Non-Isolated AC/DC Power Supply Design and Implementation based on Power Integrations LNK3205

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15-Nov-2019

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Part I: Project Background

On 11-Oct-2017, my company planned to design a Plug-In Relay (On/Off) product for our IEEE 802.15.4 based smart home application. The project was accomplished, and the product got its FCC and UL certifications, recently. As a person who involved in every detail of hardware design and manufacturing. I have to say based on my personal working experience, if the RF related design is the first most important thing for the product, the AC/DC should take the place just behand the RF design. The communication range and quality are defined by the RF design which may affect the user experience since the first time they are using the product. However, to a certain extent, the product's life span is defined by the AC/DC design which may affect the manufacturer to define the warranty time. Especially, the AC/DC circuit is the only module in our product which contains electrolytic capacitors. For a well-designed product, electrolytic capacitor is the one of main causes of product failure.

Let us focus on AC/DC design, the first thing needs to be cleared is why using Non-Isolated AC/DC. I designed a satisfied 3.3VDC isolated AC/DC solution based on the Power Integrations LNK363DN for our previous projects. Those projects already got FCC and UL certifications. Therefore, in the very beginning, I preferred to reuse the mature solution for this project, but after a little bit research I realized that the isolated solution may rise the BOM cost significantly due to HLW8032 high-precision energy metering IC. HLW8032 requires a 5VDC Non-Isolated AC/DC. So, an additional small footprint 5VDC Non-Isolated AC/DC must be used even the 3.3VDC isolated AC/DC is already at there for powering up the SOC. Digital Isolators also need to be added for the communication between the SOC and HLW8032. According to the consideration of the product's size, reliability and the BOM cost, I