

Description

The SP3842/3843 series are high performance fixed frequency current mode controllers. They are specifically designed for Off-Line and DC-to-DC converter applications offering the designer a cost effective solution with minimal external components. These integrated circuits feature a trimmed oscillator for precise duty cycle control, 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 under voltage lockouts each with hysteresis, cycle-by-cycle current limiting, programmable output dead time, and a latch for single pulse metering.

These devices are available in 8-pin dual-in-line ceramic and plastic packages as well as the 14-pin plastic surface mount (SO-14). The SO-14 package has separate power and ground pins for the totem pole output stage.

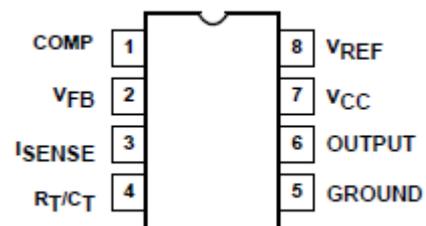
Difference between members of this series is the under-voltage lockout thresholds. The SP3842 has UVLO thresholds of 16 V (on) and 10 V (off), ideally suited for off-line converters.

The corresponding thresholds for the SP3843 are 8.5 V and 7.9 V.

Features

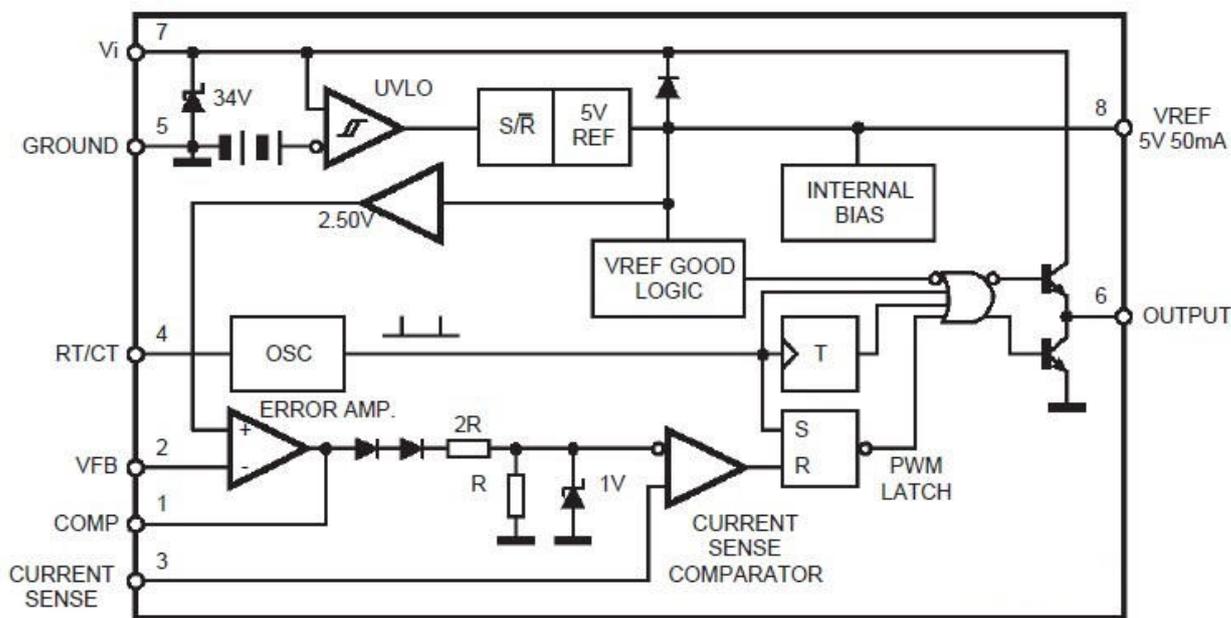
- ◆ Trimmed Oscillator Discharge Current for Precise Duty Cycle Control
- ◆ Current Mode Operation to 500 kHz
- ◆ Automatic Feed Forward Compensation
- ◆ Latching PWM for Cycle-By-Cycle Current Limiting
- ◆ Internally Trimmed Reference with Under voltage Lockout
- ◆ High Current Totem Pole Output
- ◆ Under voltage Lockout with Hysteresis
- ◆ Low Start-Up and Operating Current
- ◆ Direct Interface with Motorola SENSEFET Products

Pin Configurations (Top View)



PIN FUNCTION DESCRIPTION		
Pin No.	Function	Description
1	Compensation	This pin is the Error Amplifier output and is made available for loop compensation.
2	Voltage Feedback	This is the inverting input of the Error Amplifier. It is normally connected to the switching power supply output through a resistor divider.
3	Current Sense	A voltage proportional to inductor current is connected to this input. The PWM uses this information to terminate the output switch conduction.
4	R_T/C_T	The Oscillator frequency and maximum Output duty cycle are programmed by connecting resistor R_T to V_{ref} and capacitor C_T to ground. Operation to 500 kHz is possible.
5	Gnd	This pin is the combined control circuitry and power ground (8-pin package only).
6	Output	This output directly drives the gate of a power MOSFET. Peak currents up to 1.0 A are sourced and sunk by this pin.
7	V_{CC}	This pin is the positive supply of the control IC.
8	V_{ref}	This is the reference output. It provides charging current for capacitor C_T through resistor R_T .

Block Diagram



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Total Power Supply and Zenger 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			
NF Suffix, Plastic Package			
Maximum Power Dissipation @ T _A =25°C	P _D	862	mW
Thermal Resistance Junction to Air	R _{θJA}	145	°C/W
N Suffix, Plastic Package			
Maximum Power Dissipation @ T _A =25°C	P _D	1.25	W
Thermal Resistance Junction to Air	R _{θJA}	100	°C/W
Operating Junction Temperature	T _J	+150	°C
Operating Ambient Temperature	T _A		°C
SP3842/3843		0 to +70	
Storage Temperature Range	T _{stg}	-65 to +150	°C

ELECTRICAL CHARACTERISTICS (V_{CC}=15 V [Note 2], R_T=10 k, C_T=3.3 nF, T_A=T_{LOW} to T_{HIGH} [Note 3] unless otherwise noted)

Characteristic	SP3842/3843				
	Symbol	Min	Typ	Max	Unit
REFERENCE SECTION					
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} =12 V to 25 V)	Reg _{line}	—	2.0	20	mV
Load Regulation (I _O =1 mA to 20 mA)	Reg _{load}	—	3.0	25	mV
Temperature Stability	T _S	—	0.2	—	mV/°C
Total Output Variation over Line, Load, and Temperature	V _{ref}	4.82	—	5.18	V
Output Noise Voltage (f=10 Hz to 10 kHz, T _A =25°C)	V _n	—	50	—	μV

Long Term Stability (TA=125°C for 1000 Hours)	S	—	5.0	—	mV
Output Short Circuit Current	Isc	-30	-85	-180	mA
OSCILLATOR SECTION					
Frequency	fosc				kHz
TJ=25°C		47	52	57	
TA=TLOW to THIGH		46	—	60	
Frequency Change with Voltage (VCC=12 V to 25 V)	$\Delta f_{osc}/\Delta V$	—	0.2	1.0	%
Frequency Change with Temperature	$\Delta f_{osc}/\Delta V$	—	5.0	—	%
TA=TLOW to THIGH					
Oscillator Voltage Swing (Peak-to-Peak)	Vosc	—	1.6	—	V
Discharge Current (Vosc=2.0 V)	Idischg				mA
TJ=25°C		7.5	8.4	9.3	
TA=TLOW to THIGH		7.2	—	9.5	

Notes: 1. Maximum Package power dissipation limits must be observed.

2. Adjust VCC above the Start-Up 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. TLOW = 0°C THIGH = +70°C

4. This parameter is measured at the latch trip point with VFB = 0 V.

ΔV Output / Compensation

5. Comparator gain is defined as: $AV = \frac{\Delta V \text{ Current Sense Input}}{\Delta V \text{ Output / Compensation}}$

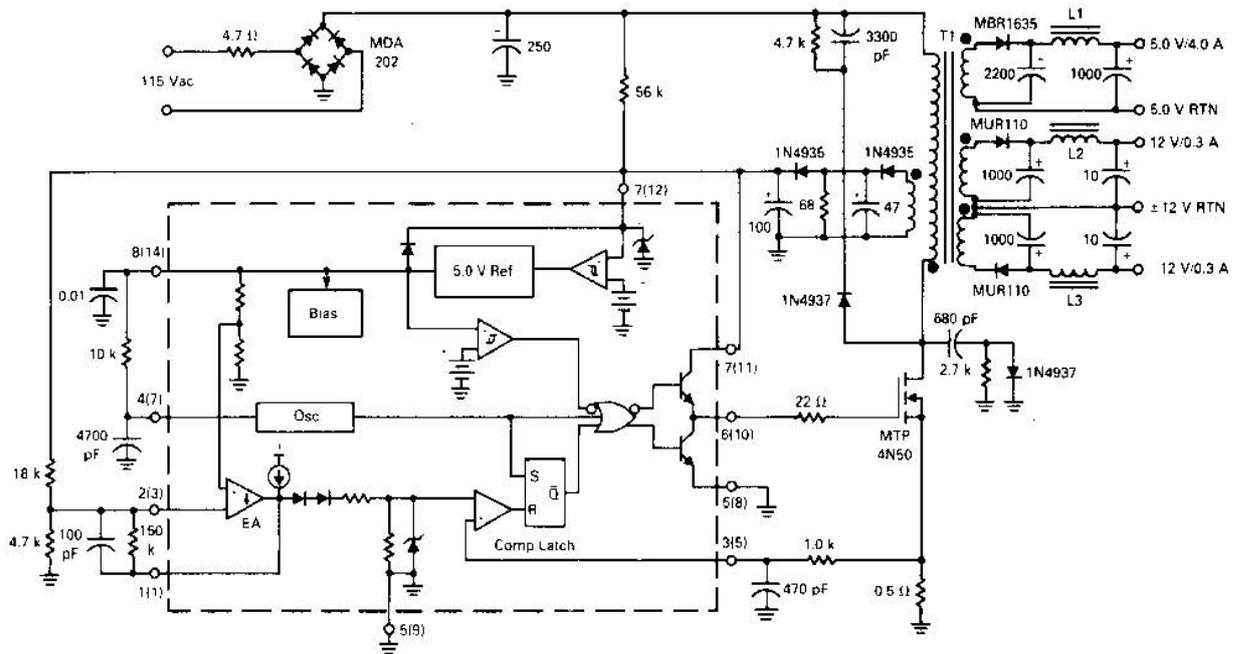
ELECTRICAL CHARACTERISTICS (VCC=15 V [Note 2], RT=10 k, CT=3.3 nF, TA=TLOW to THIGH [Note3] unless otherwise noted)

Characteristic	Symbol	SP3842/3843			Unit
		Min	TYP	Max	
ERROR AMPLIFIER SECTION					
Voltage Feedback Input (V0=2.5 V)	VFB	2.42	2.5	2.58	V
Input Bias Current (VFB=2.7 V)	IIB	—	-0.1	-2.0	μA
Open-Loop Voltage Gain (V0=2.0 V to 4.0 V)	AVOL	65	90	—	dB
Unity Gain Bandwidth (TJ=25°C)	BW	0.7	1.0	—	MHz
Power Supply Rejection Ratio (VCC=12 V to 25 V)	PSRR	60	70	—	dB
Output Current					mA

Sink ($V_0=1.1\text{ V}$, $V_{FB}=2.7\text{ V}$)	I_{Sink}	2.0	12	—	
Source ($V_0=5.0\text{ V}$, $V_{FB}=2.3\text{ V}$)	I_{Source}	-0.5	-1.0	—	
Output Voltage Swing					V
High State ($R_L=15\text{ k}$ to ground, $V_{FB}=2.3\text{ V}$)	V_{OH}	5.0	6.2	—	
Low State ($R_L=15\text{ k}$ to V_{ref} , $V_{FB}=2.7\text{ V}$)	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	PSRR	—	70	—	dB
$V_{\text{CC}}=12\text{ V}$ to 25 V , Note 4					
Input Bias Current	I_{IB}	—	-2.0	-10	μA
Propagation Delay (Current Sense Input to Output)	$t_{\text{PLH(IN/OUT)}}$	—	150	300	ns
OUTPUT SECTION					
Output Voltage					V
Low State ($I_{\text{Sink}}=20\text{ mA}$)	V_{OL}	—	0.1	0.4	
($I_{\text{Sink}}=200\text{ mA}$)		—	1.6	2.2	
High State ($I_{\text{Source}}=20\text{ mA}$)	V_{OH}	13	13.5	—	
($I_{\text{Source}}=200\text{ mA}$)		12	13.4	—	
Output Voltage with UVLO Activated $V_{\text{CC}}=6.0\text{ V}$, $I_{\text{Sink}}=1.0\text{ mA}$	$V_{\text{OL(UVLO)}}$	—	0.1	1.1	V
Output Voltage Rise Time ($C_L=1.0\text{ nF}$, $T_J=25^\circ\text{C}$)	t_r	—	50	150	ns
Output Voltage Fall Time ($C_L=1.0\text{ nF}$, $T_J=25^\circ\text{C}$)	t_f	—	50	150	ns
UNDERVOLTAGE LOCKOUT SECTION					
Start-Up Threshold	V_{th}				V
SP3842/3843		14.5/7.8	16/8.4	17.5/9.0	
Minimum Operating Voltage After Turn-On	$V_{\text{CC(min)}}$				V
SP3842		8.5	10	11.5	
PWM SECTION					
Duty Cycle					%
Maximum	DC_{max}	94	96	—	
Minimum	DC_{min}	—	—	0	
TOTAL DEVICE					
Power Supply Current	I_{CC}				mA
Start-Up		—	0.5	1.0	
($V_{\text{CC}}=14\text{ V}$ for SP3842 / $V_{\text{CC}}=6.5\text{ V}$ for SP3843)					
Operating (Note 2)		—	12	17	
Power Supply Zener Voltage ($I_{\text{CC}}=25\text{ mA}$)	V_z	30	36	—	V

Typical Applications

27 WATT OFF-LINE FLYBACK REGULATOR



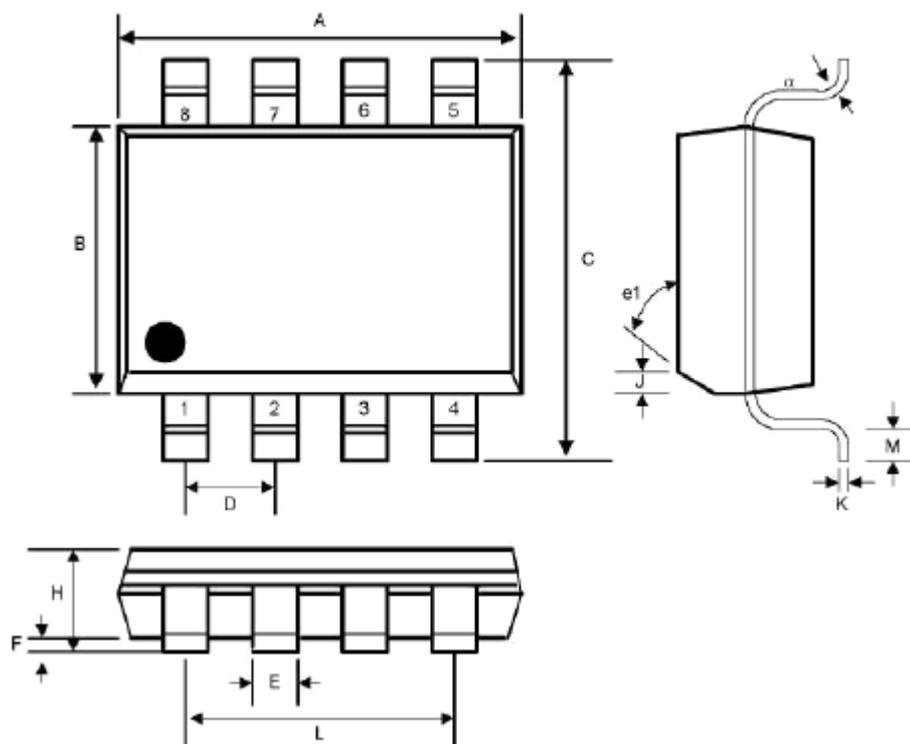
T1 — Primary: 45 Turns #26 AWG
 Secondary 12 V: 9 Turns #30 AWG (2 strands) Bifilar Wound
 Secondary 5.0 V: 4 Turns (six strands) #26 Hexfilar Wound
 Secondary Feedback: 10 Turns #30 AWG (2 strands) Bifilar Wound
 Core: Ferroxcube EC35-3C8
 Bobbin: Ferroxcube EC35PCB1
 Gap = 0.01" for a primary inductance of 1.0 mH

L1 — 15 μ H at 5.0 A, Coilcraft Z7156.
 L2, L3 — 25 μ H at 1.0 A, Coilcraft Z7157.

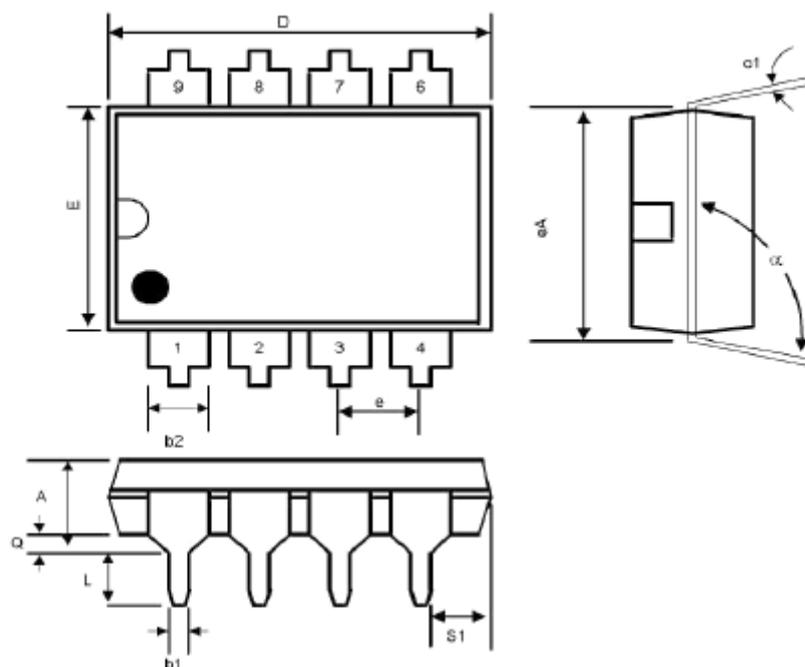
Line Regulation: 5.0V	$V_{in}=95$ to 130 Vac	$\Delta = 50$ mV or $\pm 0.5\%$
± 12 V		$\Delta = 24$ mV or $\pm 0.1\%$
Load Regulation: 5.0 V	$V_{in}=115$ Vac, $I_{out}=1.0$ A to 4.0 A	$\Delta = 300$ mV or $\pm 3.0\%$
± 12 V	$V_{in}=115$ Vac, $I_{out}=100$ mA to 300 mA	$\Delta = 60$ mV or $\pm 0.25\%$
Output Ripple: 5.0 V	$V_{in}=115$ Vac	40 mVp.p
± 12 V		80 mVp-p
Efficiency	$V_{in}=115$ Vac	70%

All outputs are at nominal load currents unless otherwise noted.

Package Description



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.188	0.197	4.80	5.00	-
B	0.149	0.158	3.80	4.00	-
C	0.228	0.244	5.80	6.20	-
D	0.050	BSC	1.27	BSC	-
E	0.013	0.020	0.33	0.51	-
F	0.004	0.010	0.10	0.25	-
H	0.053	0.069	1.35	1.75	-
J	0.011	0.019	0.28	0.48	-
K	0.007	0.010	0.19	0.25	-
M	0.016	0.050	0.40	1.27	-
L	0.150	REF	3.81	REF	-
e1	45°		45°		-
a	0°	8°	0°	8°	-



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.200	-	5.08	-
b1	0.014	0.023	0.36	0.58	-
b2	0.045	0.065	1.14	1.65	-
c1	0.008	0.015	0.20	0.38	-
D	0.355	0.400	9.02	10.16	-
E	0.220	0.310	5.59	7.87	-
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		-
L	0.125	0.200	3.18	5.08	-
Q	0.015	0.060	0.38	1.52	-
s1	0.005	-	0.13	-	-
α	90 ⁰	105 ⁰	90 ⁰	105 ⁰	-