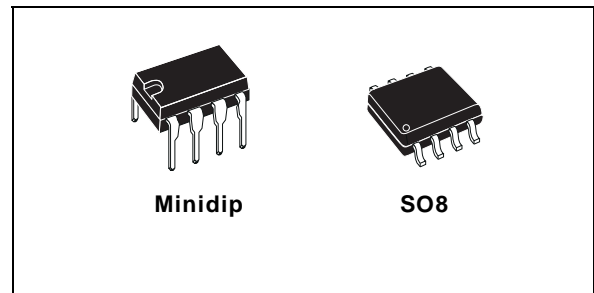




# UC2842B/3B/4B/5B UC3842B/3B/4B/5B

## 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



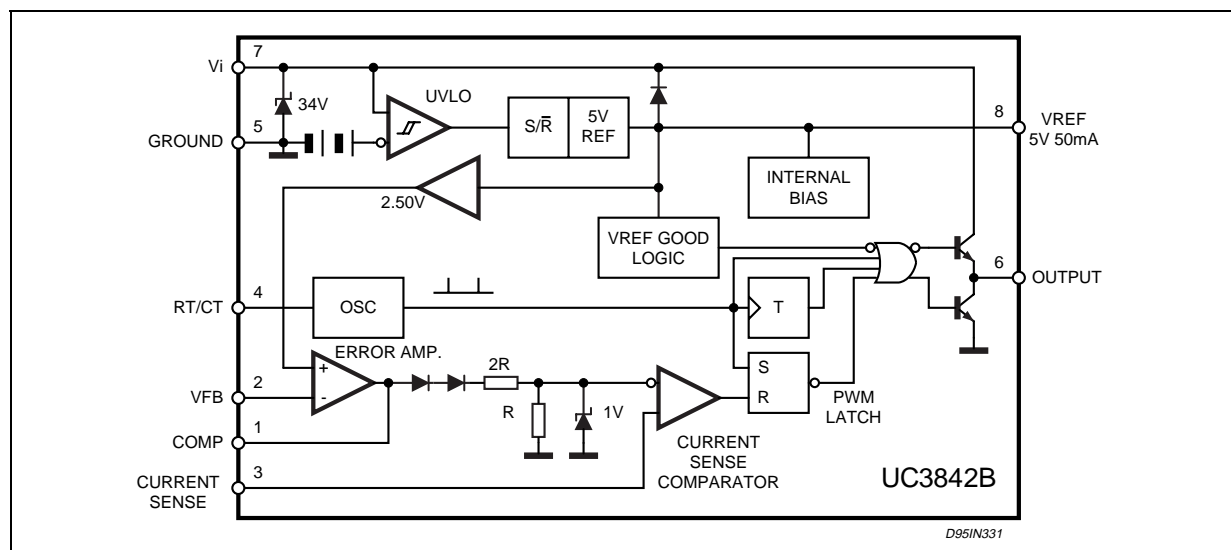
comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N-Channel MOSFETs, is low in the off-state.

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 8.5 V and 7.9 V. 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.

### 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

### 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   | $\pm 1$       | A                |
| $E_o$     | Output Energy (capacitive load)                                | 5             | $\mu\text{J}$    |
|           | 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  $-25 \leq T_{amb} \leq 85^{\circ}\text{C}$  for UC284XB;  $0 \leq T_{amb} \leq 70^{\circ}\text{C}$  for UC384XB;  $V_i = 15\text{V}$  (note 5);  $R_T = 10\text{K}$ ;  $C_T = 3.3\text{nF}$ )

| Symbol                       | Parameter                                   | Test Conditions  | UC284XB |      |      | UC384XB |      |      | Unit          |
|------------------------------|---|--|---------|------|------|---------|------|------|---------------|
|                              |   |  | Min.    | Typ. | Max. | Min.    | Typ. | Max. |               |
| <b>REFERENCE SECTION</b>     |   |  |         |      |      |         |      |      |               |
| $V_{REF}$                    | Output Voltage                              | $T_j = 25^{\circ}\text{C}$ $I_o = 1\text{mA}$                              | 4.95    | 5.00 | 5.05 | 4.90    | 5.00 | 5.10 | V             |
| $\Delta V_{REF}$             | Line Regulation                             | $12\text{V} \leq V_i \leq 25\text{V}$                                      |         | 2    | 20   |         | 2    | 20   | mV            |
| $\Delta V_{REF}$             | Load Regulation                             | $1 \leq I_o \leq 20\text{mA}$  |         | 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                        | $10\text{Hz} \leq f \leq 10\text{KHz}$ $T_j = 25^{\circ}\text{C}$ (note 2) |         | 50   |      |         | 50   |      | $\mu\text{V}$ |
|                              | Long Term Stability                         | $T_{amb} = 125^{\circ}\text{C}$ , 1000Hrs (note 2)                         |         | 5    | 25   |         | 5    | 25   | mV            |
| $I_{SC}$                     | Output Short Circuit                        |  | -30     | -100 | -180 | -30     | -100 | -180 | mA            |
| <b>OSCILLATOR SECTION</b>    |   |  |         |      |      |         |      |      |               |
| $f_{OSC}$                    | Frequency                                   | $T_j = 25^{\circ}\text{C}$   | 49      | 52   | 55   | 49      | 52   | 55   | KHz           |
|                              |   | $T_A = T_{low}$ to $T_{high}$  | 48      | -    | 56   | 48      | -    | 56   | KHz           |
|                              |   | $T_j = 25^{\circ}\text{C}$ ( $R_T = 6.2\text{k}$ , $C_T = 1\text{nF}$ )    | 225     | 250  | 275  | 225     | 250  | 275  | KHz           |
| $\Delta f_{OSC}/\Delta V$    | Frequency Change with Volt.                 | $V_{CC} = 12\text{V}$ to $25\text{V}$                                      | -       | 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 ( $V_{OSC} = 2\text{V}$ ) | $T_j = 25^{\circ}\text{C}$   | 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            |
| <b>ERROR AMP SECTION</b>     |   |  |         |      |      |         |      |      |               |
| $V_2$                        | Input Voltage                               | $V_{PIN1} = 2.5\text{V}$   | 2.45    | 2.50 | 2.55 | 2.42    | 2.50 | 2.58 | V             |
| $I_b$                        | Input Bias Current                          | $V_{FB} = 5\text{V}$   |         | -0.1 | -1   |         | -0.1 | -2   | $\mu\text{A}$ |
|                              | $A_{VOL}$                                   | $2\text{V} \leq V_o \leq 4\text{V}$  | 65      | 90   |      | 65      | 90   |      | dB            |
| BW                           | Unity Gain Bandwidth                        | $T_j = 25^{\circ}\text{C}$   | 0.7     | 1    |      | 0.7     | 1    |      | MHz           |
| PSRR                         | Power Supply Rejec. Ratio                   | $12\text{V} \leq V_i \leq 25\text{V}$                                      | 60      | 70   |      | 60      | 70   |      | dB            |
| $I_o$                        | Output Sink Current                         | $V_{PIN2} = 2.7\text{V}$ $V_{PIN1} = 1.1\text{V}$                          | 2       | 12   |      | 2       | 12   |      | mA            |
| $I_o$                        | Output Source Current                       | $V_{PIN2} = 2.3\text{V}$ $V_{PIN1} = 5\text{V}$                            | -0.5    | -1   |      | -0.5    | -1   |      | mA            |
|                              | $V_{OUT}$ High                              | $V_{PIN2} = 2.3\text{V}$ ;<br>$R_L = 15\text{K}\Omega$ to Ground           | 5       | 6.2  |      | 5       | 6.2  |      | V             |
|                              | $V_{OUT}$ Low                               | $V_{PIN2} = 2.7\text{V}$ ;<br>$R_L = 15\text{K}\Omega$ to Pin 8            |         | 0.8  | 1.1  |         | 0.8  | 1.1  | V             |
| <b>CURRENT SENSE SECTION</b> |   |  |         |      |      |         |      |      |               |
| $G_V$                        | Gain  | (note 3 & 4)   | 2.85    | 3    | 3.15 | 2.85    | 3    | 3.15 | V/V           |
| $V_3$                        | Maximum Input Signal                        | $V_{PIN1} = 5\text{V}$ (note 3)  | 0.9     | 1    | 1.1  | 0.9     | 1    | 1.1  | V             |
| SVR                          | Supply Voltage Rejection                    | $12 \leq V_i \leq 25\text{V}$ (note 3)                                     |         | 70   |      |         | 70   |      | dB            |
| $I_b$                        | Input Bias Current                          |  |         | -2   | -10  |         | -2   | -10  | $\mu\text{A}$ |
|                              | 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. |      |
| <b>OUTPUT SECTION</b>                |                                     |  |         |      |      |         |      |      |      |
| V <sub>OL</sub>                      | Output Low Level                    | I <sub>SINK</sub> = 20mA                       |         | 0.1  | 0.4  |         | 0.1  | 0.4  | V    |
|                                      |                                     | I <sub>SINK</sub> = 200mA                      |         | 1.6  | 2.2  |         | 1.6  | 2.2  | V    |
| V <sub>OH</sub>                      | Output High Level                   | I <sub>SOURCE</sub> = 20mA                     | 13      | 13.5 |      | 13      | 13.5 |      | V    |
|                                      |                                     | I <sub>SOURCE</sub> = 200mA                    | 12      | 13.5 |      | 12      | 13.5 |      | V    |
| V <sub>OLS</sub>                     | UVLO Saturation                     | V <sub>CC</sub> = 6V; I <sub>SINK</sub> = 1mA  |         | 0.1  | 1.1  |         | 0.1  | 1.1  | V    |
| t <sub>r</sub>                       | Rise Time                           | T <sub>j</sub> = 25°C C <sub>L</sub> = 1nF (2) |         | 50   | 150  |         | 50   | 150  | ns   |
| t <sub>f</sub>                       | Fall Time                           | T <sub>j</sub> = 25°C C <sub>L</sub> = 1nF (2) |         | 50   | 150  |         | 50   | 150  | ns   |
| <b>UNDER-VOLTAGE LOCKOUT SECTION</b> |                                     |  |         |      |      |         |      |      |      |
|                                      | 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    |
| <b>PWM SECTION</b>                   |                                     |  |         |      |      |         |      |      |      |
|                                      | Maximum Duty Cycle                  | X842B/3B                                       | 94      | 96   | 100  | 94      | 96   | 100  | %    |
|                                      |                                     | X844B/5B                                       | 47      | 48   | 50   | 47      | 48   | 50   | %    |
|                                      | Minimum Duty Cycle                  |  |         | 0    |      |         | 0    | %    |      |
| <b>TOTAL STANDBY CURRENT</b>         |                                     |  |         |      |      |         |      |      |      |
| I <sub>st</sub>                      | Start-up Current                    | V <sub>i</sub> = 6.5V for UCX843B/45B          |         | 0.3  | 0.5  |         | 0.3  | 0.5  | mA   |
|                                      |                                     | V <sub>i</sub> = 14V for UCX842B/44B           |         | 0.3  | 0.5  |         | 0.3  | 0.5  | mA   |
| I <sub>i</sub>                       | Operating Supply Current            | V <sub>PIN2</sub> = V <sub>PIN3</sub> = 0V     |         | 12   | 17   |         | 12   | 17   | mA   |
| V <sub>iz</sub>                      | Zener Voltage                       | I <sub>i</sub> = 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<sub>j</sub> as close to T<sub>amb</sub> as possible.
  2. These parameters, although guaranteed, are not 100% tested in production.
  3. Parameter measured at trip point of latch with V<sub>PIN2</sub> = 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<sub>i</sub> 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.

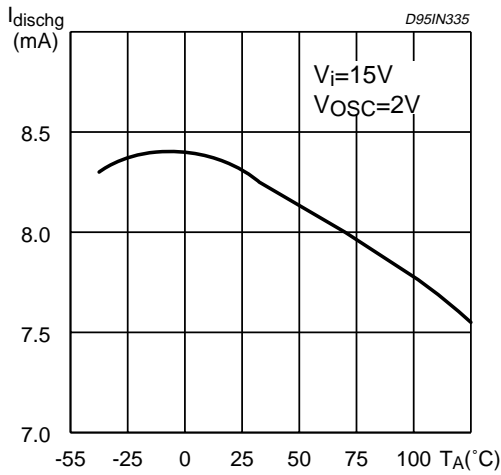
Figure 2: Timing Resistor vs. Oscillator Frequency



Figure 3: Output Dead-Time vs. Oscillator Frequency



**Figure 4:** Oscillator Discharge Current vs. Temperature.



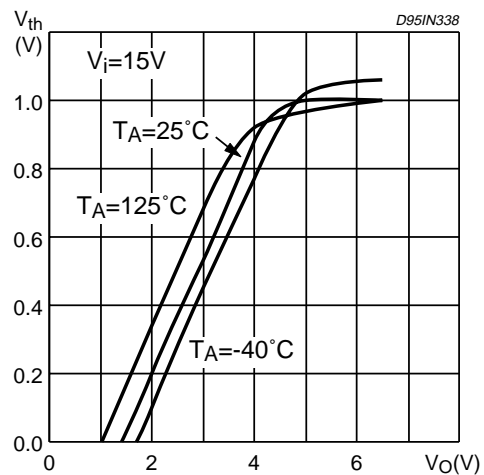
**Figure 5:** Maximum Output Duty Cycle vs. Timing Resistor.



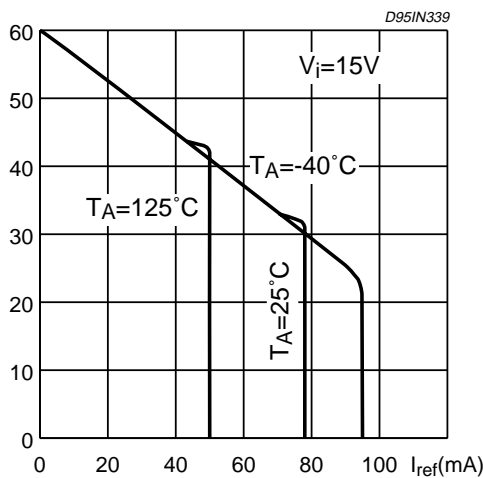
**Figure 6:** Error Amp Open-Loop Gain and Phase vs. Frequency.



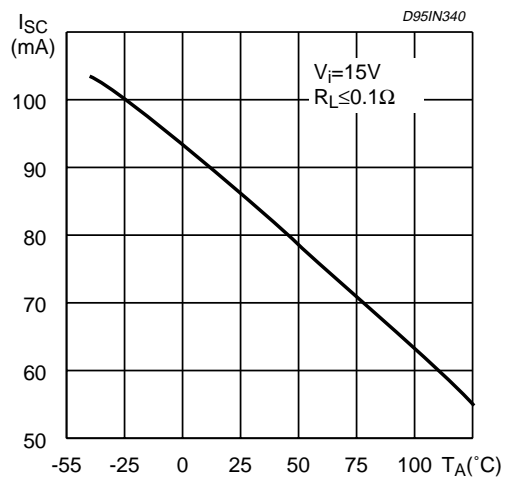
**Figure 7:** Current Sense Input Threshold vs. Error Amp Output Voltage.



**Figure 8:** Reference Voltage Change vs. Source Current.



**Figure 9:** Reference Short Circuit Current vs. Temperature.



**Figure 10:** Output Saturation Voltages vs. Load Current.



**Figure 12:** Output Waveform.



**Figure 14:** Oscillator and Output Waveforms.



**Figure 11:** Supply Current vs. Supply Voltage.



**Figure 13:** Output Cross Conduction



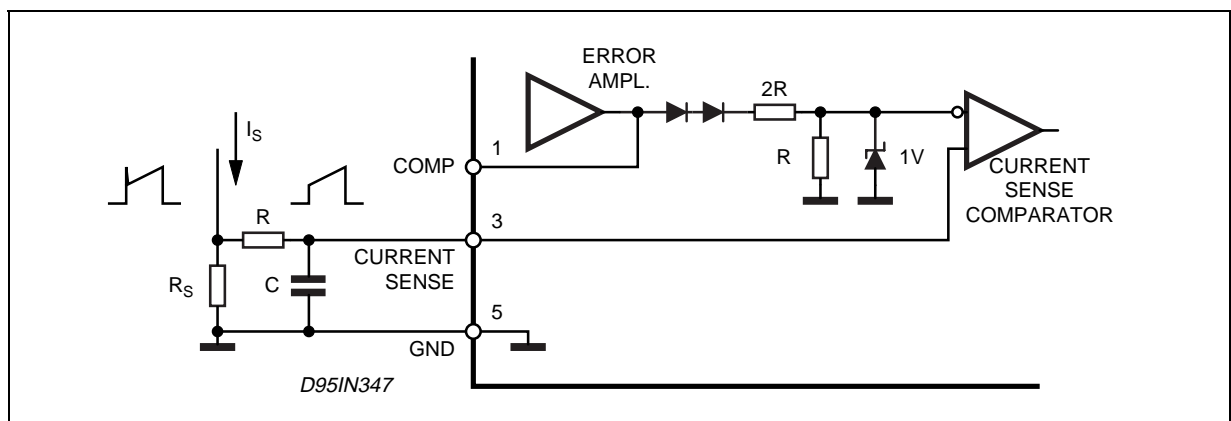
Figure 15 : Error Amp Configuration.



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

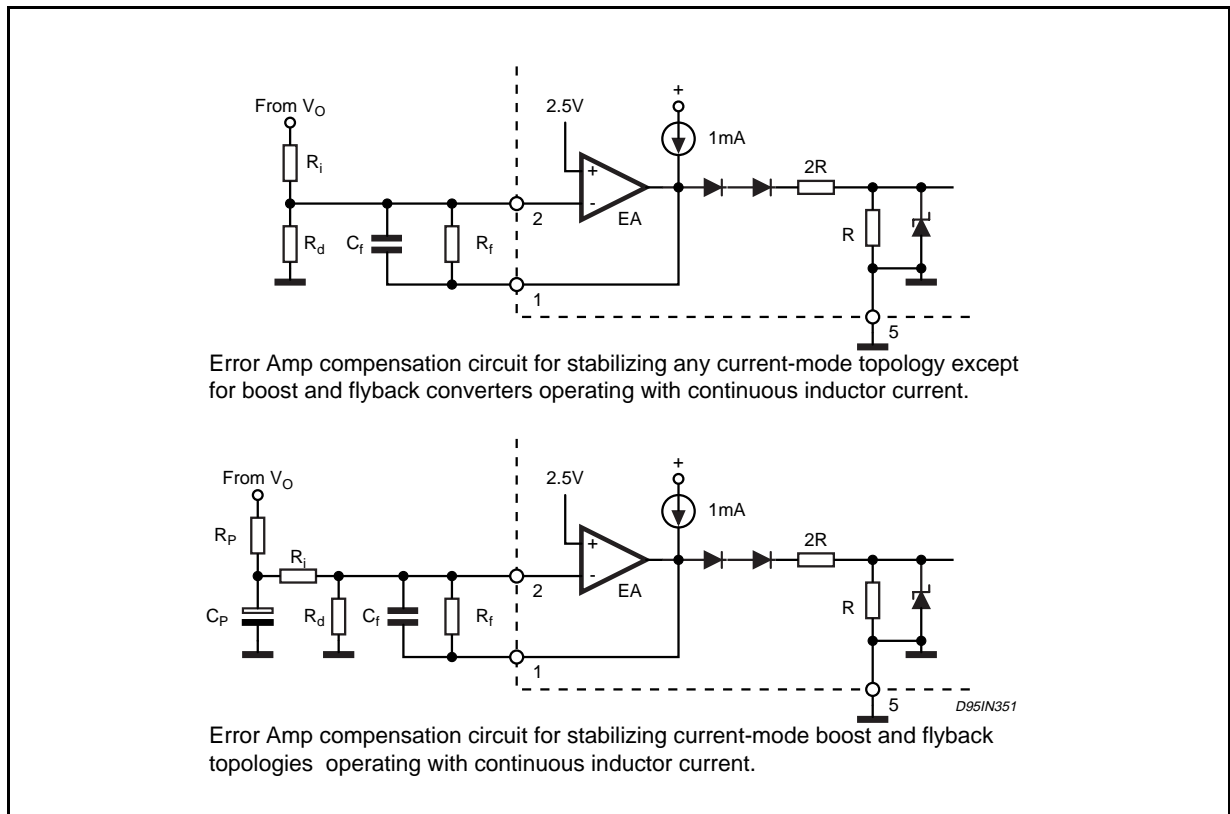


Figure 22: External Clock Synchronization.



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

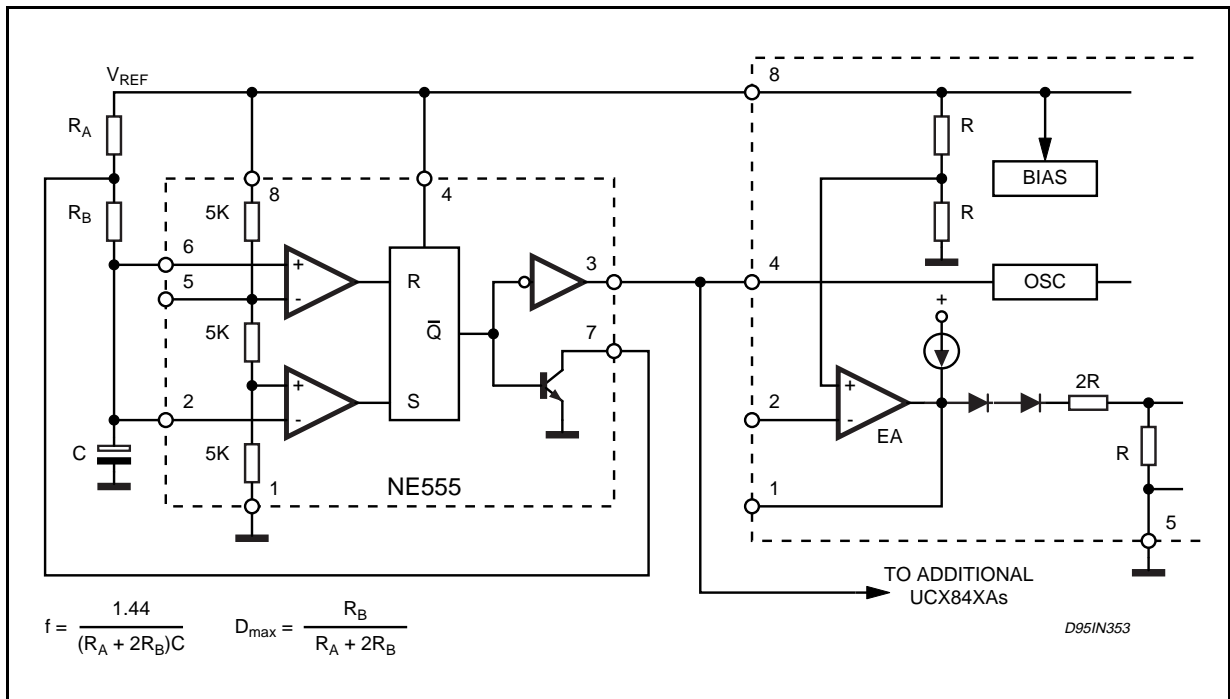


Figure 24: Soft-Start Circuit



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).



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

| 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

