UNITRODE
Design Note

UC3846, UC3856 and UCC3806
Push Pull PWM Current Mode Control ICs
by Jack Palczynski

The UC3856 is a pin for pin compatible high performance bipolar version of the industry standard UC3846. It can replace the UC3846 with few circuit modifications and features increased speed, higher gate drive current and reduced propagation delays. The UCC3806 is a BiCMOS pin for pin compatible ultra low power version ideal for battery, low power and high speed applications. The UCC3806 may also replace the UC3846 with few circuit changes.

Specification Differences :

	UC3846	UC3856	UCC3806
Process	**40V Bipolar**	**40V Bipolar**	**18V BiCMOS**
General:			
Startup Current (max)	21mA	23mA	100µA
Operating Current	21mA	23mA	1.4mA
Output Section:			
Supply Vc (max)	40V	40V	15V
Drive Voltage Supply	40V (max)	40V (max)	18V (max)
Rise and Fall Time	300ns (max)	80ns (max)	65ns (max)
Peak Output Current	0.5A	1.5A	0.5A
Oscillator Section:			
Oscillator Discharge I	---------	6.7 to 8.8mA	2.2 to 2.9mA
Initial Accuracy	43kHz $\pm$9.3%	200kHz $\pm$15%	49kHz $\pm$22%
Sync V_{OH} (min)	3.9V	2.4V	2.4V
Sync V_{OL} (max)	2.5V	0.4V	0.4V
Sync V_{IH} (min)	3.9V	2.0V	2.0V
Sync V_{IL} (max)	2.5V	0.8V	0.8V
Sync I_{INPUT} (max)	1.5mA	10µA	1µA
Sync I_{OUTPUT} (max)	-5mA	$\pm$10mA	$\pm$30mA
Error Amp Section:			
Input I_{OFFSET}(max)	250nA	500nA	500nA
Open Loop Gain	105dB (typ)	100dB (typ)	100dB (typ)
Unity Gain BW	1MHz (typ)	1.5MHz (typ)	3MHz (typ)
PSRR (typ)	105dB	100dB	100dB
Current Sense Amp Section:			
Input CM Range	0V to (V_{IN} - 3V)	0V to 3V	0V to (V_{IN} - 3.5V)
Shutdown Terminal Section:			
Threshold Voltage	0.35V (typ)	1V (typ)	1V (typ)
Input Voltage Range	0V to V_{IN}	0V to 5V	0V to V_{IN}
Delays:			
I_{SENSE} amp to Output	500ns (max)	250ns (max)	175ns (max)
Shutdown to Output	600ns (max)	110ns (max)	100ns (max)
Sync Delay to Output	300ns (typ)	50ns (typ)	50ns (typ)

Applications Information:

When replacing the UC3846 with a **UC3856**, extra care must be taken to decouple V_{IN}, V_C and V_{REF} with ceramic capacitors close to the leads of the IC. In applications where high output currents are seen, very fast rise and fall times can cause source ripple which can induce problems for PWM ICs which are not properly decoupled. Note also that the shutdown voltage changes from 350mV to 1V. Oscillator frequency is calculated differently, however similar mechanisms generate the oscillator frequency and dead times. As with any bipolar PWM IC, outputs should be protected from negatively biasing the substrate. This is typically done by using Schottky diodes from ground to each output. Failure to do this could cause spurious interruption and restart of the oscillator, dropping of output pulses and a significant increase in propagation delays. The input of the current sense amplifier is slew rate limited allowing lower values of filter capacitors to be used to eliminate leading edge noise. As with the UC3846, the UC3856 uses a differential current sense amplifier which can eliminate ground loop problems and increase noise immunity.

When replacing the UC3846 with the **UCC3806**, output Schottky diodes can be eliminated because the totem pole output is made of MOSFETs which may conduct current in either direction. As with any MOS device, higher impedances require proper decoupling with ceramic capacitors close to the IC. V_{IN}, V_C and V_{REF} should all be properly decoupled. Note that the UCC3806 has a limiting regulator to limit V_{IN} to 15V and the shunted current must be limited to 10mA. To determine oscillator frequency; a 1.25V source through R_T (min 12.5k) creates a current which is mirrored to C_T. This current charges C_T from zero to 2.5V, at which point the outputs are turned off. Both outputs remain low while C_T discharges to zero volts from a 2.6mA current sink. The Shutdown threshold voltage (pin 16) is 1V. The specific Shutdown mode is determined by a switched internal 190μA sink between pin 1 and ground, turned on when a shutdown is triggered. If the Shutdown voltage falls below 350mV, a restart is triggered. Otherwise, the oscillator remains latched off. As with the UC3856, the UCC3806 current sense amplifier is slew rate limited allowing less leading edge filtering to be used. This amplifier is also fully differential, eliminating ground loop problems associated with noisy environments. For additional information consult Application Note U-144 or contact a Unitrode Field Applications Engineer.

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