

# CS2844, CS3844, CS2845, CS3845



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## Current Mode PWM Control Circuit with 50% Max Duty Cycle

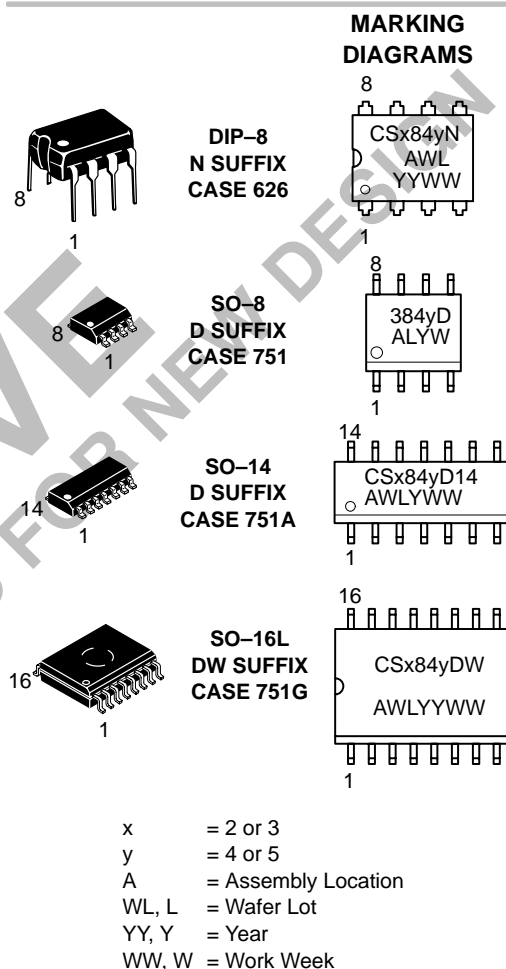
The CS3844/45 provides all the necessary features to implement off-line fixed frequency current-mode control with a minimum number of external components.

The CS3844 family incorporates a new precision temperature-controlled oscillator to minimize variations in frequency. An internal toggle flip-flop, which blanks the output every other clock cycle, limits the duty-cycle range to less than 50%. An undervoltage lockout ensures that  $V_{REF}$  is stabilized before the output stage is enabled. In the CS2844/CS3844 turn on occurs at 16 V and turn off at 10 V. In the CS2845/CS3845 turn on is at 8.4 V and turn off at 7.6 V.

Other features include low start-up current, pulse-by-pulse current limiting, and a high-current totem pole output for driving capacitive loads, such as gate of a power MOSFET. The output is low in the off state, consistent with N-channel devices.

### Features

- Optimized for Off-Line Control
- Temp. Compensated Oscillator
- 50% Max Duty-Cycle Clamp
- $V_{REF}$  Stabilized Before Output Stage Is Enabled
- Low Start-Up Current
- Pulse-By-Pulse Current Limiting
- Improved Undervoltage Lockout
- Double Pulse Suppression
- 1.0% Trimmed Bandgap Reference
- High Current Totem Pole Output



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# CS2844, CS3844, CS2845, CS3845

## PIN CONNECTIONS

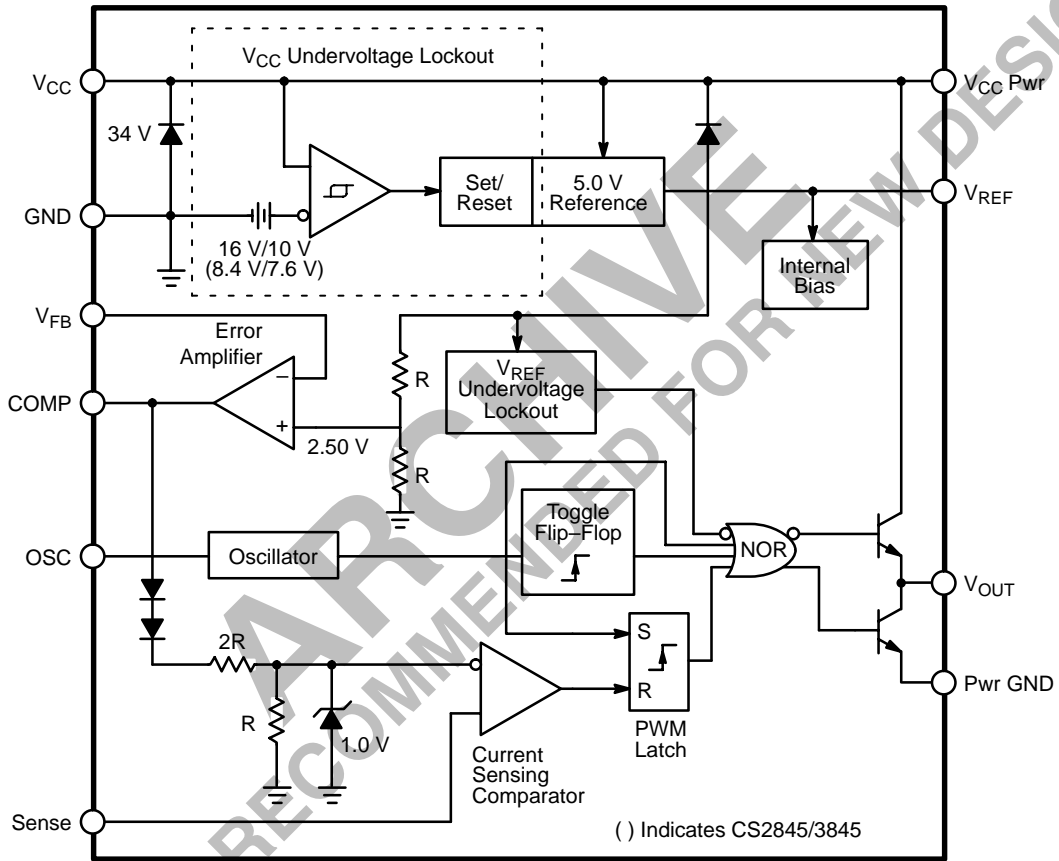
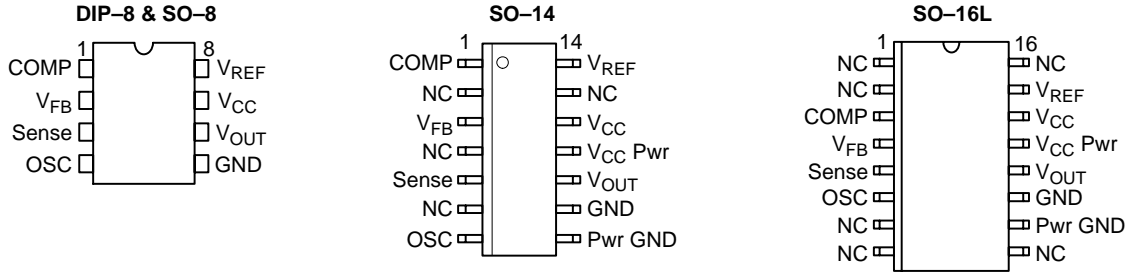


Figure 1. Block Diagram

# CS2844, CS3844, CS2845, CS3845

## MAXIMUM RATINGS\*

| Rating  | Value  | Unit   |
|---|--|--|
| Supply Voltage ( $I_{CC} < 30 \text{ mA}$ )   | Self Limiting  | –  |
| Supply Voltage (Low Impedance Source)   | 30   | V  |
| Output Current  | $\pm 1.0$  | A  |
| Output Energy (Capacitive Load)   | 5.0  | $\mu\text{J}$  |
| Analog Inputs ( $V_{FB}$ , Sense)   | –0.3 to + 5.5  | V  |
| Error Amp Output Sink Current   | 10   | mA   |
| Package Thermal Resistance, PDIP–8<br>Junction–to–Case, $R_{\theta JC}$<br>Junction–to–Ambient, $R_{\theta JA}$ | 52<br>100  | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$                     |
| Package Thermal Resistance, SO–8<br>Junction–to–Case, $R_{\theta JC}$<br>Junction–to–Ambient, $R_{\theta JA}$   | 45<br>165  | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$                     |
| Package Thermal Resistance, SO–14<br>Junction–to–Case, $R_{\theta JC}$<br>Junction–to–Ambient, $R_{\theta JA}$  | 30<br>125  | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$                     |
| Package Thermal Resistance, SO–16L<br>Junction–to–Case, $R_{\theta JC}$<br>Junction–to–Ambient, $R_{\theta JA}$ | 23<br>105  | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$                     |
| Lead Temperature Soldering:   | Wave Solder (through hole styles only) (Note 1)<br>Reflow (SMD styles only) (Note 2) | 260 peak<br>230 peak<br>$^{\circ}\text{C}$<br>$^{\circ}\text{C}$ |

1. 10 second maximum.

2. 60 second maximum above 183°C.

\*The maximum package power dissipation must be observed.

## ELECTRICAL CHARACTERISTICS ( $-25^{\circ} \leq T_A \leq 85^{\circ}$ for CS2844/2845, $0^{\circ} \leq T_A \leq 70^{\circ}$ for CS3844/CS3845.)

$V_{CC} = 15 \text{ V}^*$ ;  $R_T = 10 \text{ k}\Omega$ ,  $C_T = 3.3 \text{ nF}$  for sawtooth mode; unless otherwise stated.)

| Characteristic | Test Conditions | CS2844/CS2845 |     |     | CS3844/CS3845 |     |     | Unit |
|----------------|-----------------|---------------|-----|-----|---------------|-----|-----|------|
|                |                 | Min           | Typ | Max | Min           | Typ | Max |      |

### Reference Section

|                        |   |      |      |      |      |      |      |                              |
|------------------------|---|------|------|------|------|------|------|------------------------------|
| Output Voltage         | $T_J = 25^{\circ}\text{C}$ , $I_{REF} = 1.0 \text{ mA}$                           | 4.95 | 5.00 | 5.05 | 4.90 | 5.00 | 5.10 | V                            |
| Line Regulation        | $12 \leq V_{CC} \leq 25 \text{ V}$  | –    | 6.0  | 20   | –    | 6.0  | 20   | mV                           |
| Load Regulation        | $1.0 \leq I_{REF} \leq 20 \text{ mA}$   | –    | 6.0  | 25   | –    | 6.0  | 25   | mV                           |
| Temperature Stability  | Note 3.   | –    | 0.2  | 0.4  | –    | 0.2  | 0.4  | $\text{mV}/^{\circ}\text{C}$ |
| Total Output Variation | Line, Load, Temperature. Note 3.  | 4.90 | –    | 5.10 | 4.82 | –    | 5.18 | V                            |
| Output Noise Voltage   | $10 \text{ Hz} \leq f \leq 10 \text{ kHz}$ , $T_J = 25^{\circ}\text{C}$ . Note 3. | –    | 50   | –    | –    | 50   | –    | $\mu\text{V}$                |
| Long Term Stability    | $T_A = 125^{\circ}\text{C}$ , 1000 Hrs. Note 3.                                   | –    | 5.0  | 25   | –    | 5.0  | 25   | mV                           |
| Output Short Circuit   | $T_A = 25^{\circ}\text{C}$  | –30  | –100 | –180 | –30  | –100 | –180 | mA                           |

### Oscillator Section

|                       |   |    |     |     |    |     |     |     |
|-----------------------|---|----|-----|-----|----|-----|-----|-----|
| Initial Accuracy      | Sawtooth Mode, $T_J = 25^{\circ}\text{C}$               | 47 | 52  | 57  | 47 | 52  | 57  | kHz |
| Voltage Stability     | $12 \leq V_{CC} \leq 25 \text{ V}$                      | –  | 0.2 | 1.0 | –  | 0.2 | 1.0 | %   |
| Temperature Stability | Sawtooth Mode $T_{MIN} \leq T_A \leq T_{MAX}$ . Note 3. | –  | 5.0 | –   | –  | 5.0 | –   | %   |
| Amplitude             | $V_{OSC}$ (peak to peak)                                | –  | 1.7 | –   | –  | 1.7 | –   | V   |

3. These parameters, although guaranteed, are not 100% tested in production.

\*Adjust  $V_{CC}$  above the start threshold before setting at 15 V.

# CS2844, CS3844, CS2845, CS3845

**ELECTRICAL CHARACTERISTICS (continued)** ( $-25^{\circ} \leq T_A \leq 85^{\circ}$  for CS2844/2845,  $0^{\circ} \leq T_A \leq 70^{\circ}$  for CS3844/CS3845.  
 $V_{CC} = 15\text{ V}^*$ ;  $R_T = 10\text{ k}\Omega$ ,  $C_T = 3.3\text{ nF}$  for sawtooth mode; unless otherwise stated.)

| Characteristic | Test Conditions | CS2842A/CS2843A |     |     | CS3842A/CS3843A |     |     | Unit |
|----------------|-----------------|-----------------|-----|-----|-----------------|-----|-----|------|
|                |                 | Min             | Typ | Max | Min             | Typ | Max |      |

### Error Amp Section

|                       |  |      |      |      |      |      |      |               |
|-----------------------|--|------|------|------|------|------|------|---------------|
| Input Voltage         | $V_{COMP} = 2.5\text{ V}$  | 2.45 | 2.50 | 2.55 | 2.42 | 2.50 | 2.58 | V             |
| Input Bias Current    | $V_{FB} = 0$   | –    | –0.3 | –1.0 | –    | –0.3 | –2.0 | $\mu\text{A}$ |
| $A_{VOL}$             | $2.0 \leq V_{OUT} \leq 4.0\text{ V}$                             | 65   | 90   | –    | 65   | 90   | –    | dB            |
| Unity Gain Bandwidth  | Note 4.  | 0.7  | 1.0  | –    | 0.7  | 1.0  | –    | MHz           |
| PSRR                  | $12 \leq V_{CC} \leq 25\text{ V}$                                | 60   | 70   | –    | 60   | 70   | –    | dB            |
| Output Sink Current   | $V_{FB} = 2.7\text{ V}$ , $V_{COMP} = 1.1\text{ V}$              | 2.0  | 6.0  | –    | 2.0  | 6.0  | –    | mA            |
| Output Source Current | $V_{FB} = 2.3\text{ V}$ , $V_{COMP} = 5.0\text{ V}$              | –0.5 | –0.8 | –    | –0.5 | –0.8 | –    | mA            |
| $V_{OUT}$ High        | $V_{FB} = 2.3\text{ V}$ , $R_L = 15\text{ k}\Omega$ to GND       | 5.0  | 6.0  | –    | 5.0  | 6.0  | –    | V             |
| $V_{OUT}$ Low         | $V_{FB} = 2.7\text{ V}$ , $R_L = 15\text{ k}\Omega$ to $V_{REF}$ | –    | 0.7  | 1.1  | –    | 0.7  | 1.1  | V             |

### Current Sense Section

|                      |   |      |      |      |      |      |      |               |
|----------------------|---|------|------|------|------|------|------|---------------|
| Gain                 | Notes 5 & 6.                                | 2.85 | 3.00 | 3.15 | 2.85 | 3.00 | 3.15 | V/V           |
| Maximum Input Signal | $V_{COMP} = 5.0\text{ V}$ . Note 5.         | 0.9  | 1.0  | 1.1  | 0.9  | 1.0  | 1.1  | V             |
| PSRR                 | $12 \leq V_{CC} \leq 25\text{ V}$ . Note 5. | –    | 70   | –    | –    | 70   | –    | dB            |
| Input Bias Current   | $V_{SENSE} = 0$                             | –    | –2.0 | –10  | –    | –2.0 | –10  | $\mu\text{A}$ |
| Delay to Output      | $T_J = 25^{\circ}\text{C}$ . Note 4.        | –    | 150  | 300  | –    | 150  | 300  | ns            |

### Output Section

|                   |  |    |      |     |    |      |     |    |
|-------------------|--|----|------|-----|----|------|-----|----|
| Output Low Level  | $I_{SINK} = 20\text{ mA}$<br>$I_{SINK} = 200\text{ mA}$      | –  | 0.1  | 0.4 | –  | 0.1  | 0.4 | V  |
|                   |  | –  | 1.5  | 2.2 | –  | 1.5  | 2.2 | V  |
| Output High Level | $I_{SOURCE} = 20\text{ mA}$<br>$I_{SOURCE} = 200\text{ mA}$  | 13 | 13.5 | –   | 13 | 13.5 | –   | V  |
|                   |  | 12 | 13.5 | –   | 12 | 13.5 | –   | V  |
| Rise Time         | $T_J = 25^{\circ}\text{C}$ , $C_L = 1.0\text{ nF}$ . Note 4. | –  | 50   | 150 | –  | 50   | 150 | ns |
| Fall Time         | $T_J = 25^{\circ}\text{C}$ , $C_L = 1.0\text{ nF}$ . Note 4. | –  | 50   | 150 | –  | 50   | 150 | ns |

### Total Standby Current

|                          |  |   |     |     |   |     |     |    |
|--------------------------|--|---|-----|-----|---|-----|-----|----|
| Startup Current          | –  | – | 0.5 | 1.0 | – | 0.5 | 1.0 | mA |
| Operating Supply Current | $V_{FB} = V_{SENSE} = 0\text{ V}$ ,<br>$R_T = 10\text{ k}\Omega$ , $C_T = 3.3\text{ nF}$ | – | 11  | 17  | – | 11  | 17  | mA |
| $V_{CC}$ Zener Voltage   | $I_{CC} = 25\text{ mA}$  | – | 34  | –   | – | 34  | –   | V  |

### PWM Section

|                    |   |    |    |    |    |    |    |   |
|--------------------|---|----|----|----|----|----|----|---|
| Maximum Duty Cycle | – | 46 | 48 | 50 | 46 | 48 | 50 | % |
| Minimum Duty Cycle | – | –  | –  | 0  | –  | –  | 0  | % |

4. These parameters, although guaranteed, are not 100% tested in production.

5. Parameters measured at trip point of latch with  $V_{FB} = 0$ .

6. Gain defined as:  $A = \Delta V_{COMP} / \Delta V_{SENSE}$ ;  $0 \leq V_{SENSE} \leq 0.8\text{ V}$ .

\*Adjust  $V_{CC}$  above the start threshold before setting at 15 V.

# CS2844, CS3844, CS2845, CS3845

**ELECTRICAL CHARACTERISTICS (continued)** ( $-25^{\circ} \leq T_A \leq 85^{\circ}$  for CS2844/2845,  $0^{\circ} \leq T_A \leq 70^{\circ}$  for CS3844/CS3845.

$V_{CC} = 15\text{ V}^*$ ;  $R_T = 10\text{ k}\Omega$ ,  $C_T = 3.3\text{ nF}$  for sawtooth mode; unless otherwise stated.)

| Characteristic | Test Conditions | CS2844 |     |     | CS3844 |     |     | CS2845/CS3845 |     |     | Unit |
|----------------|-----------------|--------|-----|-----|--------|-----|-----|---------------|-----|-----|------|
|                |                 | Min    | Typ | Max | Min    | Typ | Max | Min           | Typ | Max |      |

## Undervoltage Lockout Section

|                        |               |     |    |    |      |    |      |     |     |     |   |
|------------------------|---------------|-----|----|----|------|----|------|-----|-----|-----|---|
| Start Threshold        | –             | 15  | 16 | 17 | 14.5 | 16 | 17.5 | 7.8 | 8.4 | 9.0 | V |
| Min. Operating Voltage | After Turn On | 9.0 | 10 | 11 | 8.5  | 10 | 11.5 | 7.0 | 7.6 | 8.2 | V |

\*Adjust  $V_{CC}$  above the start threshold before setting at 15 V.

## PACKAGE PIN DESCRIPTION

| Package Pin Number |             |                   | Symbol       | Description   |
|--------------------|-------------|-------------------|--------------|---|
| DIP-8 & SO-8       | SO-14       | Symbol            |              |   |
| 1                  | 1           | 3                 | COMP         | Error amp output, used to compensate error amplifier.                       |
| 2                  | 3           | 4                 | $V_{FB}$     | Error amp inverting input.  |
| 3                  | 5           | 5                 | Sense        | Noninverting input to Current Sense Comparator.                             |
| 4                  | 7           | 6                 | OSC          | Oscillator timing network with capacitor to ground, resistor to $V_{REF}$ . |
| 5                  | 9           | 11                | GND          | Ground.   |
| –                  | 8           | 10                | Pwr GND      | Output driver ground.   |
| 6                  | 10          | 12                | $V_{OUT}$    | Output drive pin.   |
| –                  | 11          | 13                | $V_{CC}$ Pwr | Output driver positive supply.  |
| 7                  | 12          | 14                | $V_{CC}$     | Positive power supply.  |
| 8                  | 14          | 15                | $V_{REF}$    | Output of 5.0 V internal reference.   |
| –                  | 2, 4, 6, 13 | 1, 2, 7, 8, 9, 16 | NC           | No connection.  |

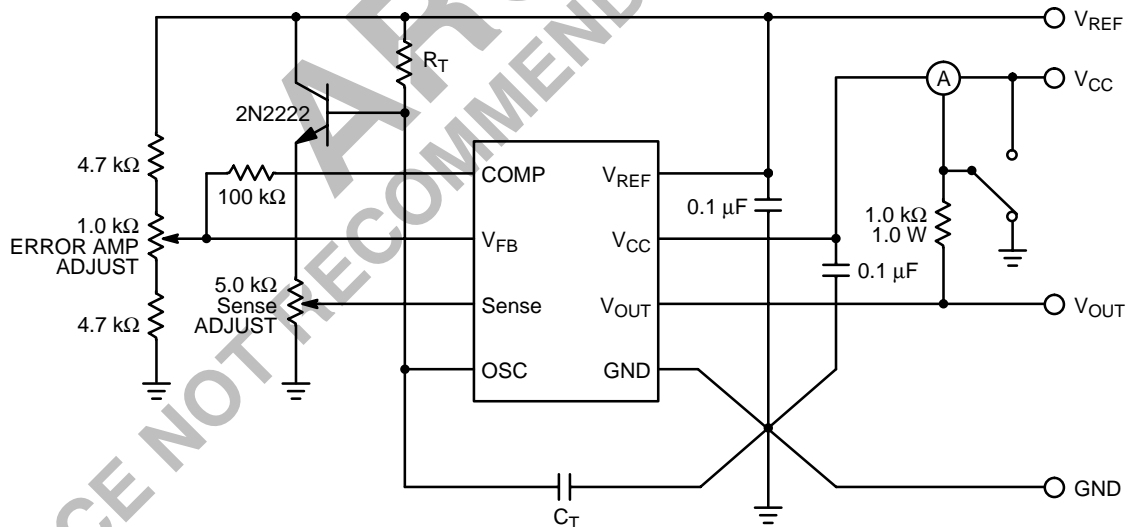


Figure 2. Test Circuit Open Loop Laboratory Test Fixture

CIRCUIT DESCRIPTION

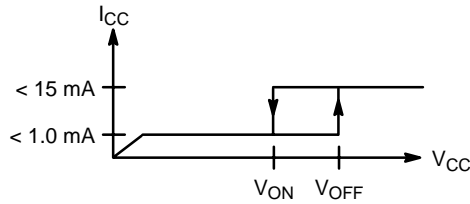
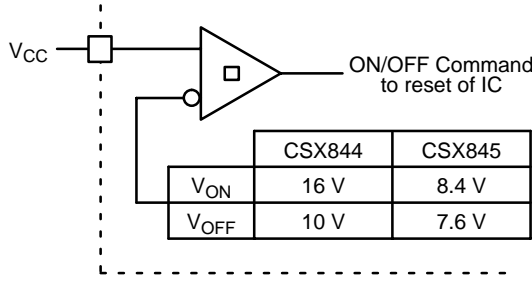


Figure 3. Startup Voltage for CSX844 and CSX845

Undervoltage Lockout

During Undervoltage Lockout (Figure 3), the output driver is biased to sink minor amounts of current. The output should be shunted to ground with a resistor to prevent activating the power switch with extraneous leakage currents.

PWM Waveform

To generate the PWM waveform, the control voltage from the error amplifier is compared to a current sense signal which represents the peak output inductor current (Figure 4). An increase in V<sub>CC</sub> causes the inductor current slope to increase, thus reducing the duty cycle. This is an inherent feed-forward characteristic of current mode control, since the control voltage does not have to change during changes of input supply voltage.

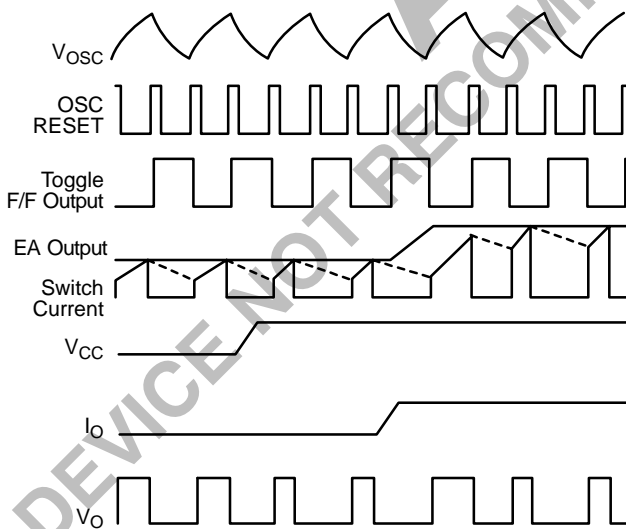


Figure 4. Timing Diagram

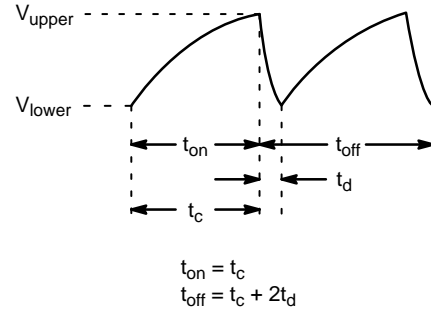


Figure 5. Duty Cycle Parameters

When the power supply sees a sudden large output current increase, the control voltage will increase allowing the duty cycle to momentarily increase. Since the duty cycle tends to exceed the maximum allowed to prevent transformer saturation in some power supplies, the internal oscillator waveform provides the maximum duty cycle clamp as programmed by the selection of OSC components.

Setting the Oscillator

The times  $t_c$  and  $t_d$  can be determined as follows:

$$t_c = RTCT \ln\left(\frac{V_{REF} - V_{lower}}{V_{REF} - V_{upper}}\right)$$

$$t_d = RTCT \ln\left(\frac{V_{REF} - I_dRT - V_{lower}}{V_{REF} - I_dRT - V_{upper}}\right)$$

Substituting in typical values for the parameters in the above formulas:

$V_{REF} = 5.0 \text{ V}$ ,  $V_{upper} = 2.7 \text{ V}$ ,  $V_{lower} = 1.0 \text{ V}$ ,  $I_d = 8.3 \text{ mA}$  then:

$$t_c \approx 0.5534RTCT$$

$$t_d = RTCT \ln\left(\frac{2.3 - 0.0083RT}{4.0 - 0.0083RT}\right)$$

For better accuracy  $R_T$  should be  $\geq 10 \text{ k}\Omega$ .

Grounding

High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to Gnd in a single point ground.

The transistor and  $5.0 \text{ k}\Omega$  potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to Sense.

## CS2844, CS3844, CS2845, CS3845

### ORDERING INFORMATION

| Device       | Temperature Range | Package | Shipping         |
|--------------|-------------------|---------|------------------|
| CS2844LN8    | -25°C to 85°C     | DIP-8   | 50 Units/Rail    |
| CS2844LD14   |                   | SO-14   | 55 Units/Rail    |
| CS2844LDR14  |                   | SO-14   | 2500 Tape & Reel |
| CS2844LDW16  |                   | SO-16L  | 48 Units/Rail    |
| CS2844LDWR16 |                   | SO-16L  | 2500 Tape & Reel |
| CS2845LN8    |                   | DIP-8   | 50 Units/Rail    |
| CS2845DW16   |                   | SO-16L  | 48 Units/Rail    |
| CS2845LDWR16 |                   | SO-16L  | 2500 Tape & Reel |
| CS3844GN8    | 0°C to 70°C       | DIP-8   | 50 Units/Rail    |
| CS3844GD8    |                   | SO-8    | 98 Units/Rail    |
| CS3844GDR8   |                   | SO-8    | 2500 Tape & Reel |
| CS3844GD14   |                   | SO-14   | 55 Units/Rail    |
| CS3844GDR14  |                   | SO-14   | 2500 Tape & Reel |
| CS3844GDW16  |                   | SO-16   | 48 Units/Rail    |
| CS3844GDWR16 |                   | SO-16   | 2500 Tape & Reel |
| CS3845GN8    |                   | DIP-8   | 50 Units/Rail    |
| CS3845GD8    |                   | SO-8    | 98 Units/Rail    |
| CS3845GDR8   |                   | SO-8    | 2500 Tape & Reel |
| CS3845GD14   |                   | SO-14   | 55 Units/Rail    |
| CS3845GDR14  |                   | SO-14   | 2500 Tape & Reel |
| CS3845GDW16  |                   | SO-16L  | 48 Units/Rail    |
| CS3845GDWR16 |                   | SO-16L  | 2500 Tape & Reel |

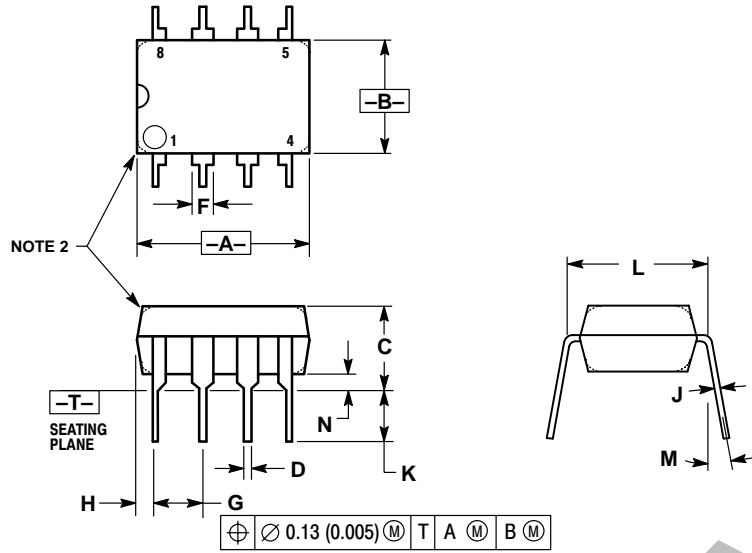
ARCHITECTURE FOR NEW DESIGN

DEVICE NOT RECOMMENDED

# CS2844, CS3844, CS2845, CS3845

## PACKAGE DIMENSIONS

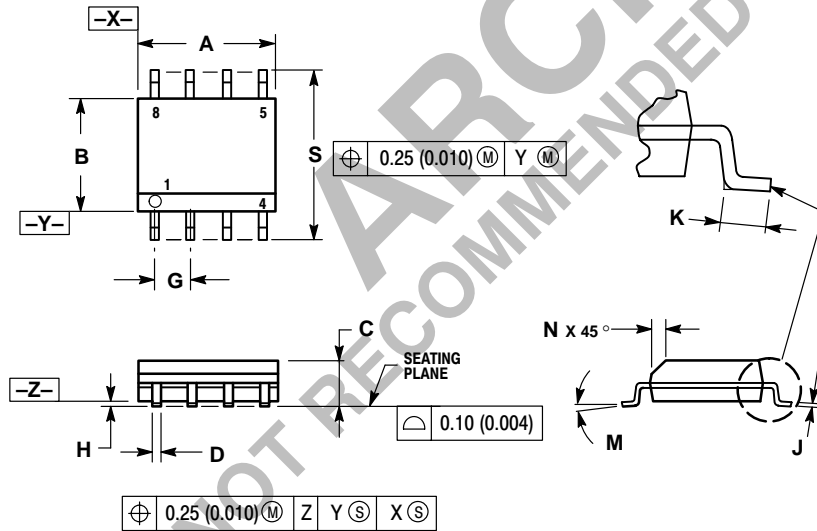
DIP-8  
N SUFFIX  
CASE 626-05  
ISSUE L



- NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
  2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
  3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.40        | 10.16 | 0.370     | 0.400 |
| B   | 6.10        | 6.60  | 0.240     | 0.260 |
| C   | 3.94        | 4.45  | 0.155     | 0.175 |
| D   | 0.38        | 0.51  | 0.015     | 0.020 |
| F   | 1.02        | 1.78  | 0.040     | 0.070 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | 0.76        | 1.27  | 0.030     | 0.050 |
| J   | 0.20        | 0.30  | 0.008     | 0.012 |
| K   | 2.92        | 3.43  | 0.115     | 0.135 |
| L   | 7.62 BSC    |       | 0.300 BSC |       |
| M   | ---         | 10°   | ---       | 10°   |
| N   | 0.76        | 1.01  | 0.030     | 0.040 |

SO-8  
D SUFFIX  
CASE 751-07  
ISSUE W



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

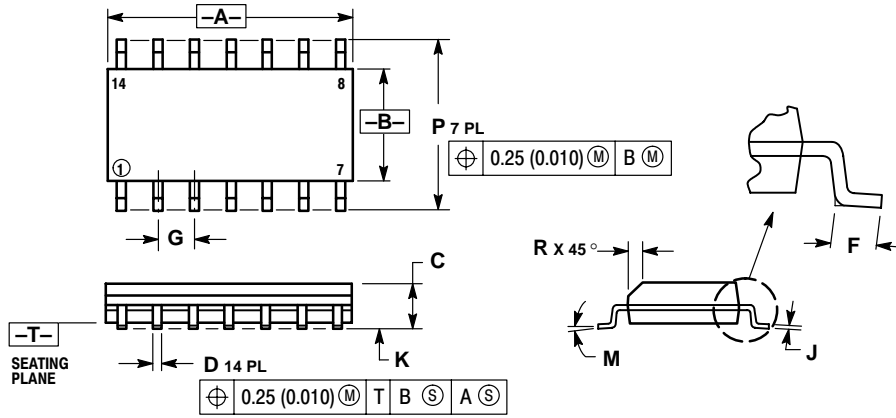
| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |



# CS2844, CS3844, CS2845, CS3845

## PACKAGE DIMENSIONS

### SO-14 D SUFFIX CASE 751A-03 ISSUE F

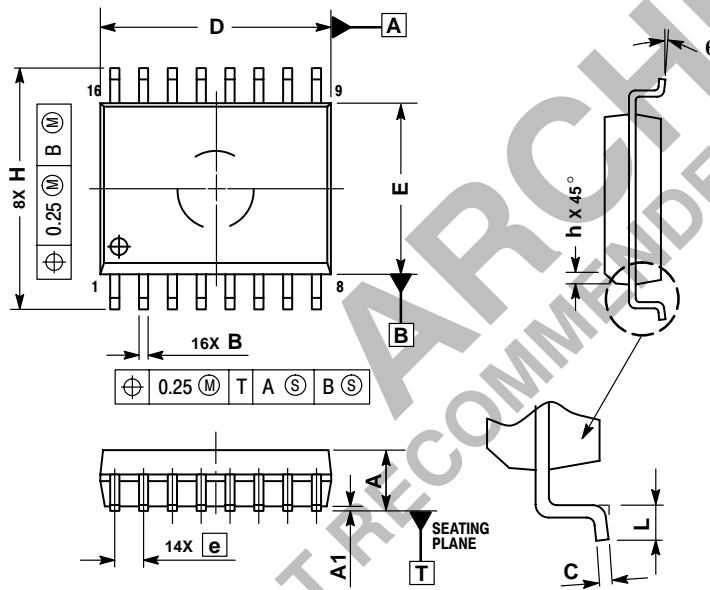


NOTES:

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| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 8.55        | 8.75 | 0.337     | 0.344 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.054     | 0.068 |
| D   | 0.35        | 0.49 | 0.014     | 0.019 |
| F   | 0.40        | 1.25 | 0.016     | 0.049 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| J   | 0.19        | 0.25 | 0.008     | 0.009 |
| K   | 0.10        | 0.25 | 0.004     | 0.009 |
| M   | 0°          | 7°   | 0°        | 7°    |
| P   | 5.80        | 6.20 | 0.228     | 0.244 |
| R   | 0.25        | 0.50 | 0.010     | 0.019 |

### SO-16L DW SUFFIX CASE 751G-03 ISSUE B



NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM   | MILLIMETERS |       |
|-------|-------------|-------|
|       | MIN         | MAX   |
| A     | 2.35        | 2.65  |
| A1    | 0.10        | 0.25  |
| B     | 0.35        | 0.49  |
| C     | 0.23        | 0.32  |
| D     | 10.15       | 10.45 |
| E     | 7.40        | 7.60  |
| e     | 1.27 BSC    |       |
| H     | 10.05       | 10.55 |
| h     | 0.25        | 0.75  |
| L     | 0.50        | 0.90  |
| theta | 0°          | 7°    |


**Notes**

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DEVICE NOT RECOMMENDED FOR NEW DESIGN

**Notes**

ARCHIVE  
DEVICE NOT RECOMMENDED FOR NEW DESIGN

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