KTA1170 Practical Methods for Standards Compliance

Power Over Ethernet (PoE) technology was introduced in the late 1990's as a simpler way to transfer data and power over ethernet cables. The Institute of Electrical and Electronics Engineers (IEEE) introduced this as part of the 802.3 standard in 2003 officially branding it as PoE and defining it to power up to 15.4W per port. The standardization required that Powered Devices (PD) and Power Sourcing Equipment (PSE), be compatible with each other to prevent damage to non-PoE devices. This widened the scope for different types of end devices such as security cameras, wireless access points and access control systems to source power and transfer data for applications in enterprise and industrial markets. Increase in wired bandwidth over the years meant that different types and number of end devices could be powered and connected to the networks. Seeing this, IEEE also expanded the PoE standards in 2009 to include PoE+ (enabling 30W per port) and more recently PoE++ (enabling up to 90W per port), where power is supplied using all four twisted pairs in an ethernet cable.

Designing a PoE enabled device requires the following design blocks to extract power from an ethernet cable: dual bridge rectification (to check DC power polarity on the four twisted pairs), PD controller (for Detection and Signature compatibility) and DC/DC converter to supply required power to the end device. Kinetic Technologies offers all these blocks to design a PoE system across all power classes. The KTA1170 is a compact, dual active bridge rectifier that can easily be integrated into current and new systems designed for the highest power standard in PoE.

While the growth in PoE-enabled devices has opened new possibilities and expanded the scope of applications in different markets and regions, it has also brought in new requirements for system designers to meet. This application note describes the different schematics and components that system designers need to include with KTA1170 to pass various compliance standards and special requirements for certain applications.

Reference Design

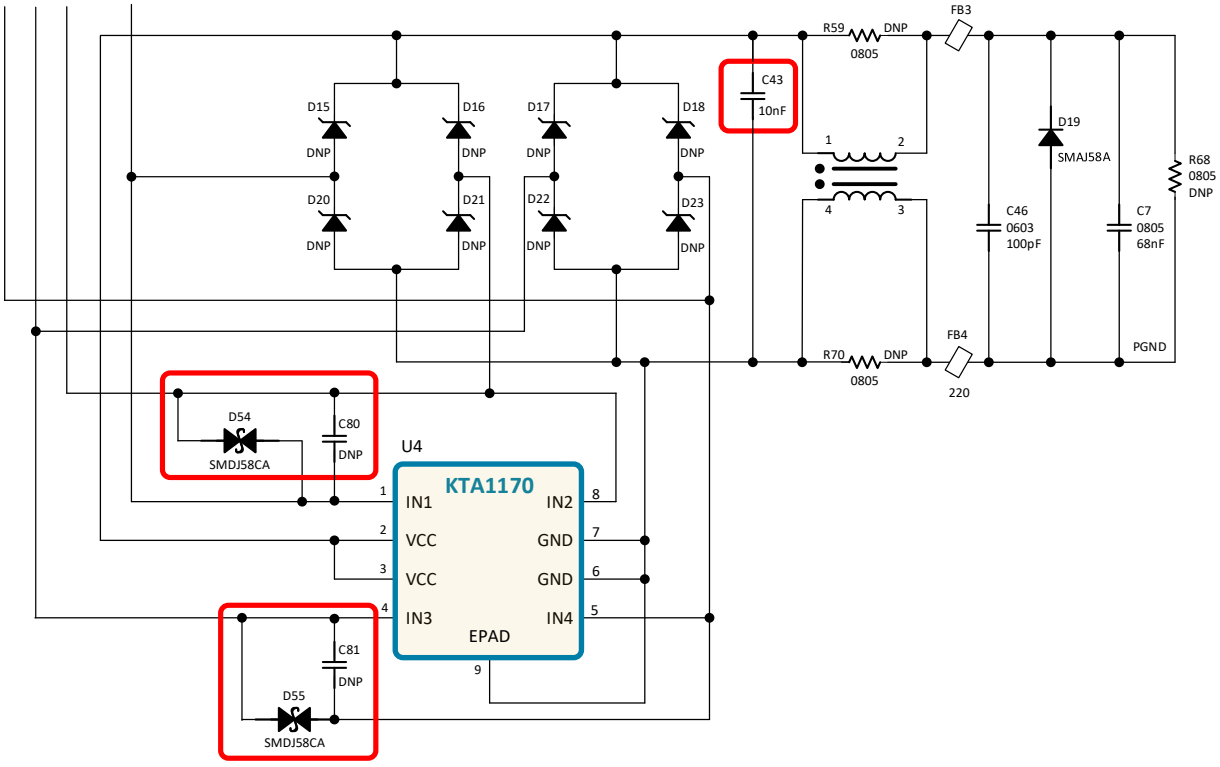

Figure 1. Input Section of KTA1142 Reference Design

Conducted Immunity Test

EMC 61000-4-6 Compliance Standard

For system designs which need to pass Conducted Immunity IEC 61000-4-6 (Test Frequency Range: 150K to 100M; Voltage level:10 V_{RMS}), a 10nF capacitor must be applied between VCC and ground. Please refer to Figure 1.

Non-Compliant PSE Environment

The KA1170 is designed to tolerate voltage overstresses in a typical PoE environment, where power is delivered by a standards-compliant PSE. The IEEE 802.3 specification clearly defines the worst case condition as the following: the fastest rise time allowed is 15µs from 10%-90% of 57V (maximum from POWER_ON to POWER_UP). However, in conditions which are outside this specification, such as a DC lab supply or non-standard PSE which have no PD detection or handshaking, additional components are required to prevent hot plug events from damaging the end devices. Bi-directional TVS diodes D54 (SMDJ58CA) and D55 (SMDJ58CA), shown in Figure 1, are used in the reference design for this purpose. Even when standards compliant PSEs are used, it is strongly recommended to use smaller bi-directional TVS diodes (SMAJ58CA) due to the inherent noise and voltage transients present when power and data are transmitted through the same cable.

Hot-Plug Test Environment

In order to demonstrate safe operability in non-compliant PSE environments, Kinetic performed a series of tests. The standard Kinetic test environment can be seen in Figure 2. It used a DC power supply, model IT6993A, connected with a 30cm cable to the Device Under Test (DUT), which is Kinetic's PoE bt power evaluation kit "KTA1142EUAT-ZU-MCEV-01" designed with its KTA1170 and KTA1142 devices (see Figure 3).

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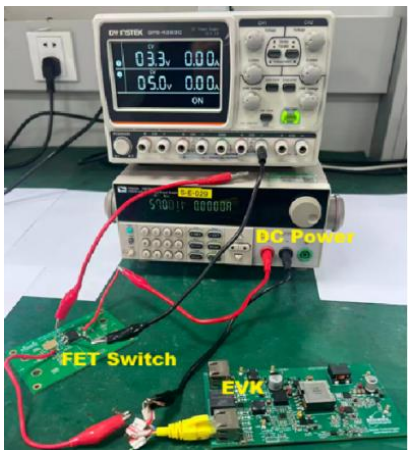

Figure 2. Standard Kinetic Test Environment

Figure 3. Close Up of KTA1142EUAT-ZU-MCEV01 Evaluation Board

Hot-Plug Test Summary and Results

The power supply was set to +57V (max input PSE voltage) to test the DUT, with its input section designed as shown in Figure 1. The DC voltage was switched directly into the ethernet cable by a MOSFET switch without any PoE handshaking, which resulted in a rise time less than 5µs. One hundred positive and negative strikes were applied to all possible input pair combinations as shown in Table 1. Each of the input pairs successfully passed with no damage, thus safely powering the end device.

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Table 1. Hot-Plug Test Summary

Number of Strikes	Hot-Plug Test Voltage	Ethernet Cable Wires		Results
		Wire Number (Positive +)	Wire Number (Negative -)	
100	57V	# 1, 2	# 3, 6	Pass
100	57V	# 3, 6	# 1, 2	Pass
100	57V	# 7, 8	# 4, 5	Pass
100	57V	# 4, 5	# 7, 8	Pass

Surge Test (10/700)

IEC61000-4-5 Standard

The reference design shown in Figure 1, passes ±1.0kV differential surge testing.