



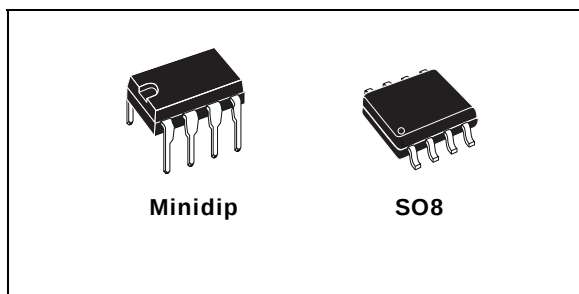
# UC2842B/3B/4B/5B UC3842B/3B/4B/5B

## 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

### DESCRIPTION

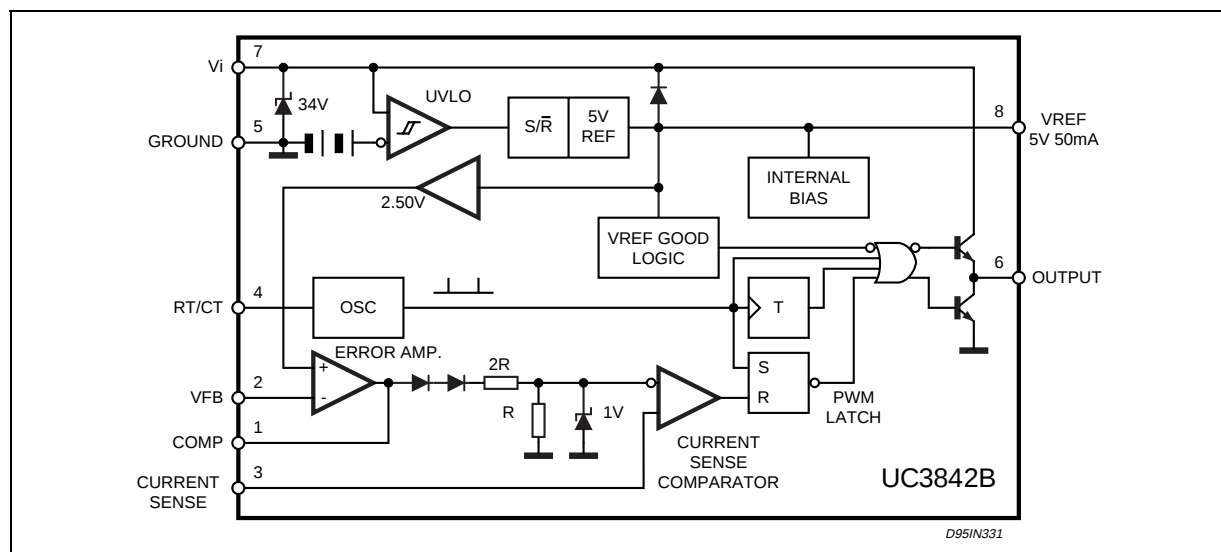
The UC384xB family of control ICs provides the necessary features to implement off-line or DC to DC fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include a trimmed oscillator for precise DUTY CYCLE CONTROL under voltage lockout featuring 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



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 8.5V 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)



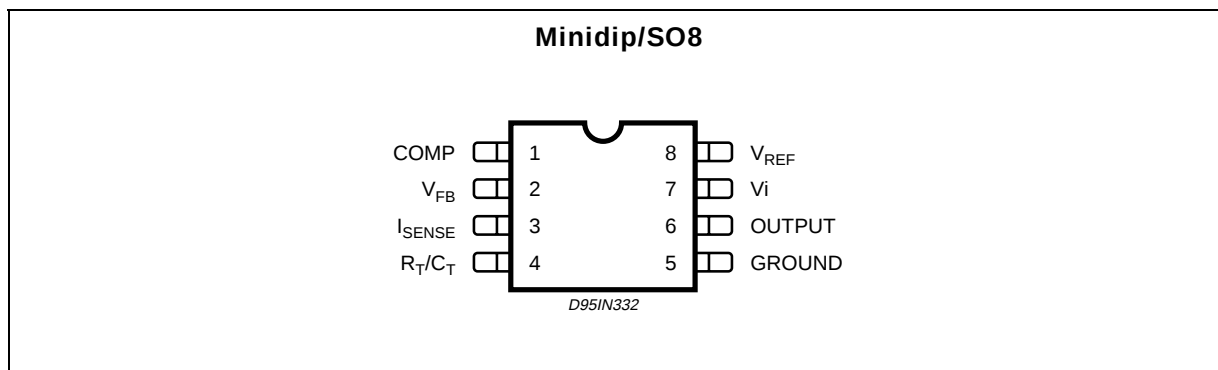
## UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

### 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                                                        | $\pm 1$         | 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               |
| $P_{\text{tot}}$ | Power Dissipation at $T_{\text{amb}} \leq 25^\circ\text{C}$ (Minidip) | 1.25            | W                |
| $P_{\text{tot}}$ | Power Dissipation at $T_{\text{amb}} \leq 25^\circ\text{C}$ (SO8)     | 800             | mW               |
| $T_{\text{stg}}$ | 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  | $I_{\text{SENSE}}$ | 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 $V_{\text{ref}}$ 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  | $V_{\text{ref}}$   | 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.            |                   |
| REFERENCE SECTION     |                                          |                                                                                                                                                        |                 |                |                 |                 |                |                 |                   |
| V <sub>REF</sub>      | Output Voltage                           | T <sub>j</sub> = 25°C I <sub>o</sub> = 1mA                                                                                                             | 4.95            | 5.00           | 5.05            | 4.90            | 5.00           | 5.10            | V                 |
| ΔV <sub>REF</sub>     | Line Regulation                          | 12V ≤ V <sub>i</sub> ≤ 25V                                                                                                                             |                 | 2              | 20              |                 | 2              | 20              | mV                |
| ΔV <sub>REF</sub>     | Load Regulation                          | 1 ≤ I <sub>o</sub> ≤ 20mA                                                                                                                              |                 | 3              | 25              |                 | 3              | 25              | mV                |
| ΔV <sub>REF</sub> /ΔT | 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 <sub>N</sub>        | Output Noise Voltage                     | 10Hz ≤ f ≤ 10KHz T <sub>j</sub> = 25°C (note 2)                                                                                                        |                 | 50             |                 |                 | 50             |                 | μV                |
|                       | Long Term Stability                      | T <sub>amb</sub> = 125°C, 1000Hrs (note 2)                                                                                                             |                 | 5              | 25              |                 | 5              | 25              | mV                |
| I <sub>SC</sub>       | Output Short Circuit                     |                                                                                                                                                        | -30             | -100           | -180            | -30             | -100           | -180            | mA                |
| OSCILLATOR SECTION    |                                          |                                                                                                                                                        |                 |                |                 |                 |                |                 |                   |
| f <sub>OSC</sub>      | Frequency                                | T <sub>j</sub> = 25°C<br>T <sub>A</sub> = T <sub>low</sub> to T <sub>high</sub><br>T <sub>j</sub> = 25°C (R <sub>T</sub> = 6.2k, C <sub>T</sub> = 1nF) | 49<br>48<br>225 | 52<br>–<br>250 | 55<br>56<br>275 | 49<br>48<br>225 | 52<br>–<br>250 | 55<br>56<br>275 | KHz<br>KHz<br>KHz |
| Δf <sub>OSC</sub> /ΔV | Frequency Change with Volt.              | V <sub>CC</sub> = 12V to 25V                                                                                                                           | –               | 0.2            | 1               | –               | 0.2            | 1               | %                 |
| Δf <sub>OSC</sub> /ΔT | Frequency Change with Temp.              | T <sub>A</sub> = T <sub>low</sub> to T <sub>high</sub>                                                                                                 | –               | 1              | –               | –               | 0.5            | –               | %                 |
| V <sub>OSC</sub>      | Oscillator Voltage Swing                 | (peak to peak)                                                                                                                                         | –               | 1.6            | –               | –               | 1.6            | –               | V                 |
| I <sub>dischg</sub>   | Discharge Current (V <sub>OSC</sub> =2V) | T <sub>j</sub> = 25°C<br>T <sub>A</sub> = T <sub>low</sub> to T <sub>high</sub>                                                                        | 7.8<br>7.5      | 8.3<br>–       | 8.8<br>8.8      | 7.8<br>7.6      | 8.3<br>–       | 8.8<br>8.8      | mA<br>mA          |
| ERROR AMP SECTION     |                                          |                                                                                                                                                        |                 |                |                 |                 |                |                 |                   |
| V <sub>2</sub>        | Input Voltage                            | V <sub>PIN1</sub> = 2.5V                                                                                                                               | 2.45            | 2.50           | 2.55            | 2.42            | 2.50           | 2.58            | V                 |
| I <sub>b</sub>        | Input Bias Current                       | V <sub>FB</sub> = 5V                                                                                                                                   |                 | -0.1           | -1              |                 | -0.1           | -2              | μA                |
|                       | A <sub>VOL</sub>                         | 2V ≤ V <sub>o</sub> ≤ 4V                                                                                                                               | 65              | 90             |                 | 65              | 90             |                 | dB                |
| BW                    | Unity Gain Bandwidth                     | T <sub>j</sub> = 25°C                                                                                                                                  | 0.7             | 1              |                 | 0.7             | 1              |                 | MHz               |
| PSRR                  | Power Supply Rejec. Ratio                | 12V ≤ V <sub>i</sub> ≤ 25V                                                                                                                             | 60              | 70             |                 | 60              | 70             |                 | dB                |
| I <sub>o</sub>        | Output Sink Current                      | V <sub>PIN2</sub> = 2.7V V <sub>PIN1</sub> = 1.1V                                                                                                      | 2               | 12             |                 | 2               | 12             |                 | mA                |
| I <sub>o</sub>        | Output Source Current                    | V <sub>PIN2</sub> = 2.3V V <sub>PIN1</sub> = 5V                                                                                                        | -0.5            | -1             |                 | -0.5            | -1             |                 | mA                |
|                       | V <sub>OUT</sub> High                    | V <sub>PIN2</sub> = 2.3V;<br>R <sub>L</sub> = 15KΩ to Ground                                                                                           | 5               | 6.2            |                 | 5               | 6.2            |                 | V                 |
|                       | V <sub>OUT</sub> Low                     | V <sub>PIN2</sub> = 2.7V;<br>R <sub>L</sub> = 15KΩ to Pin 8                                                                                            |                 | 0.8            | 1.1             |                 | 0.8            | 1.1             | V                 |
| CURRENT SENSE SECTION |                                          |                                                                                                                                                        |                 |                |                 |                 |                |                 |                   |
| G <sub>V</sub>        | Gain                                     | (note 3 & 4)                                                                                                                                           | 2.85            | 3              | 3.15            | 2.85            | 3              | 3.15            | V/V               |
| V <sub>3</sub>        | Maximum Input Signal                     | V <sub>PIN1</sub> = 5V (note 3)                                                                                                                        | 0.9             | 1              | 1.1             | 0.9             | 1              | 1.1             | V                 |
| SVR                   | Supply Voltage Rejection                 | 12 ≤ V <sub>i</sub> ≤ 25V (note 3)                                                                                                                     |                 | 70             |                 |                 | 70             |                 | dB                |
| I <sub>b</sub>        | Input Bias Current                       |                                                                                                                                                        |                 | -2             | -10             |                 | -2             | -10             | μA                |
|                       | Delay to Output                          |                                                                                                                                                        |                 | 150            | 300             |                 | 150            | 300             | ns                |

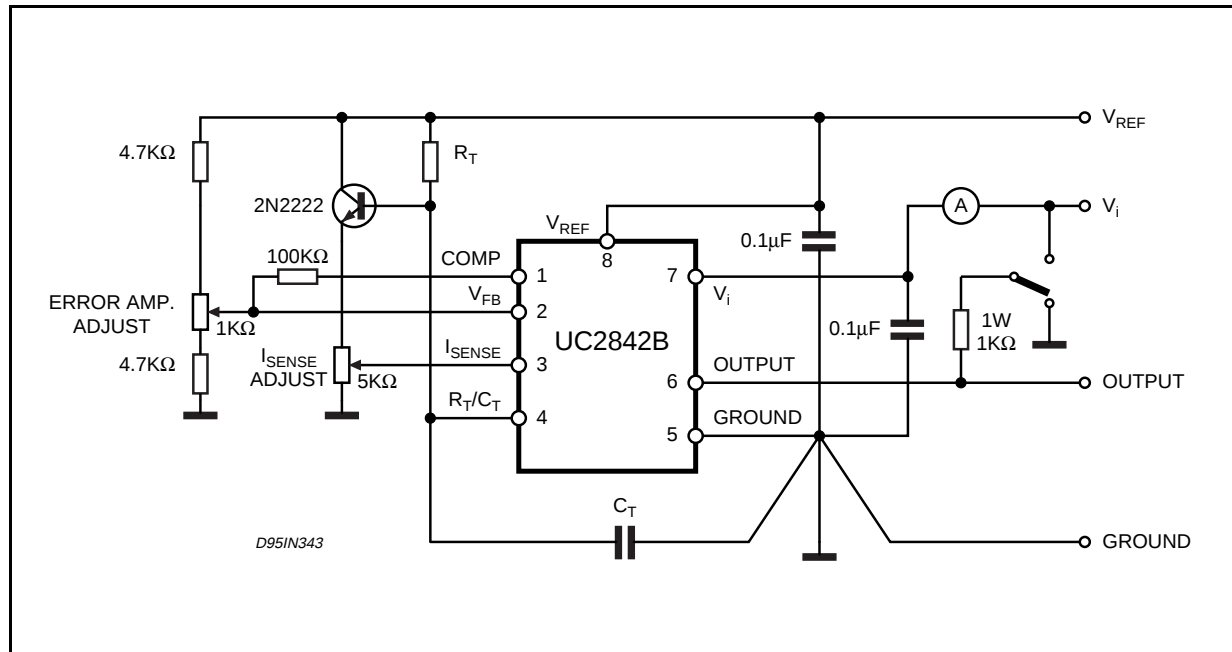
## UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

### ELECTRICAL CHARACTERISTICS (continued)

| Symbol                        | Parameter                           | Test Conditions                                | UC284XB |      |      | UC384XB |      |      | Unit |
|-------------------------------|-------------------------------------|------------------------------------------------|---------|------|------|---------|------|------|------|
|                               |                                     |                                                | Min.    | Typ. | Max. | Min.    | Typ. | Max. |      |
| OUTPUT SECTION                |                                     |                                                |         |      |      |         |      |      |      |
| V <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   |
| 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 <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    |

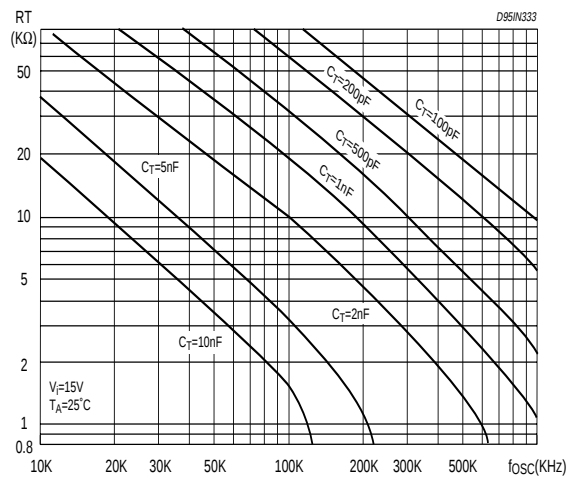
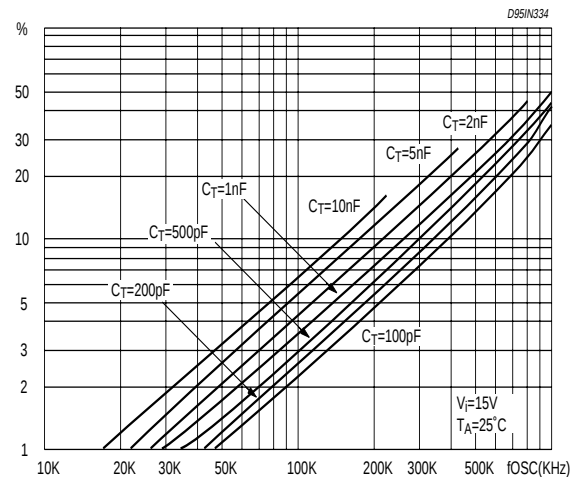
- Notes :**
1. Max package power dissipation limits must be respected; low duty cycle pulse techniques are used during test maintain T<sub>j</sub> as close to T<sub>amb</sub> as possible.
  2. These parameters, although guaranteed, are not 100% tested in production.
  3. Parameter measured at trip point 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.

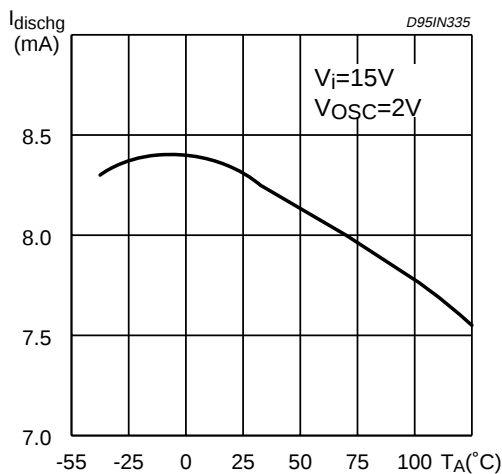
**Figure 1:** Open Loop Test Circuit.

High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close

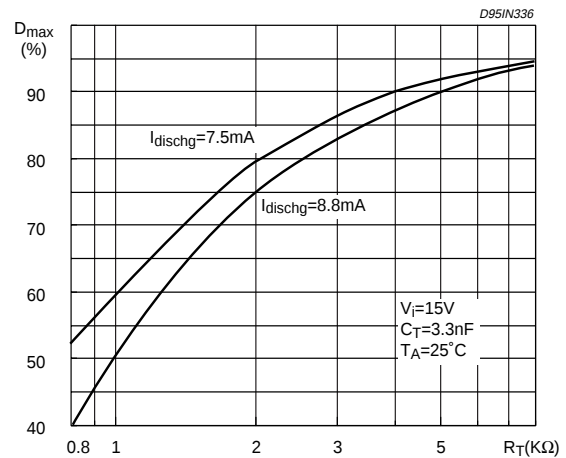
to pin 5 in a single point ground. The transistor and 5 KΩ potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin 3.

**Figure 2:** Timing Resistor vs. Oscillator Frequency**Figure 3:** Output Dead-Time vs. Oscillator Frequency

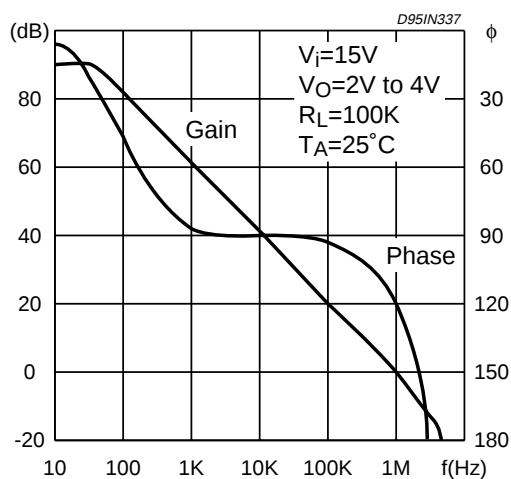
**Figure 4:** Oscillator Discharge Current vs. Temperature.



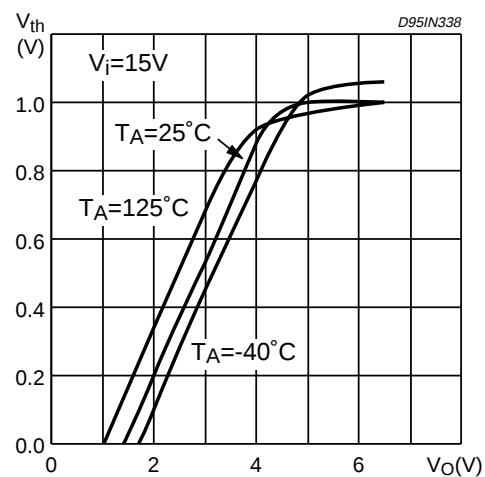
**Figure 5:** Maximum Output Duty Cycle vs. Timing Resistor.



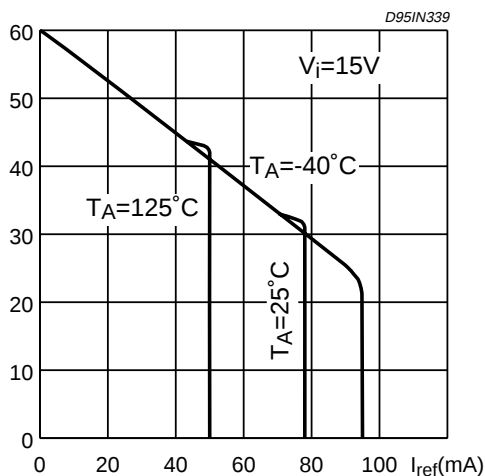
**Figure 6:** Error Amp Open-Loop Gain and Phase vs. Frequency.



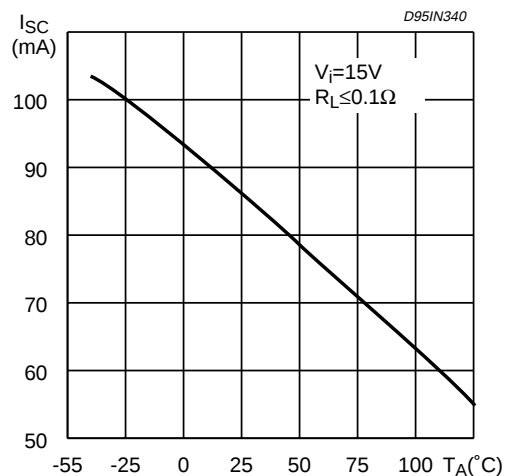
**Figure 7:** Current Sense Input Threshold vs. Error Amp Output Voltage.



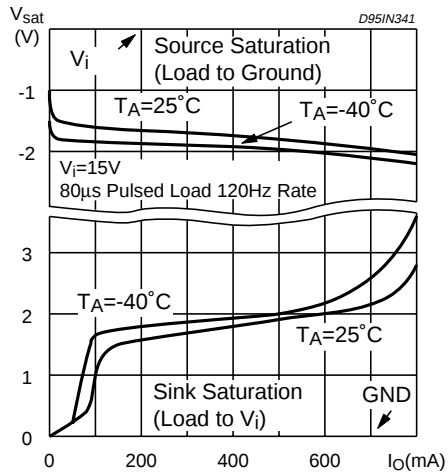
**Figure 8:** Reference Voltage Change vs. Source Current.



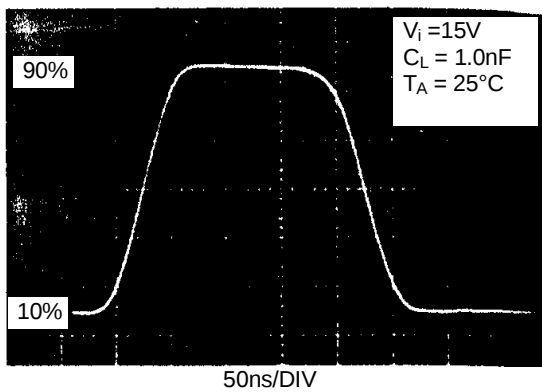
**Figure 9:** Reference Short Circuit Current vs. Temperature.



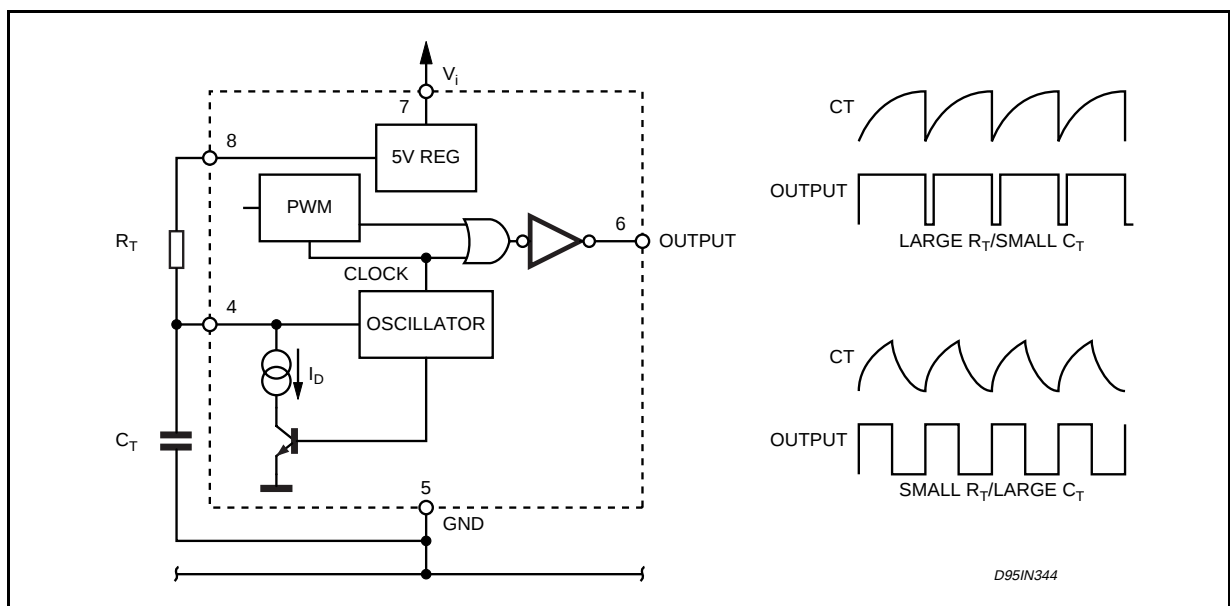
**Figure 10:** Output Saturation Voltages. Load Current.



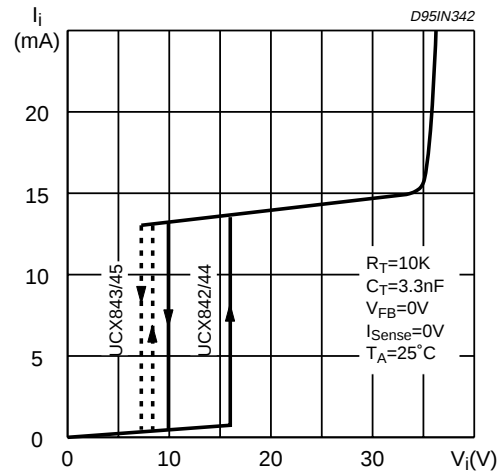
**Figure 12:** Output Waveform.



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



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



**Figure 13:** Output Cross Conduction

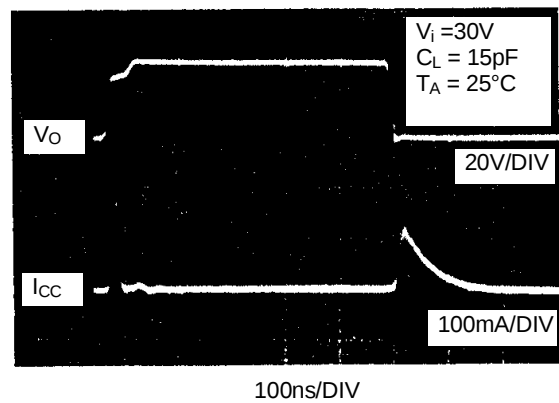


Figure 15 : Error Amp Configuration.

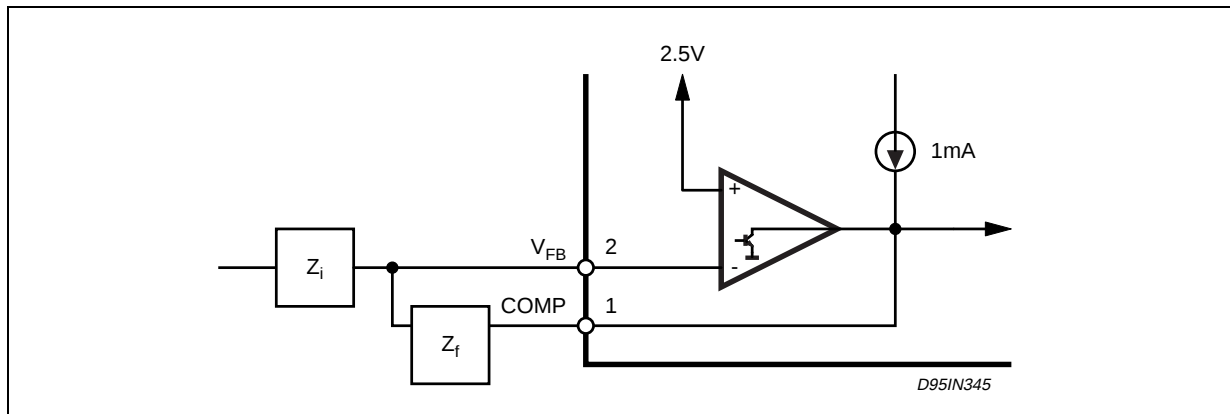


Figure 16 : Under Voltage Lockout.

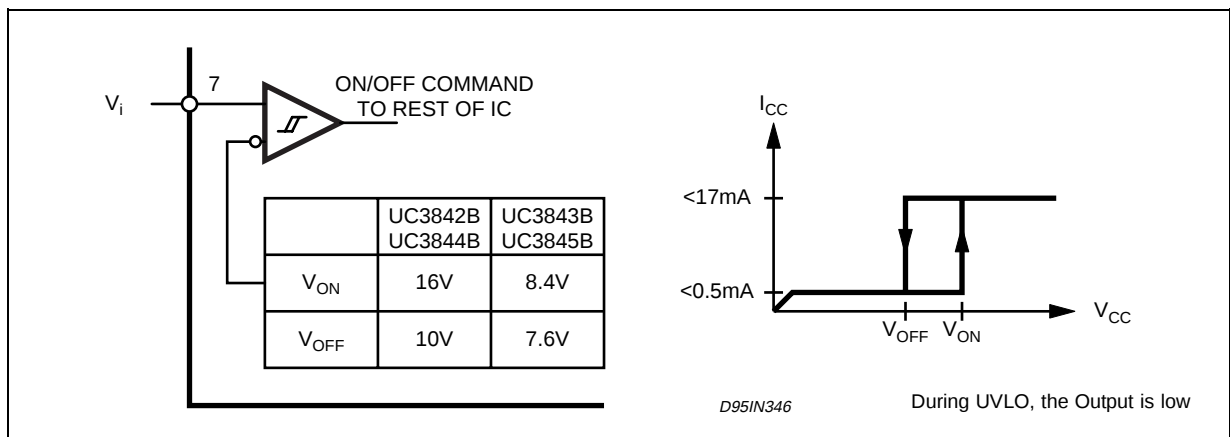
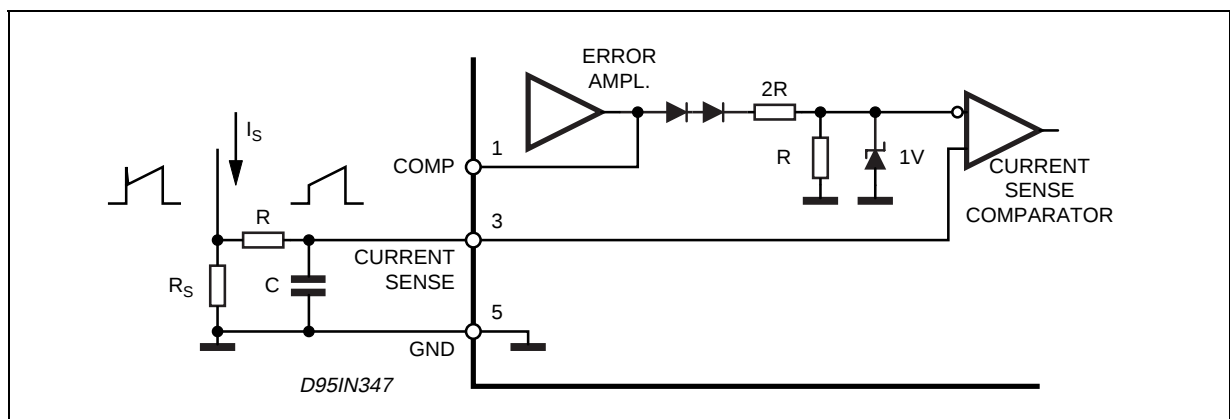


Figure 17 : Current Sense Circuit .



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 20 : Latched Shutdown.

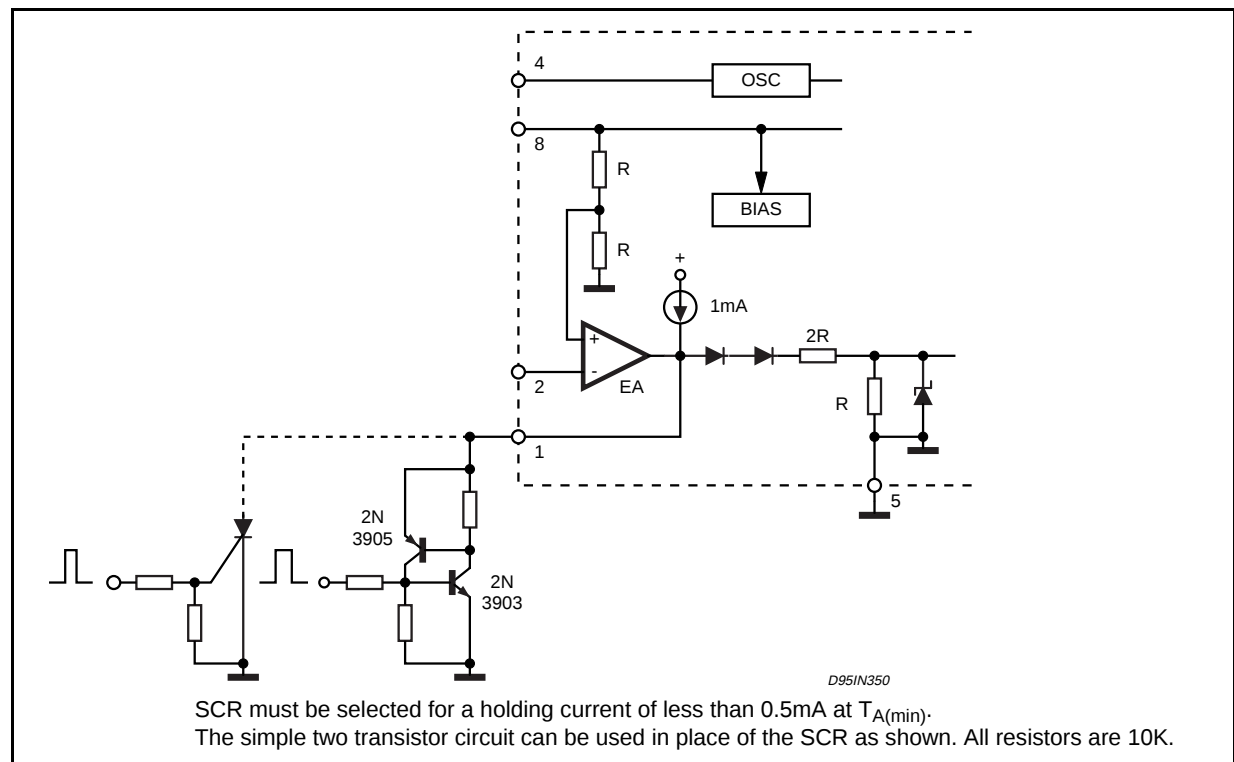
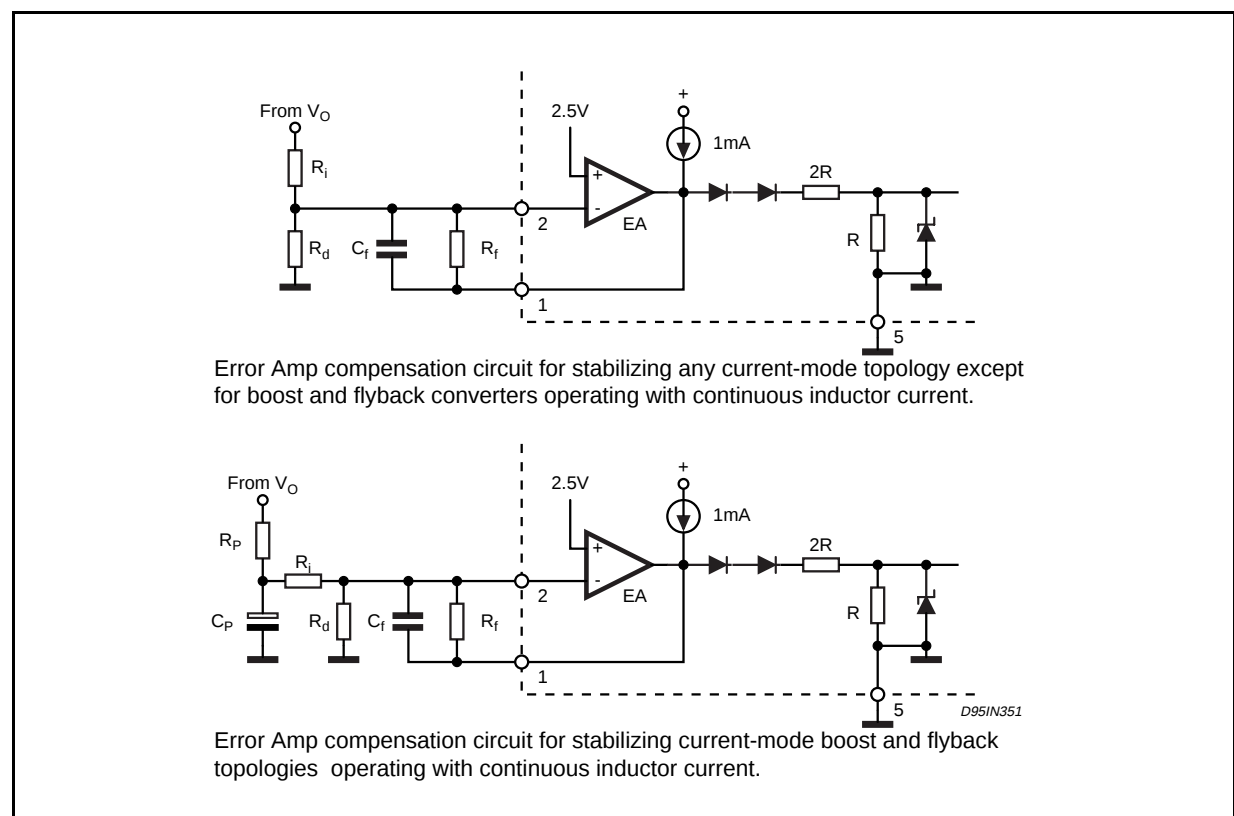


Figure 21: Error Amplifier Compensation



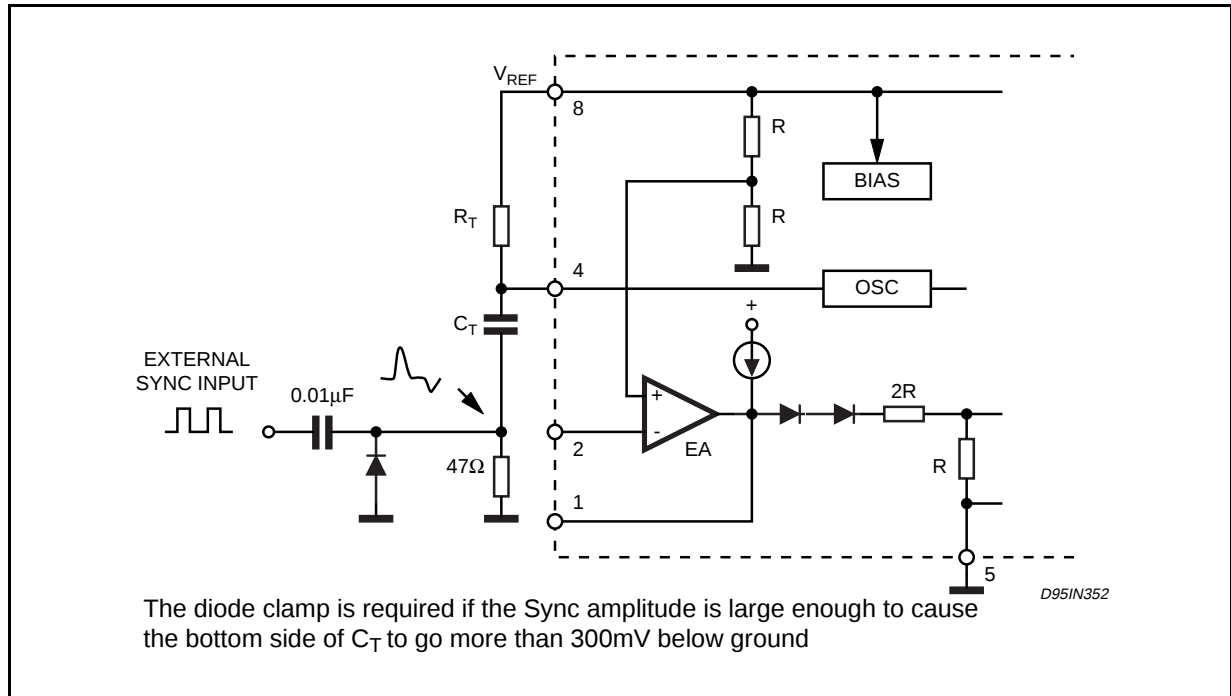
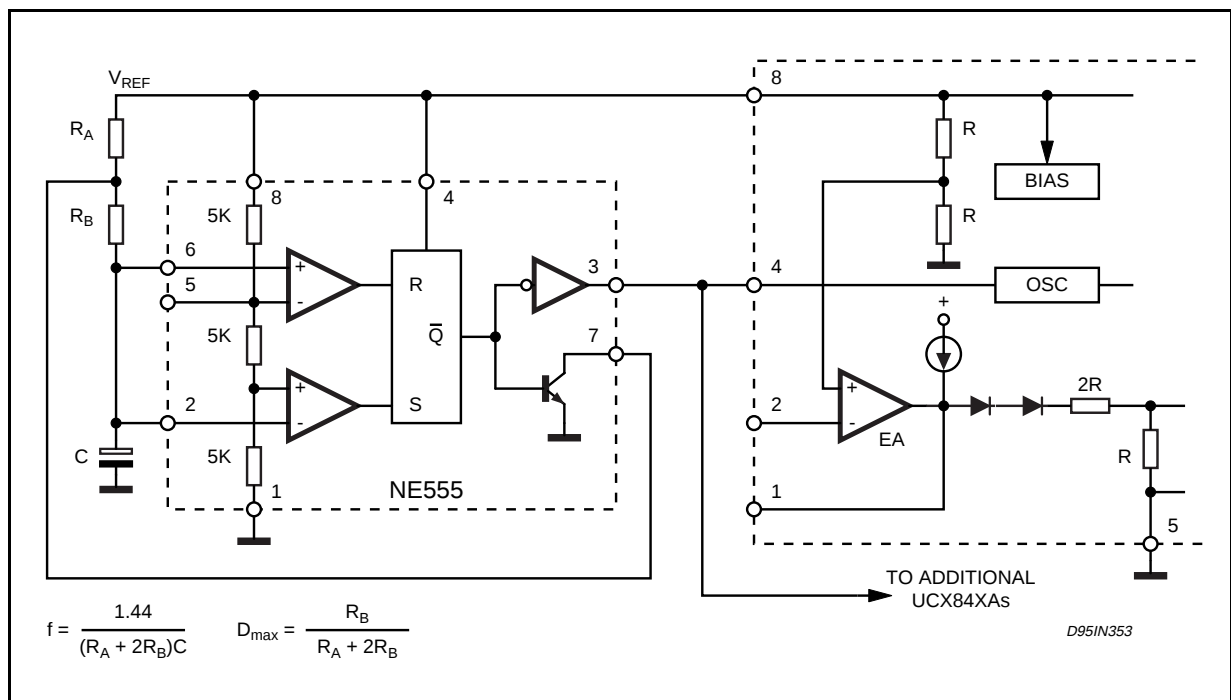
**Figure 22:** External Clock Synchronization.**Figure 23:** External Duty Cycle Clamp and Multi Unit Synchronization.

Figure 24: Soft-Start Circuit

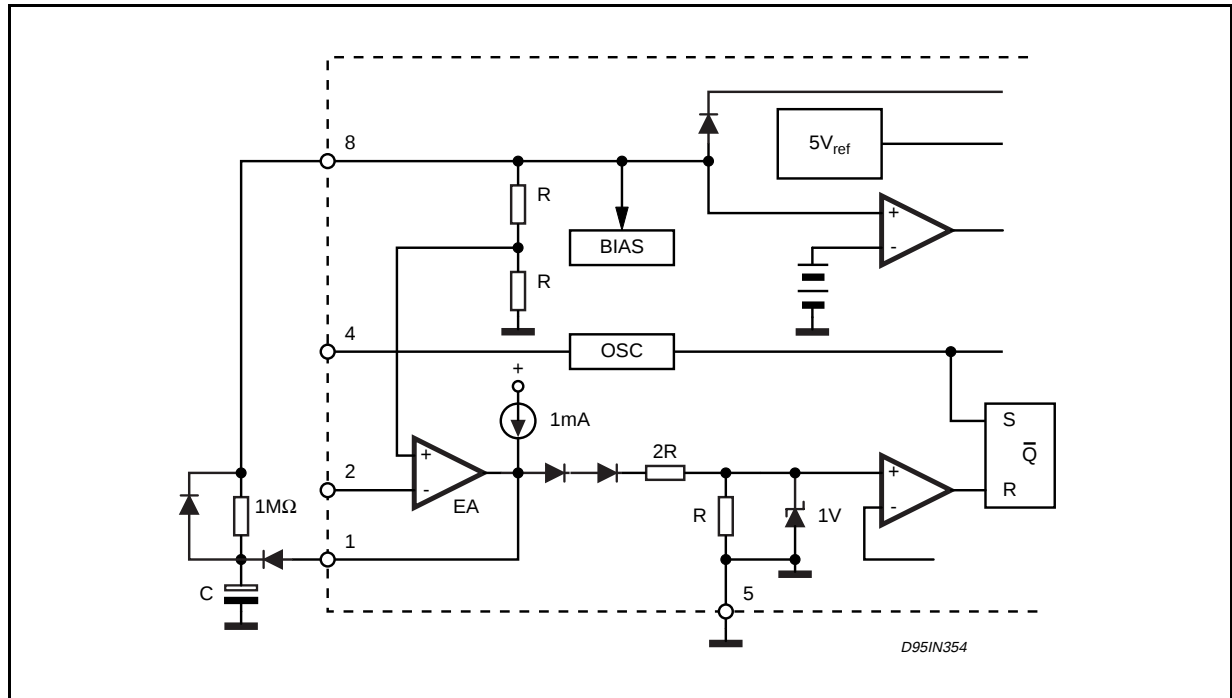
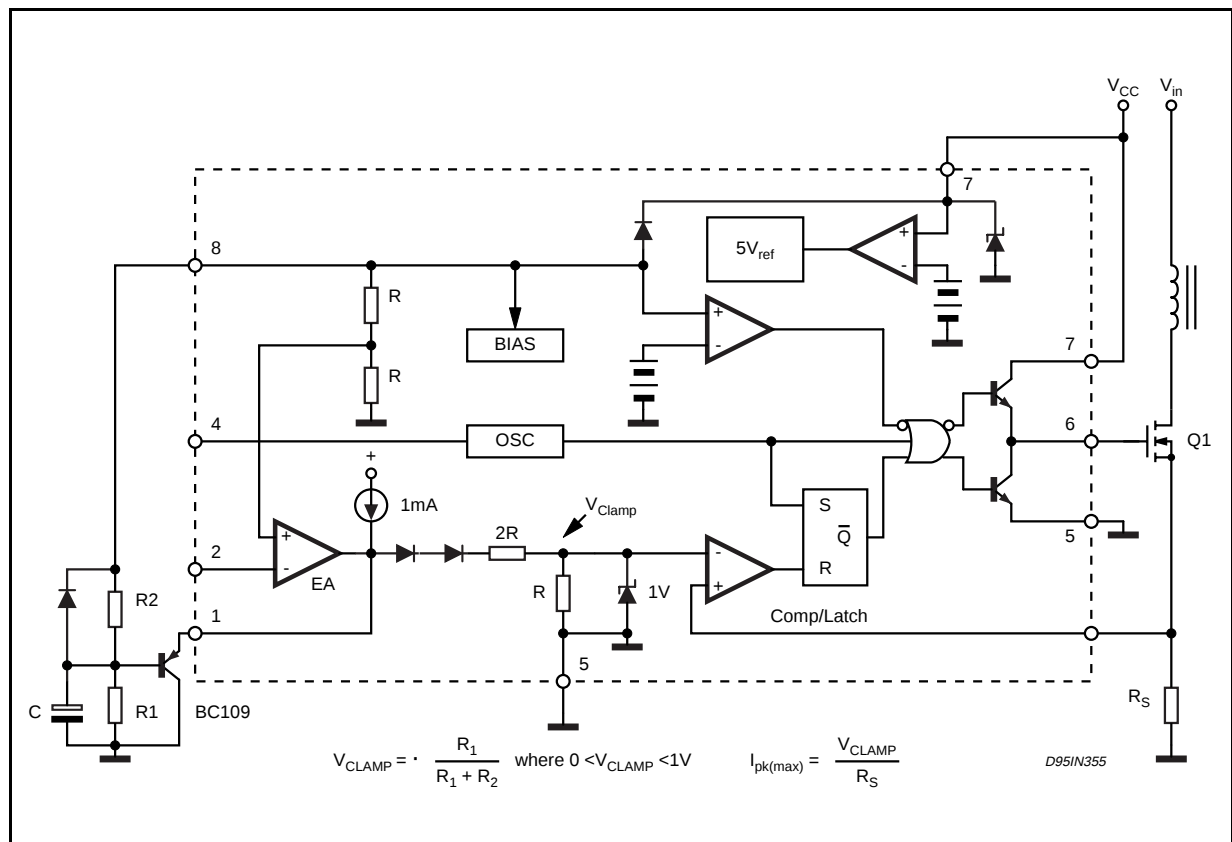


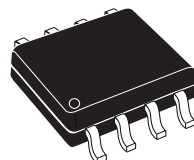
Figure 25: Soft-Start and Error Amplifier Output Duty Cycle Clamp.



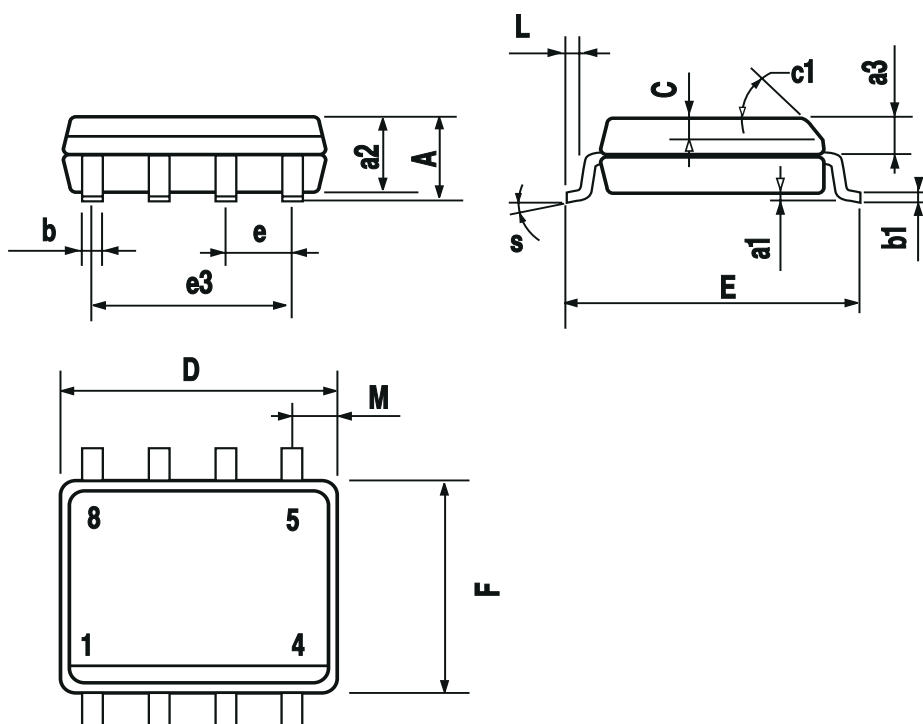
| DIM.  | mm         |      |      | inch  |       |       |
|-------|------------|------|------|-------|-------|-------|
|       | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A     |            |      | 1.75 |       |       | 0.069 |
| a1    | 0.1        |      | 0.25 | 0.004 |       | 0.010 |
| 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.)  |      |      |       |       |       |

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

## OUTLINE AND MECHANICAL DATA

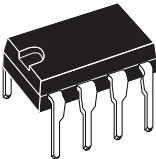


**SO8**

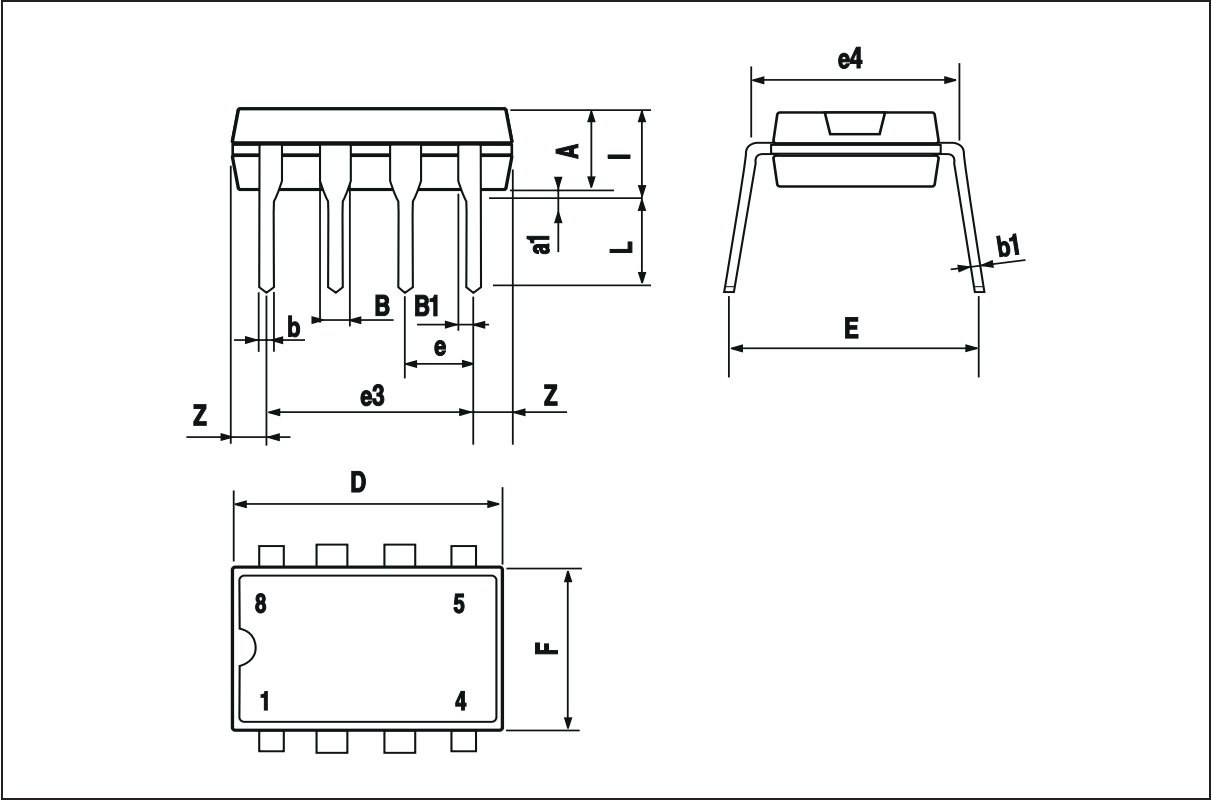


| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |       | 3.32 |       |       | 0.131 |       |
| a1   | 0.51  |      |       | 0.020 |       |       |
| B    | 1.15  |      | 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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