FCI *Semiconductor*

UC3845A High Performance Current Mode Controller

The UC3845A 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 UC3845A is designed for lower voltage applications having UVLO thresholds of 8.5V (on) and 7.6V (off).

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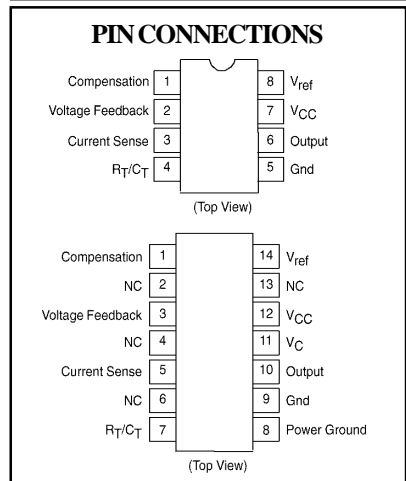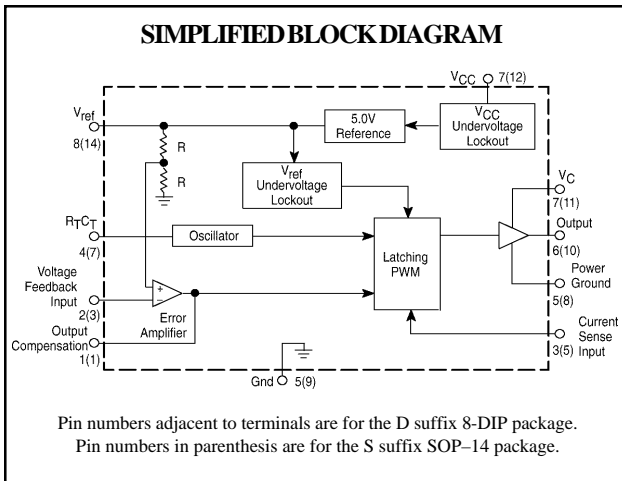- Current Mode Operation to 500 kHz
- Automatic Feed Forward Compensation
- Latching PWM for Cycle–By–Cycle Current Limiting
- Internally Trimmed Reference with Undervoltage Lockout
- High Current Totem Pole Output
- Undervoltage Lockout with Hysteresis
- Low Startup and Operating Current

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

Compensation	1	8	V_{ref}
Voltage Feedback	2	7	V_{CC}
Current Sense	3	6	Output
R_T/C_T	4	5	Gnd

(Top View)

Compensation	1	14	V_{ref}
NC	2	13	NC
Voltage Feedback	3	12	V_{CC}
NC	4	11	V_C
Current Sense	5	10	Output
NC	6	9	Gnd
R_T/C_T	7	8	Power Ground

(Top View)

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: $A_V \dfrac{\Delta V \text{ Output Compensation}}{\Delta V \text{ Current Sense Input}}$

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 Thermal Resistance, Junction to Air CD Suffix, 8-DIP Package Maximum Power Dissipation Thermal Resistance, Junction to Air	P_D $R_{\theta JA}$ P_D $R_{\theta JA}$	862 145 1.25 100	mW °C/W W °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 ($I_O = 1.0$mA, $T_J = 25$°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 ($I_O = 1.0$mA 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 ($f = 10$Hz 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

Item	Symbol	Min	Typ	Max	Unit
Frequency $T_J = 25$°C $T_A = 0$ to 70°C	f_{OSC}	47 46	52 ---	57 60	V
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 ($V_{OSC} = 2.0V$) $T_J = 25$°C	I_{dischg}	---	10.8	---	mA

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 ($T_J = 25^oC$)	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

Item	Symbol	Min	Typ	Max	Unit
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

Item		Symbol	Min	Typ	Max	Unit
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 ($C_L = 1.0nF$, $T_J = 25^oC$)		t_r	---	50	150	ns
Output Voltage Fall Time ($C_L = 1.0nF$, $T_J = 25^oC$)		t_f	---	50	150	ns

UNDERVOLTAGE LOCKOUT SECTION

Item	Symbol	Min	Typ	Max	Unit
Startup Threshold	V_{th}	7.8	8.4	9.0	V
Minimum Operating Voltage After Turn-On	$V_{CC(min)}$	7.0	7.6	8.2	V

PWM SECTION

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

TOTAL DEVICE

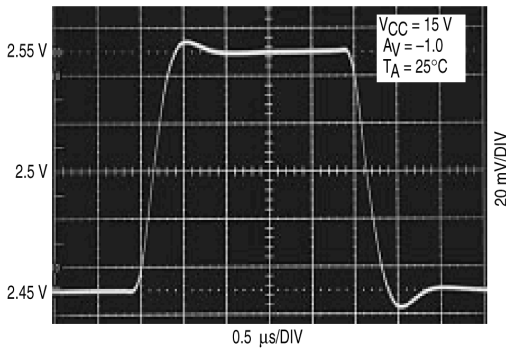| Item	Symbol	Min	Typ	Max	Unit
Power Supply Current ($V_{CC} = 6.5V$) (Note 2)	I_{CC}				mA
Startup		---	0.17	0.3	
Operating		---	12	17	
Power Supply Zener Voltage	V_Z	30	36	---	V

FIGURE 1 - TIMING RESISTOR versus OSCILLATOR FREQUENCY
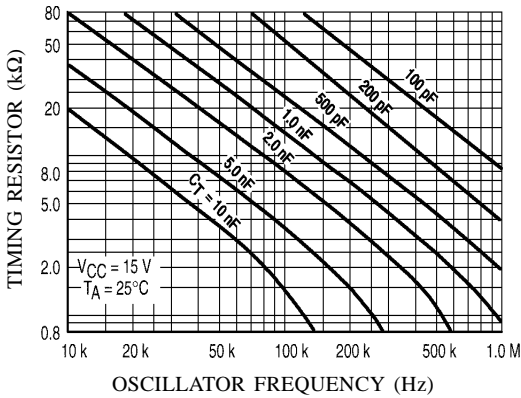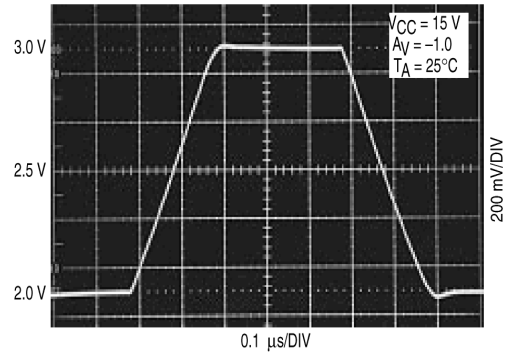

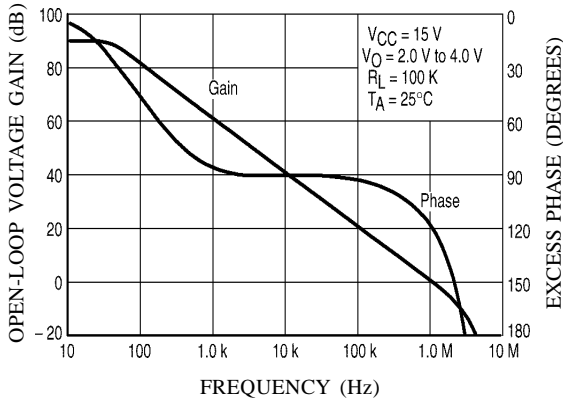**FIGURE 2 - OUTPUT DEADTIME versus OSCILLATOR FREQUENCY**
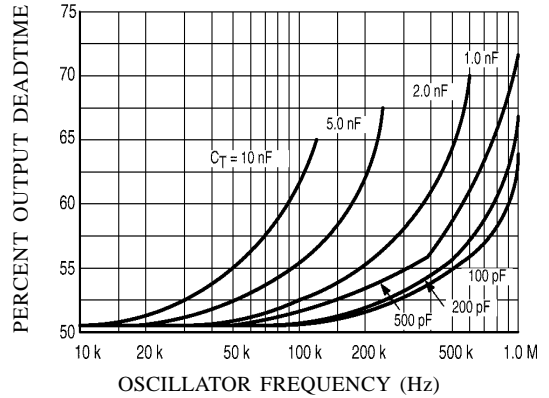
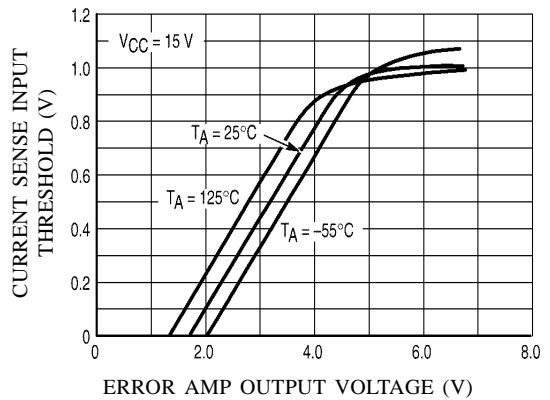**FIGURE 3 - ERROR AMP SMALL SIGNAL TRANSIENT RESPONSE**

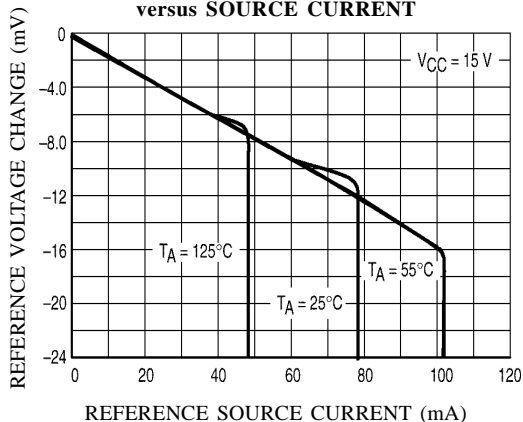**FIGURE 4 - ERROR AMP LARGE SIGNAL TRANSIENT RESPONSE**

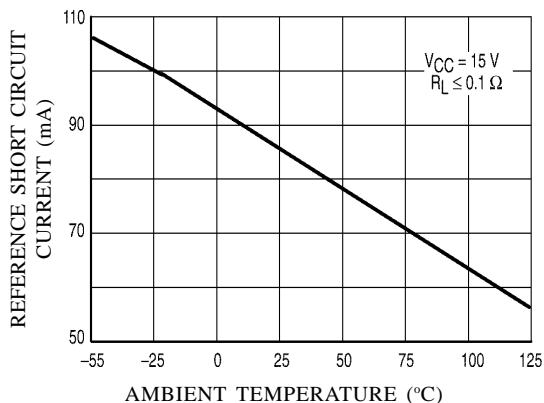**FIGURE 5 - ERROR AMP OPEN-LOOP GAIN AND PHASE versus FREQUENCY**

FIGURE 6 - CURRENT SENSE INPUT THRESHOLD versus ERROR AMP OUTPUT VOLTAGE
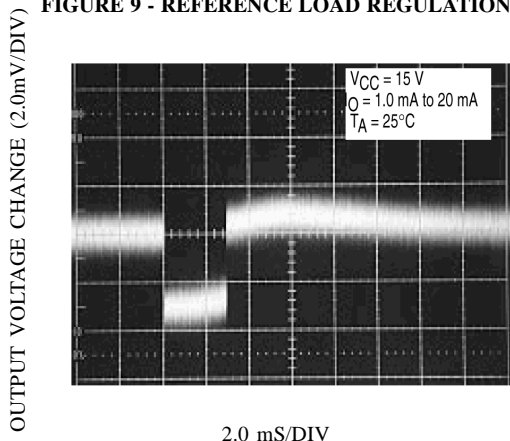
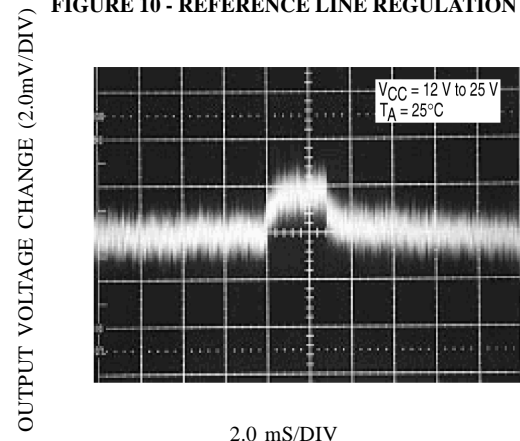**FIGURE 7 - REFERENCE VOLTAGE CHANGE versus SOURCE CURRENT**

REFERENCE VOLTAGE CHANGE (mV)

V_{CC} = 15 V

T_A = 125°C

T_A = 55°C

T_A = 25°C

REFERENCE SOURCE CURRENT (mA)

FIGURE 8 - REFERENCE SHORT CIRCUIT CURRENT versus TEMPERATURE

REFERENCE SHORT CIRCUIT CURRENT (mA)

V_{CC} = 15 V
$R_L \leq 0.1 \ \Omega$

AMBIENT TEMPERATURE (°C)

FIGURE 9 - REFERENCE LOAD REGULATION

OUTPUT VOLTAGE CHANGE (2.0mV/DIV)

V_{CC} = 15 V
O = 1.0 mA to 20 mA
T_A = 25°C

2.0 mS/DIV

FIGURE 10 - REFERENCE LINE REGULATION

OUTPUT VOLTAGE CHANGE (2.0mV/DIV)

V_{CC} = 12 V to 25 V
T_A = 25°C

2.0 mS/DIV

FIGURE 11 - OUTPUT SATURATION VOLTAGE versus LOAD CURRENT

OUTPUT SATURATION VOLTAGE (V)

V_{CC}

Source Saturation
(Load to Ground)

V_{CC} = 15 V
80 µs Pulsed Load
120 Hz Rate

T_A = 25°C

T_A = −55°C

T_A = −55°C

T_A = 25°C

Sink Saturation
(Load to V_{CC})

Gnd

OUTPUT LOAD CURRENT (mA)
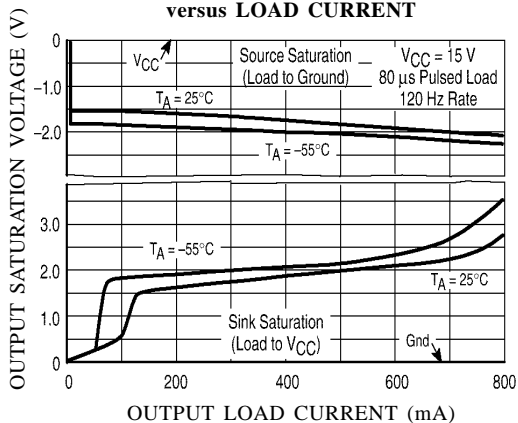
FIGURE 12 - OUTPUT WAVEFORM

90%

10%

V_{CC} = 15 V
C_L = 1.0 nF
T_A = 25°C

50 ns/DIV
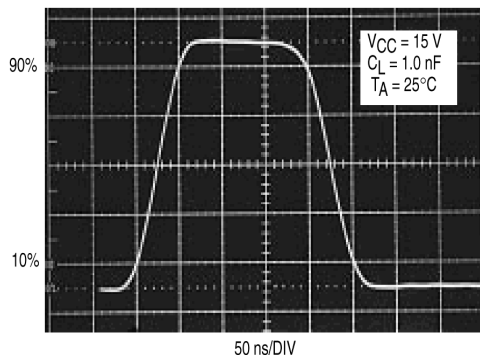
FIGURE 13 - OUTPUT CROSS CONDUCTION

V_{CC} = 30 V
C_L = 15 pF
T_A = 25°C

OUTPUT VOLTAGE — 20 V/DIV

SUPPLY CURRENT — 100 mA/DIV

100 ns/DIV
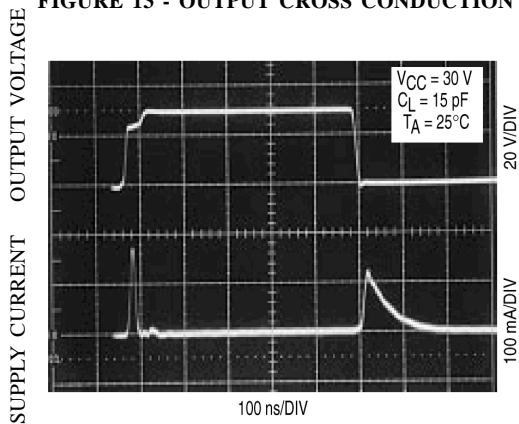
**FIGURE 14 - SUPPLY CURRENT versus
SUPPLY VOLTAGE**

R_T = 10 k
C_T = 3.3 nF
V_{FB} = 0 V
I_{Sense} = 0 V
T_A = 25°C

SUPPLY CURRENT (mA)

SUPPLY VOLTAGE (V)