KA3846

SMPS Controller

Features

- Automatic Feed Forward Compensation
- Programmable Pulse by Pulse Current Limiting
- Automatic Symmetry Correction in Push-Pull Configuration
- Enhanced Load Response Characteristics
- Parallel Operation Capability for Modulator Power Systems
- Differential Current Sense Amplifier with Common Mode Range
- Double Pulse Suppression
- 200mA Totem-Pole Outputs
- ±2% Band gap Reference
- Under-Voltage Lockout
- Soft-Start Capability
- Shutdown Terminal
- 500KHz Operation

Description

The KA3846 control IC provides all of the necessary features to implement fixed frequency, current mode control schemes while maintaining a minimum external parts count. The superior performance of this technique can be measured in improved line regulation, enhanced load response characteristics, and a simpler, easier-to-design control loop. Topological advantages include inherent pulse-by-pulse current limiting capability, automatic symmetry correction for push-pull converters, and the ability to parallel "power module" while maintaining equal current sharing. Protection circuitry includes built-in-under-voltage lockout and programmable current limit in addition to soft-start capability. A shutdown function is also available which can initiate either a complete shutdown with automatic restart or latch the supply off. Other features include fully latched operation, double pulse suppression, deadtime adjust capability, and ±2% trimmed bandgap reference. The KA3846 features low outputs in the OFF state.

16-DIP

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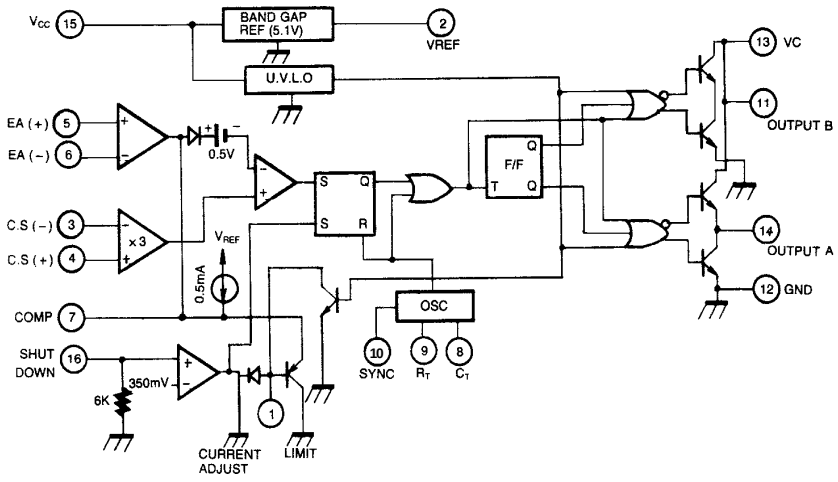
Internal Block Diagram



Rev. 5.0

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Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	40	V
Collector Supply Voltage	V_C	40	V
Output Current, Sink of Source (Peak)	I_O	500	mA
Reference Output Current	I_{REF}	30	mA
Soft Start Sink Current	$I_{SINK(S.S)}$	50	mA
Sync Output Current	I_{SYNC}	5	mA
Error Amplifier Output Current	$I_{O(E.A)}$	5	mA
Oscillator Changing Current	$I_{CHG(OSC)}$	5	mA
Power Dissipation (T_A = 25°C)	P_D	1000	mW
Operating Temperature	T_{OPR}	0 ~ +70	°C
Storage Temperature	T_{STG}	-65 ~ +150	°C
Lead Temperature (Soldering, 10sec)	T_{LEAD}	+300	°C

Electrical Characteristics

(V_{CC}=15V, T_A=0°C to +70°C, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
REFERENCE SECTION						
Reference Output Voltage	V_{REF}	T_J = 25°C, I_{REF} = 1mA	5.00	5.10	5.20	V
Line Regulation	ΔV_{REF}	V_{CC} = 8 to 40V	-	5	20	mV
Load Regulation	ΔV_{REF}	I_{REF}1 to 10mA	-	3	15	mV
Temperature Stability(Note 6)	ST_T	-	-	0.4	1.0	mV/°C
Output Voltage Range (Note 6)	V_{REF}	Line,Load,Temp	4.95	-	5.25	V
Short Circuit Output Current	I_{SC}	V_{REF} = 0V	-10	-45	-	mA
Output Noise Voltage(Note 6)	V_{NO}	f = 10Hz to 10KHz, T_J = 25°C	-	100	-	uV
Long-Term Stability(Note 6)	S_T	T_J = 125°C, 1KHz	2	5	8	mV

Electrical Characteristics

(V_{CC}= 15V,T_A=0°C to +70°C, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
OSCILLATOR SECTION (Note 2)						
Initial Accuracy	ACCUR	T_J = 25°C	39	43	47	KHz
Frequency Change with Voltage	$\Delta f/\Delta V_{CC}$	V_{CC} = 8 to 40V	-	1	2	%
Frequency Change with Temperature (Note 6)	$\Delta f/\Delta T$	-	-	1	-	%
Sync Output High Level	$V_{OH(SYNC)}$	-	3.9	4.35	-	V
Sync Output Low Level	$V_{OL(SYNC)}$	-	-	2.3	2.5	V
Sync Input High Level	$V_{IH(SYNC)}$	V_8 = 0V	3.9	-	-	V
Sync Input Low Level	$V_{IL(SYNC)}$	V_8 = 0V	-	-	2.5	V
Sync Input Current	$I_{I(SYNC)}$	Sync Voltage = 3.9V, V_8 = 0V	-	1.3	1.5	mA
ERROR AMPLIFIER SECTION						
Input Offset Voltage	V_{IO}	-	-	0.5	5	mV
Input Bias Current	I_{BIAS}	-	-	-0.6	-1	uA
Input Offset Current	I_{IO}	-	-	40	250	uA
Common-Mode Range	V_{CM}	V_{CC} = 8 to 40V	0	-	V_{CC}2	V
Open Loop Voltage Gain	G_{VO}	V_O = 1.2 to 3V, V_{CM} = 2V	80	105	-	dB
Unity Gain Bandwidth(Note 6)	BW	T_J = 25°C	0.7	1.0	-	MHz
Common Mode Rejection Ratio	CMRR	V_{CM} = 0 to 38V, V_{CC} = 40V	75	100	-	dB
Power Supply Rejection Ratio	PSRR	V_{CC} = 8 to 40V	80	105	-	dB
Output Sink Current	I_{SINK}	V_{IO} = -15mV to 5V, V_7 = 2.5V	2	6	-	mA
Output Source Current	I_{SOURCE}	R_L = 15KΩ	-0.4	-0.5	-	mA
High Output Voltage	V_{OH}	R_L = 15KΩ	4.3	4.6	-	V
Low Output Voltage	V_{OL}	-	-	0.7	1	V
CURRENT SENSE AMPLIFIER SECTION						
Amplifier Gain (Note 1, 3)	G_V	V_3 = 0V, Pin 1 open	2.5	2.75	3.0	V
Maximum Differential Input Signal (V_4 - V_3) (Note 1)	$V_{I(DIFF,MAX)}$	R_L = 15KΩ, Pin 1 open	1.1	1.2	-	V
Input Offset Voltage (Note 1)	V_{IO}	V_1 = 0.5V, Pin 1 open	-	5	25	mV
Common Mode Rejection Ratio	CMRR	V_{CM} = 1 to 12V	60	83	-	dB
Power Supply Rejection Ratio	PSRR	V_{CC} = 8 to 40V	60	84	-	dB
Input Bias Current (Note 1)	I_{BIAS}	V_1 = 0.5V, Pin 7 open	-	-2.5	-10	uA
Input Offset Current (Note 1)	I_{IO}	V_1 = 0.5V, Pin 7 open	-	0.08	1	uA
Delay to Outputs (Note 6)	t_D	T_J = 25°C	-	200	500	ns

Electrical Characteristics

(V_{CC}=15V, T_A=0°C to + 70°C, unless otherwise specified)

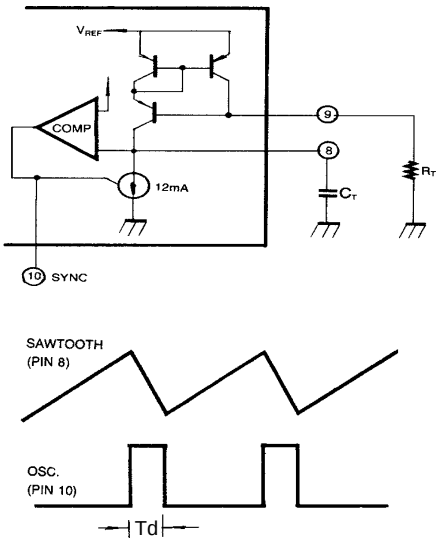
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
CURRENT LIMIT ADJUST SECTION						
Current Limit Offset Voltage (Note 1)	$V_{IO(C.L)}$	V_3 = 0V V_4 = 0V, Pin 7 open	0.45	0.5	0.55	V
Input Bias Current	I_{BIAS}	$V_5 = V_{REF}$, V_6 = 0V	-	- 10	- 30	uA
SHUTDOWN TERMINAL SECTION						
Threshold Voltage	V_{TH}	-	250	350	400	mV
Input Voltage Range	V_I	-	0	-	V_{CC}	V
Minimum Latching Current (Note 4)	$I_{(LATCH,MIN)}$	-	3.0	1.5	-	mA
Maximum Non-Latching Current (Note 5)	$I_{(NONLATCH,MAX)}$	-	-	1.5	0.8	mA
UNDER-VOLTAGE LOCKOUT SECTION						
Start Threshold	$V_{TH(ST)}$	-	7	7.7	8.4	V
Threshold Hysteresis	V_{HYS}	-	0.45	0.75	1.05	V
OUTPUT SECTION						
Collector-Emitter Voltage	V_{CEO}	-	40	-	-	V
Collector Leakage Current	I_{LEAK}	V_C = 40V	-	-	200	uA
Low Output Voltage 1	V_{OL} 1	I_{SINK} = 20mA	-	0.1	0.4	V
Low Output Voltage 2	V_{OL} 2	I_{SINK} = 100mA	-	0.4	2.1	V
High Output Voltage 1	V_{OH} 1	I_{SOURCE} = 20mA	13	13.5	-	V
High Output Voltage 2	V_{OH} 2	I_{SOURCE} = 100mA	12	13.5	-	V
Rise Time (Note 6)	t_R	C_L = 1nF, T_J = 25°C	-	50	300	us
Fall Time (Note 6)	t_F	C_L = 1nF, T_J = 25°C	-	50	300	us
TOTAL STANDBY CURRENT						
Supply Current	I_{CC}	-	-	17	21	mA

Notes :

1. Parameter measured at trip point at latch with $V_5 = V_{REF}$, V_6 = 0V
2. R_T = 10KΩ, C_T = 4.7nF
3. Amplifier gain definde as:

$$G = \frac{\Delta V7}{\Delta V4}; \Delta V_4 = 0 \text{ to } 1.0V$$

4. Current into Pin 1 guaranteed to latch circuit in shutdown state.
5. Current into Pin 1 guaranteed not to latch circuit in shutdown state.
6. These parameters, although guaranteed over the recommended operating conditions, are not 100% tested in production.



OUTPUT DEADTIME(T_d)

Figure 1. KA3846 Oscillator Circuit

Output deadtime is determined by the external capacitor, C_T, according to the formula: $Td(us) = 145C_T(\mu F)\left(\frac{12}{12 - \frac{3.6}{R_T(K\Omega)}}\right)$
For large values of R_T: T_d (us) = l45C_T (uF) Oscillator frequency is approximately

by the formula: $f_T(KHz) = \frac{2.2}{R_T(K\Omega)C_T(\mu F)}$

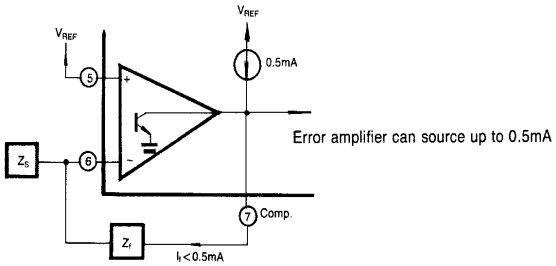


Figure 2. Error Amplifier Output Configuration

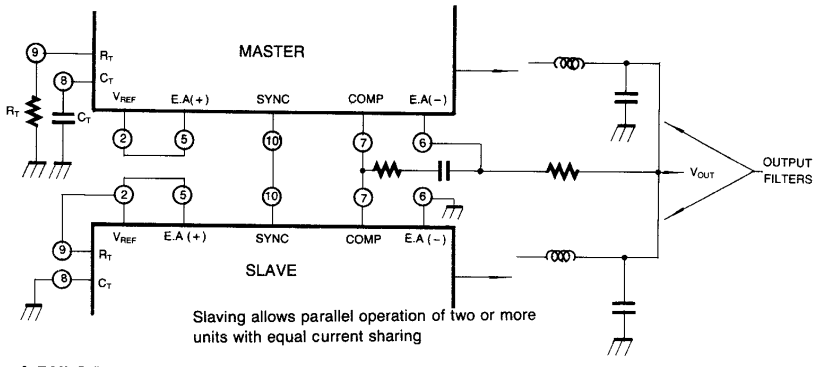


Figure 3. Parallel Operation

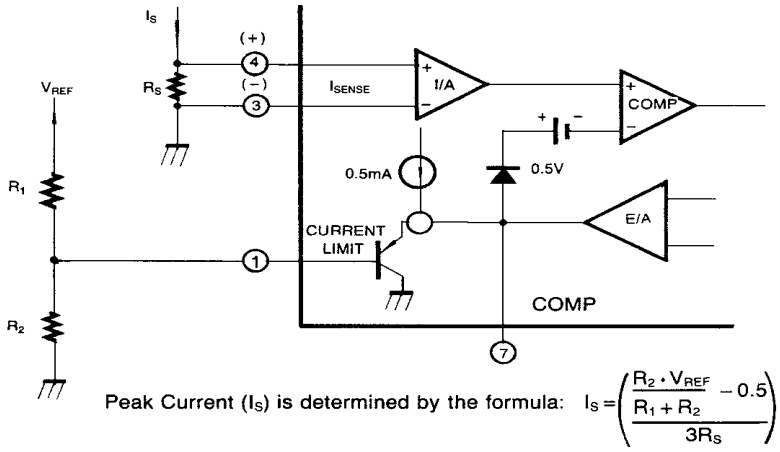


Figure 4. Pulse By Pulse Current Limiting

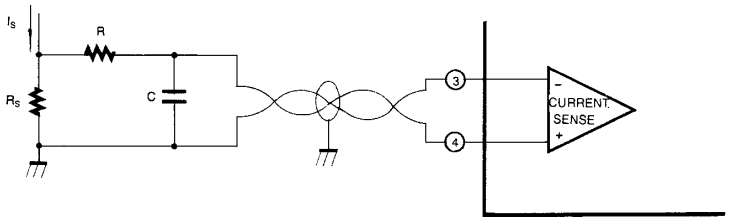


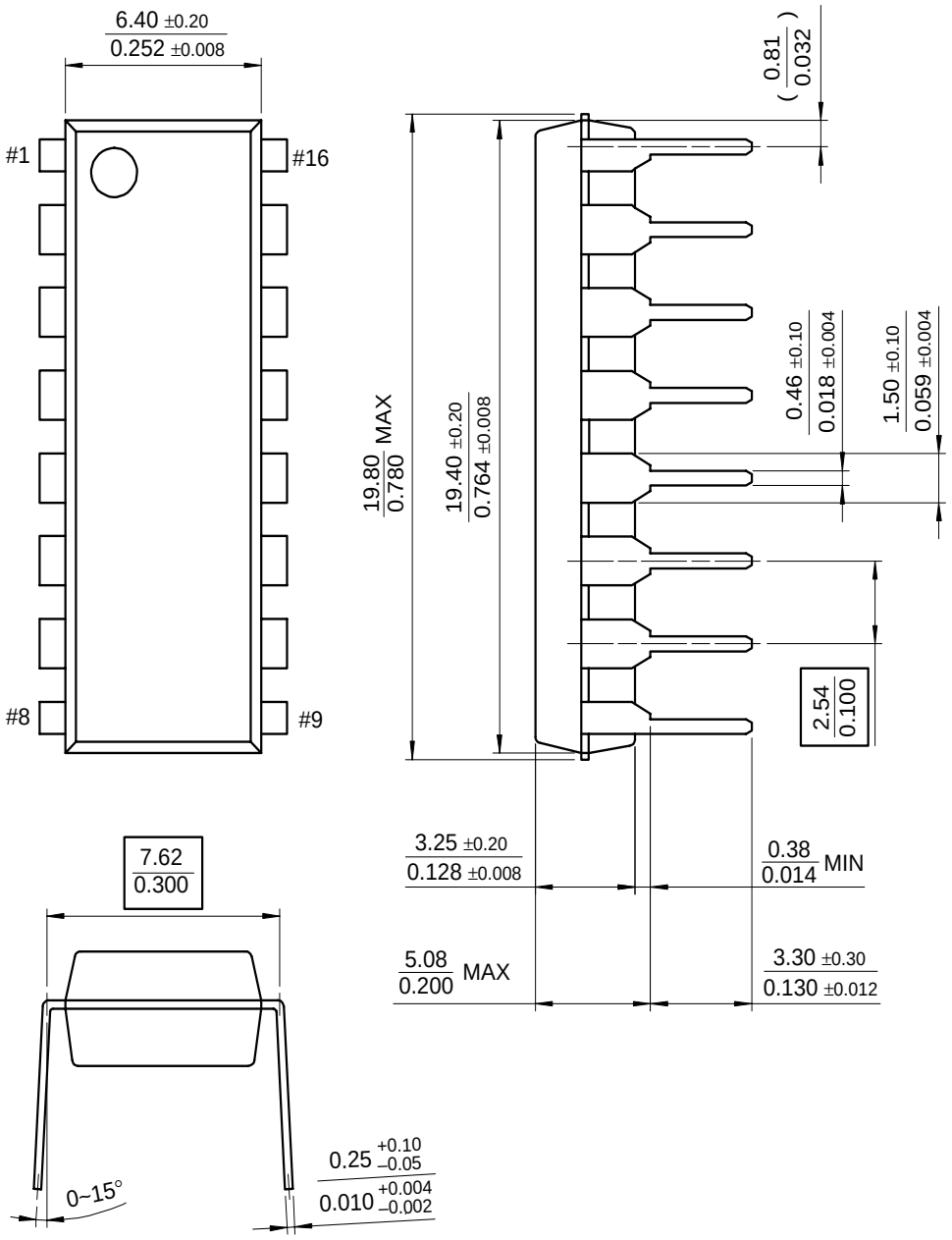
Figure 5. Current Sense Amp Connections

A small PC filter may be required in some applications to reduce switch transients
Differential input allows remote, noise free sensing.

Mechanical Dimensions

Package

16-DIP



Ordering Information

Product Number	Package	Operating Temperature
KA3846	16 DIP	0 ~ + 70°C

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