

KA3842B/3B/4B/5B

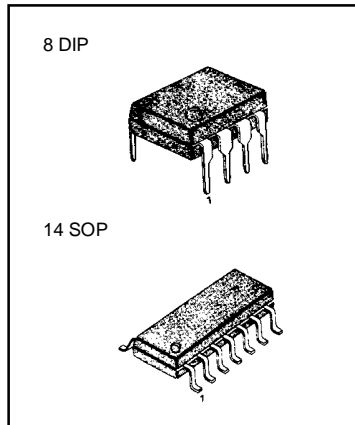
SMPS CONTROLLER

CURRENT-MODE PWM CONTROLLERS

The KA3842B/3B/4B/5B are fixed frequency current-mode PWM controller. They are specially designed for Off - Line and DC-to-DC converter applications 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 totempole output. Ideally suited for driving a power MOSFET.

Protection circuitry includes built in under-voltage lockout and current limiting.

The KA3842B and KA3844B have UVLO thresholds of 16V (on) and 10V (off). The KA3843B and KA3845B are 8.5V (on) and 7.9V (off). The KA3842B and KA3843B can operate within 100% duty cycle. The KA3844B and KA3845B can operate with 50% duty cycle.



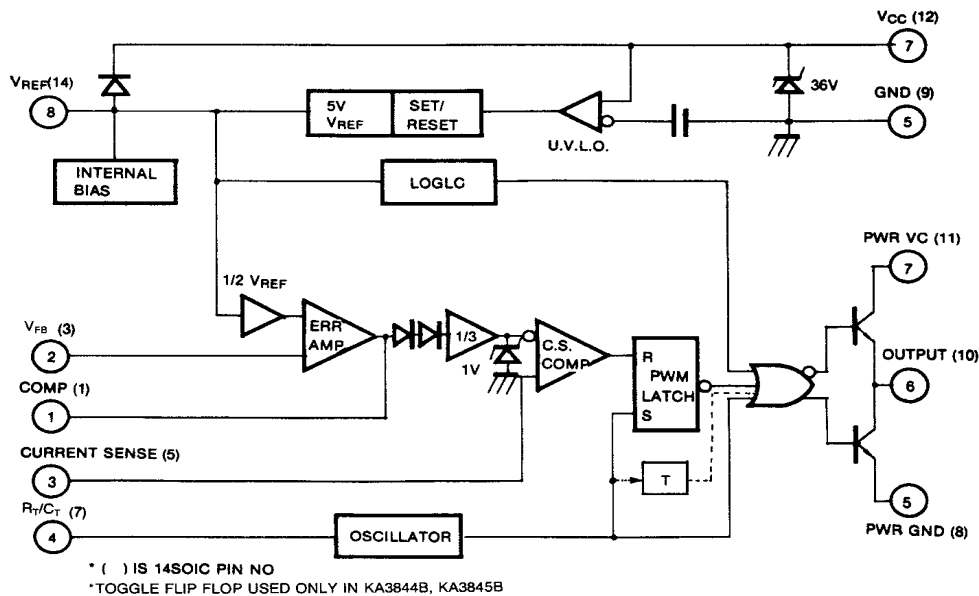
FEATURES

- Low Start Up Current
- Maximum Duty Clamp
- U/V Lockout With Hysteresis
- Operating Frequency Up To 500KHz

ORDERING INFORMATION

| Device | Package | Operating Temperature |
|----------|---------|-----------------------|
| KA384XB | 8 DIP | 0 ~ +70 °C |
| KA384XBD | 14 SOP | 0 ~ +70 °C |

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Characteristic | Symbol | Value | Unit |
|--|----------------|-------------|------|
| Supply Voltage | V_{CC} | 30 | V |
| Output Current | I_O | ± 1 | A |
| Analog Inputs (Pin 2,3) | $V_{(ANA)}$ | -0.3 to 6.3 | V |
| Error Amp Output Sink Current | $I_{SINK(EA)}$ | 10 | mA |
| Power Dissipation ($T_A = 25^\circ\text{C}$) | P_D | 1 | W |

ELECTRICAL CHARACTERISTICS

(* $V_{CC}=15\text{V}$, $R_T=10\text{K}\Omega$, $C_T=3.3\text{nF}$, $T_A=0^\circ\text{C}$ to $+70^\circ\text{C}$, unless otherwise specified)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit |
|--------------------------------|--------------------------|---|------|------|------|---------------|
| REFERENCE SECTION | | | | | | |
| Reference Output Voltage | V_{REF} | $T_J = 25^\circ\text{C}$, $I_{REF} = 1\text{mA}$ | 4.90 | 5.00 | 5.10 | V |
| Line Regulation | ΔV_{REF} | $12\text{V} \leq V_{CC} \leq 25\text{V}$ | | 6 | 20 | mV |
| Load Regulation | ΔV_{REF} | $1\text{mA} \leq I_{REF} \leq 20\text{mA}$ | | 6 | 25 | mV |
| Short Circuit Output Current | I_{SC} | $T_A = 25^\circ\text{C}$ | | -100 | -180 | mA |
| OSCILLATOR SECTION | | | | | | |
| Oscillation Frequency | f | $T_J = 25^\circ\text{C}$ | 47 | 52 | 57 | KHz |
| Frequency Change with Voltage | $\Delta f/\Delta V_{CC}$ | $12\text{V} \leq V_{CC} \leq 25\text{V}$ | | 0.05 | 1 | % |
| Oscillator Amplitude | $V_{(OSC)}$ | | | 1.6 | | V_{P-P} |
| ERROR AMPLIFIER SECTION | | | | | | |
| Input Bias Current | I_{BIAS} | | | -0.1 | -2 | μA |
| Input Voltage | $V_{I(E>A)}$ | $V_1 = 2.5\text{V}$ | 2.42 | 2.50 | 2.58 | V |
| Open Loop Voltage Gain | G_{VO} | $2\text{V} \leq V_O \leq 4\text{V}$ | 65 | 90 | | dB |
| Power Supply Rejection Ratio | PSRR | $12\text{V} \leq V_{CC} \leq 25\text{V}$ | 60 | 70 | | dB |
| Output Sink Current | I_{SINK} | $V_2 = 2.7\text{V}$, $V_1 = 1.1\text{V}$ | 2 | 7 | | mA |
| Output Source Current | I_{SOURCE} | $V_2 = 2.3\text{V}$, $V_1 = 5\text{V}$ | -0.6 | -1.0 | | mA |
| High Output Voltage | V_{OH} | $V_2 = 2.3\text{V}$, $R_L = 15\text{K}\Omega$ to GND | 5 | 6 | | V |
| Low Output Voltage | V_{OL} | $V_2 = 2.7\text{V}$, $R_L = 15\text{K}\Omega$ to Pin 8 | | 0.8 | 1.1 | V |
| CURRENT SENSE SECTION | | | | | | |
| Gain | G_V | (Note 1 & 2) | 2.85 | 3 | 3.15 | V/V |
| Maximum Input Signal | $V_{I(MAX)}$ | $V_1 = 5\text{V}$ (Note 1) | 0.9 | 1 | 1.1 | V |
| Power Supply Rejection Ratio | PSRR | $12\text{V} \leq V_{CC} \leq 25\text{V}$ (Note 1) | | 70 | | dB |
| Input Bias Current | I_{BIAS} | | | -3 | -10 | μA |

ELECTRICAL CHARACTERISTICS (Continued)(* $V_{CC}=15V$, $R_T=10K\Omega$, $C_T=3.3nF$, $T_A=0^\circ C$ to $+70^\circ C$ unless otherwise specified)

| Characteristic | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|----------------|---|------|------|------|------|
| OUTPUT SECTION | | | | | | |
| Low Output Voltage | V_{OL} | $I_{SINK} = 20mA$ | | 0.08 | 0.4 | V |
| | | $I_{SINK} = 200mA$ | | 1.4 | 2.2 | V |
| High Output Voltage | V_{OH} | $I_{SOURCE} = 20mA$ | 13 | 13.5 | | V |
| | | $I_{SOURCE} = 200mA$ | 12 | 13.0 | | V |
| Rise Time | t_R | $T_J = 25^\circ C$, $C_L = 1nF$ (Note 3) | | 45 | 150 | nS |
| Fall Time | t_F | $T_J = 25^\circ C$, $C_L = 1nF$ (Note 3) | | 35 | 150 | nS |
| UNDER-VOLTAGE LOCKOUT SECTION | | | | | | |
| Start Threshold | $V_{TH(ST)}$ | KA3842B/44B | 14.5 | 16.0 | 17.5 | V |
| | | KA3843B/45B | 7.8 | 8.4 | 9.0 | V |
| Min. Operating Voltage (After Turn On) | $V_{OPR(MIN)}$ | KA3842B/44B | 8.5 | 10.0 | 11.5 | V |
| | | KA3843B/45BG | 7.0 | 7.6 | 8.2 | V |
| PWM SECTION | | | | | | |
| Max. Duty Cycle | $D_{(MAX)}$ | KA3842B/43B | 95 | 97 | 100 | % |
| | | KA3844B/45B | 47 | 48 | 50 | % |
| Min. Duty Cycle | $D_{(MIN)}$ | | | 0 | % | |
| TOTAL STANDBY CURRENT | | | | | | |
| Start-Up Current | I_{ST} | | | 0.45 | 1 | mA |
| Operating Supply Current | $I_{CC(OPR)}$ | $V_3=V_2=ON$ | | 14 | 17 | mA |
| Zener Voltage | V_Z | $I_{CC} = 25mA$ | 30 | 38 | | V |

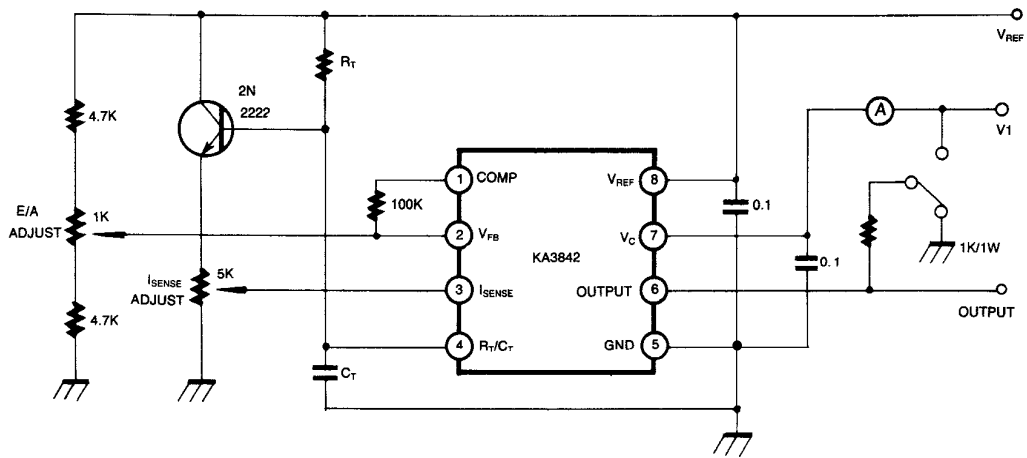
* Adjust V_{CC} above the start threshold before setting at 15V

Note 1. Parameter measured at trip point of latch

$$2. \text{ Gain defined as: } A = \frac{\Delta V_1}{\Delta V_3}; 0 \leq V_3 \leq 0.8V$$

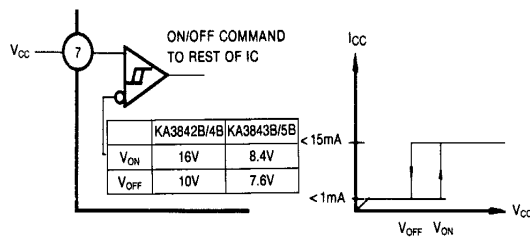
3. These parameters, although guaranteed, are not 100% tested in production.

Fig. 1 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 5K potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

Fig. 2 Under Voltage Lockout



During Under-Voltage Lock-Out, the output driver is biased to a high impedance state. Pin 6 should be shunted to ground with a bleeder resistor to prevent activating the power switch with output leakage current.

Fig. 3 Error Amp Configuration

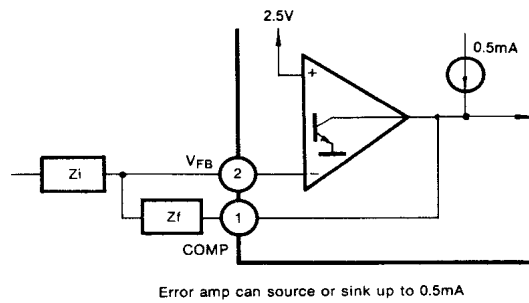
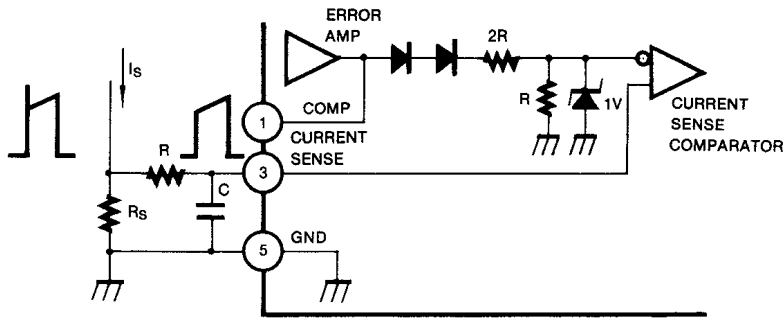


Fig. 4 Current Sense Circuit

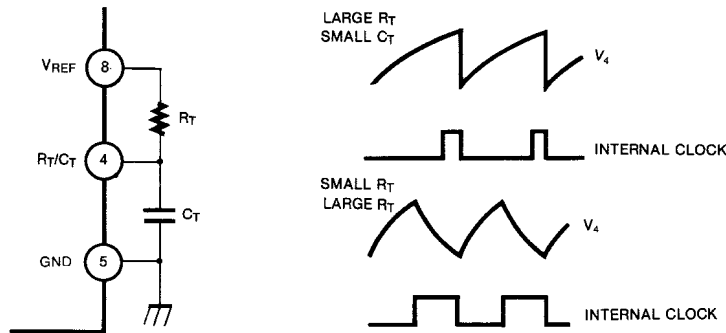


Peak current (I_s) is determined by the formula:

$$I_{s(MAX)} = \frac{1.0V}{R_s}$$

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

Fig. 5 Oscillator Waveforms and Maximum Duty Cycle



Oscillator timing capacitor, C_T , is charged by V_{REF} through R_T , and discharged by an internal current source. During the discharge time, the internal clock signal blanks the output to the low state. Selection of R_T and C_T therefore determines both oscillator frequency and maximum duty cycle. Charge and discharge times are determined by the formulas:

$$t_c = 0.55 R_T C_T$$

$$t_d = R_T C_T \ln \left(\frac{0.0063 R_T - 2.7}{0.0063 R_T - 4} \right)$$

Frequency, then, is: $f = (t_c + t_d)^{-1}$

$$\text{For } R_T > 5K\Omega, f = \frac{1.8}{R_T C_T}$$

Fig. 6 Oscillator Dead Time & Frequency
DEADTIME vs CT (RT>5K)

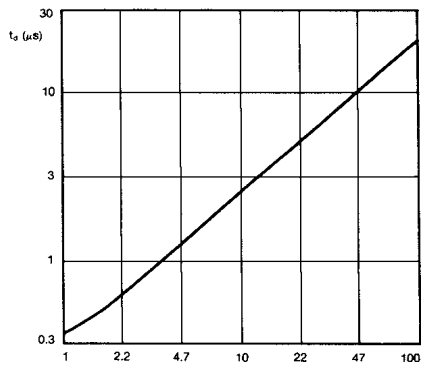


Fig. 7 Timing Resistance vs Frequency

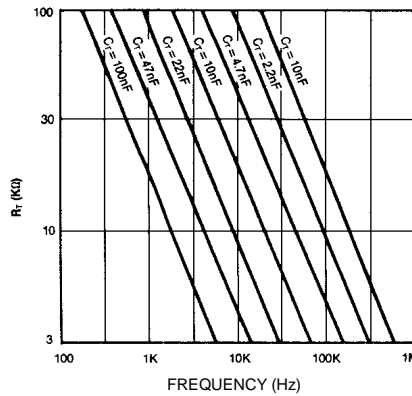
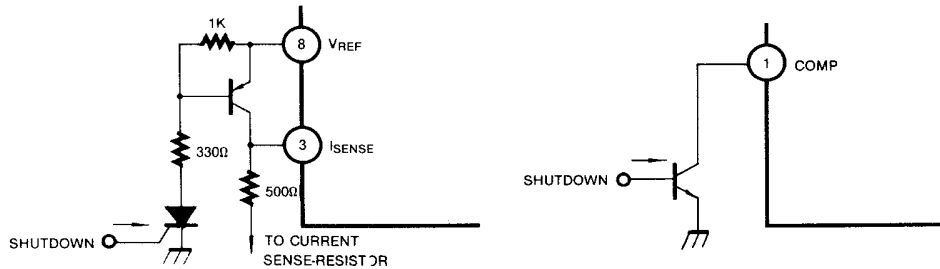
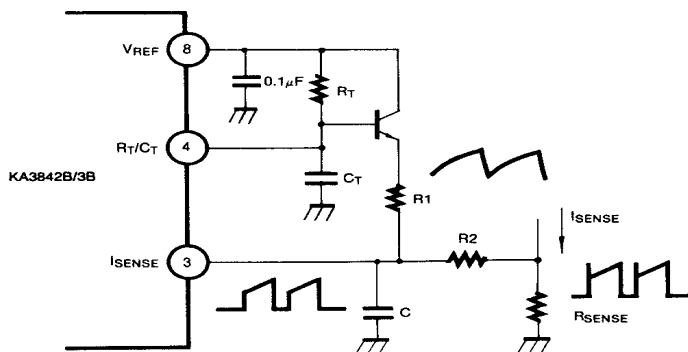


Fig. 8 Shutdown Techniques



Shutdown of the KA3842B 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 causes 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 SOR which will be reset by cycling Voc below the lower UVLO threshold. At this point the reference turns off, allowing the SCR to reset.

Fig. 9 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 R2 to suppress the leading edge switch spikes.

Fig. 10 TEMPERATURE DRIFT (Vref)
KA3842B

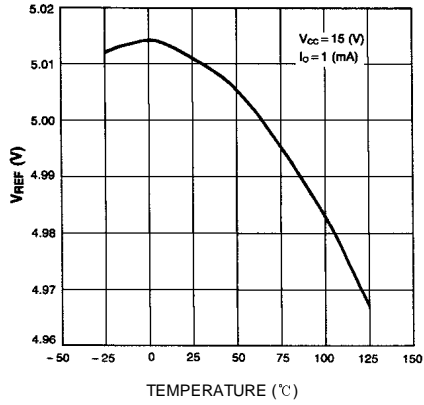
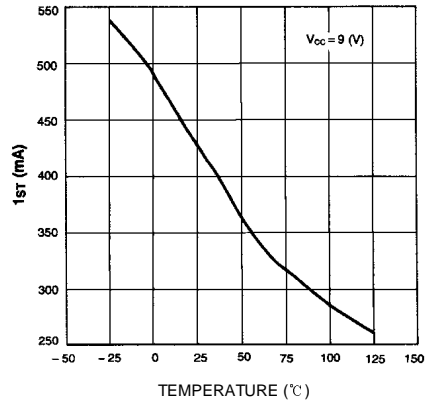
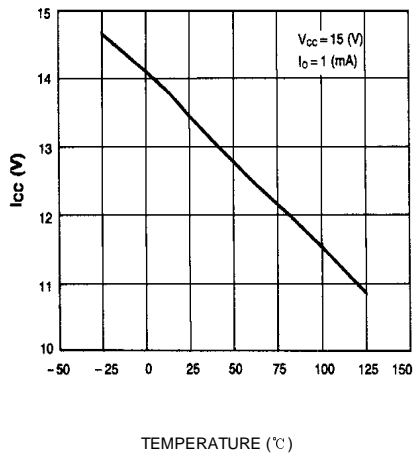


Fig. 11 TEMPERATURE DRIFT (1st)
KA3B42B



TEMPERATURE (°C)
TEMPERATURE (°C)

Fig. 12 TEMPERATURE DRIFT (Icc)
KA3842B



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