SYNCHRONOUS RECTIFICATION FOR FORWARD CONVERTERS.

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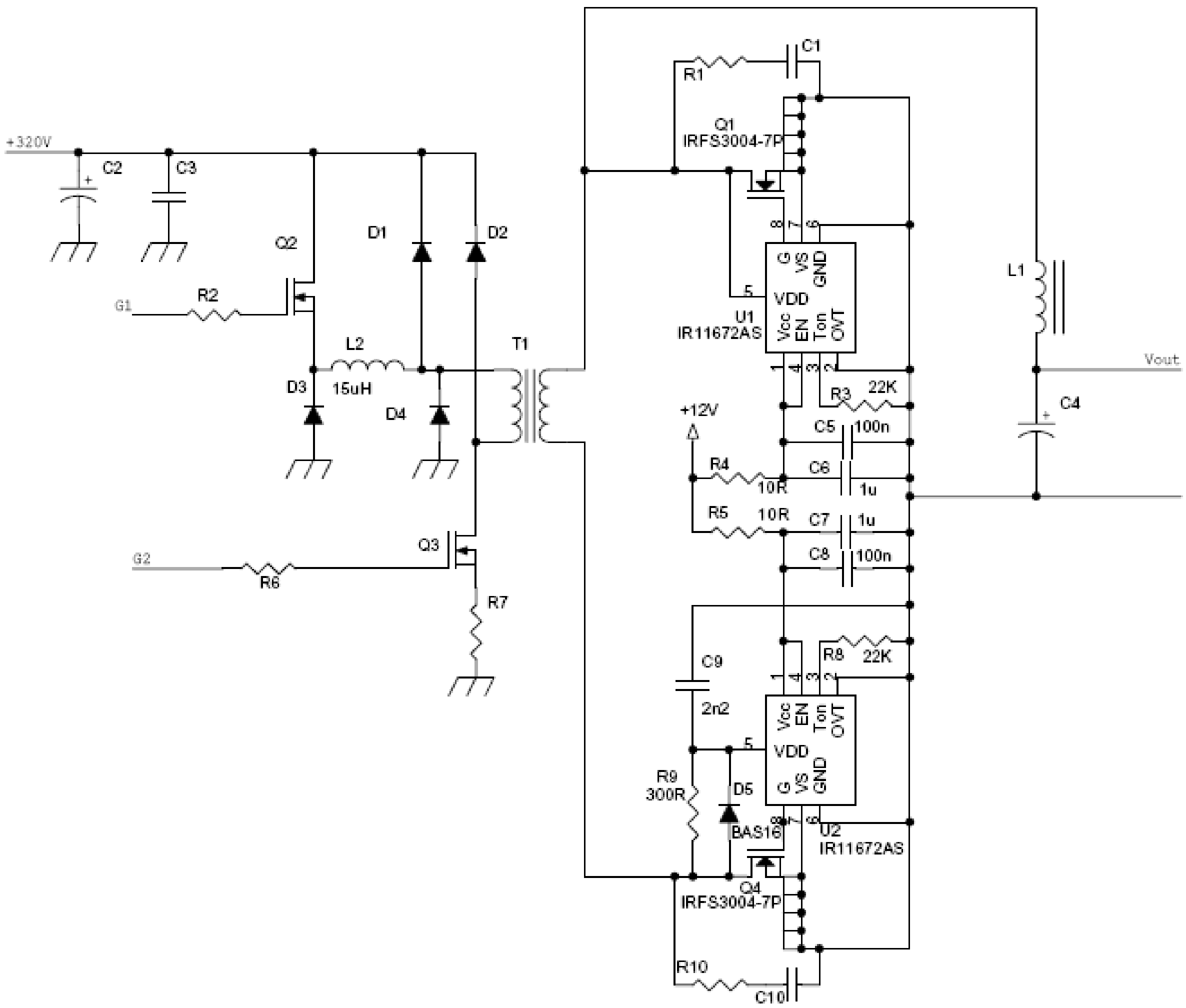
Synchronous rectification allows dramatic reduction of losses in the output rectification stage of most converters. It can be easily implemented in discontinuous mode fly-back, LLC converters and full bridge phase shift converters. Fly-back converters are restricted to a low power range and LLC converters are difficult to build for low voltage outputs, where synchronous rectification is most useful. For medium power range, forward converters, especially the dual ones are ideal. However, implementing synchronous rectification in continuous mode forward converters is not so easy.

The first problem is cross conduction between both rectifying MOSFETs.

To solve the problem, the usual proposed solution is the use of a pulse transformer that transmits the primary gate pulses to the secondary side, and a circuit that provides the appropriate delays.

We will show a simpler way.

The new circuit uses the IR11672 synchronous rectifier driver and the only components added to a standard dual forward converter are L2, D1, D4, C9, R9 and D5.



When Q2 and Q3 turn on, the current was flowing through Q1, acting as a free-wheeling diode. Because there is a delay time from U1 detecting the polarity change and Q1 switching off, for some nanoseconds Q1 short circuits de secondary.

In some circuits this is solved by advancing the turn off of Q1, but then Q1 intrinsic diode conducts, and because this diode is much slower than a Schottky, a peak current and EMI interference is unavoidable.

The use of the small inductor L2 solves the problem. The inductor introduces a slope in the primary current dI/dt = V / L. The value of L2 is limited by the practical duty cycle of the converter.

An added advantage of using L2 is the reduction in switching losses of the primary MOSFETS and lower EMI.

U2 detects the change of polarity in the transformer and turns Q4 on. The detection is made through the VDD pin and thanks to R9 and C9, Q4 does not turn on until Q1 is fully off.

When Q2 and Q3 turn off, the voltage in the secondary changes polarity, so Q1 intrinsic diode starts to conduct and some nanoseconds later U1 turns Q1 on to reduce forward losses. Thanks to D6, U2 turns Q4 off fast, but this is not so important as now the secondary current is limited to Ip*Np/Ns (Were Ip = magnetizing primary current, Np/Ns transformer turns ratio).