UC3844A High Performance Current Mode Controller

The UC3844A series of high performance fixed frequency current mode controllers are specifically designed for off–line and dc–to–dc converter applications offering the designer a cost effective solution with minimal external components. This integrated circuit features an oscillator, a temperature compensated reference, high gain error amplifier, current sensing comparator, and a high current totem pole output ideally suited for driving a power MOSFET.

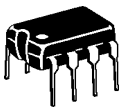
Also included are protective features consisting of input and reference undervoltage lockouts each with hysteresis, cycle–by–cycle current limiting, a latch for single pulse metering, and a flip-flop which blanks the output off every other oscillator cycle, allowing output deadtimes to be programmed for 50% to 70%.

This device is available in an 8–pin dual–in–line plastic package as well as the 14–pin plastic surface mount (SOP–14). The SOP–14 package has separate power and ground pins for the totem pole output stage.

The UC3844A has UVLO thresholds of 16V (on) and 10V (off), Ideally suited for off-line converters.

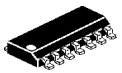
- Output Deadtime Adjustable from 50% to 70%
- Current Mode Operation to 500 kHz
- Automatic Feed Forward Compensation
- Latching PWM for Cycle–By–Cycle Current Limiting
- Internally Trimmed Reference with Undervoltage Lockout
- High Current Totem Pole Output
- Undervoltage Lockout with Hysteresis
- Low Startup and Operating Current

CD SUFFIX
PLASTIC PACKAGE
8 DIP

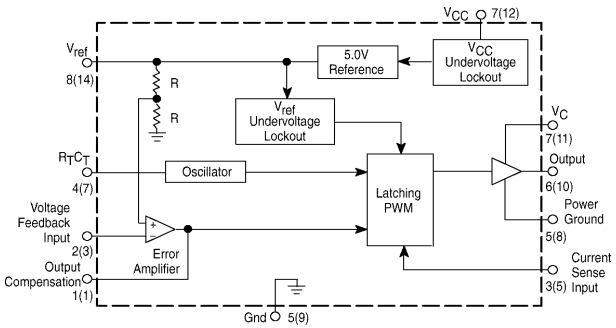


D8 SUFFIX
PLASTIC PACKAGE
8 SOP

CS SUFFIX
PLASTIC PACKAGE
SOP-14

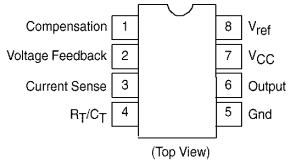


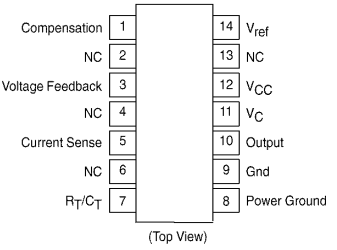
SIMPLIFIED BLOCK DIAGRAM



Pin numbers adjacent to terminals are for the D suffix 8-DIP package.
Pin numbers in parenthesis are for the S suffix SOP–14 package.

PIN CONNECTIONS





NOTES:
1. Maximum Package power dissipation limits must be observed.
2. Adjust V_{CC} above the Startup threshold before setting to 15 V.
3. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible $T_{low} = 0°C$, $T_{high} = +70°C$.
4. This parameter is measured at the latch trip point with $V_{FB} = 0V$.
5. Comparator gain is defined as: $A_V \frac{\Delta V \text{ Output Compensation}}{\Delta V \text{ Current Sense Input}}$

ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Total Power Supply and Zener Current	$(I_{CC} + I_Z)$	30	mA
Output Current, Source or Sink (Note 1)	I_O	1.0	A
Output Energy (Capacitive Load per Cycle)	W	5.0	µJ
Current Sense and Voltage Feedback Inputs	V_{in}	-0.3 to +5.5	V
Error Amp Output Sink Current	I_O	10	mA
Power Dissipation and Thermal Characteristics			
CS, D8 Suffix, SOP-14, SOP-8 Package			
Maximum Power Dissipation	P_D	862	mW
Thermal Resistance, Junction to Air	$R_{\theta JA}$	145	°C/W
CD Suffix, 8-DIP Package			
Maximum Power Dissipation	P_D	1.25	W
Thermal Resistance, Junction to Air	$R_{\theta JA}$	100	°C/W
Operating Ambient Temperature Range	T_A	0 to 70	°C
Operating Junction Temperature	T_J	150	°C
Storage Temperature Range	T_S	-65 to 150	°C

ELECTRICAL CHARACTERISTICS

V_{CC} = 15V (Note 2), R_T = 10k, CT = 3.3nF, T_A = 0 to 70°C (Note 3) unless otherwise noted.

REFERENCE SECTION

Item	Symbol	Min	Typ	Max	Unit
Reference Output Voltage (I_O = 1.0mA, T_J = 25°C)	V_{REF}	4.9	5.0	5.1	V
Line Regulation (V_{CC} = 12V to 25V)	Reg_{line}	---	2.0	20	mV
Load Regulation (I_O = 1.0mA to 20mA)	Reg_{load}	---	3.0	25	mV
Temperature Stability	T_S	---	0.2	---	mV/°C
Total Output Variation over Line, Load, Temp.	V_{REF}	4.82	---	5.18	V
Output Noise Voltage (f = 10Hz to 10kHz, T_J = 25°C)	V_n	---	50	---	µV
Long Term Stability (T_A = 125°C for 1000 Hours)	S	---	5.0	---	mV
Output Short Circuit Current	ISC	-30	-85	-180	mA

OSCILLATOR SECTION

Frequency	f_{OSC}				V
T_J = 25°C		47	52	57	
T_A = 0 to 70°C		46	---	60	
Frequency Change with Voltage (V_{CC} = 12V to 25V)	$\Delta f_{OSC}/\Delta V$	---	0.2	1.0	%
Frequency Change with Temperature	$\Delta f_{OSC}/\Delta T$	---	5.0	---	%
Oscillator Voltage Swing (Peak-to-Peak)	V_{OSC}	---	1.6	---	V
Discharge Current (V_{OSC} = 2.0V)	I_{dischg}				mA
T_J = 25°C		---	10.8	---	

ELECTRICAL CHARACTERISTICS

ERROR AMPLIFIER SECTION

Item	Symbol	Min	Typ	Max	Unit
Voltage Feedback Input (V_O = 2.5V)	V_{FB}	2.42	2.5	2.58	V
Input Bias Current (V_{FB} = 2.7V)	I_{IB}	---	-0.1	-2.0	µA
Open Loop Voltage Gain (V_O = 2.0V to 4.0V)	A_{VOL}	65	90	---	dB
Unity Gain Bandwidth (T_J = 25°C)	BW	0.7	1.0	---	MHz
Power Supply Rejection Ratio (V_{CC} = 12V to 25V)	PSRR	60	70	---	dB
Output Current					mA
Sink (V_O = 1.1V, V_{FB} = 2.7V)	I_{Sink}	2.0	12	---	
Source (V_O = 5.0V, V_{FB} = 2.3V)	I_{Source}	-0.5	-1.0	---	
Output Voltage Swing					V
High State (R_L = 15k to GND, V_{FB} = 2.3V)	V_{OH}	5.0	6.2	---	
Low State (R_L = 15k to V_{REF}, V_{FB} = 2.3V)	V_{OL}	---	0.8	1.1	

CURRENT SENSE SECTION

Current Sense Input Voltage Gain (Notes 4 & 5)	A_V	2.85	3.0	3.15	V/V
Maximum Current Sense Input Threshold (Note 4)	V_{TH}	0.9	1.0	1.1	V
Power Supply Rejection Ratio (V_{CC} = 12V to 25V)	PSRR	---	70	---	dB
Input Bias Current	I_{IB}	---	-2.0	-10	µA
Propagation Delay (Current Sense Input to Output)	$t_{PLH(in/out)}$	---	150	300	ns

OUTPUT SECTION

Output Voltage					V
Low State	(I_{Sink} = 20mA)	V_{OL}	---	0.1	0.4
	(I_{Sink} = 200mA)		---	1.6	2.2
High State	(I_{Sink} = 20mA)	V_{OH}	13	13.5	---
	(I_{Sink} = 200mA)		12	13.4	---
Output Voltage with UVLO Activated		$V_{OL(UVLO)}$			V
(V_{CC} = 6.0V, I_{Sink} = 1.0mA)			---	0.1	1.1
Output Voltage Rise Time (C_L = 1.0nF, T_J = 25°C)		t_r	---	50	150	ns
Output Voltage Fall Time (C_L = 1.0nF, T_J = 25°C)		t_f	---	50	150	ns

UNDERVOLTAGE LOCKOUT SECTION

Startup Threshold	V_{th}	14.5	16	17.5	V
Minimum Operating Voltage After Turn-On	$V_{CC(min)}$	8.5	10	11.5	V

PWM SECTION

Duty Cycle	Max.	DC_{max}	47	48	50	%
	Min.	DC_{min}	---	---	0	

TOTAL DEVICE

Power Supply Current (V_{CC} = 14V) (Note 2)	I_{CC}				mA
Startup		---	0.17	0.3	
Operating		---	12	17	
Power Supply Zener Voltage	V_Z	30	36	---	V

FIGURE 1 - TIMING RESISTOR versus OSCILLATOR FREQUENCY

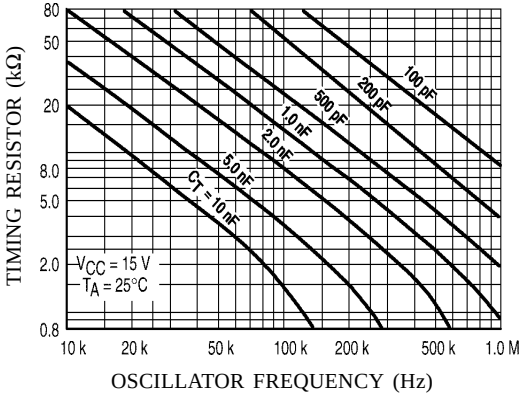


FIGURE 2 - OUTPUT DEADTIME versus OSCILLATOR FREQUENCY

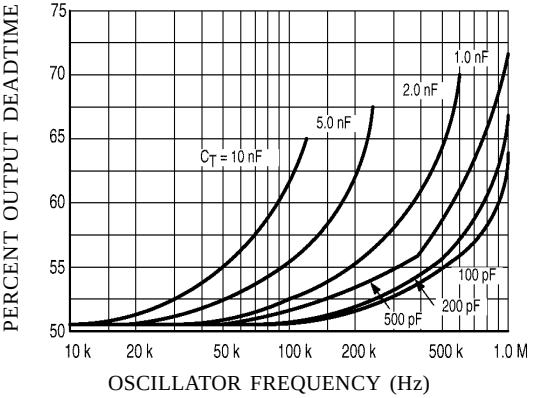


FIGURE 3 - ERROR AMP SMALL SIGNAL TRANSIENT RESPONSE

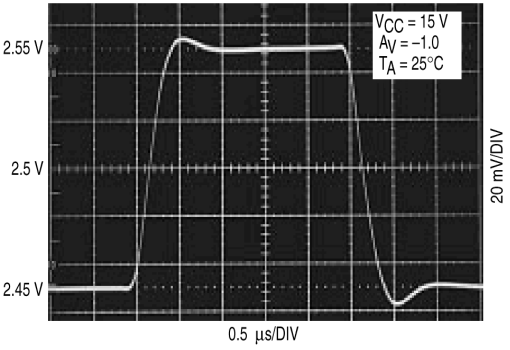


FIGURE 4 - ERROR AMP LARGE SIGNAL TRANSIENT RESPONSE

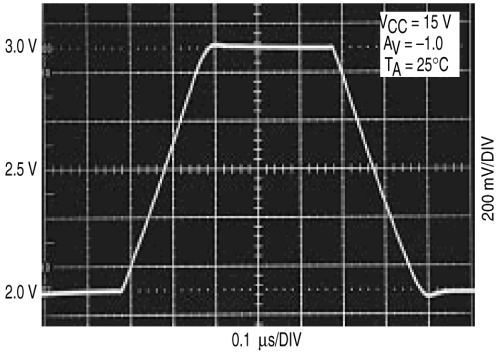


FIGURE 5 - ERROR AMP OPEN-LOOP GAIN AND PHASE versus FREQUENCY

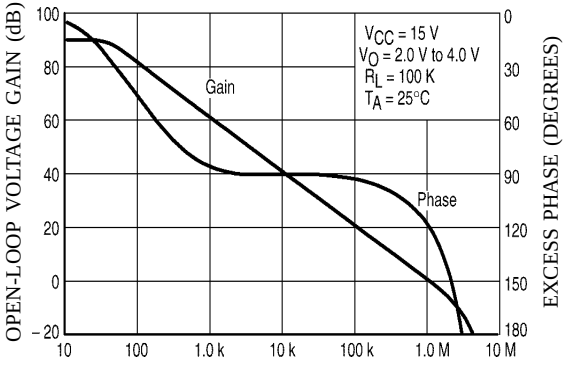


FIGURE 6 - CURRENT SENSE INPUT THRESHOLD versus ERROR AMP OUTPUT VOLTAGE

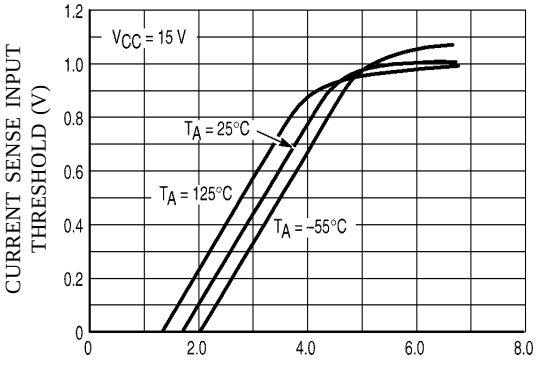


FIGURE 7 - REFERENCE VOLTAGE CHANGE versus SOURCE CURRENT

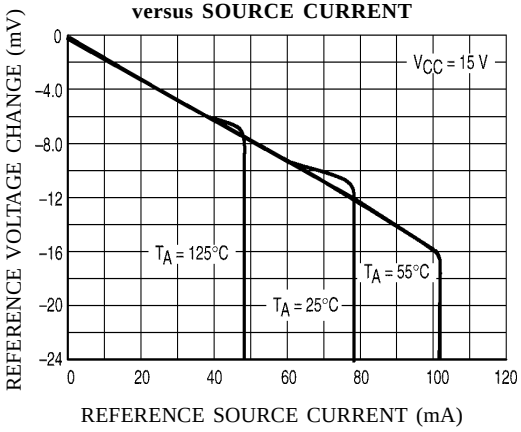


FIGURE 8 - REFERENCE SHORT CIRCUIT CURRENT versus TEMPERATURE

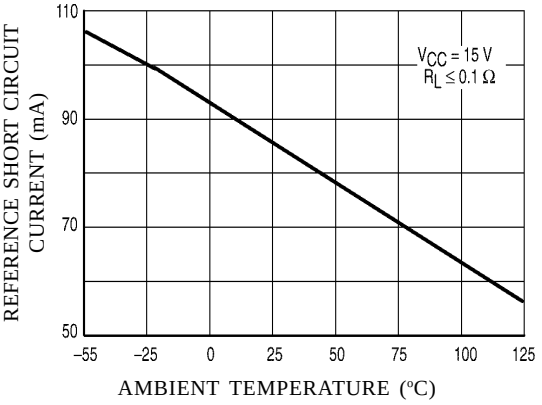


FIGURE 9 - REFERENCE LOAD REGULATION

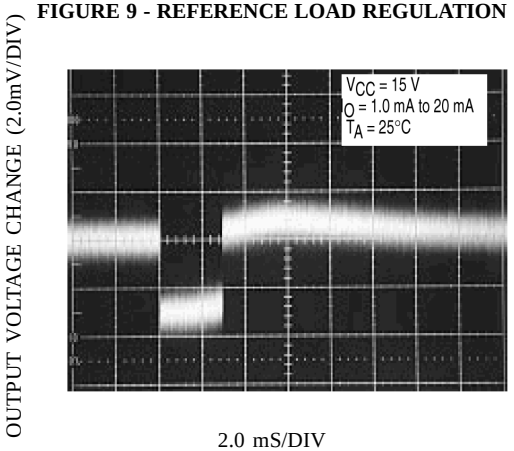


FIGURE 10 - REFERENCE LINE REGULATION

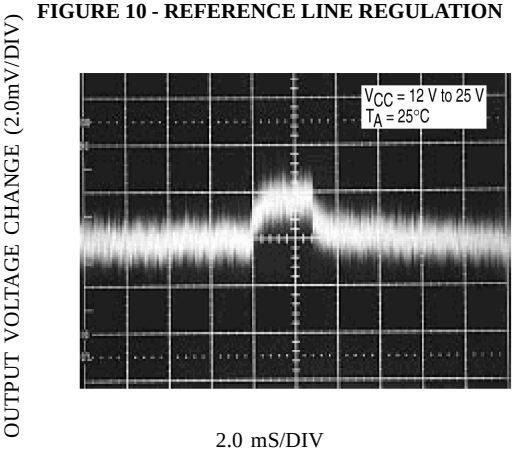


FIGURE 11 - OUTPUT SATURATION VOLTAGE versus LOAD CURRENT

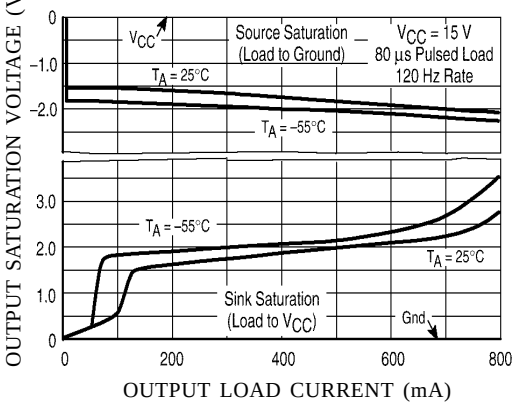


FIGURE 12 - OUTPUT WAVEFORM

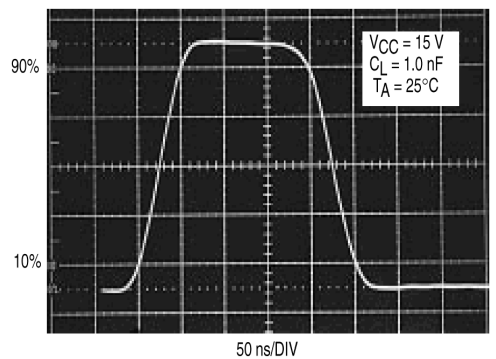


FIGURE 13 - OUTPUT CROSS CONDUCTION

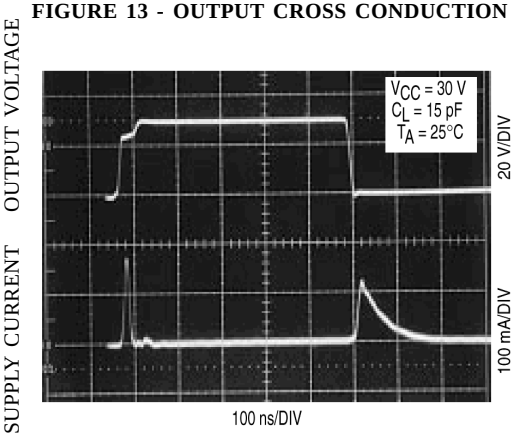


FIGURE 14 - SUPPLY CURRENT versus SUPPLY VOLTAGE