UC3842/3/4/5B PWM Controller Models

1.0 Scope

This document contains the SPICE models and test and application circuits for the ON Semiconductor UC3842B, UC3843B, UC3844B, and UC3845B high performance current mode controllers.

Analysis:	High Performance Current Mode Controller
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Revision	April, 2002-Rev.1
SPICE File	UC384x.LIB

This set of parameters is specified by the manufacturer's published data sheet. The operating temperature of the model was 27°C.

2.0 Functional Description

The UC384x are high performance fixed frequency current mode controllers. They are designed for off-line and dc-dc converter applications. The IC features a trimmed oscillator, temperature compensated reference, high gain error amplifier, input and reference under voltage lockouts with hysteresis, current sensing comparator, and a high current totem pole output suited for driving power MOSFETs.

The UC3842/4B have UVLO thresholds of 16V (on) and 10V(off). The UC3843/5B have UVLO thresholds of 8.4V (on) and 7.6V(off). The UC3842/3B have a

maximum duty cycle of 96%, whereas the UC3844/5B have a maximum duty cycle of 48%.

3.0 Model Description

The control circuit was decomposed into elemental blocks, and then modeled accordingly. The model was then applied to one of the applications circuits specified by the manufacturer's data sheets for verification.

3.1 Assumptions

- Behavior is based on typical values given in the specification sheet for operation at 27 ºC.
- Thermal shutdown is not modeled.

4.0 Model Verification

An open loop transient test circuit for the UC384x series was created using PSpice, and shown in figures 4.1 and 4.2. The model was tested as per the manufacturer's datasheet using various types of loads and power supply levels. As per the datasheet, the model was run at 15V VCC and RT = 10K and CT = 3.3nF. An open loop AC test circuit for the error amplifier frequency response is shown in figures 4.3 and 4.4.

The results comparing the data sheet and simulation performance for various model aspects are shown in Table 4.5.

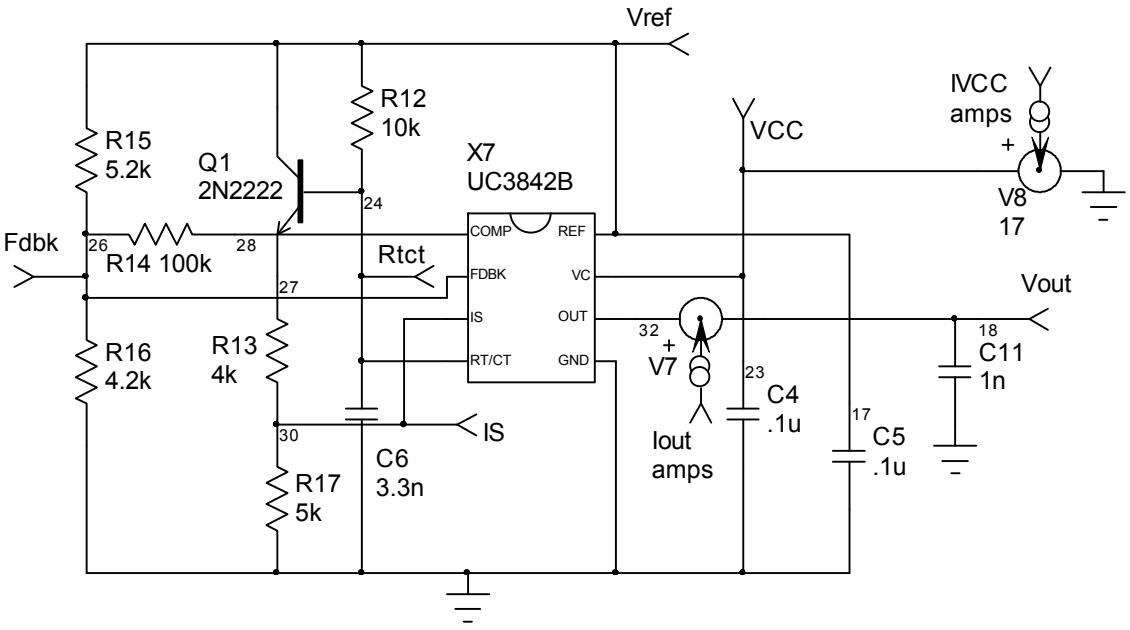

Figure 4.1: UC3842/3/4/5B open loop test circuit. The resistors R13 and R17 are used to sample the oscillator waveform and apply an adjustable ramp to the IS pin. Resistors R15 and R16 adjust the Feedback signal.

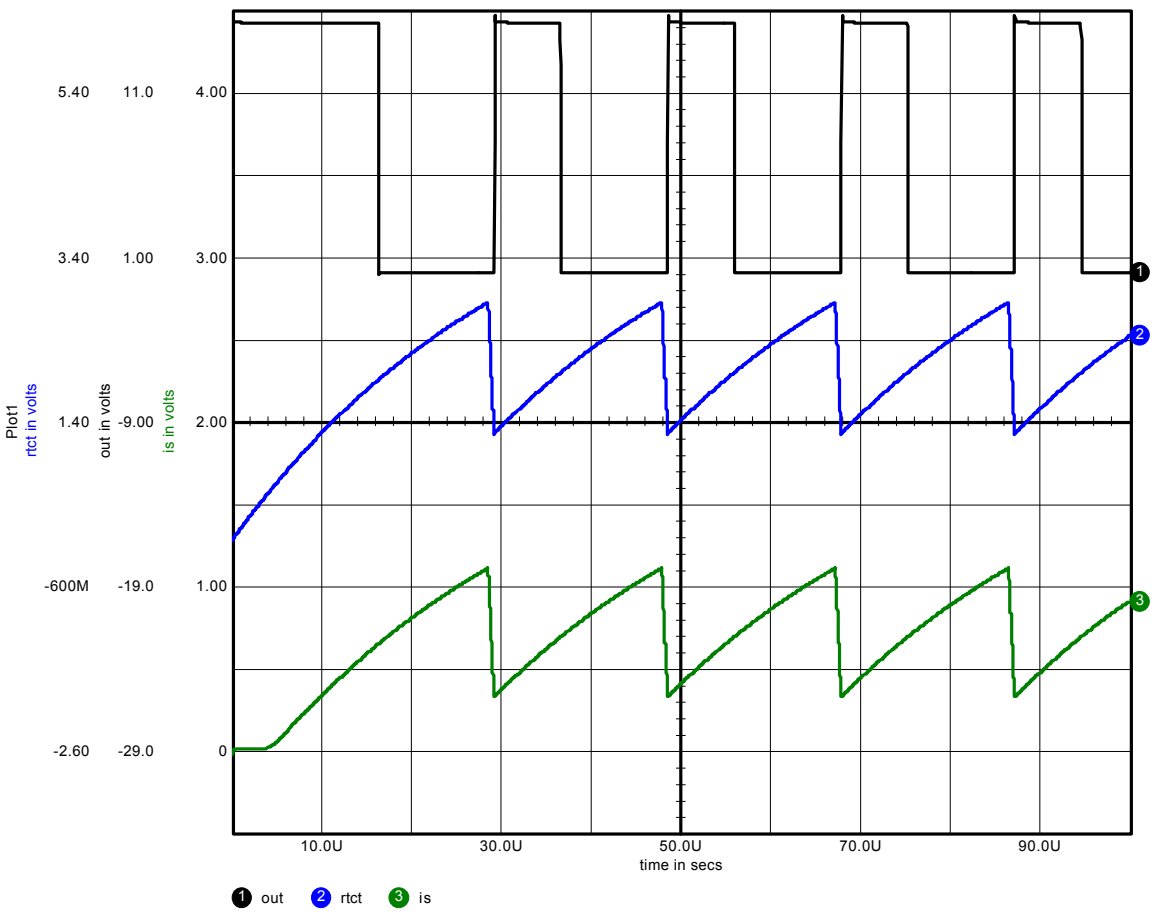

Figure 4.2: Output from the open loop test circuit (UC3842).

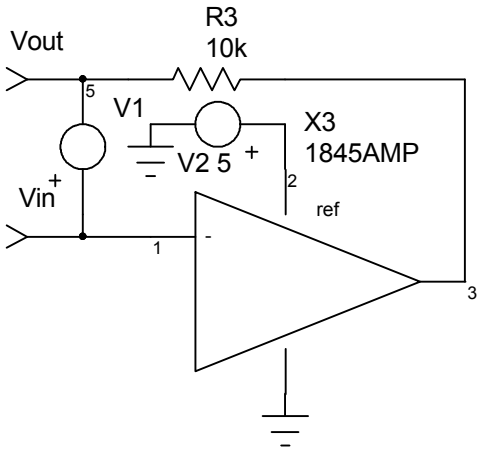

Figure 4.3: Open loop test circuit for the error amplifier's frequency response.

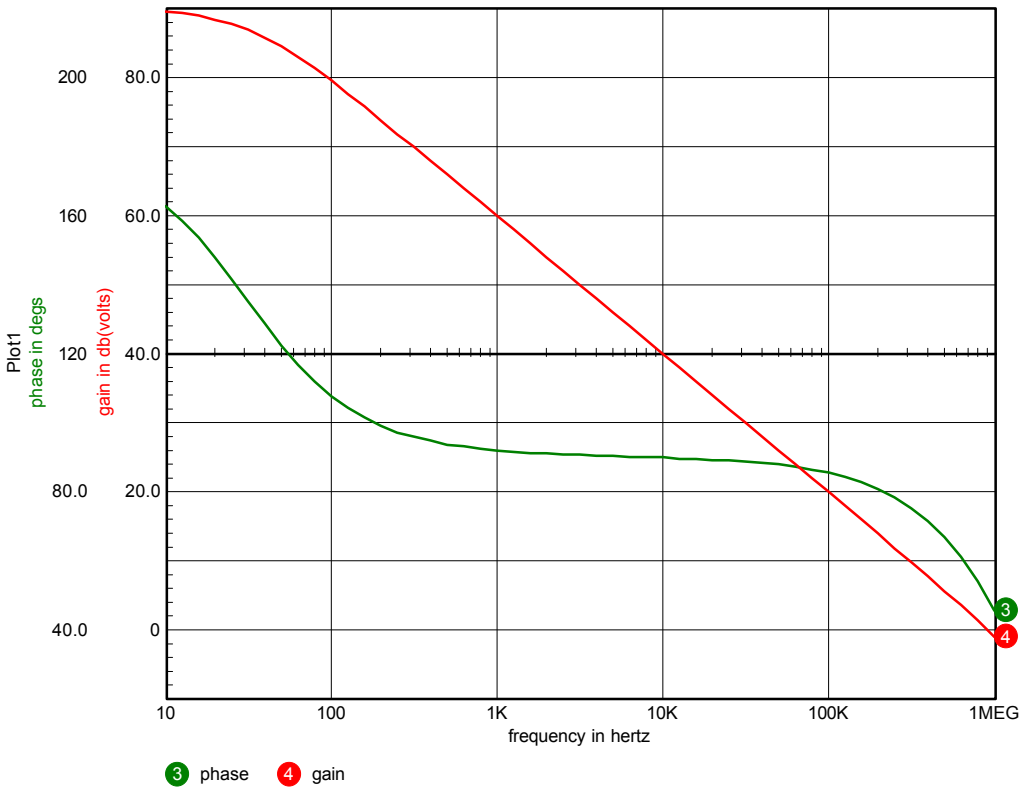

Figure 4.4: Error amplifier open loop gain/phase response.

Table 4.5: Comparison of the data sheet and simulation performance for the UC384xB series of AEi models.

UC3842/3/4/5B Model Performance Comparison				
Parameter	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Reference				
Output Voltage	1mA	5V	4.99V	4.99V
Load Regulation	1ma-20mA	6mV	6.2mV	6.2mV
Oscillator Section	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Initial Accuracy		52kHz	51.9kHz	51.9kHz
Amplitude	Peak-Peak	1.6Vp-p	1.61Vp-p	1.61Vp-p
Discharge Current Standard	Vosc=2V	8.3mA	8.3mA	8.3mA
Error Amplifier	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
AVOL	Vout 2-4V	90dB	89.44dB	89.44dB
Output Sink Current	Vo=1.1V VFB=2.7	12mA	6.07mA	6.07mA
Output Source Current	Vo=5 Vfb=2.3	-1.0mA	-0.8mA	-0.8mA
Vout Low	Rl=15k to vref, Vfb=2.7	0.8V	0.72V	0.72V
Current Sense	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Gain		3V/V	3V/V	3V/V
Maximum Input Signal		1V	1V	1V
Delay To Output		150nS	151nS	151nS
Output Section	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Output Low Level	Sink=20mA	0.1V	0.127V	0.127V
Output Low Level	Sink=200mA	1.6V	1.54V	1.54V
Output High Level	Source=200mA	13.5V	13.44V	13.44V
Rise Time	CL=1nf	50nS	48.8nS	48.8nS
Fall Time	CL=1nf	50nS	41.6nS	41.6nS
Under voltage Lockout	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Start Threshold		16V/8.4V	16V/8.4V	16V/8.4V
Min Operating after Turn On		10V/7.6V	10V/7.6V	10V/7.6V
PWM Section	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Maximum Duty Cycle		96%/48%	96.7%	48%
Total Standby Current	**Condition**	**Data Sheet**	**UC1842/43**	**UC1844/45**
Start-up Current		0.3mA	0.45mA	0.45mA
Operating Current		12mA	12.5mA	12.5mA

5.0 Application Circuits

As an example, a 50W forward converter circuit using UC3843B PWM and Magnetics MPP58121 core models was constructed and simulated. Two waveforms (Node V(30)) are shown in the figure 5.1. The bottom V(30) waveform uses loose coupling (transformer coupling coefficient K=.95) while the bottom uses tighter coupling (K=.9999). Note the increased ringing with loose coupling. The start-up transient waveform (VOUT, top right) is shown along with a close-up view of the output ripple. The INDUCTANCE waveform shows the inductance variation of the MPP core. The MOSFETs switching characteristics, operating current into VCC, under voltage lockout threshold, and propagation delay through the PWM can also be examined.

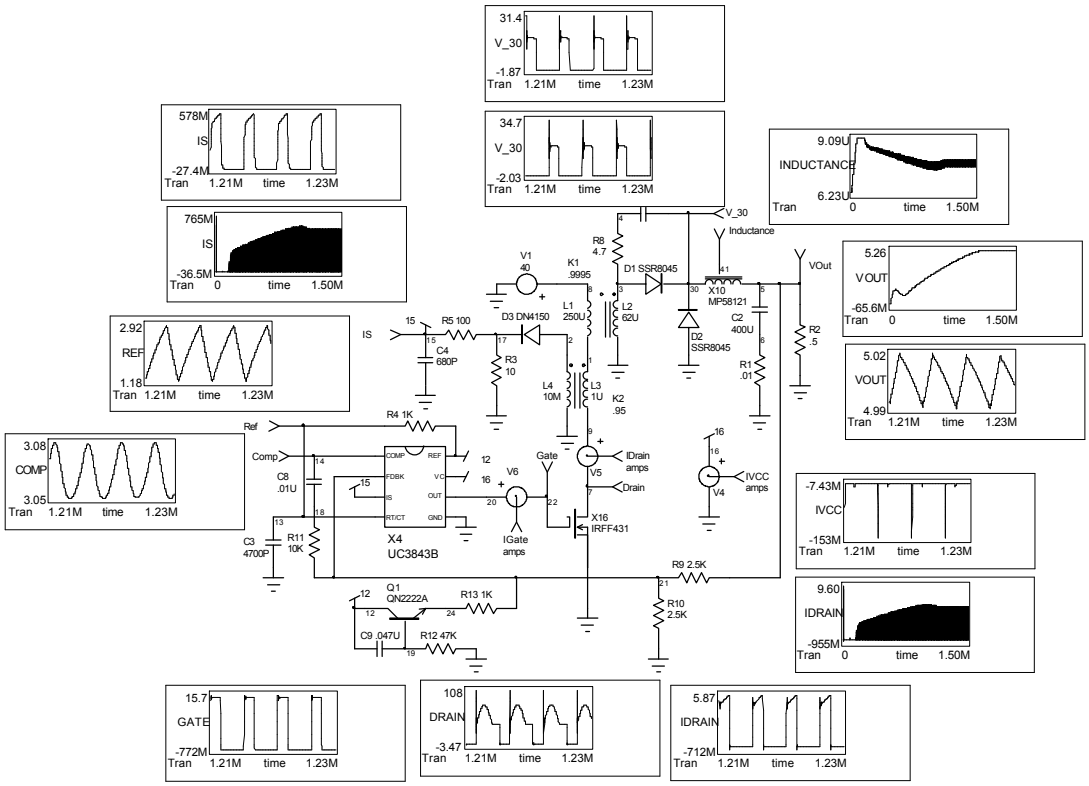

Figure 5.1: Application test circuit for a 50W Forward Converter.

5 Conclusions

The model of the UC384x driver correlates very well with the manufacturer's datasheet. This data should be verified against actual hardware for further confirmation.