

AP3842/3/4/5

High Performance Current Mode PWM Controller

■ Features

- Optimized for Off-Line and DC to DC Converters
- Low Start-Up Current ($\leq 0.5\text{mA}$)
- Automatic Feed Forward Compensation
- Pulse-by-Pulse Current Limiting
- Enhanced Load Response Characteristics
- Under-Voltage Lockout (UVLO) with Hysteresis
- Double Pulse Suppression
- High Current Totem Pole Output
- Internally Trimmed Bandgap Reference
- Current Mode Operation to 500KHZ
- Low Ro Error Amplifier

■ Ordering Information

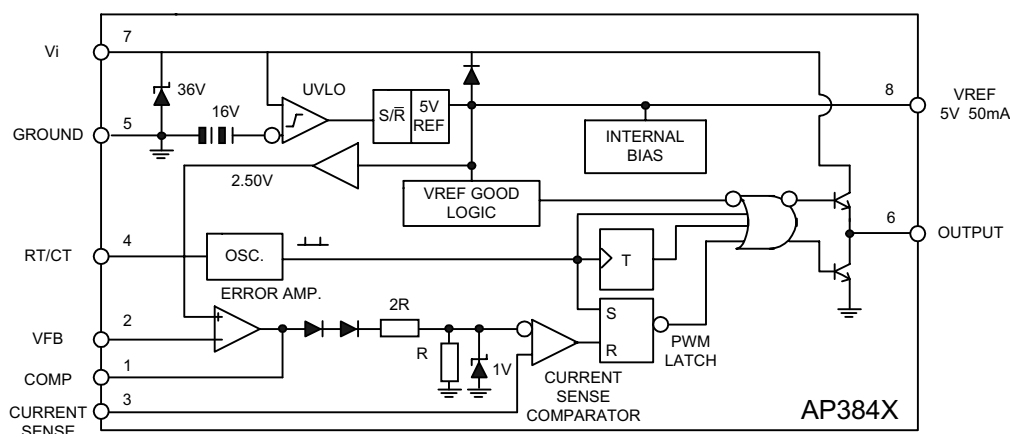
AP 3842 X X		
Part No.	Package	Packing
3842	S8 : SOP-8L	Blank: Tube
3843	N8 : PDIP-8L	A : Taping
3844		
3845		

■ General Description

The AP3842/3/4/5 family of control ICs provides the necessary features to implement off-line or DC to DC fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include under voltage lockout featuring start-up current less than 0.5 mA, a precision reference trimmed for accuracy at the error amp input, logic to insure latched operation, a PWM comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N-Channel MOSFETs, is low in the off-state.

Differences between members of this family are the under-voltage lockout thresholds and maximum duty cycle ranges. The AP3842 and AP3844 have UVLO thresholds of 16V(on) and 10V(off), ideally suited off-line applications. The corresponding thresholds for the AP3843 and AP3845 are 8.5V and 7.6V. The AP3842 and AP3843 can operate to duty cycles approaching 100%. A range of the zero to < 50% is obtained by the AP3844 and AP3845 by the addition of an internal toggle flip flop which blanks the output off every other clock cycle.

■ Block Diagram (toggle flip flop used only in AP3844 and AP3845)



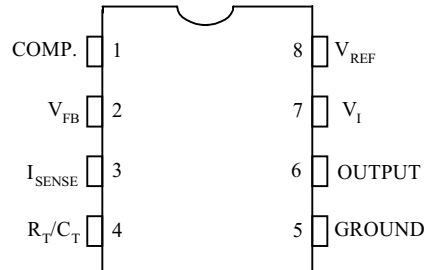
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■ Pin Connections

PDIP-8L , SOP-8L

Top View



■ Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V _i	Supply Voltage (low impedance source)	36	V
V _i	Supply Voltage (I _i < 30mA)	Self Limiting	
I _o	Output Current	± 0.7	A
E _o	Output Energy (capacitive load)	5	μJ
	Analog Inputs (pins2,3)	-0.3 to 5.5	V
	Error Amplifier Output Sink Current	10	mA
P _{tot}	Power Dissipation at T _{amb} ≤ 50°C (PDIP8)	1.25	W
P _{tot}	Power Dissipation at T _{amb} ≤ 25°C (SOP8)	800	mW
T _{stg}	Storage Temperature Range	-65 to 150	°C
T _L	Lead Temperature (soldering 10s)	260	°C

*Notes: 1. All voltages are with respect to pin 5, all currents are positive into the specified terminal.

■ Electrical Characteristics

(Unless otherwise stated, these specifications apply for 0 ≤ T_{amb} ≤ 70°C for AP384X ; V_i = 15V(note 5); R_T = 10K; C_T = 3.3nF)

Symbol	Parameter	Test Conditions	AP384X			Unit
			Min.	Typ.	Max.	
REFERENCE SECTION						
V _{REF}	Output Voltage	T _j = 25 ⁰ C I ₀ =1mA	4.90	5.00	5.10	V
Δ V _{REF}	Line Regulation	12V ≤ V _i ≤ 25V		2	20	mV
Δ V _{REF}	Load Regulation	1mA ≤ I _o ≤ 20mA		3	25	mV
Δ V _{REF} /Δ T	Temperature Stability	(Notes 2)		0.2	0.4	mV/ ⁰ C
	Total Output Variation	Line, Load, Temperature (Notes 2)	4.82		5.18	V
e _N	Output Noise Voltage	10Hz ≤ f ≤ 10KHz T _j =25 ⁰ C (Notes 2)		50		μ V
	Long Term Stability	T _{amb} =125 ⁰ C, 1000Hrs (Notes2)		5	25	mV
I _{SC}	Output Short Circuit current			-85	-120	mA
OSCILLATOR SECTION						
f _s	Oscillator Frequency	T _j =25 ⁰ C (Notes 6)	49	52	55	KHz
	Voltage Stability	12V ≤ V _i ≤ 25V		0.2	1	%
	Temperature Stability	T _{MIN} ≤ T _{amb} ≤ T _{MAX} (Notes 2)		0.5		%
V ₄	Amplitude	V _{PIN4} Peak to Peak		1.6		V
	Discharge Current	T _j =25 ⁰ C V _{PIN4} =2V	7.8	8.3	8.8	mA

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ERROR AMP SECTION						
V ₂	Feedback Input Voltage	V _{PIN1} =2.5V	2.42	2.50	2.58	V
I _b	Input Bias Current	V _{FB} =5V		-0.1	-2	μ A
	A _{VOL}	12≤V ₀ ≤4V	65	90		dB
B	Unity Gain Bandwidth	T _j =25°C	0.7	1		MHz
SVRR	Supply Voltage Rejection Ratio	12V≤V _i ≤25V	60	70		dB
I _O	Output Sink Current	V _{PIN2} =2.7V V _{PIN1} =1.1V	2	6		mA
I _O	Output Source Current	V _{PIN2} =2.3V V _{PIN1} =5V	-0.5	-0.8		mA
	V _{OUT} High	V _{PIN2} =2.3V; R _L =15KΩ to ground	5	7		V
	V _{OUT} Low	V _{PIN2} =2.7V; R _L =15KΩ to pin 8		0.8	1.1	V
CURRENT SENSE SECTION						
G _v	Gain	(Notes3&Notes4)	2.85	3	3.15	V/V
V ₃	Maximum Input Signal	V _{PIN1} =5V (Notes3)	0.9	1	1.1	V
SVRR	Supply Voltage Rejection Ratio	12≤V _i ≤25V (Notes3)		70		dB
I _b	Input Bias Current			-2	-10	μ A
	Delay to Output			150	300	ns
OUTPUT SECTION						
V _{OL}	Output Low Level	I _{SINK} = 20mA		0.1	0.4	V
		I _{SINK} = 200mA		1.6	2.2	V
V _{OH}	Output High Level	I _{SOURCE} = 20mA	13	13.5		V
		I _{SOURCE} = 200mA	12	13.5		V
T _r	Rise Time	T _j =25°C C _L =1nF (Notes2)		50	150	ns
T _f	Fall Time	T _j =25°C C _L =1nF (Notes2)		50	150	ns
V _{OLS}	UVLO Saturation	V _{cc} = 6V ; I _{sink} = 1mA		0.1	1.1	V
UNDER-VOLTAGE LOCKOUT SECTION						
	Start Threshold	3842/4	14.5	16	17.5	V
		3843/5	7.8	8.4	9	V
	Min Operating Voltage After Turn-on	3842/4	8.5	10	11.5	V
		3843/5	7.0	7.6	8.2	V
PWM SECTION						
	Maximum Duty Cycle	3842/3	94	96		%
		3844/5	47	48	50	%
	Minimum Duty Cycle				0	%
TOTAL STANDBY CURRENT						
I _{st}	Start-up Current	V _i =14V,3842/4 ; V _i =6.5V 3843/4/5		0.3	0.5	mA
I _i	Operating Supply Current	V _{PIN2} =V _{PIN3} =0V		12	17	mA
V _{iz}	Zener Voltage	I _i =25mA	30	36		V

Notes : 2.These parameters, although guaranteed, are not 100% tested in production.

3.Parameter measured at trip point of latch with V_{PIN2}=0.

4.Gain defined as:

$$A = \frac{\Delta V_{PIN1}}{\Delta V_{PIN3}} ; 0 \leq V_{PIN3} \leq 0.8V$$

5.Adjust V_i above the start threshold before setting at 15V.

6.Output frequency equals oscillator frequency for the AP3842 and AP3843.

Output frequency is one half oscillator frequency for the AP3844 and AP3845.

Figure 1 : Error Amp Configuration.

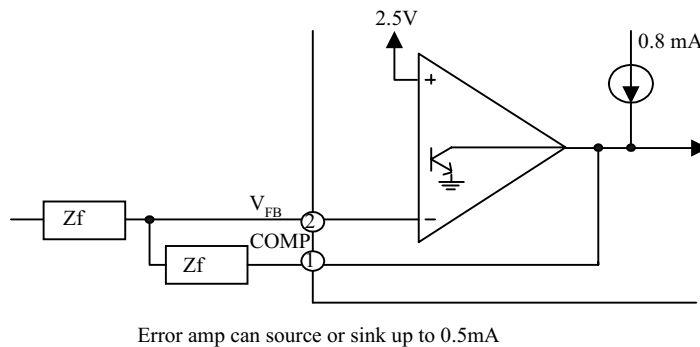
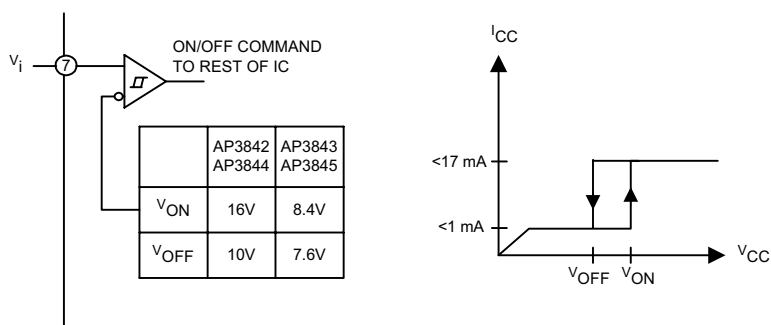
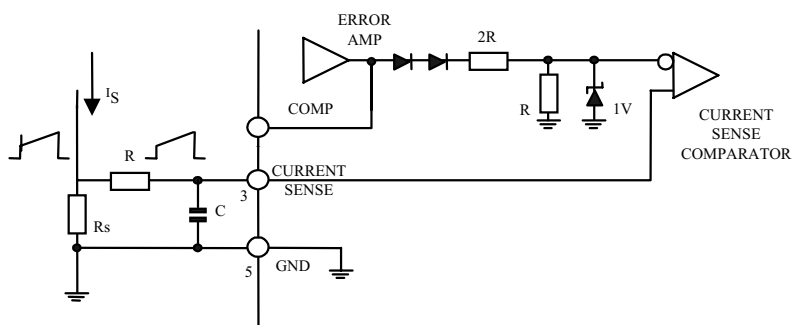


Figure 2 : Under Voltage Lockout.



During Under-Voltage Lockout, the output driver is biased to sink minor amounts of current. Pin 6 should be shunted to ground with a bleeder resistor to prevent activating the power switch with extraneous leakage currents.

Figure 3 : Current Sense Circuit.



Peak current(i_s) is determined by the formula

$$I_s \text{ max} \approx \frac{1.0V}{R_s}$$

A small RC filter may be required to suppress switch transients.

Figure 4.

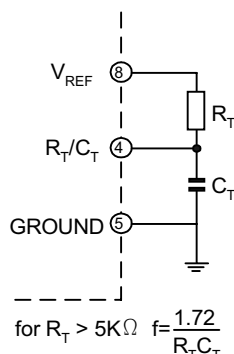
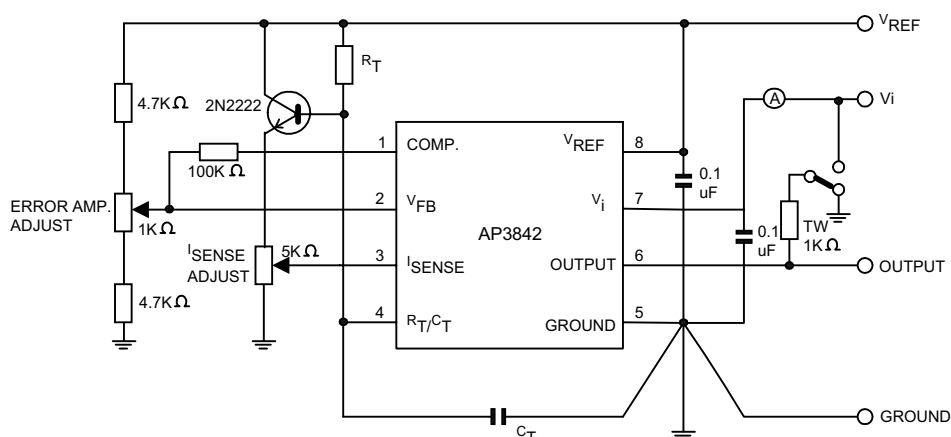
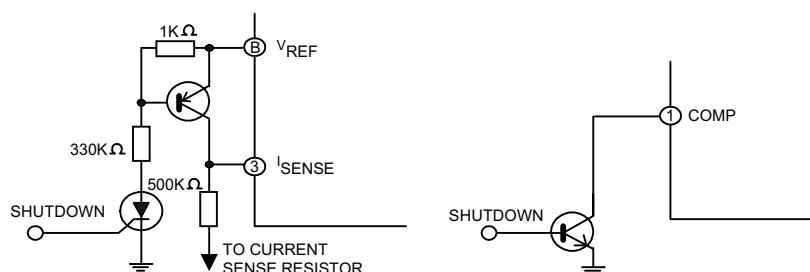


Figure 5 : Open Loop Test Circuit.



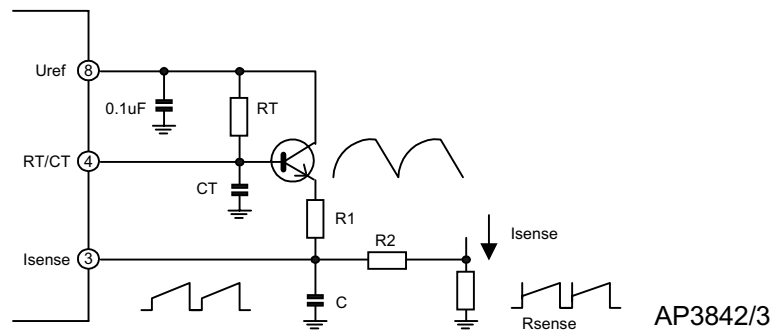
High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin 5 in a single point ground. The transistor and 5 KΩ potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

Figure 6 : Shutdown Techniques.



Shutdown of the AP3842 can be accomplished by two methods ; either raise pin 3 above 1V or pull pin 1 below a voltage two diode drops above ground. Either method cause the output of the PWM comparator to be high (refer to block diagram). The PWM latch is reset dominant so that the output will remain low until the next clock cycle after the shutdown condition at pins 1 and/or 3 is removed. In one example, an externally latched shutdown may be accomplished by adding an SCR which will be reset by cycling V_i below the lower UVLO threshold. At this point the reference turns off, allowing the SCR to reset.

Figure 7 : Slope Compensation.



A fraction of the oscillator ramp can be resistively summed with the current sense signal to provide slope compensation for converters requiring duty cycles over 50%. Note that capacitor, C, forms a filter with R_2 to suppress the leading edge switch spikes.

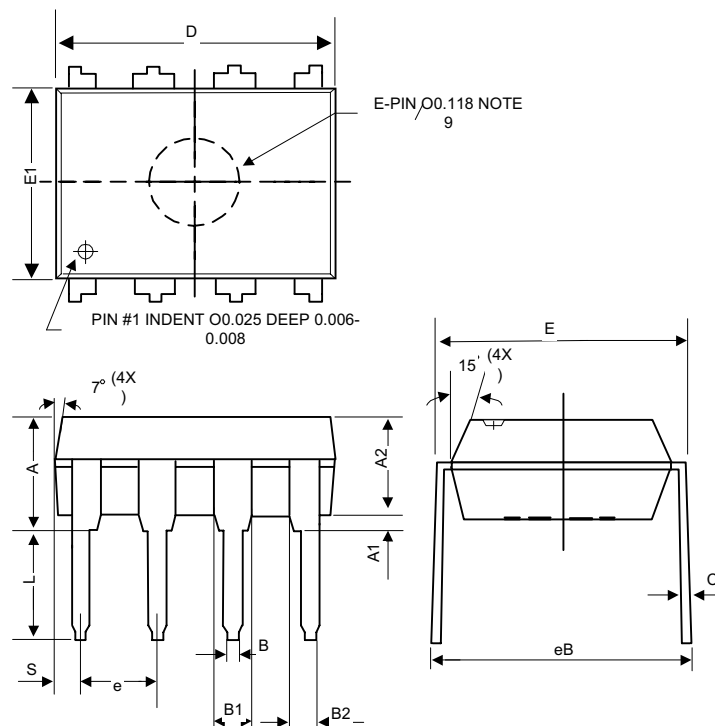
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■ Package Diagrams

(1) PDIP-8L (Plastic Dual-in-line Package)



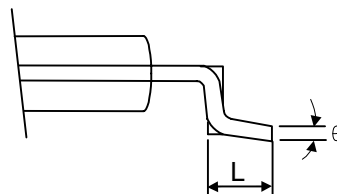
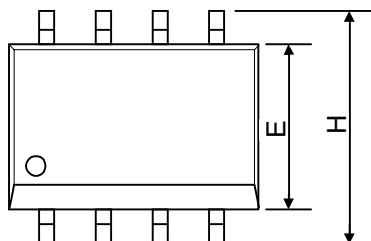
SYMBOL	DIMENSION IN MILLIMETER(mm)			DIMENSION IN INCH(inch)		
	Min	Nom	Max	MIN	NOM	MAX
A	*	*	5.33	-	-	0.210
A1	0.38	*	*	0.015	-	-
A2	3.1	3.3	3.5	0.122	0.130	0.138
B	0.36	0.46	0.56	0.014	0.018	0.022
B1	1.4	1.52	1.65	0.055	0.060	0.065
B2	0.81	0.99	1.14	0.032	0.039	0.045
C	0.2	0.25	0.36	0.008	0.010	0.014
D	9.02	9.35	9.75	0.355/0.364	0.365/0.374	0.375/0.384
E	7.62	7.94	8.26	0.300	0.313	0.325
E1	6.15	6.35	6.55	0.242	0.250	0.258
e	*	2.54	*	-	0.100	-
L	2.92	3.3	3.81	0.115	0.130	0.150
eB	8.38	8.89	9.4	0.330	0.350	0.370
S	0.71	0.84	0.97	0.028	0.033	0.038

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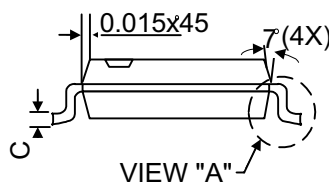
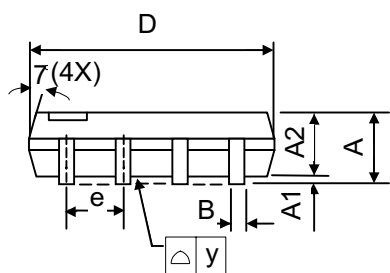
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(2) SOP-8L (JEDEC Small Outline Package)



VIEW "A"



VIEW "A"

SYMBOLS	DIMENSION IN MILLIMETER (mm)			DIMENSION IN INCH (inch)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	-	0.25	0.040	-	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	4.85	5.05	0.189	0.191	0.199
E	3.80	3.91	4.00	0.150	0.154	0.157
e	-	1.27	-	-	0.050	-
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
Θ	0	-	8	0	-	8