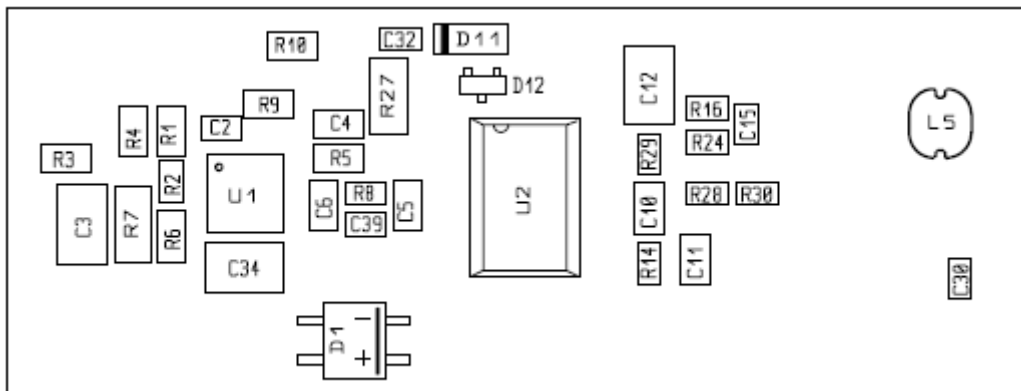
Figure 1. POE_12V_JS_0 TOP Placement

Figure 2. POE_12V_JS_0 BOTTOM Placement

2.1.2 Flyback Transformer

The flyback transformer is a coupled inductor with multiple windings wound on a single gapped core. For simplification, we refer to the first, driven winding, as the primary and the main output winding as the secondary winding of the flyback transformer.

The flyback converter is a converter in which inductive energy is stored by applying a voltage across the primary in a similar manner to that of a boost converter. A second coupled winding (secondary) of the inductor transfers the energy to a secondary side rectifier after the primary voltage has been switched off.

In the PoE application kit, the LM5070 directly drives a MOSFET switch to apply voltage across the primary. When the switch turns off, the secondary applies a forward current to the output rectifier and charges the output capacitors.

2.1.3 Current Limit / Current Sense

The LM5070 provides a cycle-by-cycle over current protection function. Current limit is accomplished by an internal current sense comparator. If the voltage at the current sense comparator input CS exceeds 0.5V with respect to RTN/ARTN, the output pulse will be immediately terminated. A small RC filter, located near the CS pin of the controller, is recommended to filter noise from the current sense signal because the LM5070 current sense and PWM comparators are very fast, and may respond to short duration noise pulses.

The PoE application kit has a 0.33R sense resistor that limits the output current to 1.5A for the 12V signal.

2.1.4 Working Frequency

A single external resistor connected between the RT and ARTN pins sets the LM5070 oscillator frequency. In the LM5070-50 the internal oscillator operates at twice the frequency of the output (OUT). To set a desired output operational frequency, the RT resistor can be calculated from:

$$RT = \frac{1}{F \times 330 \times 10^{-12}}$$

In the PoE application kit the RT resistor is 15KHz, so the output operational frequency is set to 20KHz.

2.1.5 Error Amplifier

An internal high gain error amplifier is provided within the LM5070. The amplifier's non-inverting reference is set to a fixed reference voltage of 1.25V. The inverting input is connected to the FB pin

For the PoE application kit the error amplifier function is implemented on the secondary side of the converter and the internal error amplifier is not used. The internal error amplifier is configured as an open drain output and can be disabled by connecting the FB pin to ARTN. An internal 5K pull-up resistor between a 5V reference and COMP can be used as the pull-up for an optocoupler in isolated applications.

2.2 PoE module usage

The POE_12V_JS application kit provides a +12V supply voltage. This +12V_POE supply output is connected directly to the power switch of the JumpStart kit board through a diode and so we reuse the Jump Start power controller, which provides +5V (and also +/-12V) from the input power supply 9-30V (in our case the input power supply is +12V_POE).

The POE module can be used directly once it's plugged on the Jump Start boards. In this case, the module replaces the input power supply plug and so provides all internal power supplies.

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3 Connectors pinout

3.1 Connector P1

Pin	Description	Comments
1	POE_TX_CT	
2	POE_RX_CT	
3	POE_RJ45_4/5	
4	POE_RJ45_7/8	

3.2 Connector P2

Pin	Description	Comments
1	+12V	
2	+12V	
3	GND	
4	GND	
5	POE_GND	
6	POE_GND	

4   Application notes from National Semiconductors

- Application Note 1358: LM5070 "AE" Evaluation Board

http://www.national.com/an/AN/AN-1358.pdf

- LM5070 Reference Design - Isolated Power-over-Ethernet (POE) Regulator, Low-cost, High Efficiency 5V 7W Output

http://www.national.com/rd/PAhtml/PADC_POE_5V_7W_ISO.html