

Inside *iCoupler*[®] Technology: ADuM347x PWM Controller and Transformer Driver with Quad-Channel Isolators Design Summary

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Systems that require isolation often need to isolate both data paths and power supplies. To simplify such designs and to reduce area, Analog Devices recently released the ADuM347x family of *iCoupler* digital isolators. These products integrate four channels of high speed data isolation with a transformer driver and secondary PWM controller that can be used to implement an isolated push-pull dc-to-dc converter. Integrating the elements of an isolated power supply into the same package as the data isolation significantly reduces the number of components and reduces the overall design complexity. To achieve this, the ADuM347x incorporates ADI's proprietary *iCoupler* technology to produce a two-chip solution in a 20-lead SSOP package; the block diagram is shown in Figure 1:

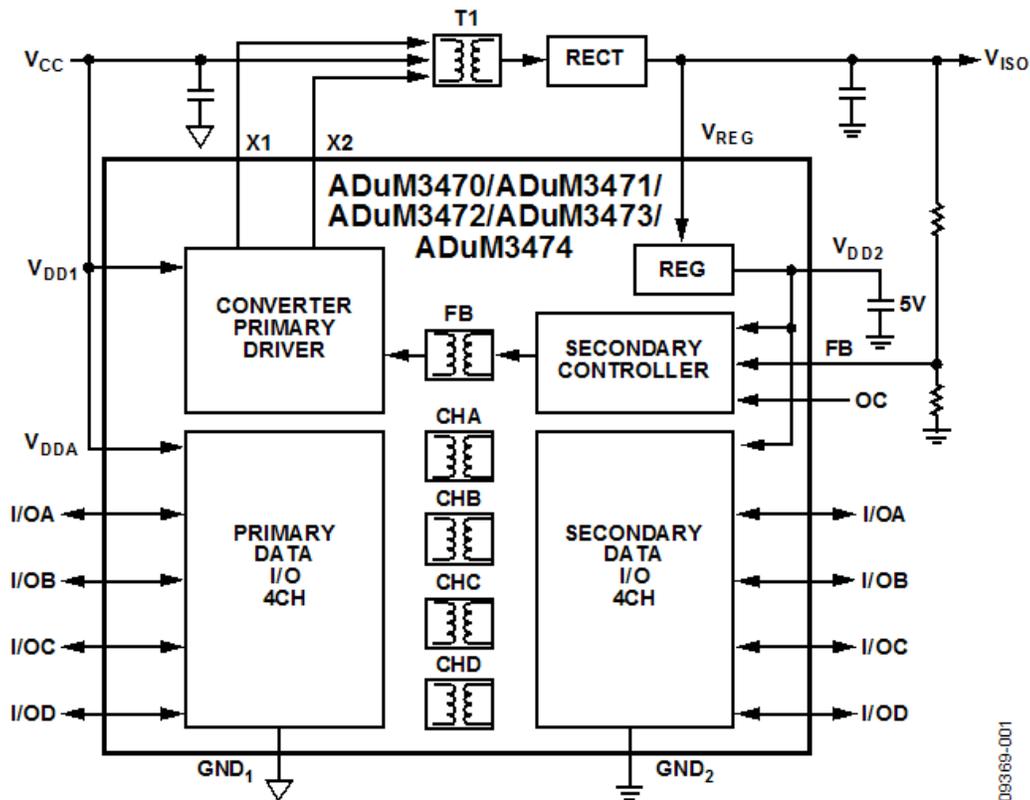


Figure 1. ADuM347X Functional Block Diagram

Figure 1 shows that, even though the ADuM347x is a four-channel digital isolator, it actually incorporates five *iCoupler* chip-scale isolation transformers that are typically used to isolate data. In fact, four of these *iCoupler* transformers form the basis of a quad-channel digital isolator supporting data rates up to 25 Mbps in a variety of channel configurations. The fifth *iCoupler* channel is used as feedback to transfer a PWM control signal from the secondary controller across the isolation barrier from the secondary side to the primary side. The integrated secondary controller together with integrated

feedback channel provides stable response for an isolated push pull converter.

The power transformer (T1) and rectifier (RECT) in Figure 1 are external components required to complete the isolated dc-to-dc converter. The dc-to-dc converter provides up to 2 W of regulated, isolated power at 3.3 V to 24 V from 5.0 V or 3.3 V input supply. Efficiency is over 70% at maximum load of 400 mA with 5 V output. To reduce the possibility of interference with other systems, the switching frequency can be easily adjusted from 200 kHz to 1 MHz with an external resistor connected to OC pin. The REG block is an on-chip regulator that eliminates the need for an external linear regulator. When the isolated output power exceeds 5 V (e.g. 15 V), this block provides a regulated 5 V supply that can be used to power the ADuM347x itself, as well as other components connected to the secondary side power supply.

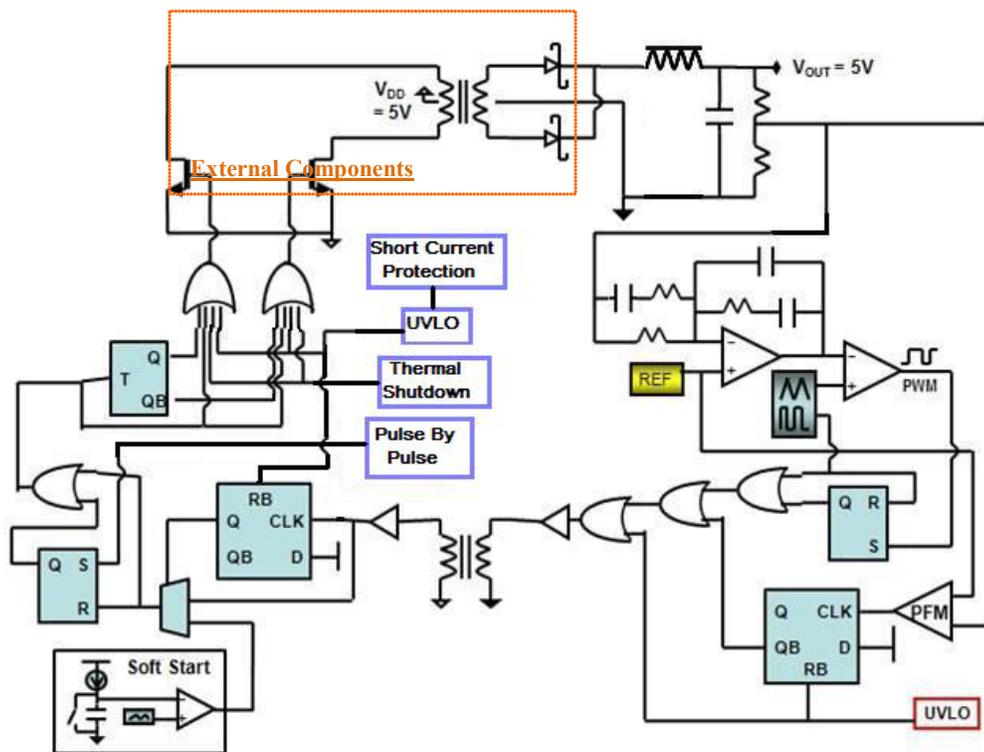


Figure 2. Detailed Block Diagram

To achieve high output accuracy and frequency compensation, the ADuM347x employs a Type III amplifier with two zeros chosen to compensate the pair of poles generated by the power stage. This yields good phase margin and wide crossover frequency. Integration allows all compensation elements to be designed on-chip, and no external compensation components are required.

To further improve performance as well as safe and reliable operation, the ADuM347x incorporates undervoltage detection, pulse-by-pulse current limits, short circuit protection, and thermal shutdown, as shown in Figure 2. The ADuM347x also uses leading-edge blanking to prevent tripping of current sense circuitry to achieve fast response to overcurrent conditions. The pulse-by-pulse current limit is fast enough to protect the converter under most conditions; however, in severe cases such as a shorted output or saturated magnetic core within the external transformer, short-circuit protection can be triggered.

In addition to these safety features, the ADuM347x also incorporates a patent pending soft start scheme to ensure smooth startup of the secondary and to minimize overshoot at the startup.

In summary, ADuM347x takes advantage of the integration capability of *iCoupler* technology to provide a complete isolation solution for data and power that delivers high efficiency and output current capability. These benefits are achieved along with a significant reduction of external components, system complexity and board space.