Digitally Controlled Pots Program PWM's Features

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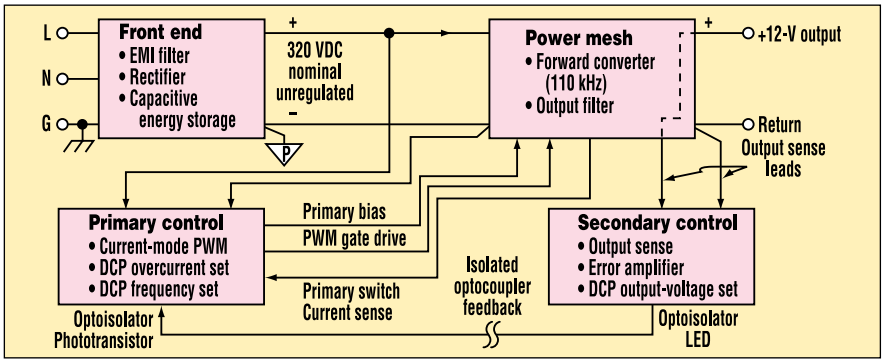
The circuit described here is a switching 12-V, 10-A power supply whose topology is that of a conventional single-switch forward converter *(Fig. 1)*. To derive the pulse-width modulation for its switch, the converter uses peak-current control. The front end processes the ac-line power and delivers an unregulated 320 V dc to the downstream dc-dc converter in the power mesh.

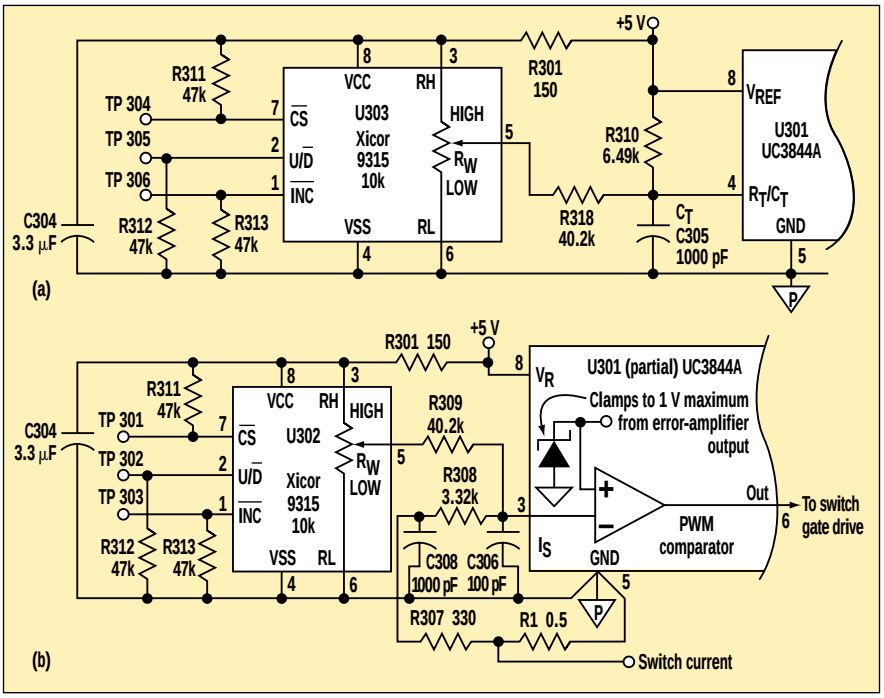
After processing the power delivered by the front end, the power mesh drives a regulated 12 V dc at 10 A at the front end's output. Included in the secondary control is an error amplifier that compares the 12-V dc output voltage with a reference voltage. It also provides optocoupled feedback to the primary control. The primary-control section of the power supply is designed around the low-cost UC3844A pulse-width-modulator (PWM) current-mode controller *(Figs. 2a and 2b)*. In addition to controlling the transformer switches in the power mesh, the pulse-width-modulated output of the PWM regulates the power supply's output voltage.

Two key features of the PWM, the operating frequency and the overcurrent limit, are programmed by Xicor's digitally controlled potentiometers (U303 and U302). Using electronic potentiometers rather than their traditional mechanical counterparts offers lower cost, higher reliability, and automatic calibration during production testing. The PWM clock frequency is set by C305 (C_T) and the Thevenin resistance (R_T) formed by R310, R318, and potentiometer U303 *(Fig. 2a, again)*. For high values of R_T, $f \approx 1.72/R_TC_T$. Setting the converter frequency precisely to its design target value of 110 kHz reduces the design margin needed when designing the supply's expensive magnetic components.



1. In addition to the 12-V output level, both the switching frequency and overcurrent limit are programmed by digitally controlled potentiometers in this 10-A switching supply.

The PWM's overcurrent limit is established by the 1-V zener diode connected to the PWM comparator's noninverting input *(Fig. 2b, again)*. This voltage's



2. The clock frequency is set by C305 (C_T) and the Thevenin resistance (R_T) at U301, pin 4 (a). The overcurrent limit is controlled by the 1-V zener diode internal to U301 (b).

limit controls the maximum value of the transformer's primary peak current. The voltage at the inverting input is proportional to the sum of the switch/output current through R1 and the current through R309 (which is generated by the programmed voltage of digitally controlled potentiometer U302). The nominal onset of overcurrent protection is 10.67 A.

From the measured data, the programmable converter frequency can be varied from 101.7 kHz to 122.9 kHz. The overcurrent protection onset can range from 8.09 A to 13.85 A. A "bed-of-nails" interface, similar to those used for parametric testing, supplies low-cost access to the DCP pins through test points 301 to 306. R301 and C304 provide the proper turn-on slope for the 5-V output or V_{REF}. As a result, the proper initial wiper setting of the DCP can be recovered from nonvolatile memory during power-up.