



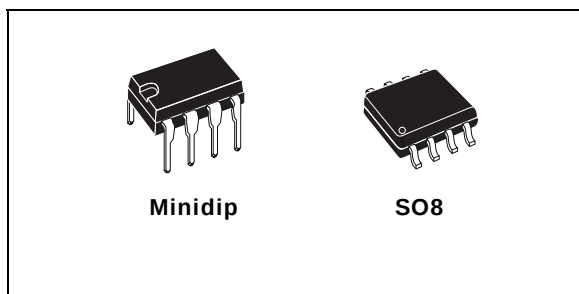
# UC2842A/3A/4A/5A UC3842A/3A/4A/5A

## HIGH PERFORMANCE CURRENT MODE PWM CONTROLLER

- TRIMMED OSCILLATOR DISCHARGE CURRENT
- 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 CURRENT ( $< 0.5\text{mA}$ )
- DOUBLE PULSE SUPPRESSION

### DESCRIPTION

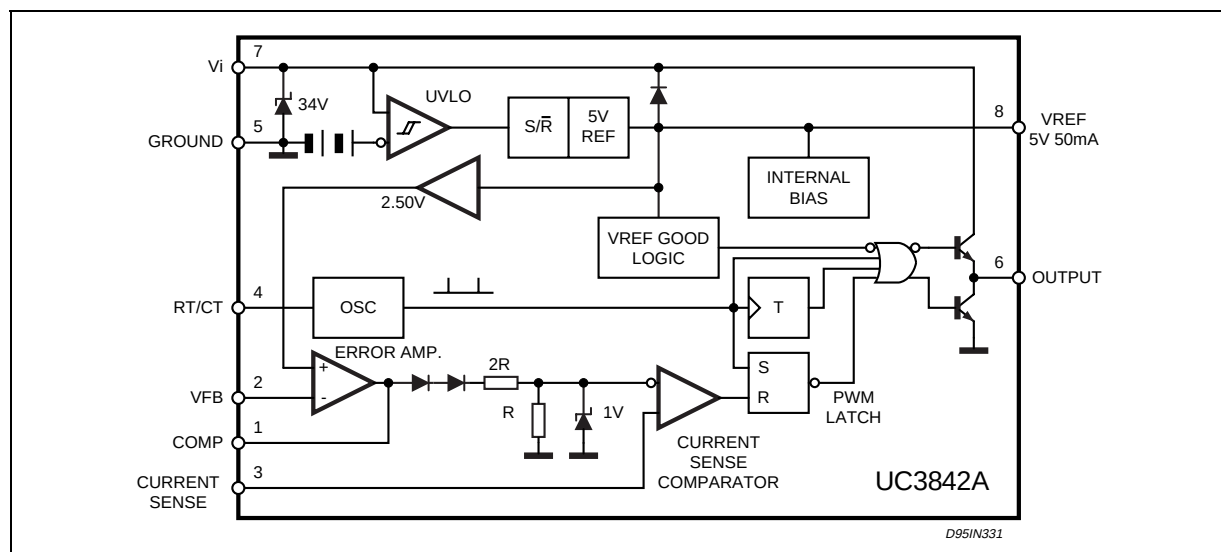
The UC384xA family of control ICs provides the necessary features to implement off-line or DC to DC fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include a trimmed oscillator for precise DUTY CYCLE CONTROL under voltage lockout featuring 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 UC3842A and UC3844A have UVLO thresholds of 16V (on) and 10V (off), ideally suited off-line applications. The corresponding thresholds for the UC3843A and UC3845A are 8.5 V and 7.9V. The UC3842A and UC3843A can operate to duty cycles approaching 100%. A range of the zero to  $< 50\%$  is obtained by the UC3844A and UC3845A 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 UC3844A and UC3845A)



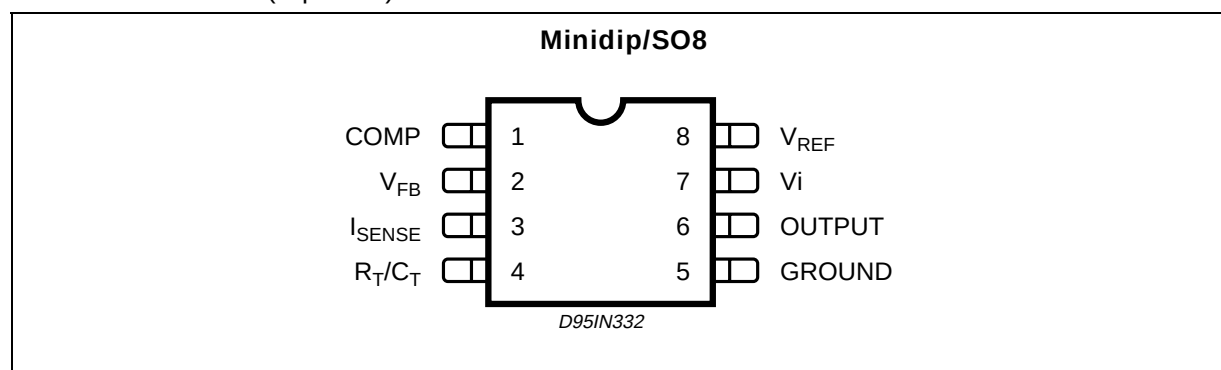
## UC2842A/3A/4A/5A - UC3842A/3A/4A/5A

### 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                                                                              |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| UC2842AD1; UC3842AD1<br>UC2843AD1; UC3843AD1<br>UC2844AD1; UC3844AD1<br>UC2845AD1; UC3845AD1 | UC2842AN; UC3842AN<br>UC2843AN; UC3843AN<br>UC2844AN; UC3844AN<br>UC2845AN; UC3845AN |

## 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 UC284XA;  $0 \leq T_{amb} \leq 70^{\circ}\text{C}$  for UC384XA;  $V_i = 15\text{V}$  (note 5);  $R_T = 10\text{K}$ ;  $C_T = 3.3\text{nF}$ )

| Symbol                | Parameter                                | Test Conditions                                              | UC284XA |      |      | UC384XA |      |      | 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                                        | 47      | 52   | 57   | 47      | 52   | 57   | 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>       | –       | 5    | –    | –       | 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                                        | 7.8     | 8.3  | 8.8  | 7.8     | 8.3  | 8.8  | 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    |

## UC2842A/3A/4A/5A - UC3842A/3A/4A/5A

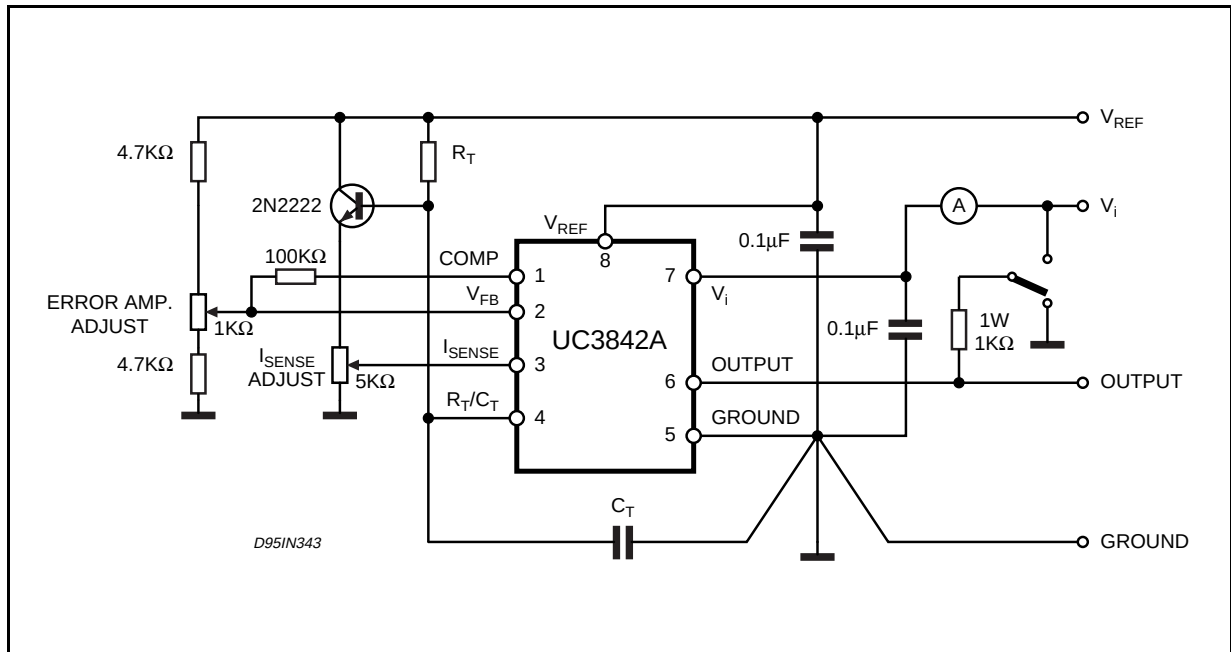
### ELECTRICAL CHARACTERISTICS (continued)

| Symbol                        | Parameter                           | Test Conditions                                | UC284XA |      |      | UC384XA |      |      | 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  |         | 0.7  | 1.2  |         | 0.7  | 1.2  | 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                     | X842A/4A                                       | 15      | 16   | 17   | 14.5    | 16   | 17.5 | V    |
|                               |                                     | X843A/5A                                       | 7.8     | 8.4  | 9.0  | 7.8     | 8.4  | 9.0  | V    |
|                               | Min Operating Voltage After Turn-on | X842A/4A                                       | 9       | 10   | 11   | 8.5     | 10   | 11.5 | V    |
|                               |                                     | X843A/5A                                       | 7.0     | 7.6  | 8.2  | 7.0     | 7.6  | 8.2  | V    |
| PWM SECTION                   |                                     |                                                |         |      |      |         |      |      |      |
|                               | Maximum Duty Cycle                  | X842A/3A                                       | 94      | 96   | 100  | 94      | 96   | 100  | %    |
|                               |                                     | X844A/5A                                       | 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 UCX843A/45A          |         | 0.3  | 0.5  |         | 0.3  | 0.5  | mA   |
|                               |                                     | V <sub>i</sub> = 14V for UCX842A/44A           |         | 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.

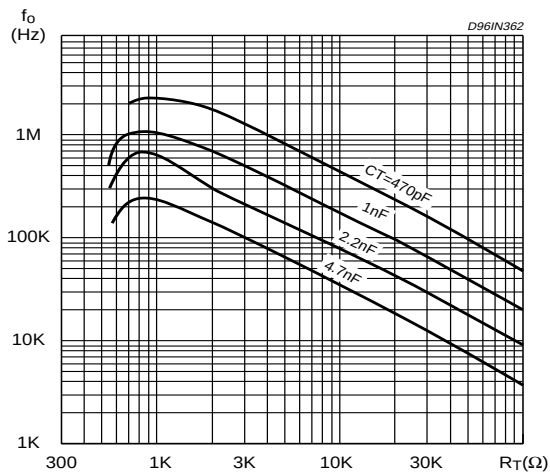
**Figure 1:** Open Loop Test Circuit.



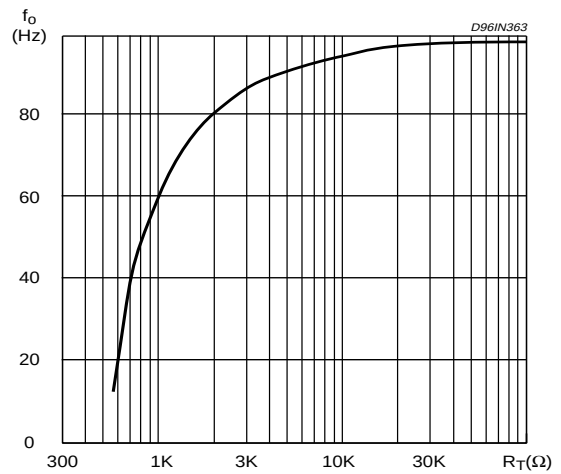
High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close

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.

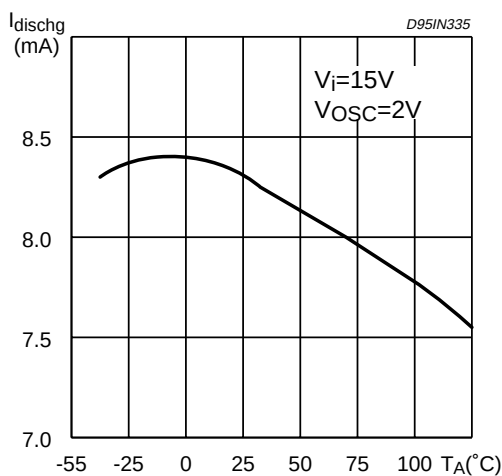
**Figure 2:** Oscillator Frequency vs Timing Resistance



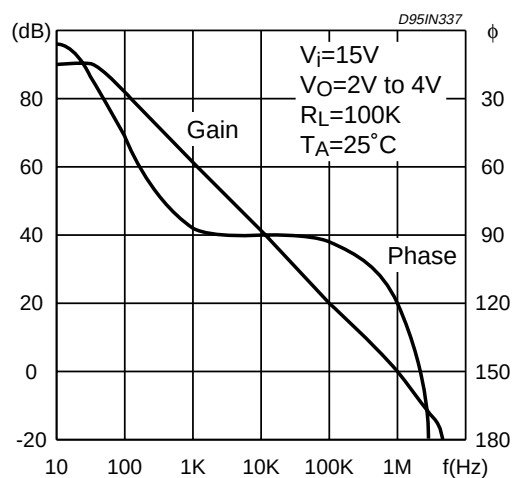
**Figure 3:** Maximum Duty Cycle vs Timing Resistance



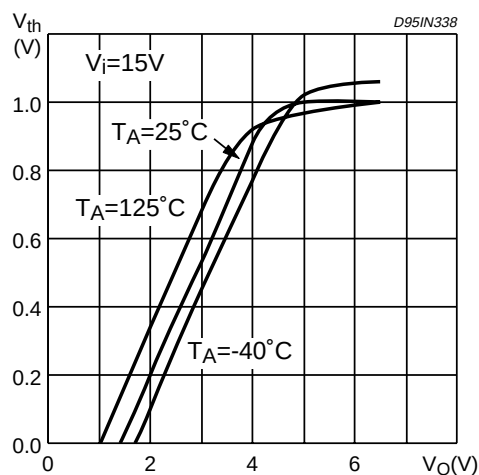
**Figure 4:** Oscillator Discharge Current vs. Temperature.



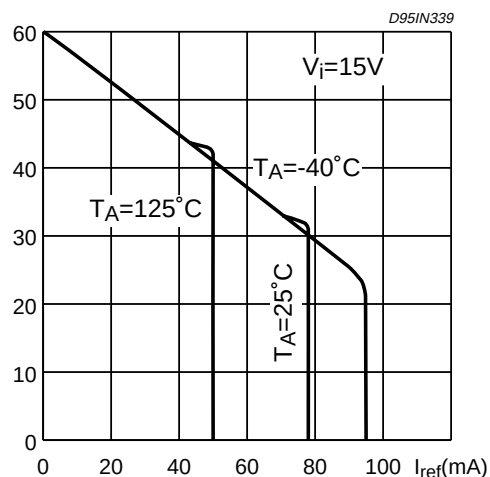
**Figure 5:** Error Amp Open-Loop Gain and Phase vs. Frequency.



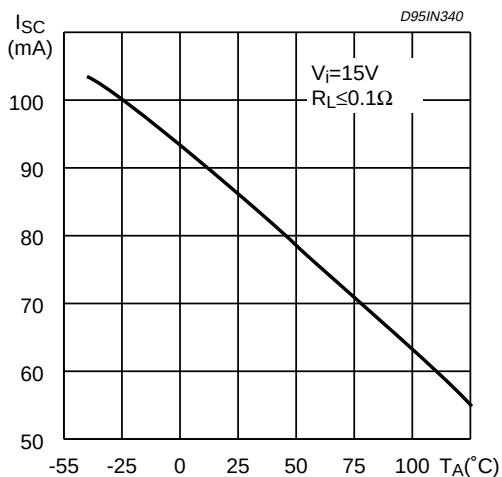
**Figure 6:** Current Sense Input Threshold vs. Error Amp Output Voltage.



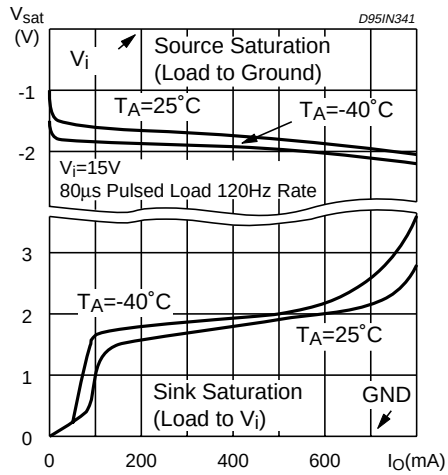
**Figure 7:** Reference Voltage Change vs. Source Current.



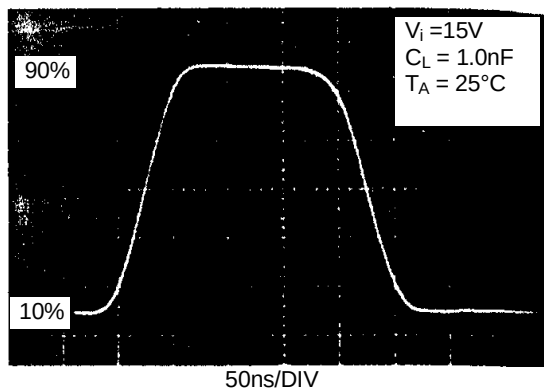
**Figure 8:** Reference Short Circuit Current vs. Temperature.



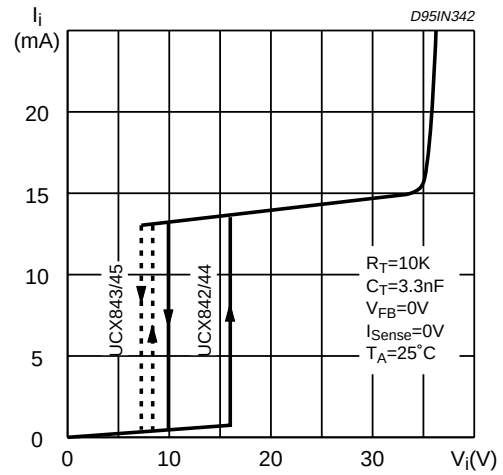
**Figure 9:** Output Saturation Voltage vs. Load Current.



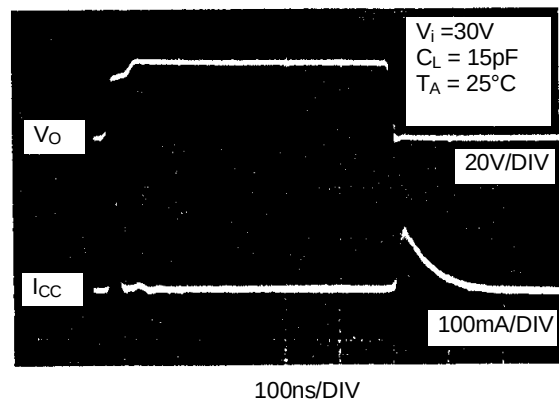
**Figure 11:** Output Waveform.



**Figure 10:** Supply Current vs. Supply Voltage.



**Figure 12:** Output Cross Conduction



**Figure 13:** Oscillator and Output Waveforms.

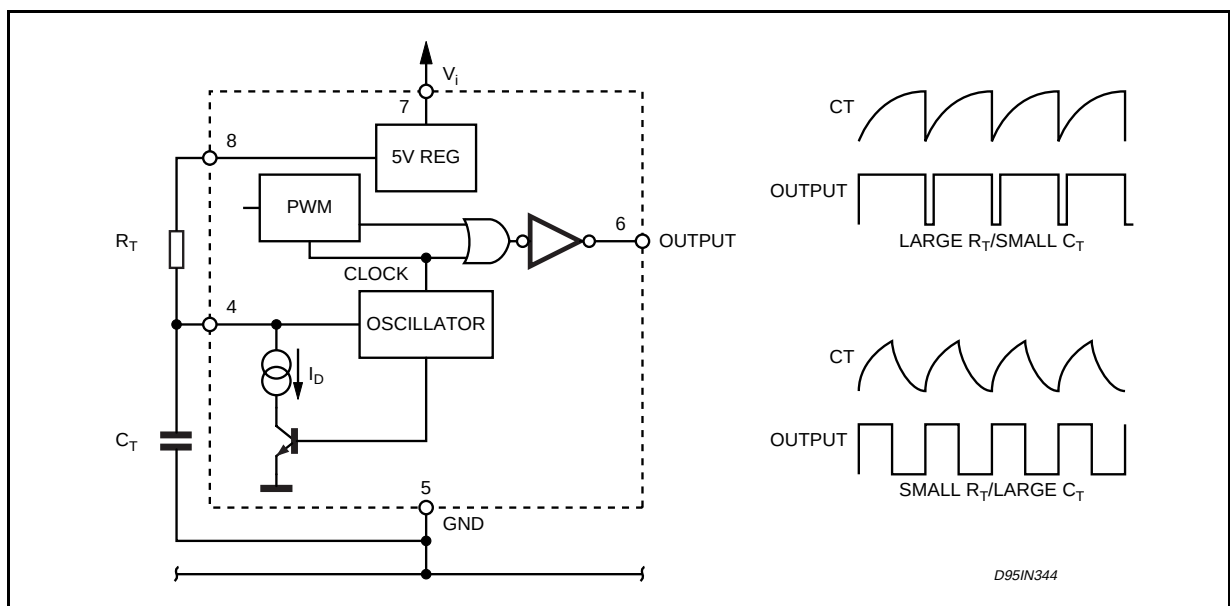


Figure 14 : Error Amp Configuration.

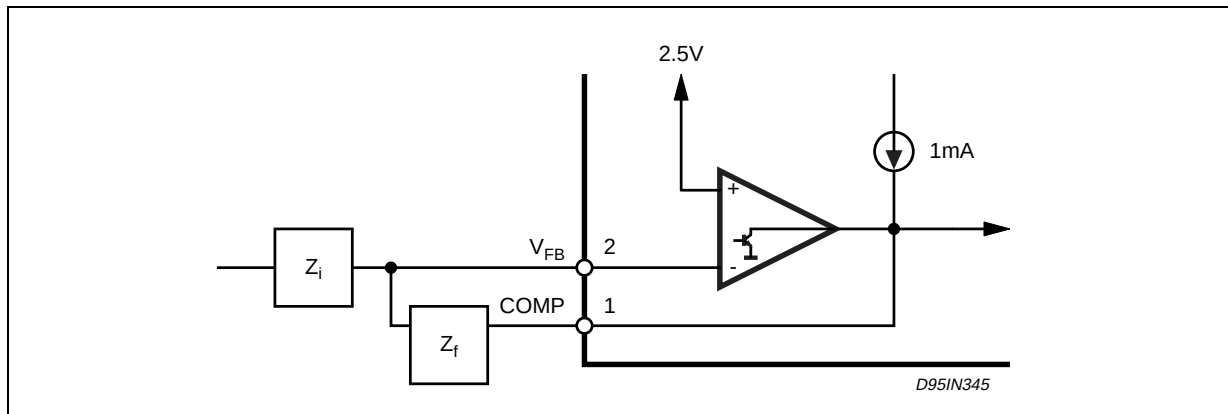


Figure 15 : Under Voltage Lockout.

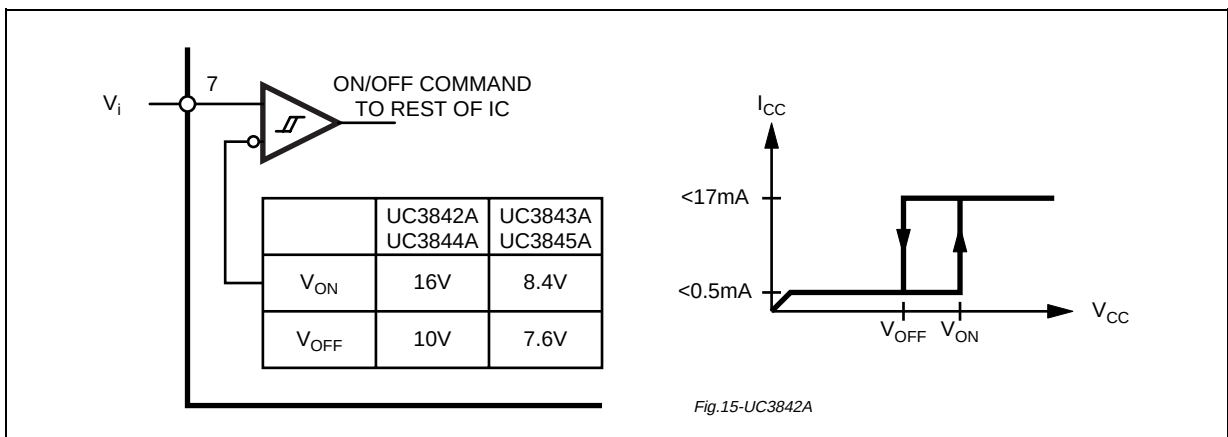
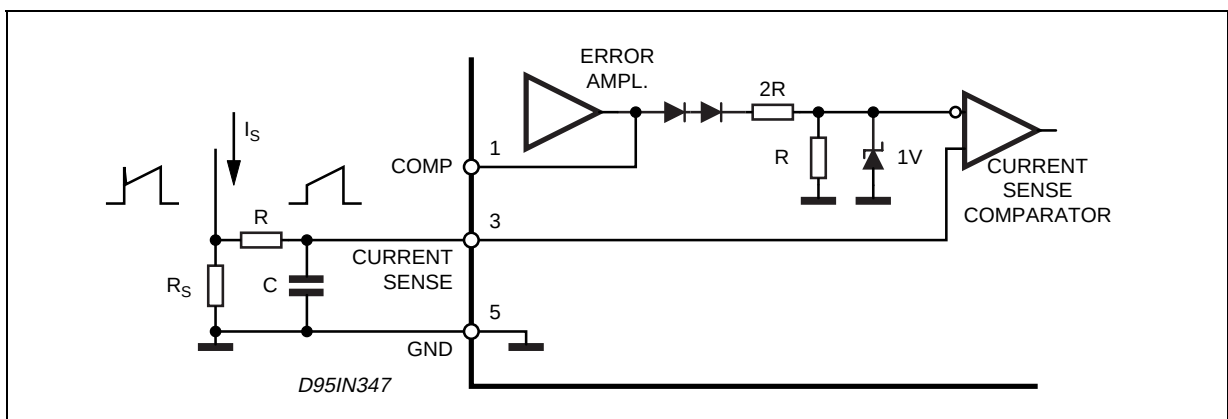


Figure 16 : Current Sense Circuit .



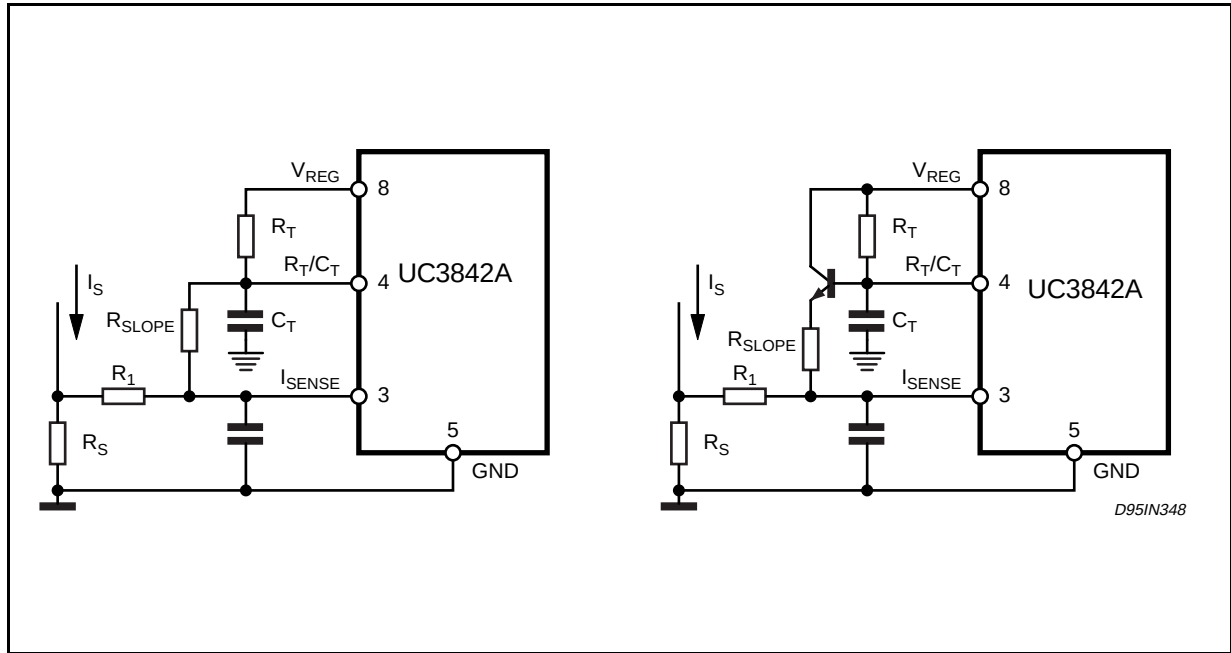
Peak current ( $i_s$ ) is determined by the formula

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

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



**Figure 17 : Slope Compensation Techniques.**



**Figure 18 : Isolated MOSFET Drive and Current Transformer Sensing.**

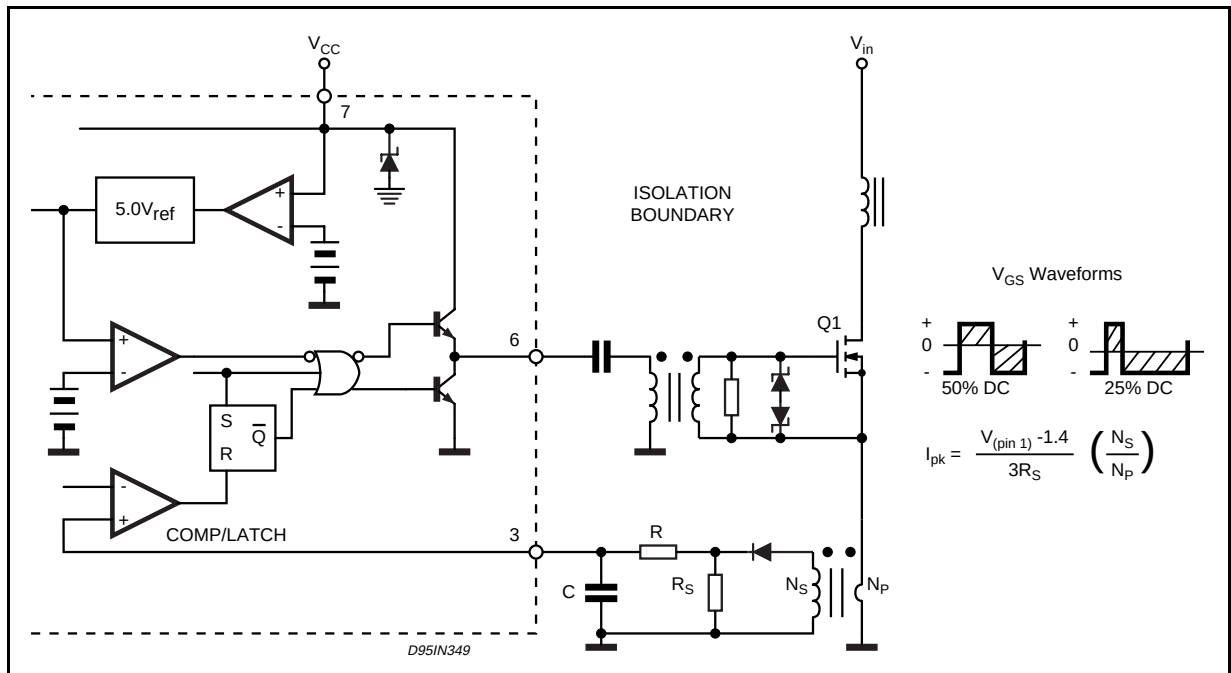


Figure 19 : Latched Shutdown.

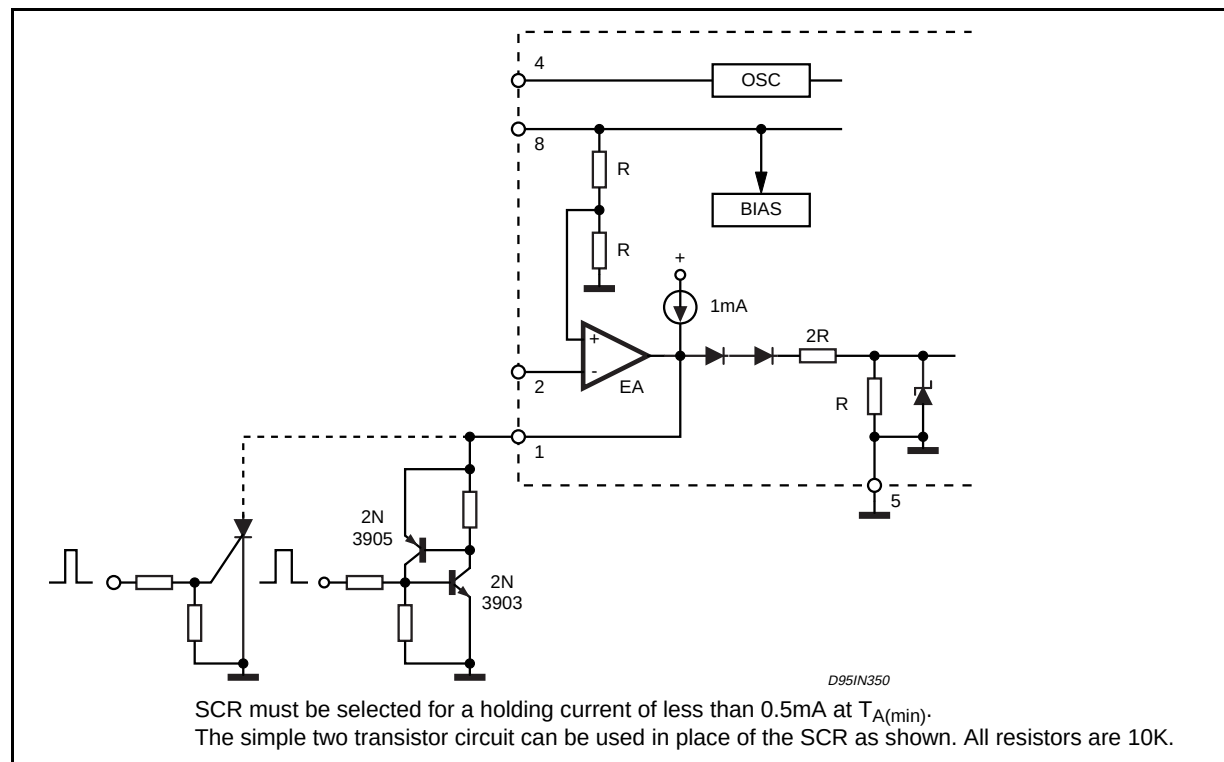
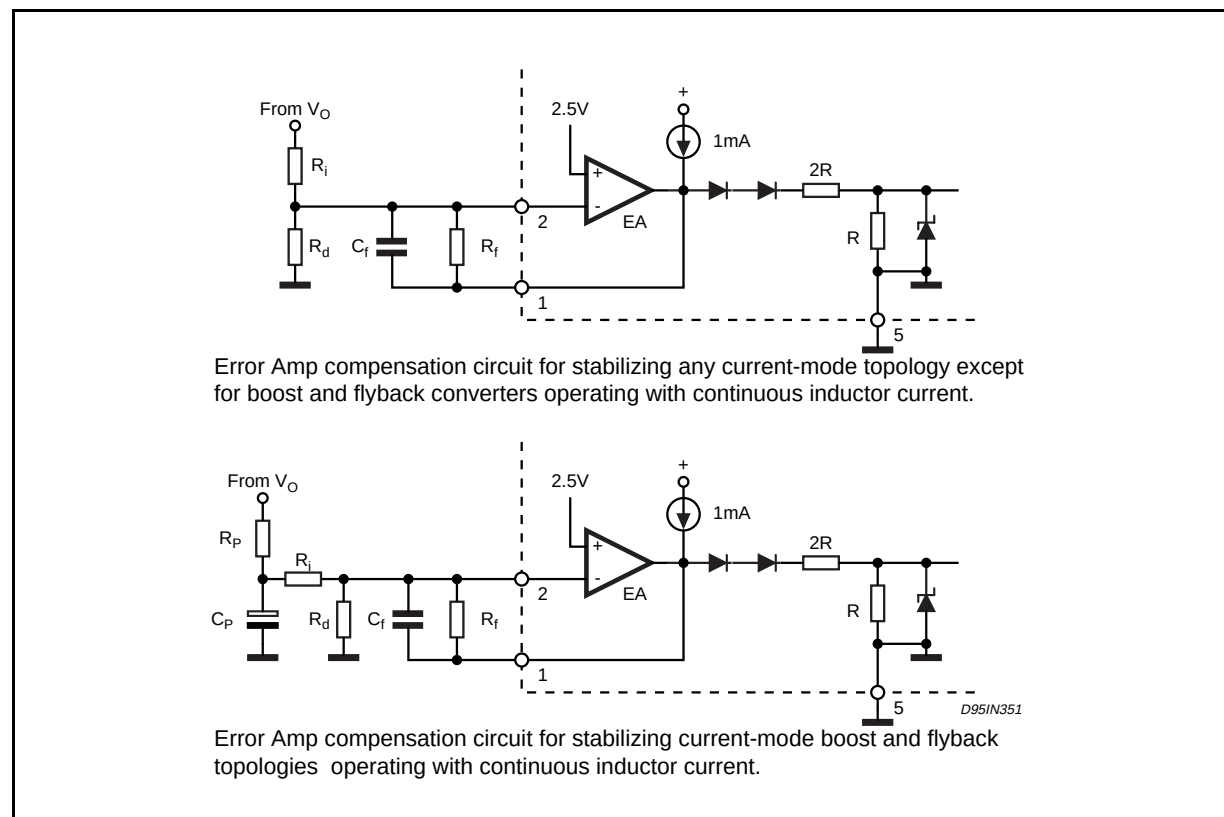


Figure 20: Error Amplifier Compensation



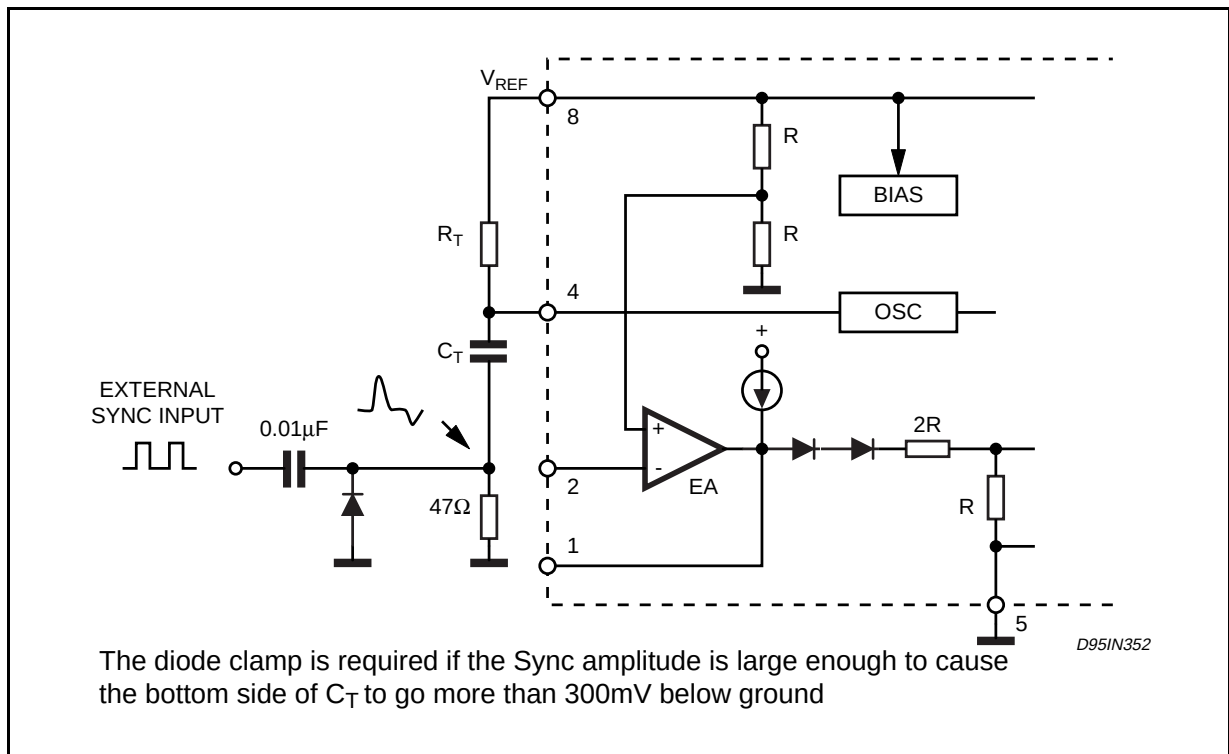
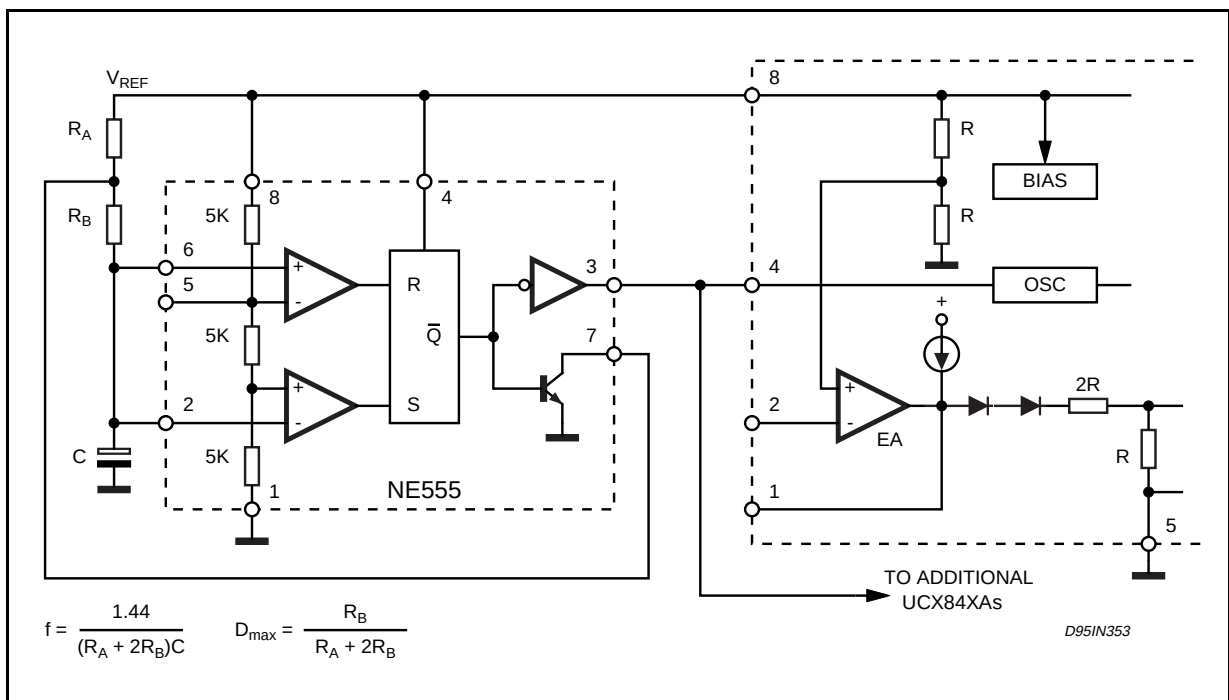
**Figure 21:** External Clock Synchronization.**Figure 22:** External Duty Cycle Clamp and Multi Unit Synchronization.

Figure 23: Soft-Start Circuit

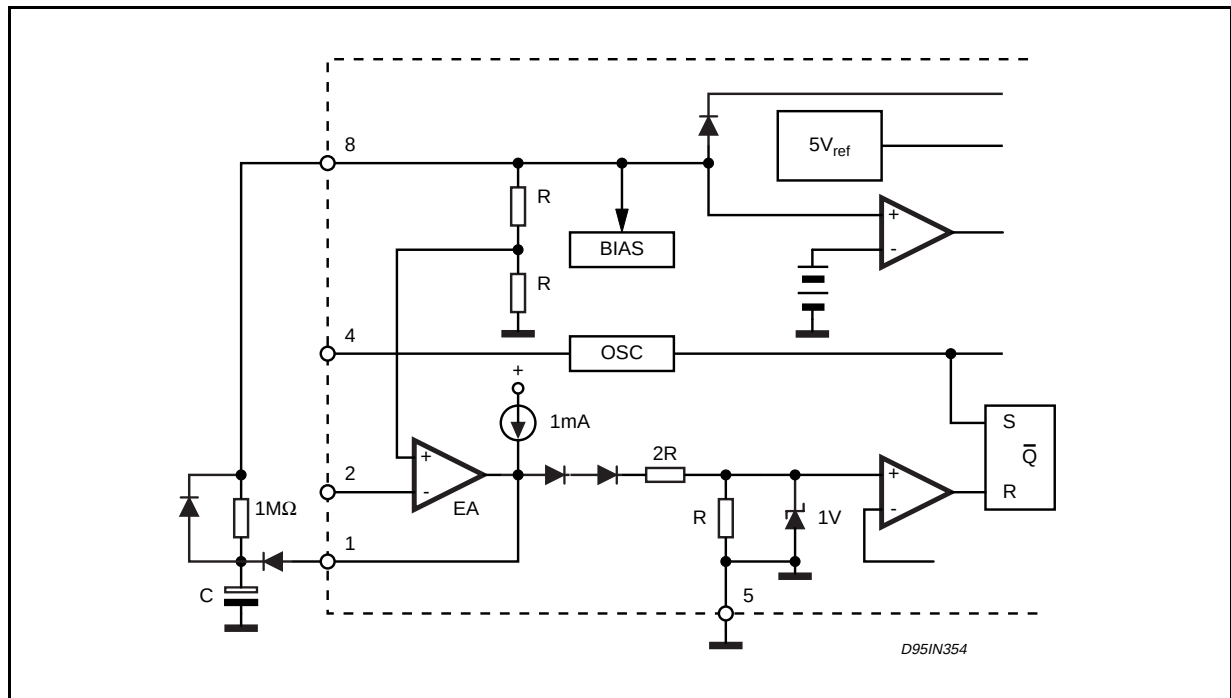
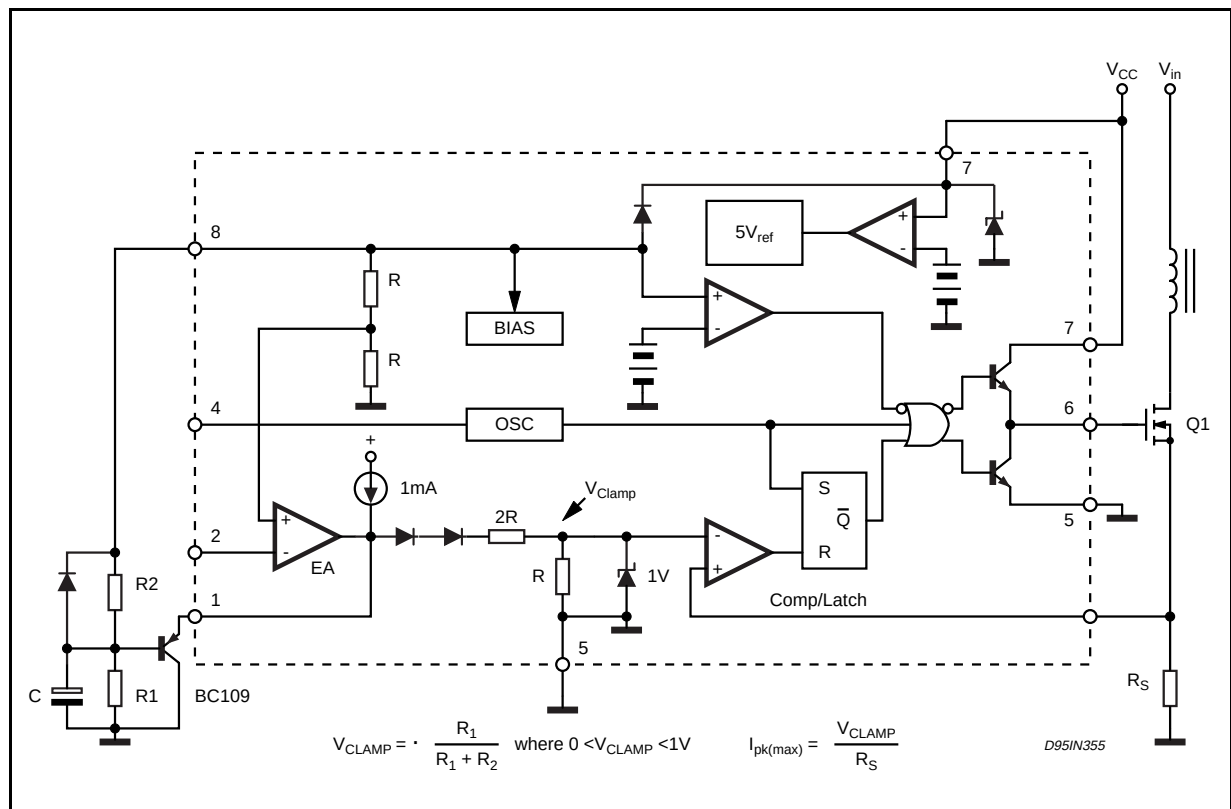


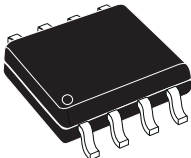
Figure 24: Soft-Start and Error Amplifier Output Duty Cycle Clamp.



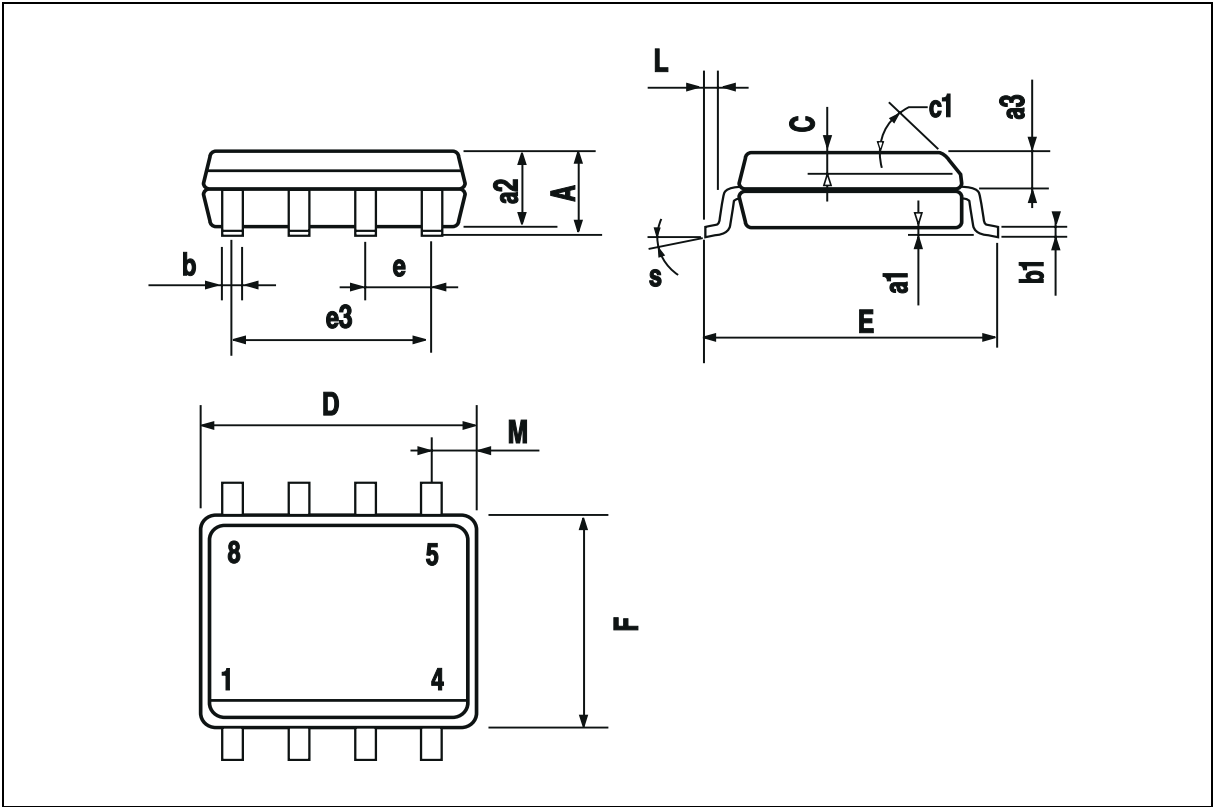
| DIM.  | mm         |      |      | inch  |       |       |
|-------|------------|------|------|-------|-------|-------|
|       | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A     |            |      | 1.75 |       |       | 0.069 |
| a1    | 0.1        |      | 0.25 | 0.004 |       | 0.010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

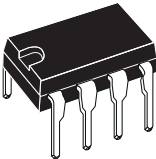


SO8

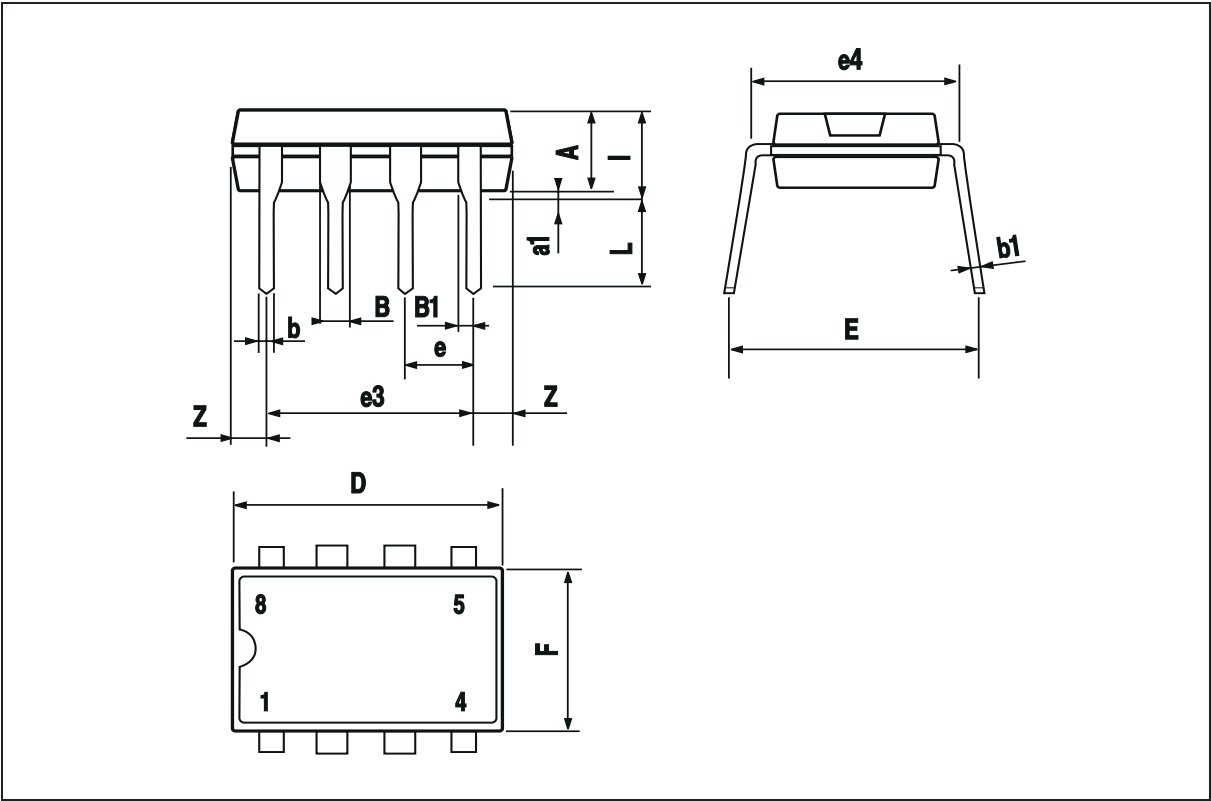


| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |       | 3.32 |       |       | 0.131 |       |
| a1   | 0.51  |      |       | 0.020 |       |       |
| B    | 1.15  |    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