



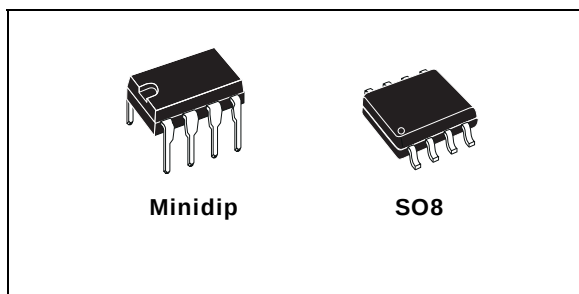
# UC2842B/3B/4B/5B UC3842B/3B/4B/5B

## 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

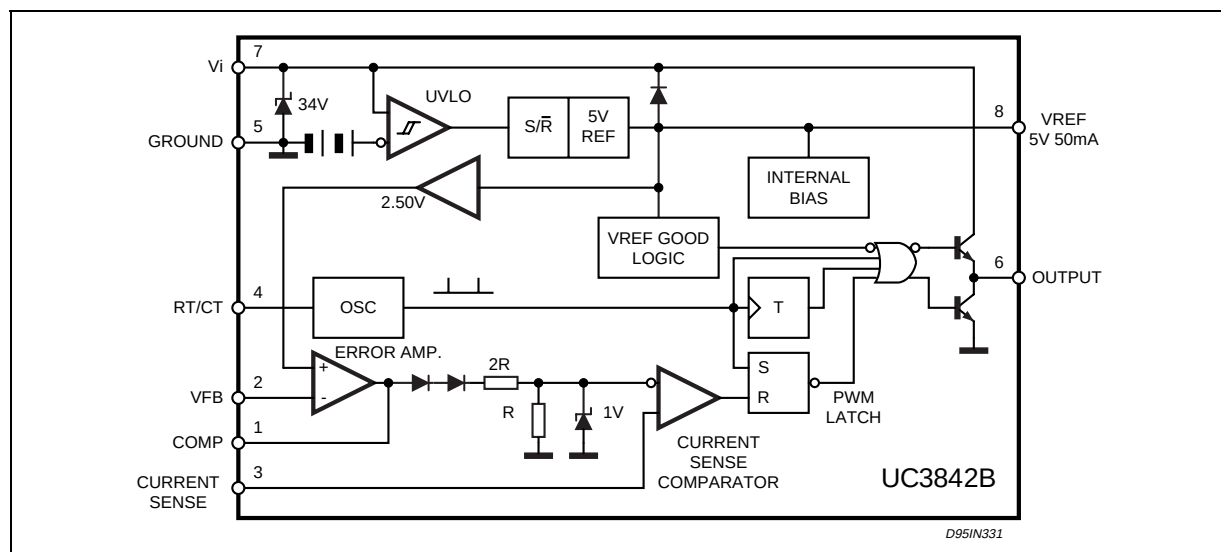
The UC384xB family of control ICs provides the necessary features to implement off-line or DC to DC fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include a trimmed oscillator for precise DUTY CYCLE CONTROL under voltage lockout featuring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



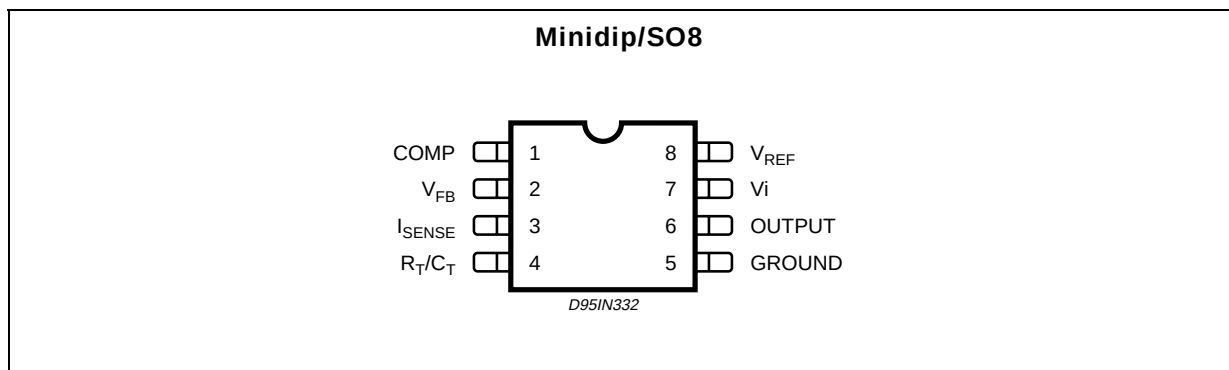
## UC2842B/3B/4B/5B - UC3842B/3B/4B/5B

### 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  | $V_{\text{FB}}$    | 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  | $V_{\text{CC}}$    | 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                |

## ELECTRICAL CHARACTERISTICS (continued)

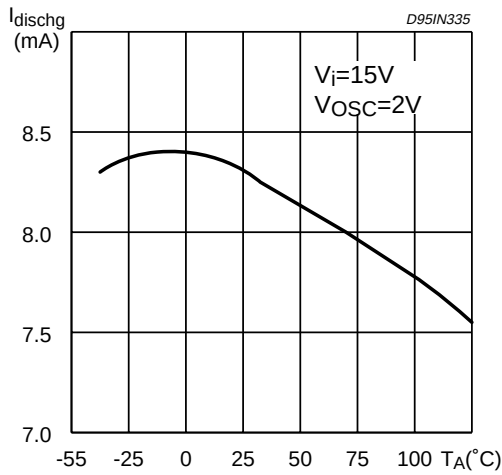
| Symbol                        | Parameter                           | Test Conditions                                | UC284XB |      |      | UC384XB |      |      | Unit |
|-------------------------------|-------------------------------------|------------------------------------------------|---------|------|------|---------|------|------|------|
|                               |                                     |                                                | 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 :  

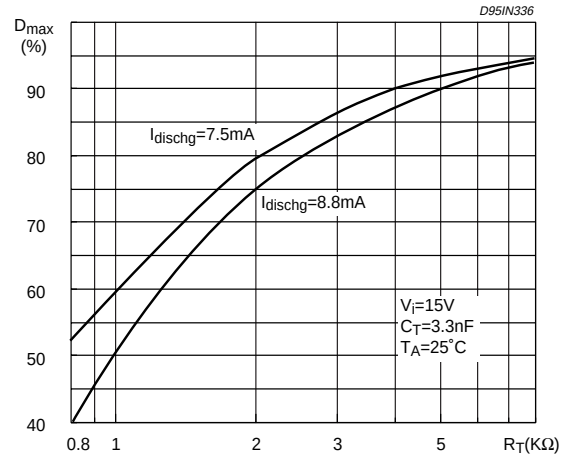
$$A = \frac{\Delta V_{PIN1}}{\Delta V_{PIN3}} ; 0 \leq V_{PIN3} \leq 0.8 \text{ V}$$
  5. Adjust V<sub>i</sub> above the start threshold before setting at 15 V.



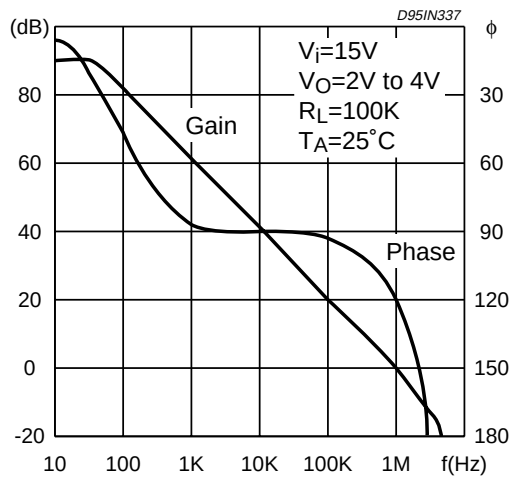
**Figure 4:** Oscillator Discharge Current vs. Temperature.



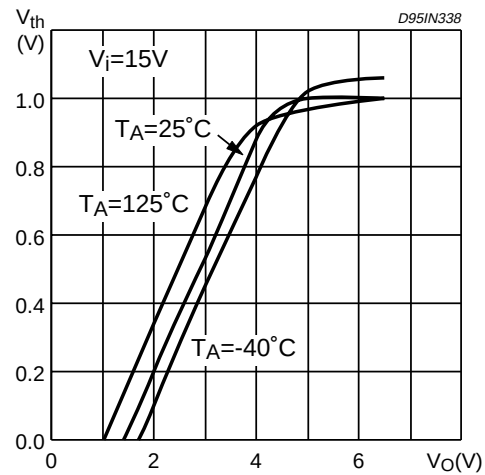
**Figure 5:** Maximum Output Duty Cycle vs. Timing Resistor.



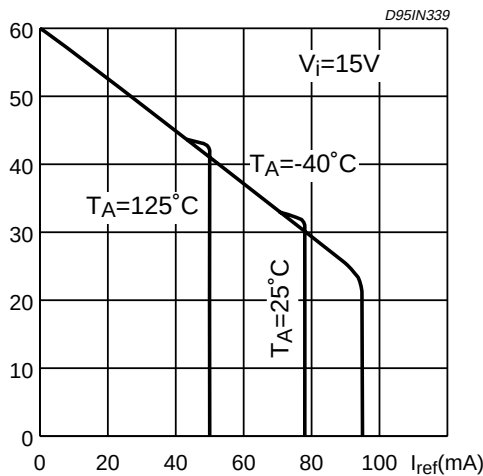
**Figure 6:** Error Amp Open-Loop Gain and Phase vs. Frequency.



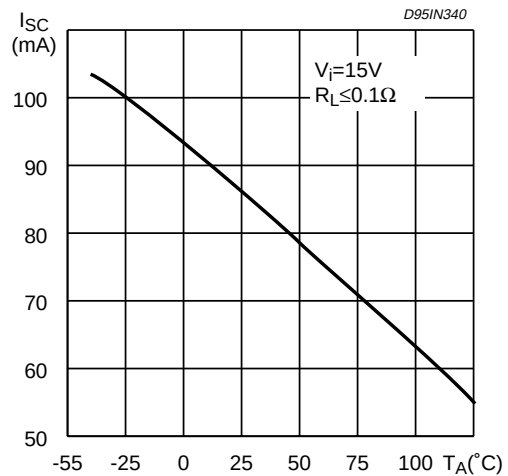
**Figure 7:** Current Sense Input Threshold vs. Error Amp Output Voltage.



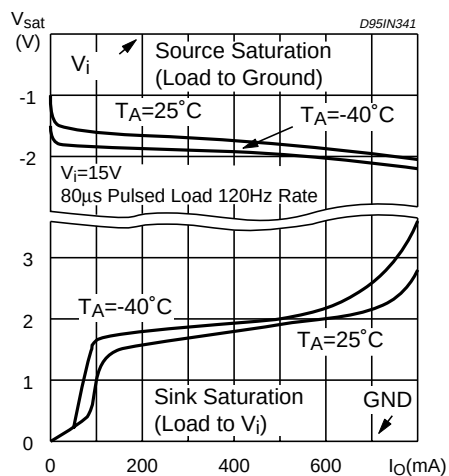
**Figure 8:** Reference Voltage Change vs. Source Current.



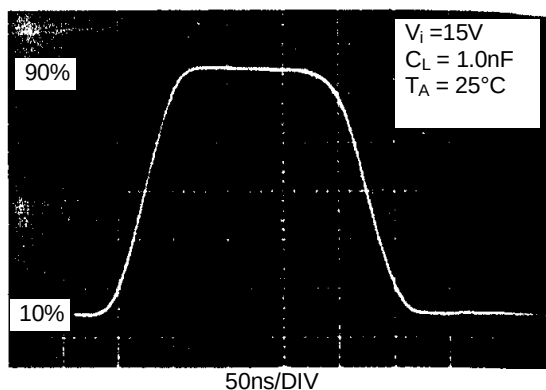
**Figure 9:** Reference Short Circuit Current vs. Temperature.



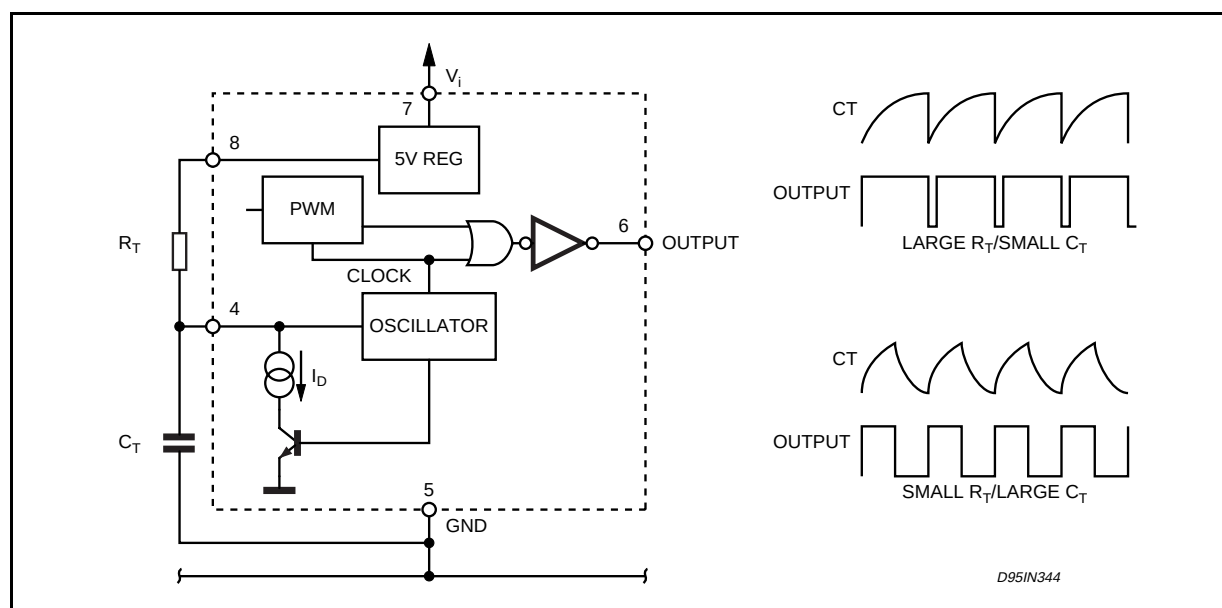
**Figure 10:** Output Saturation Voltages vs. Load Current.



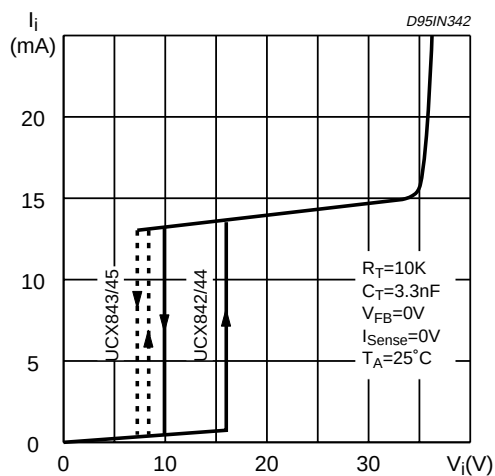
**Figure 12:** Output Waveform.



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



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



**Figure 13:** Output Cross Conduction

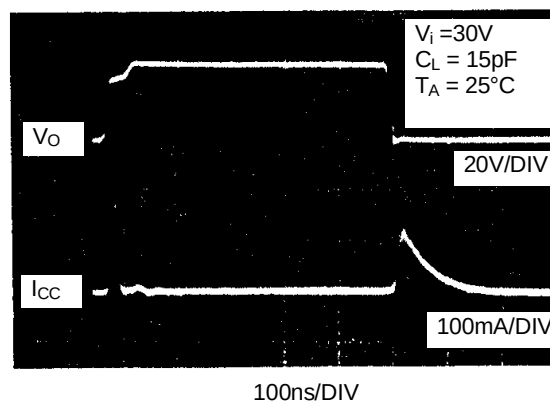


Figure 15 : Error Amp Configuration.

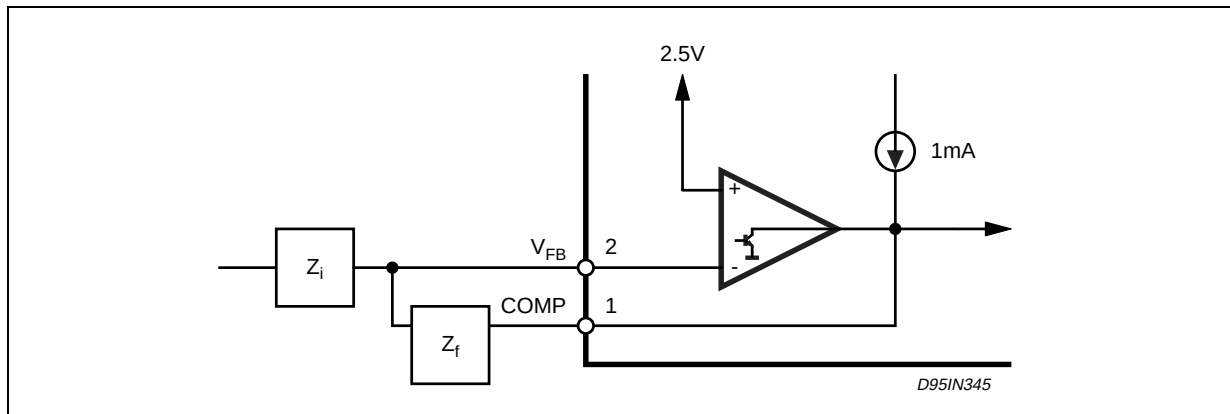


Figure 16 : Under Voltage Lockout.

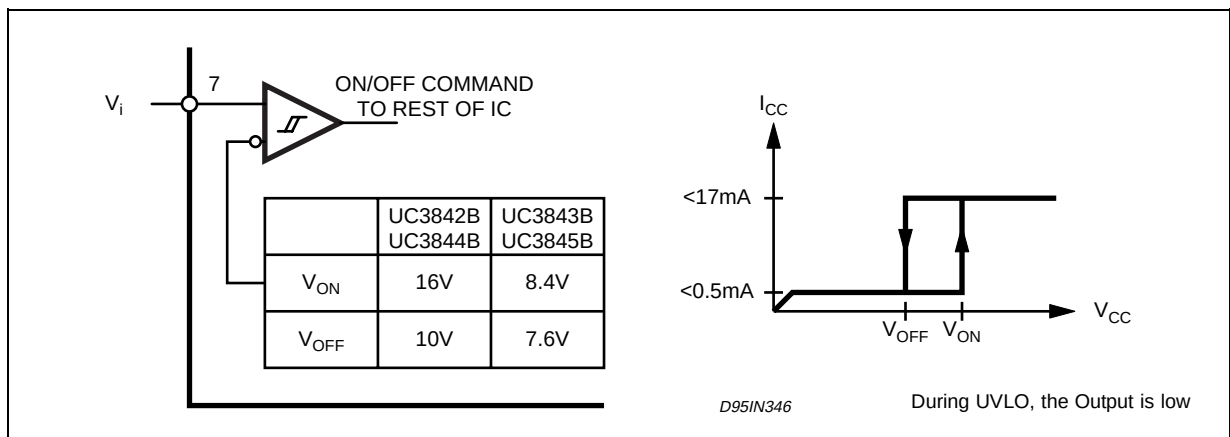
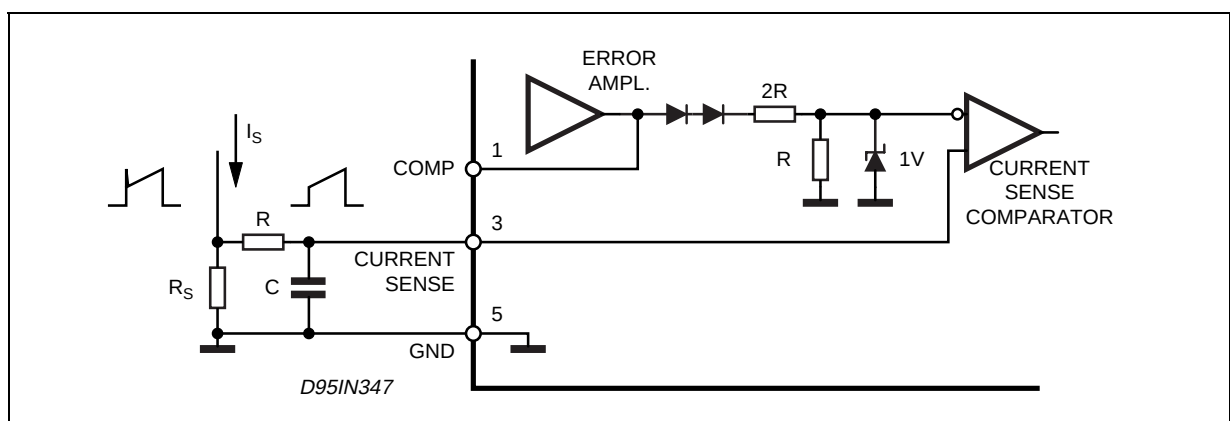


Figure 17 : Current Sense Circuit .



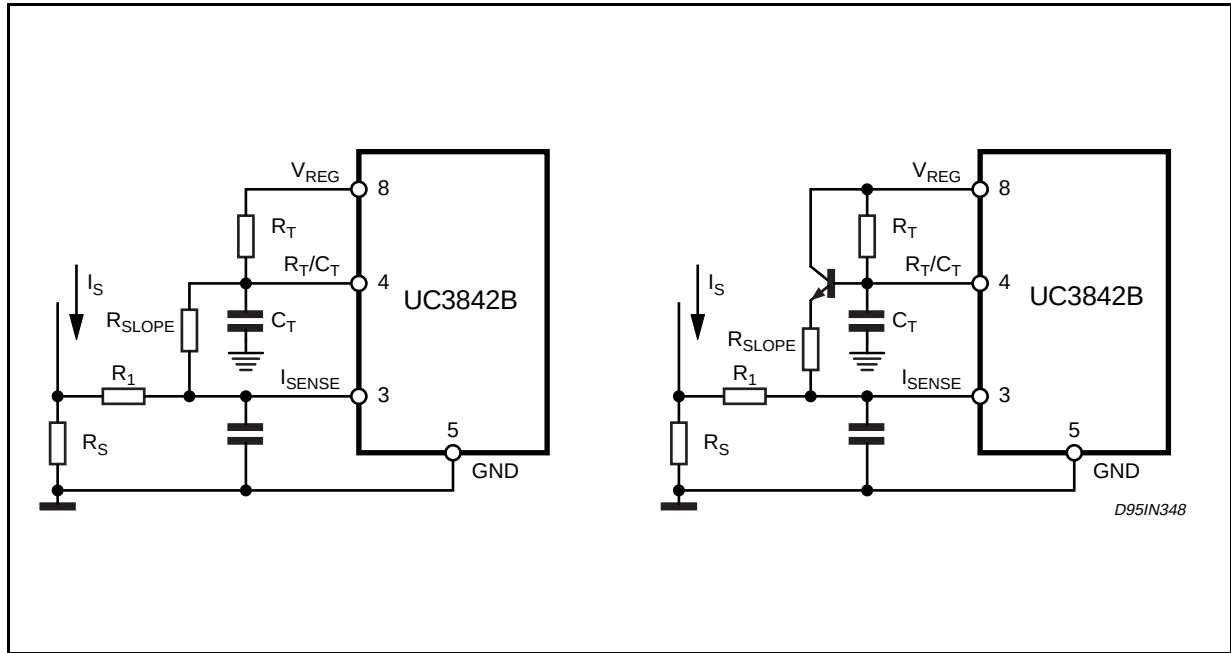
Peak current ( $i_s$ ) is determined by the formula

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

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.**

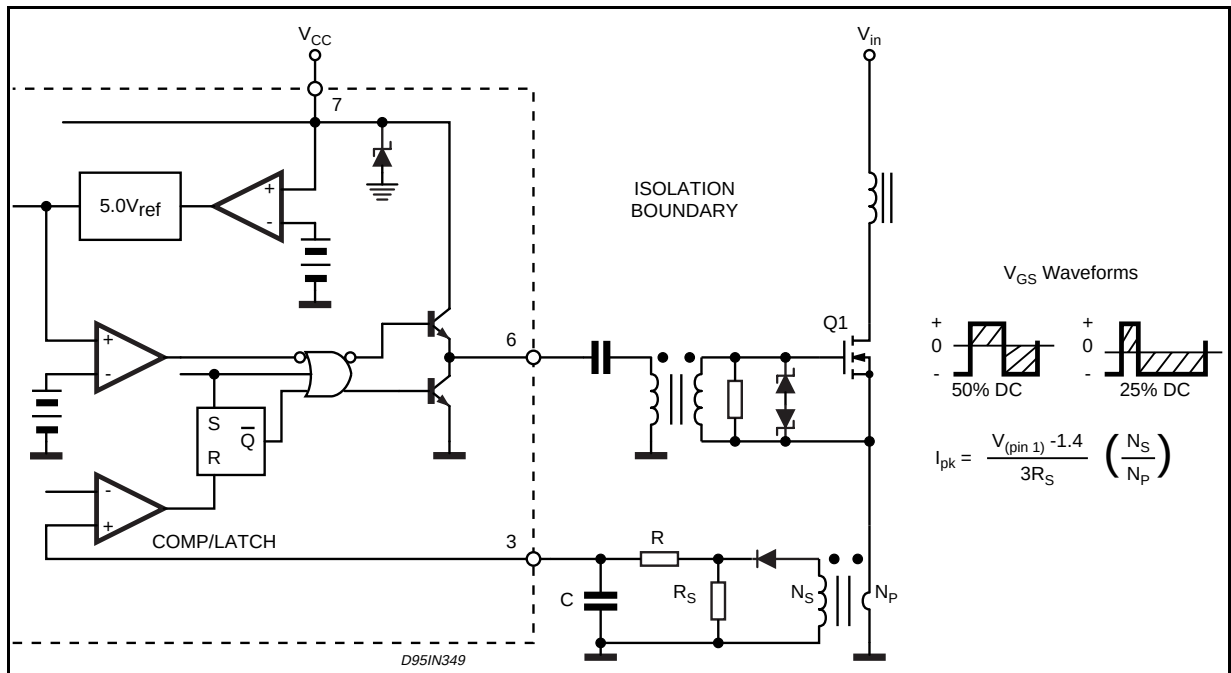


Figure 20 : Latched Shutdown.

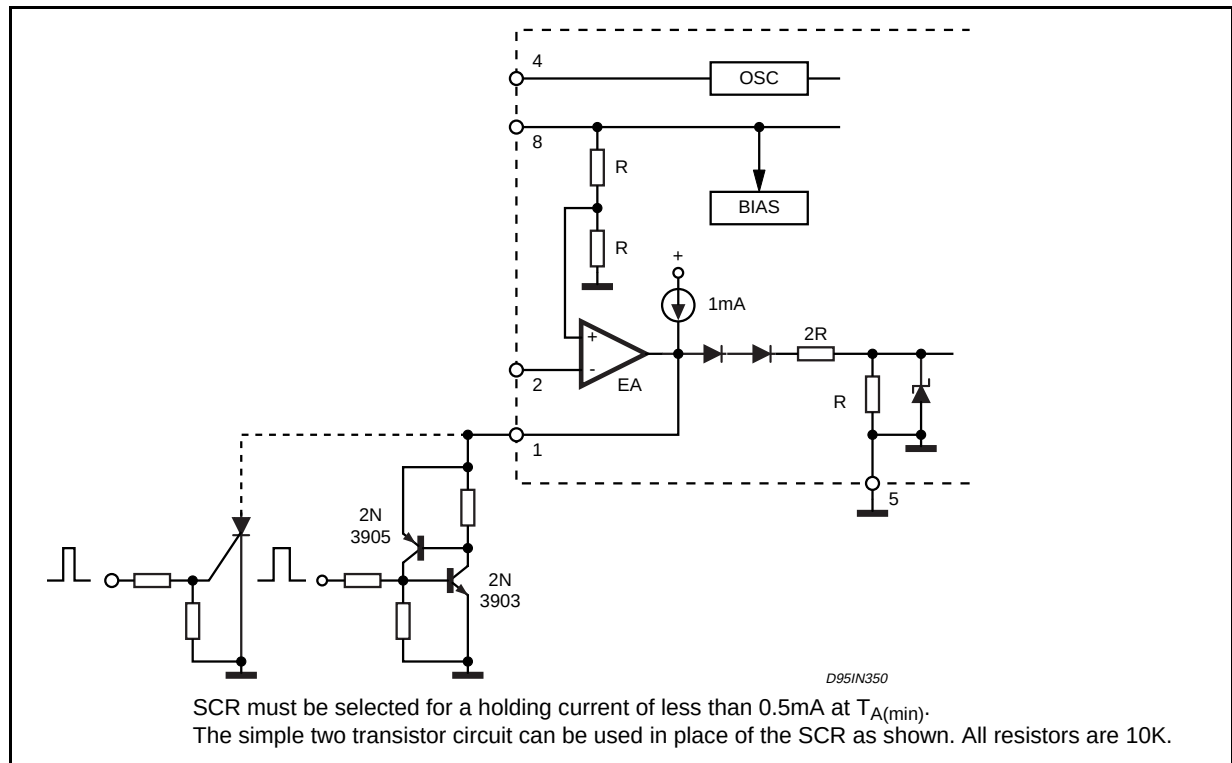
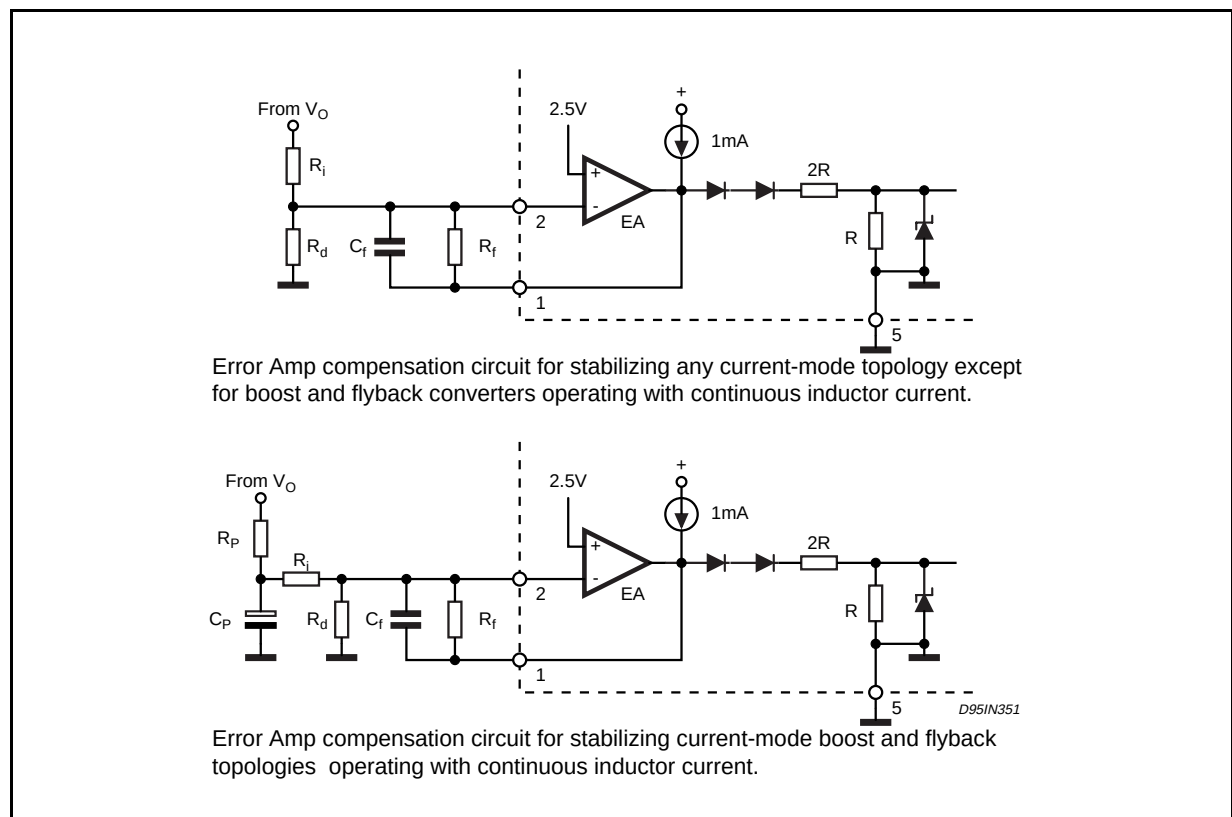


Figure 21: Error Amplifier Compensation



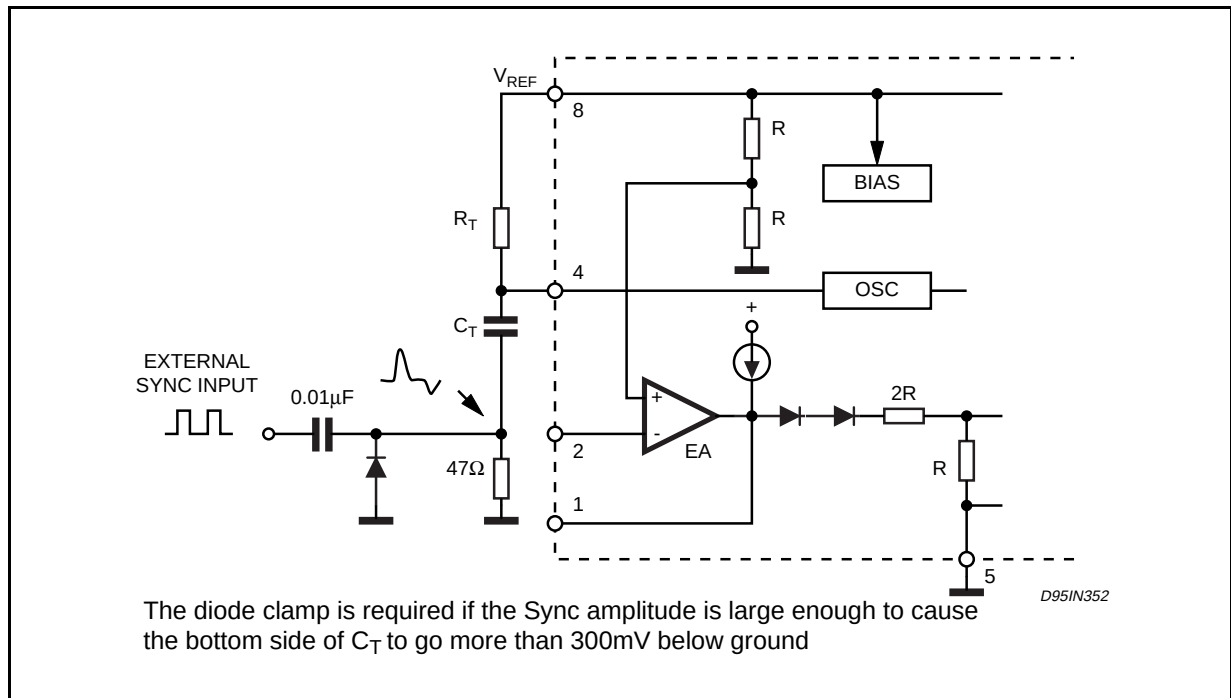
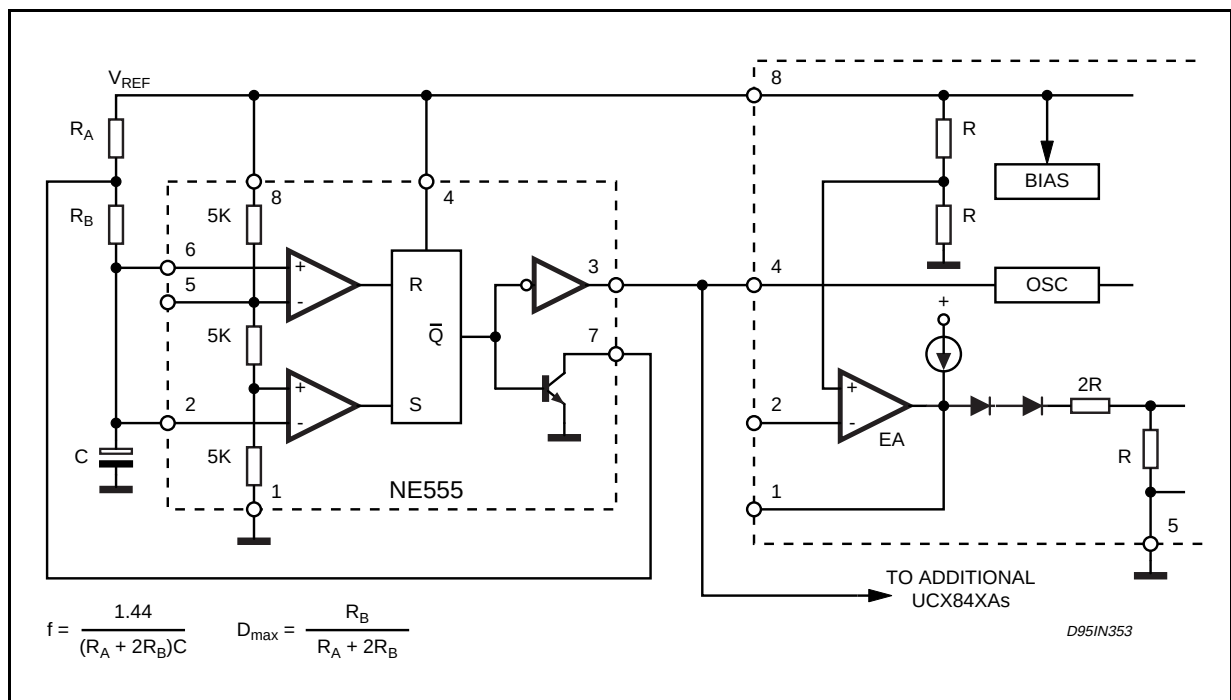
**Figure 22:** External Clock Synchronization.**Figure 23:** External Duty Cycle Clamp and Multi Unit Synchronization.

Figure 24: Soft-Start Circuit

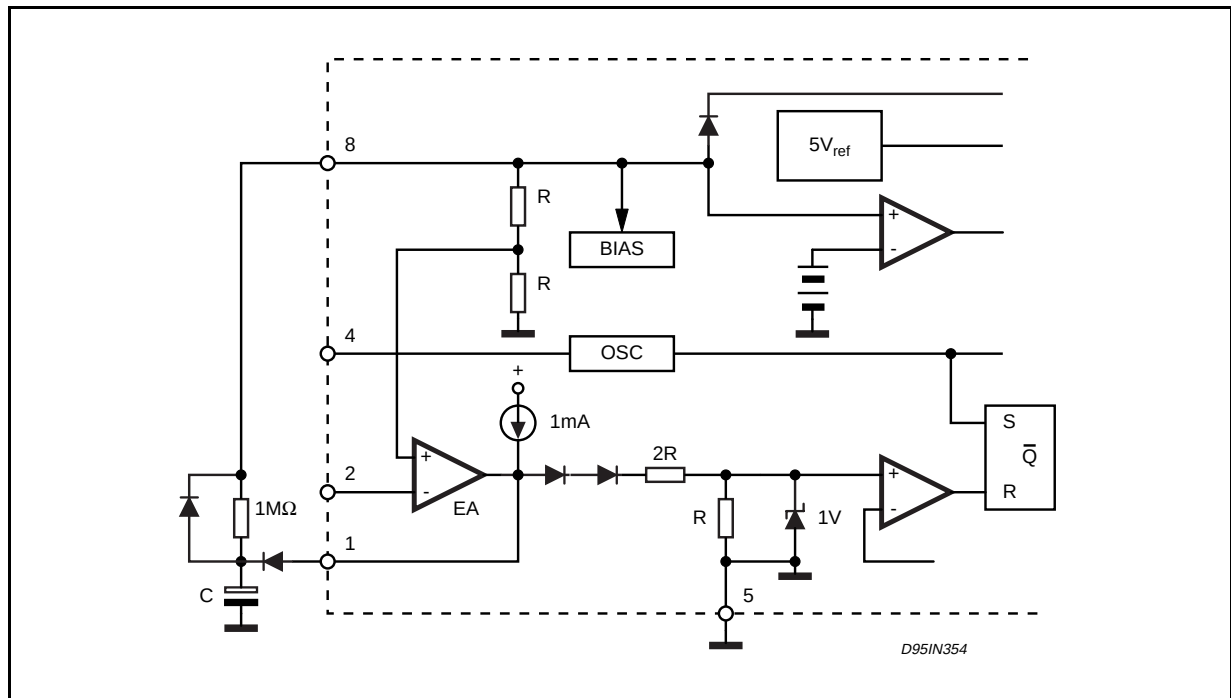
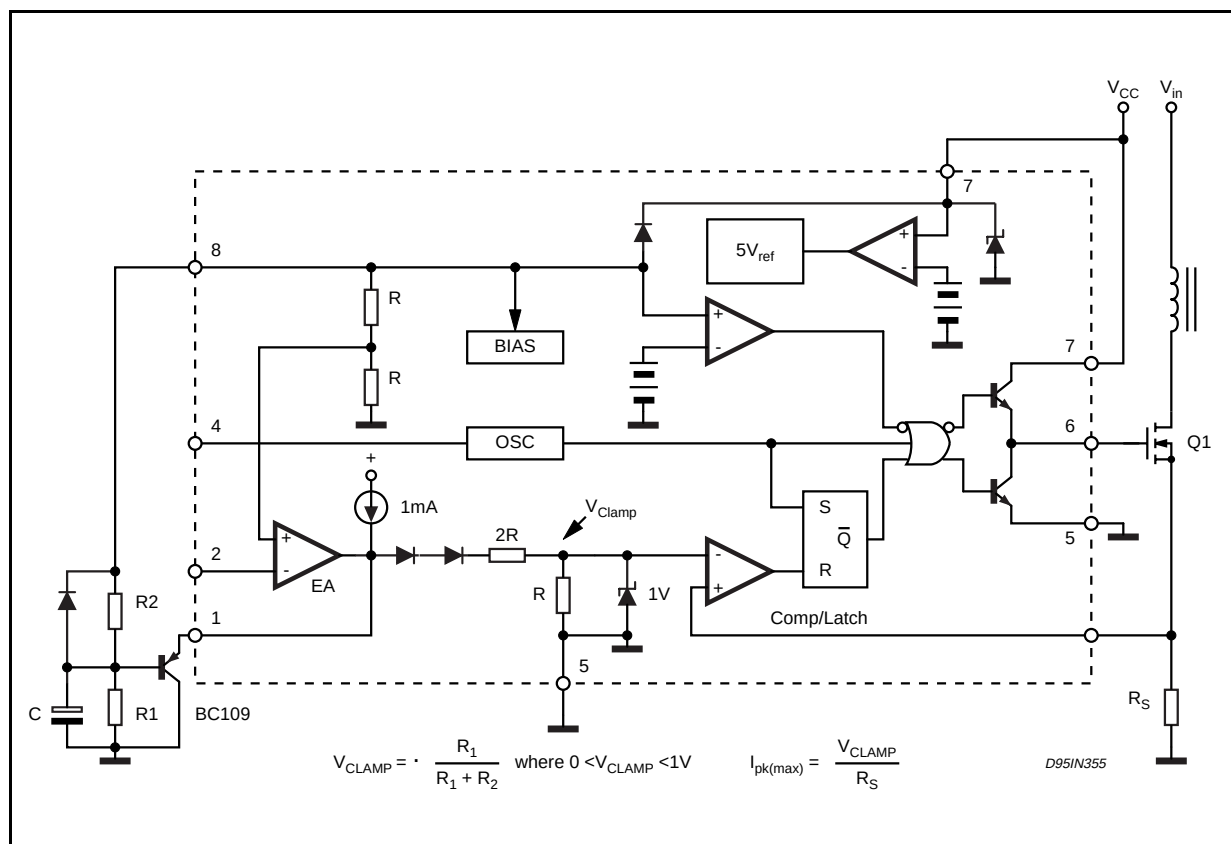


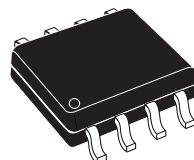
Figure 25: Soft-Start and Error Amplifier Output Duty Cycle Clamp.



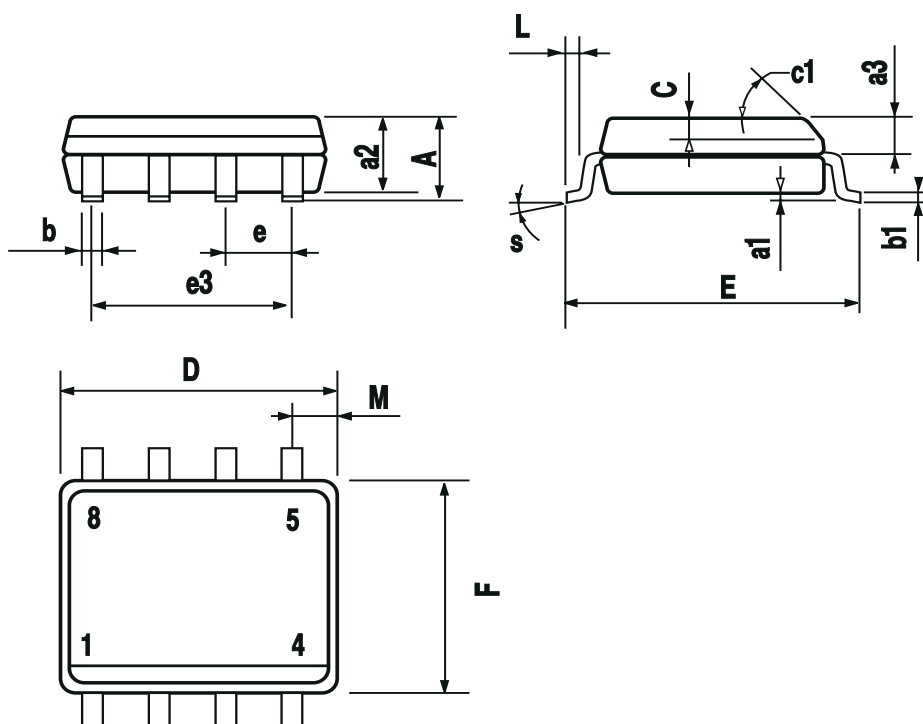
| DIM.  | mm         |      |      | inch  |       |       |
|-------|------------|------|------|-------|-------|-------|
|       | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A     |            |      | 1.75 |       |       | 0.069 |
| a1    | 0.1        |      | 0.25 | 0.004 |       | 0.010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

(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

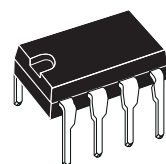


**SO8**

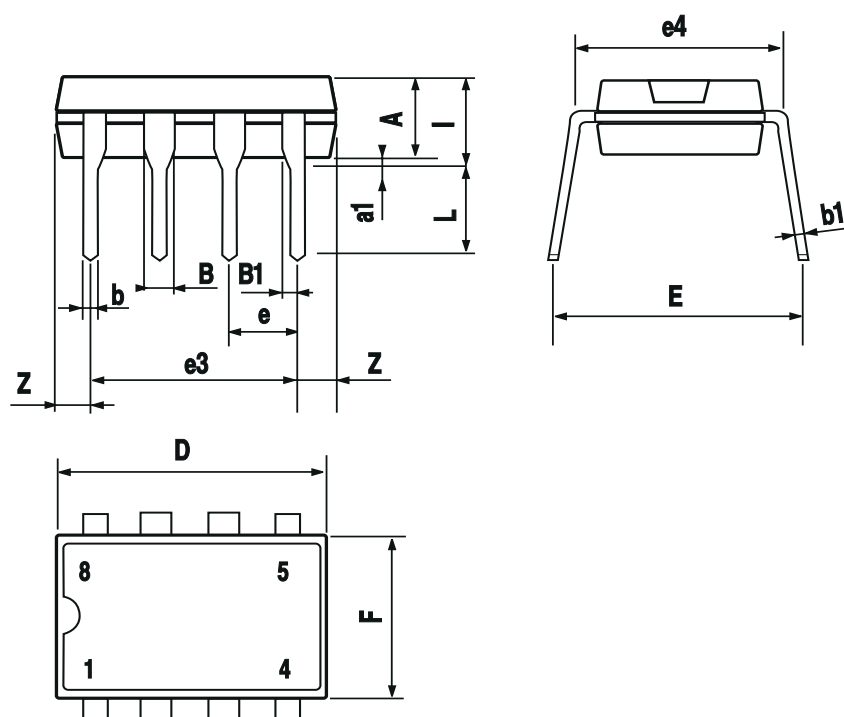


| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |       | 3.32 |       |       | 0.131 |       |
| a1   | 0.51  |      |       | 0.020 |       |       |
| B    | 1.15  |    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



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specification mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics  
© 1999 STMicroelectronics – Printed in Italy – All Rights Reserved  
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - France - Germany - Italy - Japan - Korea - Malaysia - Malta - Mexico - Morocco - The Netherlands -  
Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A.

<http://www.st.com>