



UC2842B/3B/4B/5B UC3842B/3B/4B/5B

HIGH PERFORMANCE CURRENT MODE PWM CONTROLLER

- TRIMMED OSCILLATOR FOR PRECISE FREQUENCY CONTROL
- OSCILLATOR FREQUENCY GUARANTEED AT 250kHz
- CURRENT MODE OPERATION TO 500kHz
- 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 START-UP AND OPERATING CURRENT



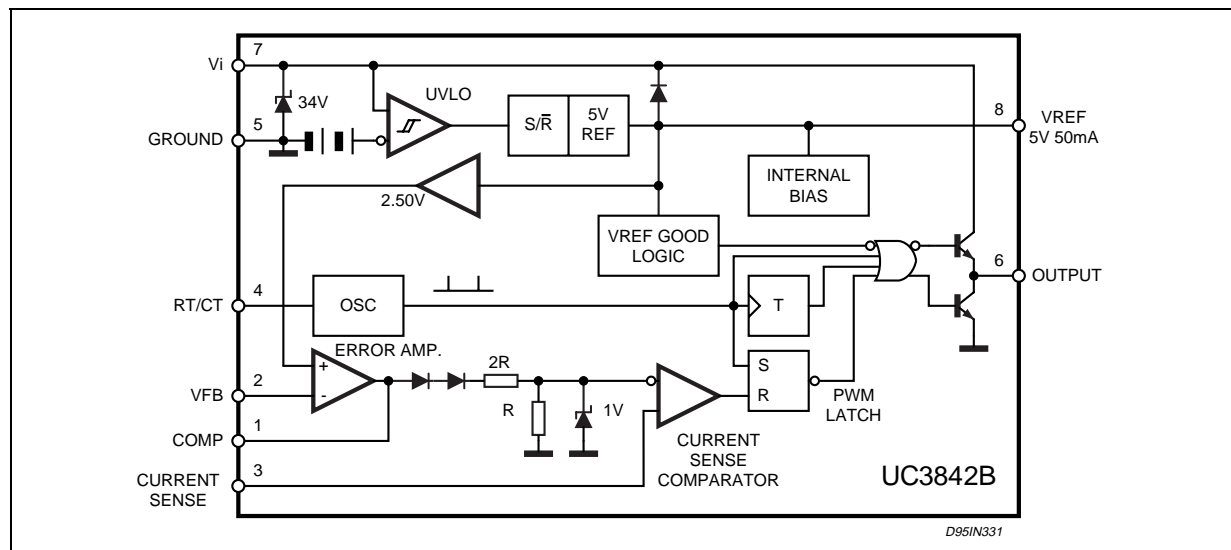
comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N-Channel MOSFETs, is low in the off-state.

DESCRIPTION

The UC384xB 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 a trimmed oscillator for precise DUTY CYCLE CONTROL under voltage lockout featuring start-up current less than 0.5mA, a precision reference trimmed for accuracy at the error amp input, logic to insure latched operation, a PWM

Differences between members of this family are the under-voltage lockout thresholds and maximum duty cycle ranges. The UC3842B and UC3844B have UVLO thresholds of 16V (on) and 10V (off), ideally suited off-line applications. The corresponding thresholds for the UC3843B and UC3845B are 8.5V and 7.9V. The UC3842B and UC3843B can operate to duty cycles approaching 100%. A range of the zero to < 50% is obtained by the UC3844B and UC3845B 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 UC3844B and UC3845B)



UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------|--|---------------|------------------|
| V_i | Supply Voltage (low impedance source) | 30 | V |
| V_i | Supply Voltage ($I_i < 30\text{mA}$) | Self Limiting | |
| I_o | Output Current | ± 1 | A |
| E_o | Output Energy (capacitive load) | 5 | μJ |
| | Analog Inputs (pins 2, 3) | -0.3 to 5.5 | V |
| | Error Amplifier Output Sink Current | 10 | mA |
| P_{tot} | Power Dissipation at $T_{amb} \leq 25^\circ\text{C}$ (Minidip) | 1.25 | W |
| P_{tot} | Power Dissipation at $T_{amb} \leq 25^\circ\text{C}$ (SO8) | 800 | mW |
| T_{stg} | Storage Temperature Range | -65 to 150 | $^\circ\text{C}$ |
| T_J | Junction Operating Temperature | -40 to 150 | $^\circ\text{C}$ |
| T_L | Lead Temperature (soldering 10s) | 300 | $^\circ\text{C}$ |

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

PIN CONNECTION (top view)



PIN FUNCTIONS

| No | Function | Description |
|----|-------------|---|
| 1 | COMP | This pin is the Error Amplifier output and is made available for loop compensation. |
| 2 | V_{FB} | This is the inverting input of the Error Amplifier. It is normally connected to the switching power supply output through a resistor divider. |
| 3 | I_{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 500kHz is possible. |
| 5 | GROUND | This pin is the combined control circuitry and power ground. |
| 6 | OUTPUT | This output directly drives the gate of a power MOSFET. Peak currents up to 1A 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 . |

ORDERING NUMBERS

| SO8 | Minidip |
|----------------------|--------------------|
| UC2842BD1; UC3842BD1 | UC2842BN; UC3842BN |
| UC2843BD1; UC3843BD1 | UC2843BN; UC3843BN |
| UC2844BD1; UC3844BD1 | UC2844BN; UC3844BN |
| UC2845BD1; UC3845BD1 | UC2845BN; UC3845BN |

THERMAL DATA

| Symbol | Description | Minidip | SO8 | Unit |
|-----------------|--------------------------------------|----------|-----|------|
| $R_{th\ j-amb}$ | Thermal Resistance Junction-ambient. | max. 100 | 150 | °C/W |

ELECTRICAL CHARACTERISTICS ([note 1] Unless otherwise stated, these specifications apply for $-25 \leq T_{amb} \leq 85^{\circ}C$ for UC284XB; $0 \leq T_{amb} \leq 70^{\circ}C$ for UC384XB; $V_i = 15V$ (note 5); $R_T = 10K$; $C_T = 3.3nF$)

| Symbol | Parameter | Test Conditions | UC284XB | | | UC384XB | | | Unit |
|------------------------------|--------------------------------------|---|---------|------|------|---------|------|------|---------|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| REFERENCE SECTION | | | | | | | | | |
| V_{REF} | Output Voltage | $T_j = 25^{\circ}C$ $I_o = 1mA$ | 4.95 | 5.00 | 5.05 | 4.90 | 5.00 | 5.10 | V |
| ΔV_{REF} | Line Regulation | $12V \leq V_i \leq 25V$ | | 2 | 20 | | 2 | 20 | mV |
| ΔV_{REF} | Load Regulation | $1 \leq I_o \leq 20mA$ | | 3 | 25 | | 3 | 25 | mV |
| $\Delta V_{REF}/\Delta T$ | Temperature Stability | (Note 2) | | 0.2 | | | 0.2 | | mV/°C |
| | Total Output Variation | Line, Load, Temperature | 4.9 | | 5.1 | 4.82 | | 5.18 | V |
| e_N | Output Noise Voltage | $10Hz \leq f \leq 10KHz$ $T_j = 25^{\circ}C$ (note 2) | | 50 | | | 50 | | μV |
| | Long Term Stability | $T_{amb} = 125^{\circ}C$, 1000Hrs (note 2) | | 5 | 25 | | 5 | 25 | mV |
| I_{SC} | Output Short Circuit | | -30 | -100 | -180 | -30 | -100 | -180 | mA |
| OSCILLATOR SECTION | | | | | | | | | |
| f_{OSC} | Frequency | $T_j = 25^{\circ}C$ | 49 | 52 | 55 | 49 | 52 | 55 | KHz |
| | | $T_A = T_{low}$ to T_{high} | 48 | - | 56 | 48 | - | 56 | KHz |
| | | $T_j = 25^{\circ}C$ ($R_T = 6.2k$, $C_T = 1nF$) | 225 | 250 | 275 | 225 | 250 | 275 | KHz |
| $\Delta f_{OSC}/\Delta V$ | Frequency Change with Volt. | $V_{CC} = 12V$ to $25V$ | - | 0.2 | 1 | - | 0.2 | 1 | % |
| $\Delta f_{OSC}/\Delta T$ | Frequency Change with Temp. | $T_A = T_{low}$ to T_{high} | - | 1 | - | - | 0.5 | - | % |
| V_{OSC} | Oscillator Voltage Swing | (peak to peak) | - | 1.6 | - | - | 1.6 | - | V |
| I_{dischg} | Discharge Current ($V_{OSC} = 2V$) | $T_j = 25^{\circ}C$ | 7.8 | 8.3 | 8.8 | 7.8 | 8.3 | 8.8 | mA |
| | | $T_A = T_{low}$ to T_{high} | 7.5 | - | 8.8 | 7.6 | - | 8.8 | mA |
| ERROR AMP SECTION | | | | | | | | | |
| V_2 | Input Voltage | $V_{PIN1} = 2.5V$ | 2.45 | 2.50 | 2.55 | 2.42 | 2.50 | 2.58 | V |
| I_b | Input Bias Current | $V_{FB} = 5V$ | | -0.1 | -1 | | -0.1 | -2 | μA |
| | A_{VOL} | $2V \leq V_o \leq 4V$ | 65 | 90 | | 65 | 90 | | dB |
| BW | Unity Gain Bandwidth | $T_j = 25^{\circ}C$ | 0.7 | 1 | | 0.7 | 1 | | MHz |
| PSRR | Power Supply Rejec. Ratio | $12V \leq V_i \leq 25V$ | 60 | 70 | | 60 | 70 | | dB |
| I_o | Output Sink Current | $V_{PIN2} = 2.7V$ $V_{PIN1} = 1.1V$ | 2 | 12 | | 2 | 12 | | mA |
| I_o | Output Source Current | $V_{PIN2} = 2.3V$ $V_{PIN1} = 5V$ | -0.5 | -1 | | -0.5 | -1 | | mA |
| | V_{OUT} High | $V_{PIN2} = 2.3V$; $R_L = 15K\Omega$ to Ground | 5 | 6.2 | | 5 | 6.2 | | V |
| | V_{OUT} Low | $V_{PIN2} = 2.7V$; $R_L = 15K\Omega$ to Pin 8 | | 0.8 | 1.1 | | 0.8 | 1.1 | V |
| CURRENT SENSE SECTION | | | | | | | | | |
| G_V | Gain | (note 3 & 4) | 2.85 | 3 | 3.15 | 2.85 | 3 | 3.15 | V/V |
| V_3 | Maximum Input Signal | $V_{PIN1} = 5V$ (note 3) | 0.9 | 1 | 1.1 | 0.9 | 1 | 1.1 | V |
| SVR | Supply Voltage Rejection | $12 \leq V_i \leq 25V$ (note 3) | | 70 | | | 70 | | dB |
| I_b | Input Bias Current | | | -2 | -10 | | -2 | -10 | μA |
| | Delay to Output | | | 150 | 300 | | 150 | 300 | ns |



UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

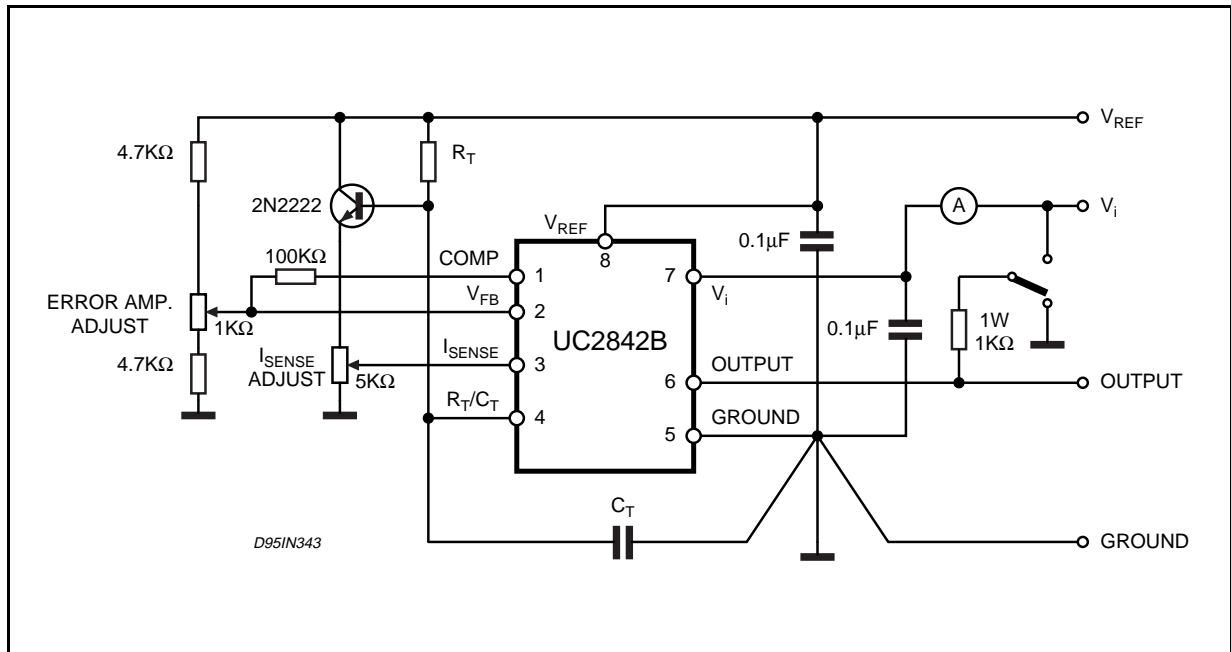
ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Parameter | Test Conditions | UC284XB | | | UC384XB | | | Unit |
|--------------------------------------|-------------------------------------|--|---------|------|------|---------|------|------|------|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| OUTPUT SECTION | | | | | | | | | |
| V _{OL} | Output Low Level | I _{SINK} = 20mA | | 0.1 | 0.4 | | 0.1 | 0.4 | V |
| | | I _{SINK} = 200mA | | 1.6 | 2.2 | | 1.6 | 2.2 | V |
| V _{OH} | Output High Level | I _{SOURCE} = 20mA | 13 | 13.5 | | 13 | 13.5 | | V |
| | | I _{SOURCE} = 200mA | 12 | 13.5 | | 12 | 13.5 | | V |
| V _{OLS} | UVLO Saturation | V _{CC} = 6V; I _{SINK} = 1mA | | 0.1 | 1.1 | | 0.1 | 1.1 | V |
| t _r | Rise Time | T _j = 25°C C _L = 1nF (2) | | 50 | 150 | | 50 | 150 | ns |
| t _f | Fall Time | T _j = 25°C C _L = 1nF (2) | | 50 | 150 | | 50 | 150 | ns |
| UNDER-VOLTAGE LOCKOUT SECTION | | | | | | | | | |
| | Start Threshold | X842B/4B | 15 | 16 | 17 | 14.5 | 16 | 17.5 | V |
| | | X843B/5B | 7.8 | 8.4 | 9.0 | 7.8 | 8.4 | 9.0 | V |
| | Min Operating Voltage After Turn-on | X842B/4B | 9 | 10 | 11 | 8.5 | 10 | 11.5 | V |
| | | X843B/5B | 7.0 | 7.6 | 8.2 | 7.0 | 7.6 | 8.2 | V |
| PWM SECTION | | | | | | | | | |
| | Maximum Duty Cycle | X842B/3B | 94 | 96 | 100 | 94 | 96 | 100 | % |
| | | X844B/5B | 47 | 48 | 50 | 47 | 48 | 50 | % |
| | Minimum Duty Cycle | | | 0 | | | 0 | % | |
| TOTAL STANDBY CURRENT | | | | | | | | | |
| I _{st} | Start-up Current | V _i = 6.5V for UCX843B/45B | | 0.3 | 0.5 | | 0.3 | 0.5 | mA |
| | | V _i = 14V for UCX842B/44B | | 0.3 | 0.5 | | 0.3 | 0.5 | mA |
| I _i | Operating Supply Current | V _{PIN2} = V _{PIN3} = 0V | | 12 | 17 | | 12 | 17 | mA |
| V _{iz} | Zener Voltage | I _i = 25mA | 30 | 36 | | 30 | 36 | V | |

- Notes :**
1. Max package power dissipation limits must be respected; low duty cycle pulse techniques are used during test maintain T_j as close to T_{amb} as possible.
 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 :

$$A = \frac{\Delta V_{PIN1}}{\Delta V_{PIN3}} ; 0 \leq V_{PIN3} \leq 0.8 \text{ V}$$
 5. Adjust V_i above the start threshold before setting at 15 V.

Figure 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 5 KΩ potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

Figure 2: Timing Resistor vs. Oscillator Frequency

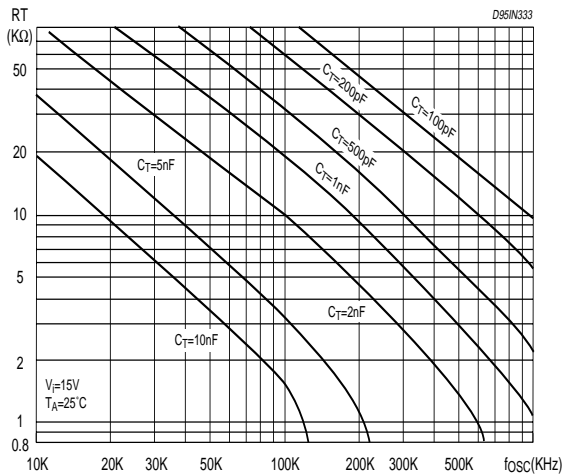


Figure 3: Output Dead-Time vs. Oscillator Frequency



Figure 4: Oscillator Discharge Current vs. Temperature.

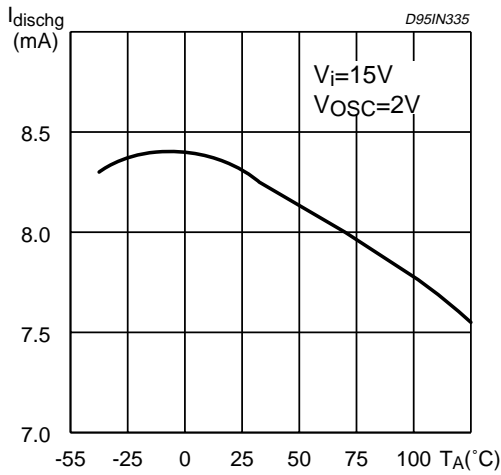


Figure 5: Maximum Output Duty Cycle vs. Timing Resistor.



Figure 6: Error Amp Open-Loop Gain and Phase vs. Frequency.



Figure 7: Current Sense Input Threshold vs. Error Amp Output Voltage.



Figure 8: Reference Voltage Change vs. Source Current.



Figure 9: Reference Short Circuit Current vs. Temperature.

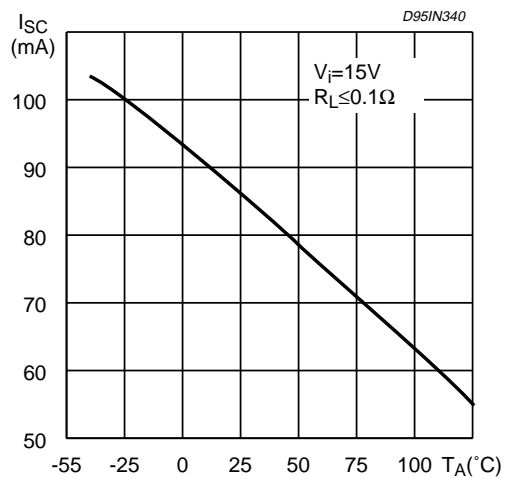


Figure 10: Output Saturation Voltages. Load Current.



Figure 12: Output Waveform.

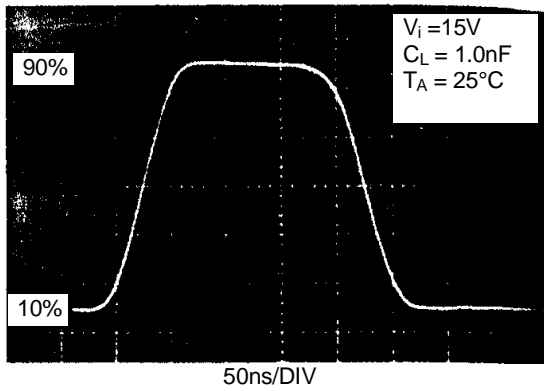


Figure 11: Supply Current vs. Supply Voltage.

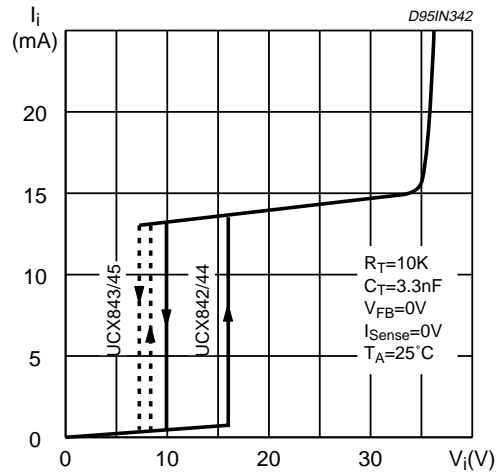


Figure 13: Output Cross Conduction

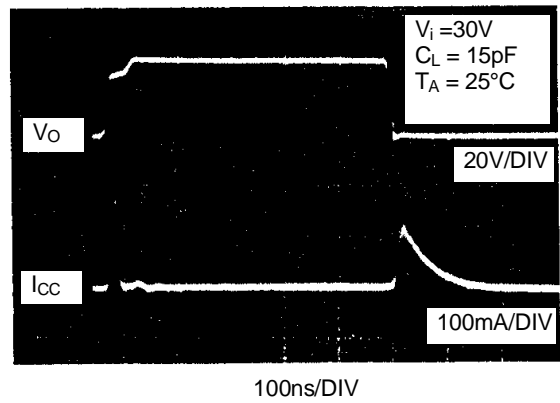
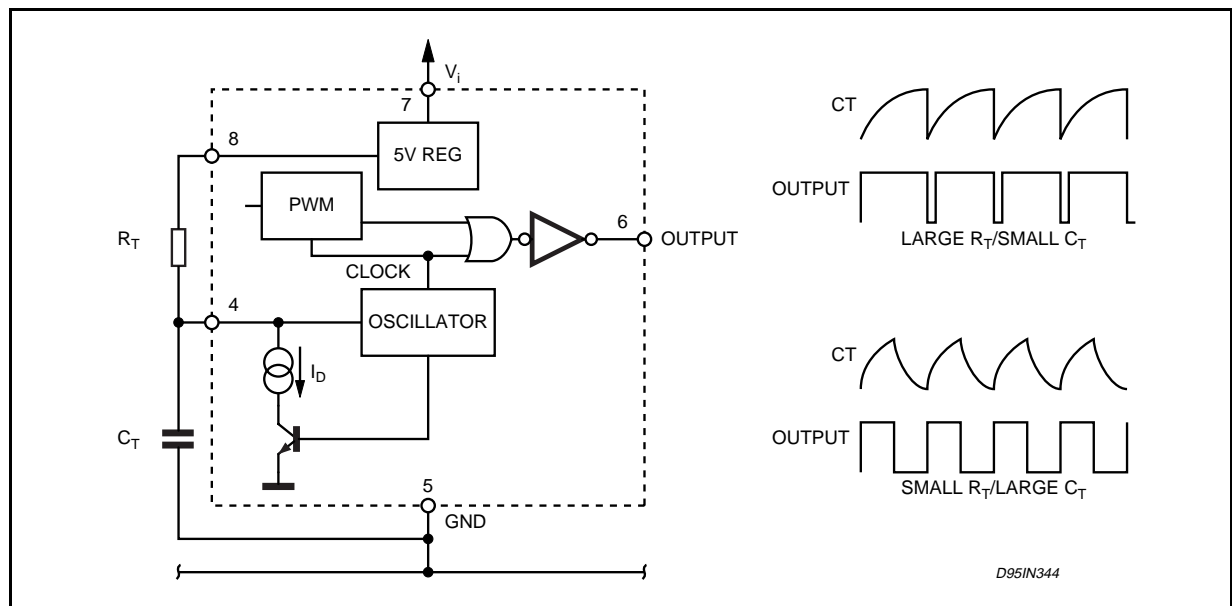


Figure 14: Oscillator and Output Waveforms.



UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

Figure 15 : Error Amp Configuration.

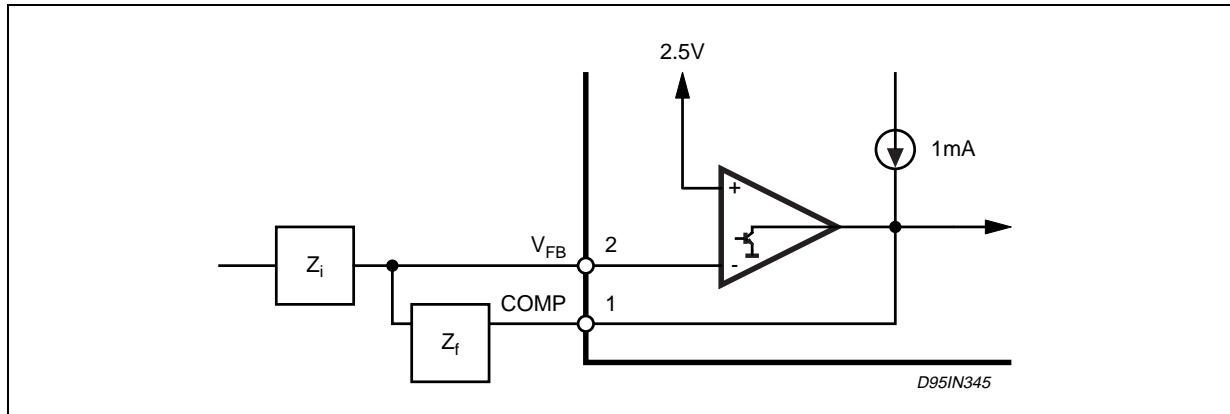


Figure 16 : Under Voltage Lockout.

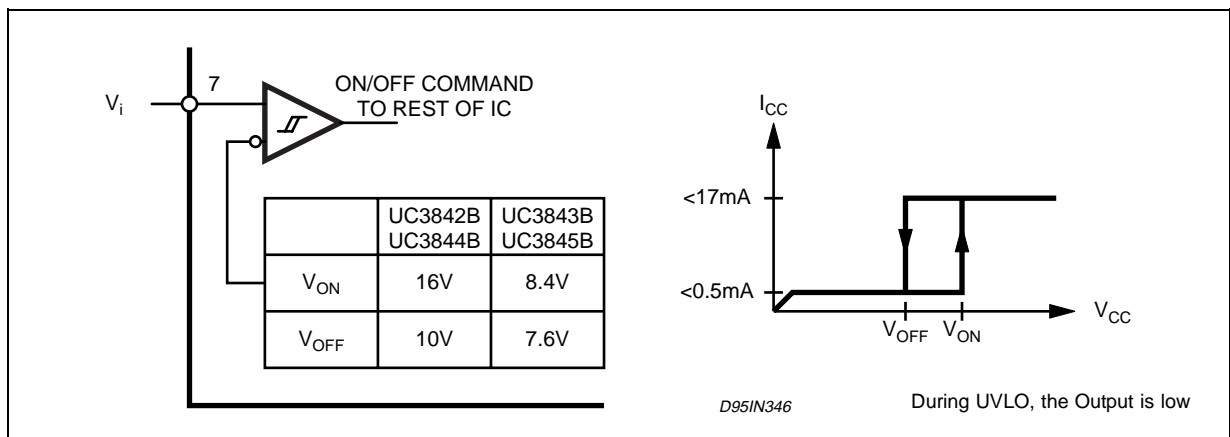
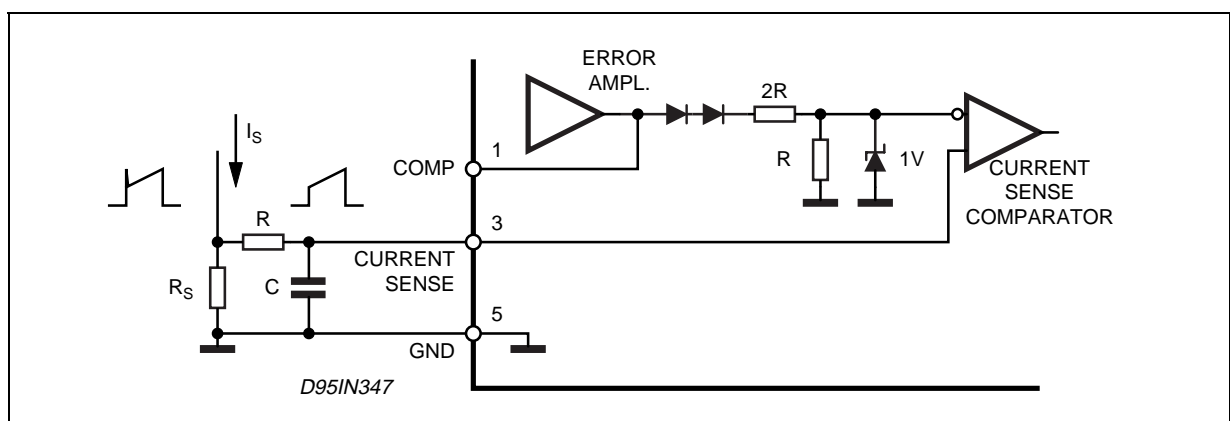


Figure 17 : Current Sense Circuit .



Peak current (i_s) is determined by the formula

$$I_{s \max} \approx \frac{1.0 \text{ V}}{R_s}$$

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

Figure 18 : Slope Compensation Techniques.



Figure 19 : Isolated MOSFET Drive and Current Transformer Sensing.

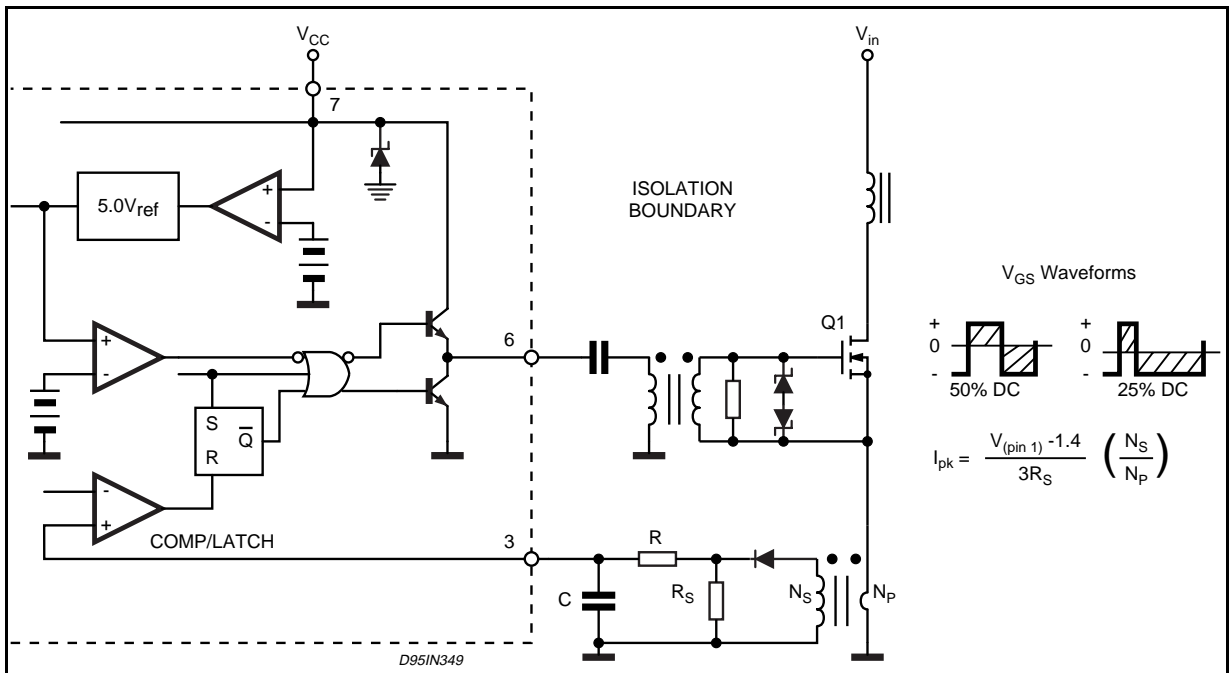


Figure 20 : Latched Shutdown.



Figure 21: Error Amplifier Compensation



Figure 22: External Clock Synchronization.



Figure 23: External Duty Cycle Clamp and Multi Unit Synchronization.



Figure 24: Soft-Start Circuit



Figure 25: Soft-Start and Error Amplifier Output Duty Cycle Clamp.



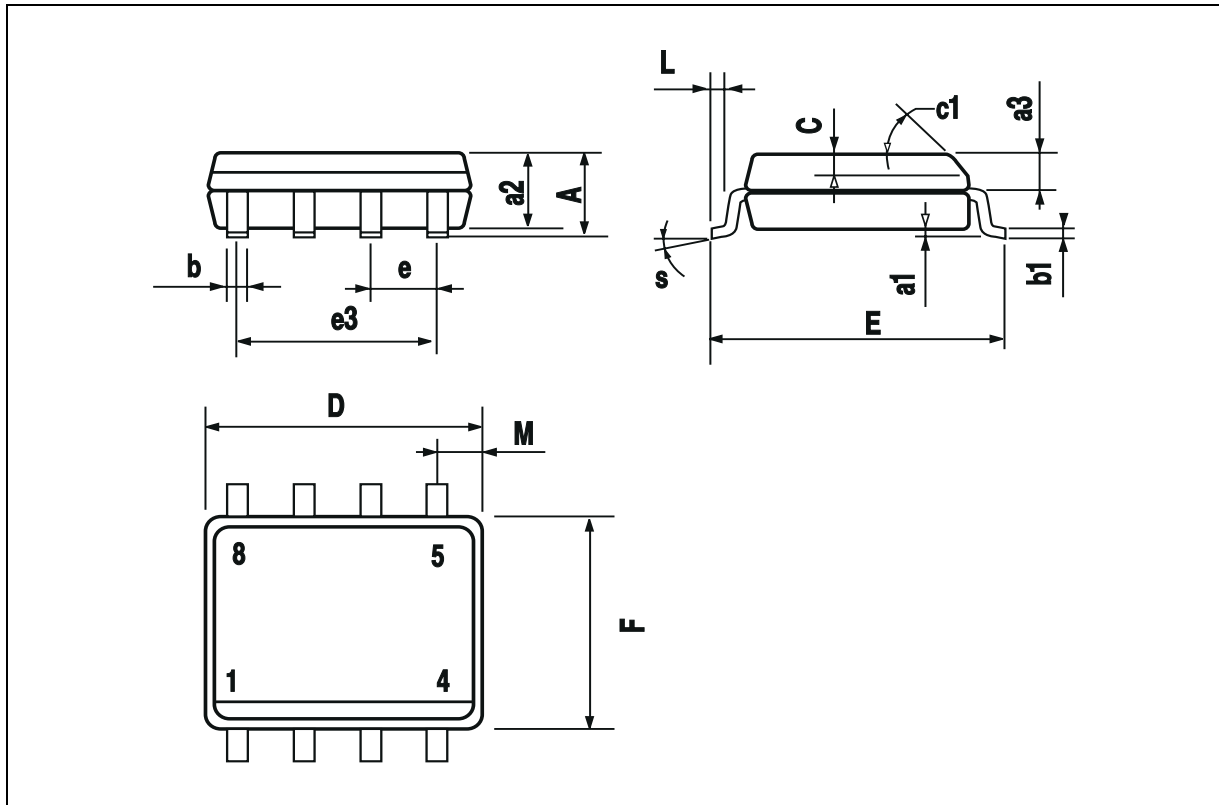
| DIM. | mm | | | inch | | |
|-------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.069 |
| a1 | 0.1 | | 0.25 | 0.004 | | 0.010 |
| a2 | | | 1.65 | | | 0.065 |
| a3 | 0.65 | | 0.85 | 0.026 | | 0.033 |
| b | 0.35 | | 0.48 | 0.014 | | 0.019 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | 0.25 | | 0.5 | 0.010 | | 0.020 |
| c1 | 45° (typ.) | | | | | |
| D (1) | 4.8 | | 5.0 | 0.189 | | 0.197 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 3.81 | | | 0.150 | |
| F (1) | 3.8 | | 4.0 | 0.15 | | 0.157 |
| L | 0.4 | | 1.27 | 0.016 | | 0.050 |
| M | | | 0.6 | | | 0.024 |
| S | 8° (max.) | | | | | |

OUTLINE AND MECHANICAL DATA



SO8

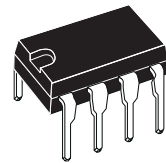
(1) D and F do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (.006inch).



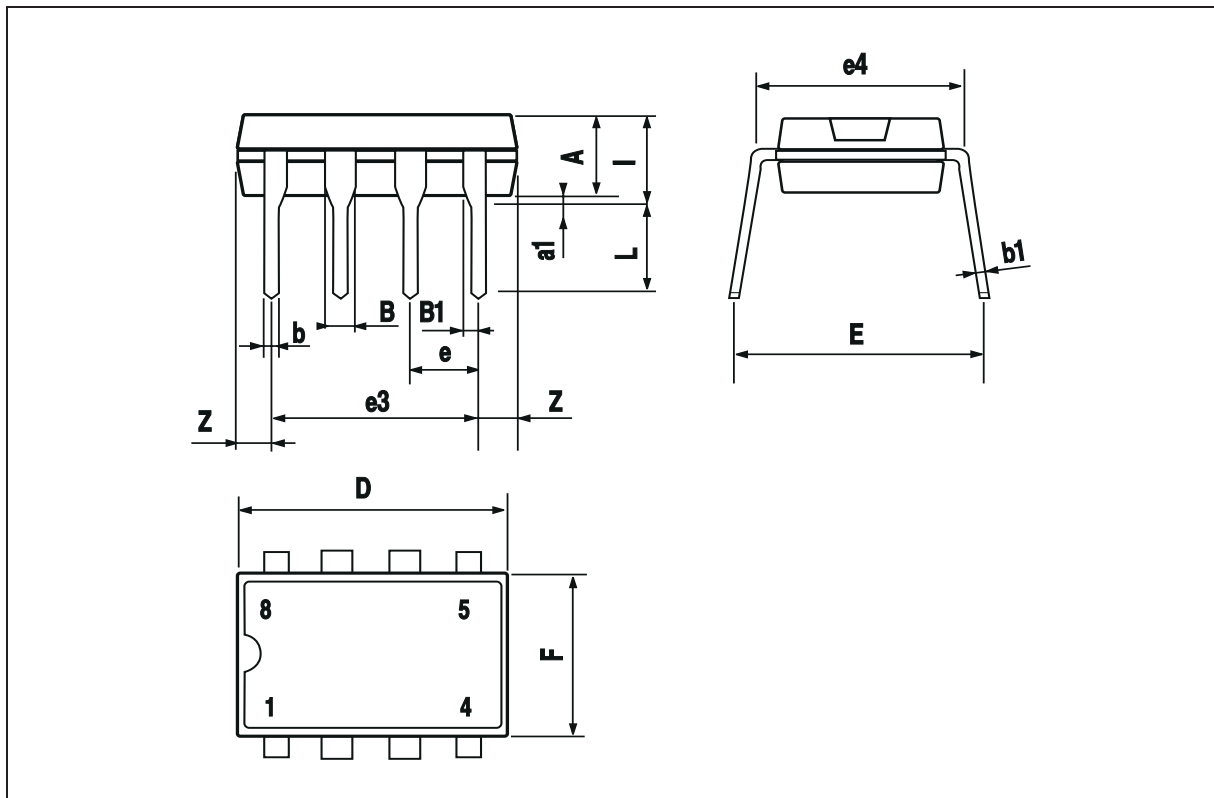
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| DIM. | mm | | | inch | | |
|------|-------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | 3.32 | | | 0.131 | |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.15 | | 1.65 | 0.045 | | 0.065 |
| b | 0.356 | | 0.55 | 0.014 | | 0.022 |
| b1 | 0.204 | | 0.304 | 0.008 | | 0.012 |
| D | | | 10.92 | | | 0.430 |
| E | 7.95 | | 9.75 | 0.313 | | 0.384 |
| e | | 2.54 | | | 0.100 | |
| e3 | | 7.62 | | | 0.300 | |
| e4 | | 7.62 | | | 0.300 | |
| F | | | 6.6 | | | 0.260 |
| I | | | 5.08 | | | 0.200 |
| L | 3.18 | | 3.81 | 0.125 | | 0.150 |
| Z | | | 1.52 | | | 0.060 |

OUTLINE AND MECHANICAL DATA



Minidip



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