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Design Notes

DESIGN CONSIDERATIONS FOR TRANSITIONING FROM UC3842 TO THE NEW UCC3802 FAMILY

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In an attempt to stay abreast of trends in the power supply marketplace, the Power Supply Design Engineer is perpetually seeking methods of improving upon existing designs. Requirements such as lower power for battery operated equipment, higher switching frequencies for reduced magnetics size, higher levels of circuit integration for improved reliability and lower cost have become necessities for survival.

The UCC3802 offers numerous advantages which allow the Power Supply Design Engineer to meet these challenging requirements. Features include:

- BI-CMOS Process
- Low Starting Supply Current: typically 100µA
- Low Operating Supply Current: typically 500µA
- Pin out Compatible with UC3842 and UC3842A families
- 5 Volt Operation (UCC3803, UCC3805)
- Leading Edge Blanking of Current Sense Signal
- On-Chip Soft Start
- Internal Full Cycle Restart Delay
- 1% Voltage Reference
- Up to 1 MHz Oscillator
- Self-Biasing Output Low During UVLO
- Very Few External Components Required
- 70ns Response from Current Sense to Output
- Available in Surface Mount or DIP Package

The UCC3802 family of devices are pin out compatible with the UC3842 and UC3842A families however, they are **NOT PLUG-IN COMPATIBLE**. In general, the UCC3802 requires fewer external components and consumes less operating current. The following UCC3802 family attributes should be considered **BEFORE** inserting the device into a UC3842/42A family socket:

1. Maximum supply voltage
2. Turn-on and Turn-off thresholds
3. Oscillator Rt, Ct values
4. Schottky diodes may not be required on output
5. No current sense filter required
6. No soft start circuitry required
7. Auxiliary power (bootstrap winding) may not be required

Detailed Pin By Pin Description

PIN 1 COMP--The UCC3802 has a true low output impedance error amplifier which both sources and sinks current. The error amplifier associated with the UC3842 family is an open collector in parallel with a current source. The UCC3802 has power-up soft start and fault soft start built on-chip with a fixed COMP rise time to 5V in 5ms. Therefore, **NO EXTERNAL SOFT START CIRCUITRY IS REQUIRED** saving 1 resistor, 1 capacitor, and 1 PNP transistor.

PIN 2 FB--The UCC3802 features a 2 MHz bandwidth error amplifier versus 1 MHz on the UC3842. Feedback techniques are identical to the UC3842 family. Stray capacitance on FB should be kept as small as possible, and the lead length as short as possible to achieve best stability.

PIN 3 CS--The UCC3802 current sense is significantly different from its predecessor. The UC3842 current sense input connects to only the PWM comparator. The UCC3802 Current Sense input connects to two comparators; the PWM comparator and the over-current comparator. Internal leading edge blanking masks the first 100ns of the current sense signal. This **MAY ELIMINATE THE NEED FOR AN RC CURRENT SENSE FILTER AND PREVENT FALSE TRIGGERING** due to leading edge noise. Connect CS directly to MOSFET source current sense resistor. The gain of the current sense amplifier on the UCC3802 family is typically 1.65 V/V versus typically 3 V/V with the UC3842 family.

PIN 4 RC--The UCC3802's oscillator allows for operation to 1 MHz versus 500KHz with the UC3842. Both devices make use of an external resistor to set the charging current for the capacitor which determines the oscillator frequency. For the UCC3802 and UCC3804

$$F_{Hz} = \frac{1.5}{R_{OHMS} \bullet C_F}$$

For the UCC3803 and UCC3805

$$F_{Hz} = \frac{1.0}{R_{OHMS} \bullet C_F}$$

The two equations are different due to different reference voltages. The recommended range of timing resistor values is between 10K and 200K; the recommended range of timing capacitor values is between 100pF and 1000pF. The peak to peak amplitude of the oscillator waveform is 2.45 Volts versus 1.7 Volts. For best performance, keep the timing capacitor lead to GND as short as possible. Separate ground traces for the timing capacitor and all other pins are recommended. The maximum duty cycle for the UCC3802/03 is approximately 99%; the maximum duty cycle for the UCC3803/04 is approximately 49%. The duty cycle **CANNOT** be

easily modified by adjusting RT and CT, unlike the UC3842A family. The maximum duty cycle limit is set by the ratio of the external oscillator charging resistor RT and the internal oscillator discharge transistor on-resistance, like the UC3842. However, maximum duty cycle limits less than 90% for the UCC3802/03 and less than 45% for the UCC3804/05 can not reliably be set in this manner. For better control of maximum duty cycle, consider using the UCC3807.

PIN 5 GND--Both devices same.

PIN 6 OUT--The output of the UCC3802 is a CMOS output versus a Bipolar output on the UC3842. Peak output current remains the same +/- 1 Amp. The CMOS output provides very smooth rising and falling waveforms, with virtually no overshoot or undershoot. Additionally, the CMOS output provides a low resistance to the supply in response to overshoot, and a low resistance to ground in response to undershoot. Because of this, **SCHOTTKY DIODES MAY NOT BE NECESSARY** on the output. Furthermore, the UCC3802 has a self-biasing, active low output during UVLO. This feature **ELIMINATES THE GATE TO SOURCE**
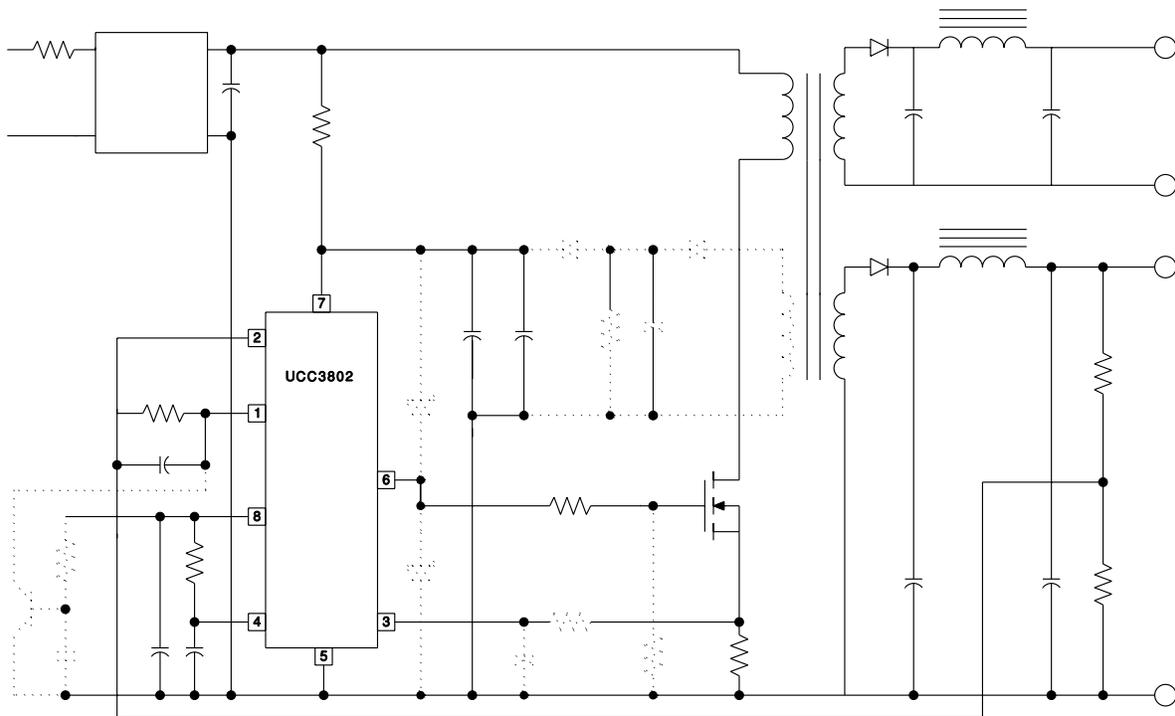

Figure 1

Figure 1 illustrates a nonisolated off-line flyback. Dotted components may be eliminated using the UCC3802 family.

"BLEEDER" RESISTOR associated with the MOSFET gate drive. Finally, **NO MOSFET GATE VOLTAGE CLAMP** is necessary with the UCC3802 as the on-chip zener diode automatically clamps the output to VCC.

PIN 7 VCC--The UCC3802 has a lower VCC (supply voltage) clamp of 13.5 Volts typical versus 30 Volts on the UC3842. For applications which require a higher VCC voltage, a resistor must be placed in series with VCC to increase the source impedance. The maximum value of this resistor

$$Rmax = \frac{VIN(min) - VCC(max)}{ICC + Qgate \bullet F}$$

Additionally, the UCC3802 has an on-chip zener diode to regulate VCC to 13.5 Volts. The turn-on and turn-off thresholds for the UCC3802 family are significantly different: 12.5V and 8V for the UCC3802 and UCC3804; 4.1 V and 3.6V for the UCC3803 and UCC3805. 5 Volt PWM operation is now possible. To ensure against noise related problems, filter VCC with an electrolytic and bypass with a ceramic capacitor to ground. Keep the capacitors close to the IC pins.

PIN 8 REF--The UCC3802 and UCC3804 have a 5 Volt reference. The UCC3803 and UCC3805 have a 4 Volt reference; both +/- 1% versus +/- 2% on the UC3842 family. The output short circuit current is lower...5mA versus 30mA. REF must be bypassed to ground with a ceramic capacitor to prevent oscillation and noise problems. REF can be used as a logic output; as when VCC is lower than the UVLO threshold, REF is held low.

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