**3A, 40V, 100kHz Step-Down Converter**

**With Output Line Drop Compensation**

# CE8630 Series

## INTRODUCTION

The CE8630 is a monolithic step-down switch mode converter with a programmable output current limit. It achieves 3A continuous output current over a wide input supply range with excellent load and line regulation. An internal 2~4ms soft start prevents inrush current at turning on. And it is capable of providing output line drop compensation.

CE8630 achieves low EMI signature with well controlled switching edges.

Fault condition protection includes hiccup current limit and short circuit protection, programmable output over voltage protection and thermal shutdown.

The CE8630 requires a minimum number of readily available standard external components. The CE8630 is available in SOP8 and SOP8-PP package.

## FEATURES

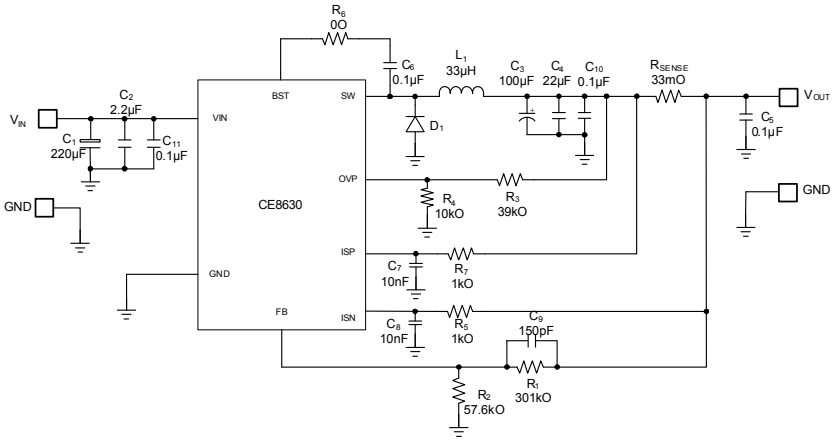
- Wide 4.5V to 40V Operating Input Range
- Programmable Output Over Voltage Protection
- Output Adjustable from 0.8V to 25V
- 0.15Ω Internal Power MOSFET Switch
- Internal 4ms Soft Start
- Stable with Low ESR Output Ceramic Capacitors
- Fixed 100kHz Frequency
- Low EMI Signature
- Thermal Shutdown
- Output Line Drop Compensation
- Hiccup Circuit Limit and Short Circuit Protection
- Available in SOP8 and SOP8-PP Package

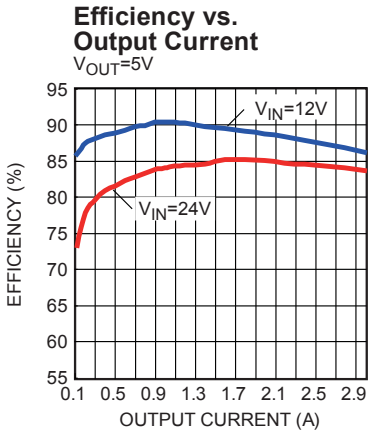
## APPLICATIONS

- USB Power Supplies
- Automotive Cigarette Lighter Adapters
- Power Supply for Linear Chargers

All CHIPOWER parts are lead-free and adhere to the RoHS directive.

## TYPICAL APPLICATION

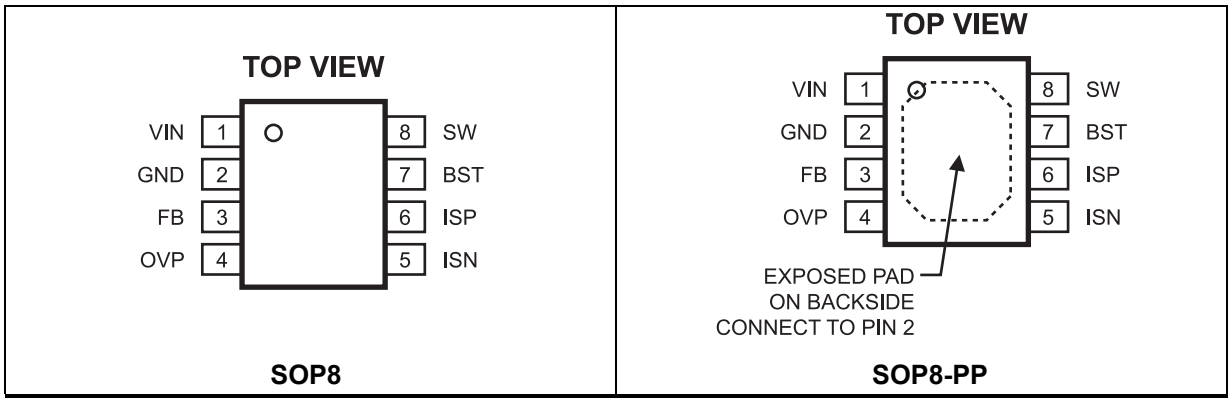


## ORDERING INFORMATION

| Part Number | Package | Top Marking | Operating Temperature ($T_J$) |
|---|---|---|---|
| CE8630AS | SOP8 | CE8630 | -40°C to +125°C |
| CE8630AES | SOP8-PP | CE8630 | -40°C to +125°C |

## PACKAGE REFERENCE




## PIN FUNCTIONS

| Package Pin # | Name | Description |
|---|---|---|
| 1 | $V_{IN}$ | Supply Voltage. The CE8630 operates from a +4.5V to +40V unregulated input. $C_{IN}$ is needed to prevent large voltage spikes from appearing at the input. Put $C_{IN}$ as close to the IC as possible. It is the drain of the internal power device and power supply for the whole chip. |
| 2 | GND, Exposed Pad | Ground. This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout. This node should be placed outside of the D1 to $C_{IN}$ ground path to prevent switching current spikes from inducing voltage noise into the part. Connect exposed pad to GND plane for optimal thermal performance. |
| 3 | FB | Feedback. An external resistor divider from the output to GND tapped to the FB pin sets the output voltage. To prevent current limit run away during a short circuit fault condition the frequency-fold-back comparator lowers the oscillator frequency when the FB voltage is below 250mV. |
| 4 | OVP | Output Over Voltage Protection. Connect OVP to the center point of an external resistor divider from output to GND. The OVP reference is 1.23V. |
| 5 | ISN | Negative Current Sense Input. It is used for load current limiting and output line drop compensation. |
| 6 | ISP | Positive Current Sense Input. It is used for load current limiting and output line drop compensation. |
| 7 | BST | Bootstrap. This capacitor is needed to drive the power switch's gate above the supply voltage. It is connected between SW and BST pins to form a floating supply across the power switch driver. An on-chip regulator is used to charge up the external boot-strap capacitor. If the on-chip regulator is not strong enough, one optional diode can be connected from IN or OUT to charge the external boot-strap capacitor. |
| 8 | SW | Switch Output. It is the source of power device. |

## ABSOLUTE MAXIMUM RATINGS (1)

Input Voltage $V_{IN}$ ..... 45V
$V_{ISN}$, $V_{ISP}$ ..... 0V to 25V
$|V_{ISN} - V_{ISP}|$ ..... 0V to 0.4V
$V_{SW}$ ..... -0.3V to $V_{IN}$ + 0.3V
$V_{BST}$ ..... $V_{SW}$ + 6.5V
All Other Pins ..... -0.3V to +6.5V
Junction Temperature ..... 150°C
Lead Temperature ..... 260°C
Storage Temperature ..... -65°C to +150°C
Continuous Power Dissipation ($T_A$ = +25°C) (2)
SOP8 ..... 1.38W
SOP8-PP ..... 2.5W

## *Recommended Operating Conditions* (3)

Input Voltage $V_{IN}$ ..... 4.5V to 40V
Output Voltage $V_{OUT}$ ($V_{IN}$>26.5V) ..... 0.8V to 25V
Output Voltage $V_{OUT}$ ($V_{IN}$<=26.5V) .....
..... 0.8V to ($V_{IN}$–1.5)V
Maximum Junction Temp. ($T_J$) ..... +125°C

## *Thermal Resistance* (4)

| | $\theta_{JA}$ | $\theta_{JC}$ | |
|---|---|---|---|
| SOP8 | 90 | 45 | °C/W |
| SOP8-PP | 50 | 10 | °C/W |

**Notes:**

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature $T_J$ (MAX), the junction-to-ambient thermal resistance $\theta_{JA}$, and the ambient temperature $T_A$. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_D$ (MAX) = ($T_J$ (MAX)-$T_A$)/$\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) The device is not guaranteed to function outside of its operating conditions.
4) Measured on JESD51-7, 4-layer PCB.

# ELECTRICAL CHARACTERISTICS

**$V_{IN}$ = 12V, $T_A$ = +25°C, unless otherwise noted.**

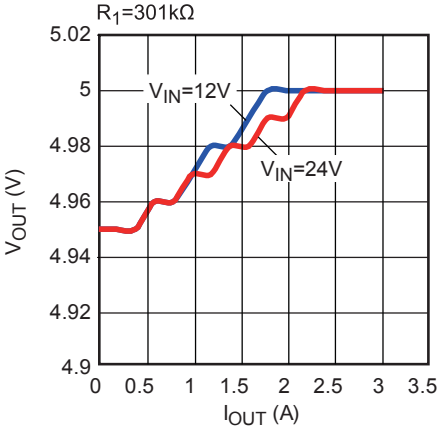
| Parameters | Symbol | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Feedback Voltage | $V_{FB}$ | 4.5V ≤ $V_{IN}$ ≤ 40V | 0.78 | 0.8 | 0.82 | V |
| Feedback Bias Current | $I_{BIAS(FB)}$ | $V_{FB}$ = 0.8V | | 10 | | nA |
| Output Over Voltage Reference | $V_{OVREF}$ | $T_A$=-40°C to +85°C | 1.10 | 1.23 | 1.36 | V |
| Input Bias Current (OVP) | $I_{BIAS(OVP)}$ | $V_{OVP}$=1.23V | | 0.1 | | μA |
| Switch On Resistance | $R_{DS(ON)}$ | | | 0.15 | | Ω |
| Switch Leakage | | $V_{OVP}$ = 2V, $V_{SW}$ = 0V | | 0.1 | 10 | μA |
| Current Limit | | Duty Cycle=10% | | 5 | | A |
| Oscillator Frequency | $f_{SW}$ | $V_{FB}$ = 0.6V | 80 | 100 | 120 | kHz |
| Boot-Strap Voltage | $V_{BST}$ - $V_{SW}$ | | | 4.5 | | V |
| Minimum On Time | $t_{ON}$ | | | 100 | | ns |
| SW Rising Edge | $t_{RISE}$ | | | 50 | | ns |
| SW Falling Edge | $t_{FALL}$ | | | 50 | | ns |
| Under Voltage Lockout Threshold Rising | | | 2.9 | 3.4 | 3.9 | V |
| Under Voltage Lockout Threshold Hysteresis | | | | 200 | | mV |
| Load Line Compensation Gain | $G_{LLC}$ | $V_{ISP}$-$V_{ISN}$=100mV, check $I_{FB}$ | 15 | 20 | 25 | μA/V |
| Current Sense Voltage | $V_{ISP}$ –$V_{ISN}$ | $V_{ISP}$, $V_{ISN}$ 0.5–15V | 90 | 100 | 110 | mV |
| Input Bias Current (ISN, ISP) | $I_{BIAS\ (ISN,ISP)}$ | $V_{ISP}$, $V_{ISN}$ 0.5–15V | -1 | -0.5 | +1 | μA |
| Supply Current (Quiescent) | | $V_{OVP}$ = 0V, $V_{FB}$ = 1V | | 1.2 | 1.5 | mA |
| Thermal Shutdown | | | | 150 | | °C |
| Thermal Shutdown Hysteresis | | | | 30 | | °C |

# TYPICAL PERFORMANCE CHARACTERISTICS

**C1=220μF, C2=2.2μF, C3=100μF, C4=22μF, L=33μH, $R_{SENSE}$=33mΩ, $T_A$=25ºC，unless otherwise noted.**

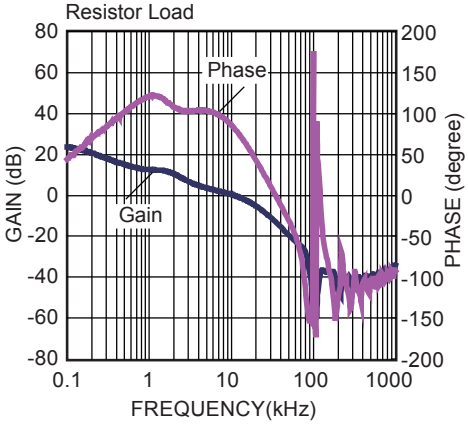
### Output Line Drop Compensation

$R_{SENSE}$=25mΩ, $R_{TRACE}$=120mΩ
$R_1$=301kΩ



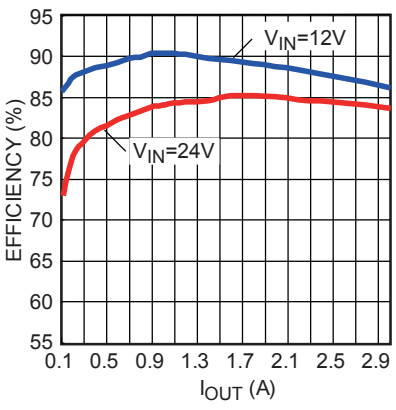

### Loop Gain with Phase Margin

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
Resistor Load



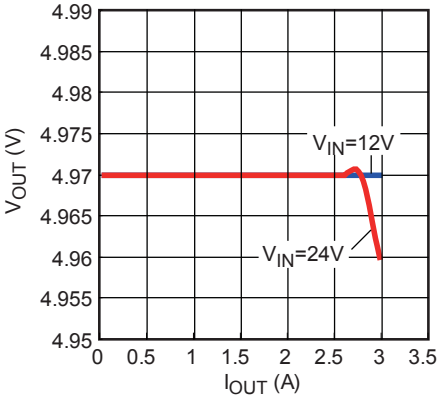

### Efficiency vs. Output Current

$V_{OUT}$=5V



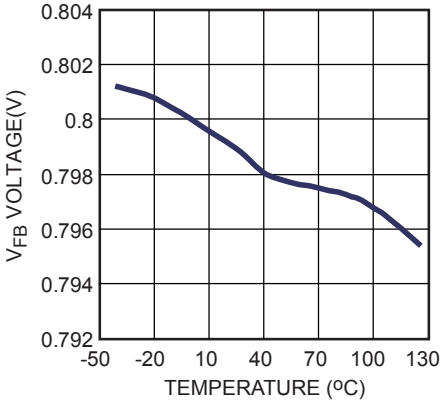

### Load Regulation

Connect ISP, ISN to GND



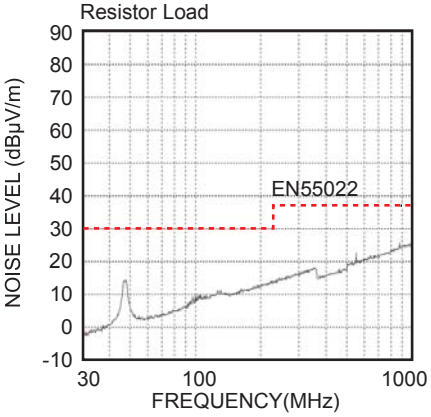

### $V_{FB}$ vs. Temperature

$V_{IN}$=12V




### EMI Radiation

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
Resistor Load

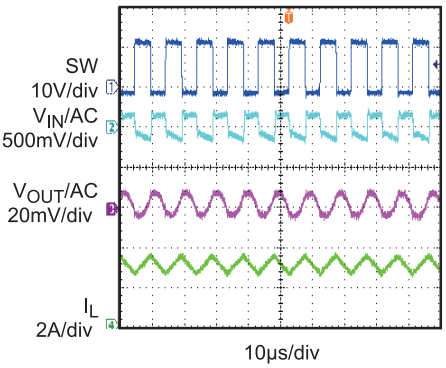


## TYPICAL PERFORMANCE CHARACTERISTICS *(Continued)*

**C1=220μF, C2=2.2μF, C3=100μF, C4=22μF, L=33μH, $R_{SENSE}$=33mΩ, $T_A$=25ºC，unless otherwise noted.**

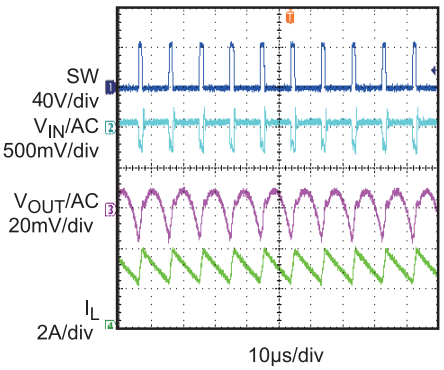
### Steady State

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
E-Load



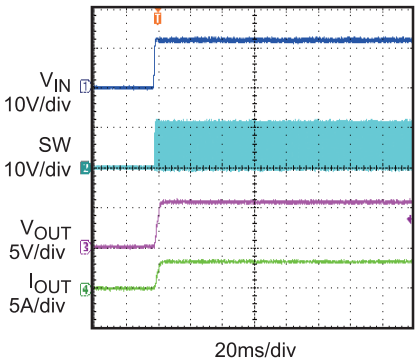

### Steady State

$V_{IN}$=40V, $V_{OUT}$=5V, $I_{OUT}$=3A
E-Load



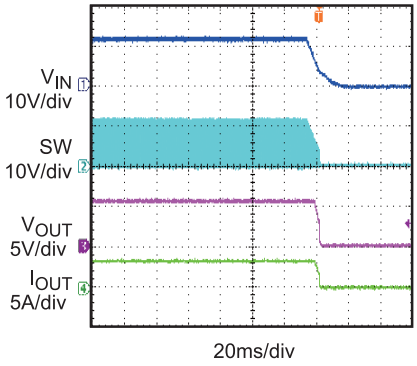

### Power Ramp Up

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
Resistor Load



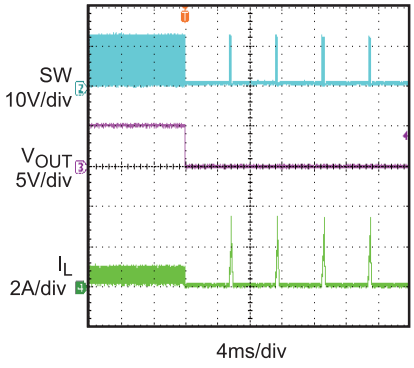

### Power Ramp Down

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
Resistor Load



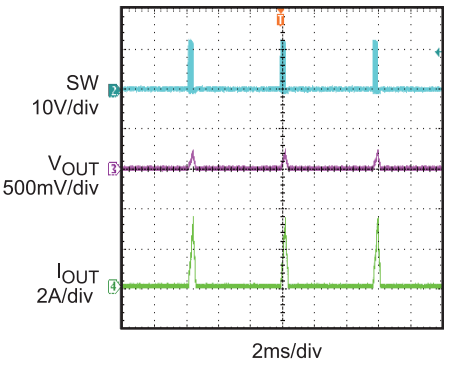

### Short Circuit Enter

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=0.5A
E-Load



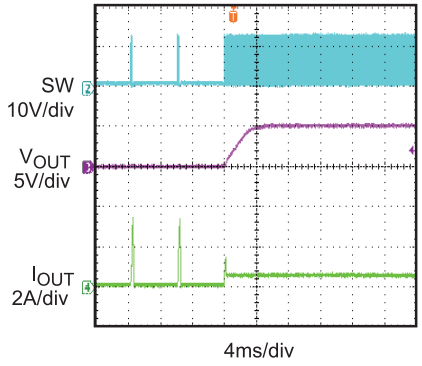

### Short Circuit Steady

$V_{IN}$=12V, $V_{OUT}$=5V
E-Load



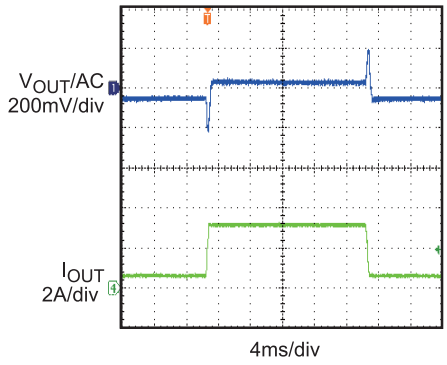

### Short Circuit Recovery

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=0.5A
E-Load



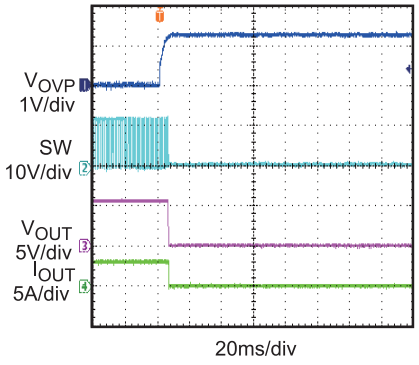

### Load Transient Response

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=0.3A-3A
Slew Rate=6.4mA/μs




### Over Voltage Protection

$V_{IN}$=12V, $V_{OUT}$=5V, $I_{OUT}$=3A
Add an External Power to OVP



# BLOCK DIAGRAM

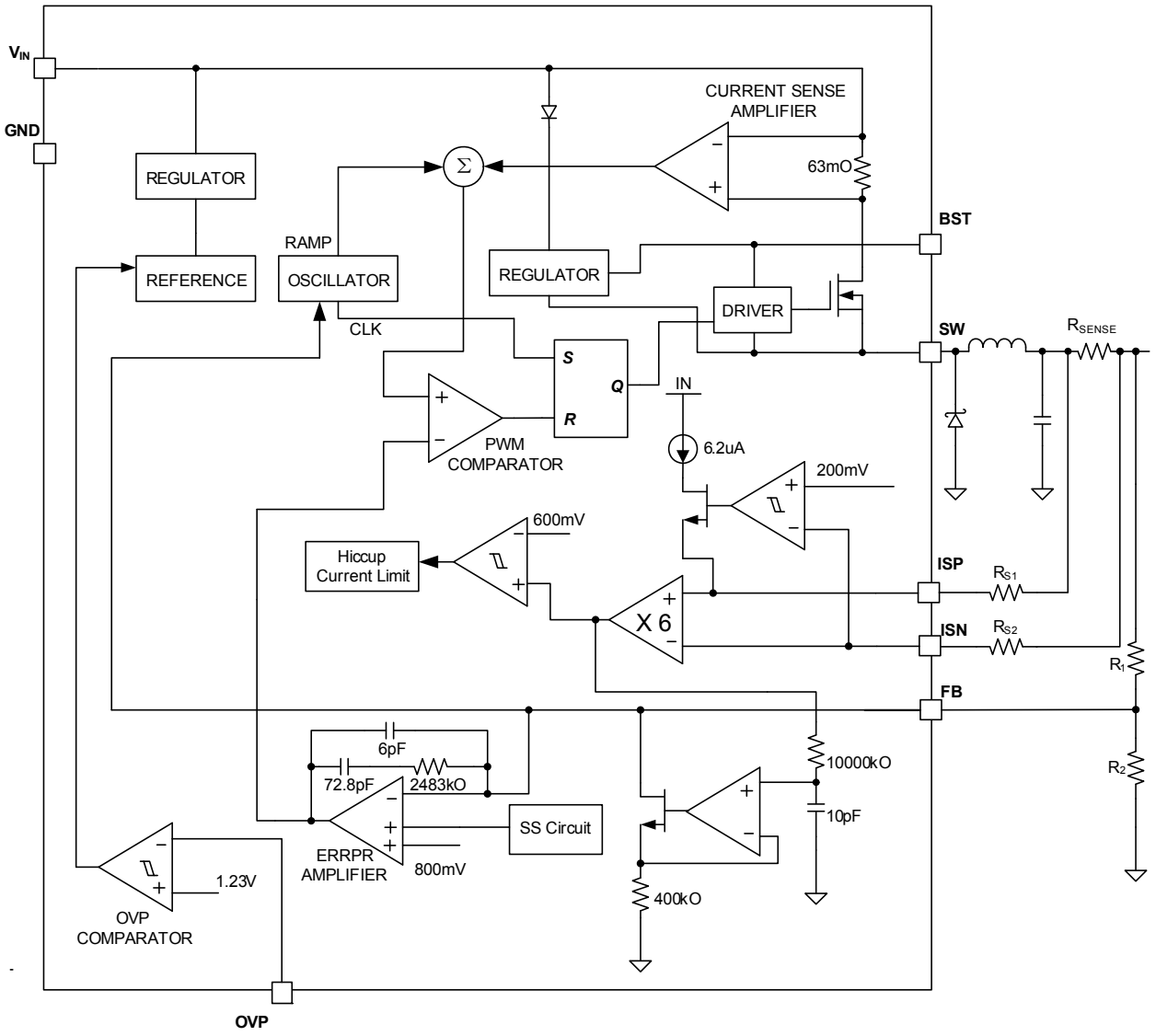



**Figure 1—Functional Block Diagram**

# OPERATION

### Main Control Loop

The CE8630 is a current mode buck regulator. That is, the EA output voltage is proportional to the peak inductor current.

At the beginning of a cycle SW is off; the Error Amplifier output voltage is higher than the Current Sense Amplifier output. The rising edge of the 100kHz CLK signal sets the RS Flip-Flop. Its output turns on SW thus connecting the SW pin and inductor to the input supply.

The increasing inductor current is sensed and amplified by the Current Sense Amplifier. Ramp Compensation is summed to Current Sense Amplifier output and compared to the Error Amplifier output by the PWM Comparator. When the Current Sense Amplifier plus Slope Compensation signal exceeds the Error Amplifier output voltage, the RS Flip-Flop is reset and the CE8630 reverts to its initial SW off state.

If the Current Sense Amplifier plus Slope Compensation signal does not exceed the COMP voltage, then the falling edge of the CLK resets the Flip-Flop.

The output of the Error Amplifier integrates the voltage difference between the feedback and the reference. The polarity is such that an FB pin voltage is lower than 0.8V increases the EA output voltage. Since the EA output voltage is proportional to the peak inductor current, an increase in its voltage increases current delivered to the output. An external Schottky Diode (D1) carries the inductor current when SW is off.

### Hiccup Mode Current Limit Protection

The output current information for current limit protection is sensed via the ISP and ISN pins. The sense voltage limit threshold is set at 100mV. CE8630 has hiccup over current limit function. Once the $V_{SENSE}$ exceeds the 100mV, the current limit loop will turn off high side switch immediately. Meanwhile, internal soft start circuit will be reset after FB is lower than 0.3V, and then the high side switch turns on and CE8630 restarts with a full soft start. This hiccup process is repeated until the fault is removed. And, current limit value can be programmed to be lower by internal current source and external resistors connected to ISN and ISP pins, when output voltage is lower than 200mV. Then, the average short circuit current can be greatly reduced.

### Output Over Voltage Protection

The CE8630 has output over voltage protection. The OVP reference 1.23V is on the positive input of the OVP comparator. The output voltage is fed to OVP pin through an external resistor divider. If the voltage on OVP pin is higher than 1.23V, the high side switch will be turned off immediately and part will be lathed off after a timer delay.

### Output Line Drop Compensation

If the trace from CE8630 output terminator to the load is too long, there will be a voltage drop on the long trace which is variable with load current. CE8630 is capable of compensating the output voltage drop to keep a constant voltage at load, whatever the load current is. The output voltage is compensated by feeding a current to the top feedback resistance R1. The load line compensation gain can be programmed according to $R_{SENSE}$ and $R_{TRACE}$ (Figure 2) values.

# APPLICATION INFORMATION

### Setting the Output Line Drop Compensation

Figure 2 shows the block of output line drop compensation.

If the trace to the load is long, there is a voltage drop between $V_{OUT}$ and $V_{LOAD}$. $V_{OUT}$ (voltage at output terminator) is not equal to $V_{LOAD}$(voltage at load). The voltage drop can be described by:

$$V_{DROP} = I_{OUT} \times R_{TRACE} \quad (1)$$

Where, the $R_{TRACE}$ is the resistance of the output line. ($R_{TRACE} = R_{TRACE1} + R_{TRACE2}$)

Then, the $V_{LOAD}$ is:

$$V_{LOAD} = V_{OUT} - I_{OUT} \times R_{TRACE} \quad (2)$$

To keep an accurate and constant load voltage, the output line drop compensation is necessary.

CE8630 offers a compensation method, by adjusting the FB voltage slightly according to the load current.

The relation between $V_{OUT}$ and $V_{FB}$ can be described by:

$$\frac{V_{OUT} - V_{FB}}{R1} = \frac{V_{FB}}{R2} + \frac{I_{OUT} \times R_{SENSE} \times 6}{400k\Omega} \quad (3)$$

Where, $V_{FB}$ is 0.8V.

Then, the $V_{OUT}$ can be calculated by:

$$V_{OUT} = (1 + \frac{R1}{R2}) \times 0.8V + \frac{I_{OUT} \times R_{SENSE} \times 6 \times R1}{400k\Omega} \quad (4)$$

The $V_{LOAD}$ is determined by:

$$V_{LOAD} = (1 + \frac{R1}{R2}) \times 0.8V + \frac{I_{OUT} \times R_{SENSE} \times 6 \times R1}{400k\Omega} - I_{OUT} \times R_{TRACE} \quad (5)$$

To maintain the $V_{LOAD}$ is not variable with load current. The equation below should be satisfied:

$$\frac{I_{OUT} \times R_{SENSE} \times 6 \times R1}{400k\Omega} = I_{OUT} \times R_{TRACE} \quad (6)$$

Simplify the formula above, we can get:

$$R1 = \frac{R_{TRACE} \times 400k\Omega}{6 \times R_{SENSE}} \quad (7)$$

In the formula above, $R_{SENSE}$ is known. And $R_{TRACE}$ can be tested or evaluated. So, we can select a proper top feedback resistor R1 according to the $R_{TRACE}$ and $R_{SENSE}$ to compensate the output line voltage drop.

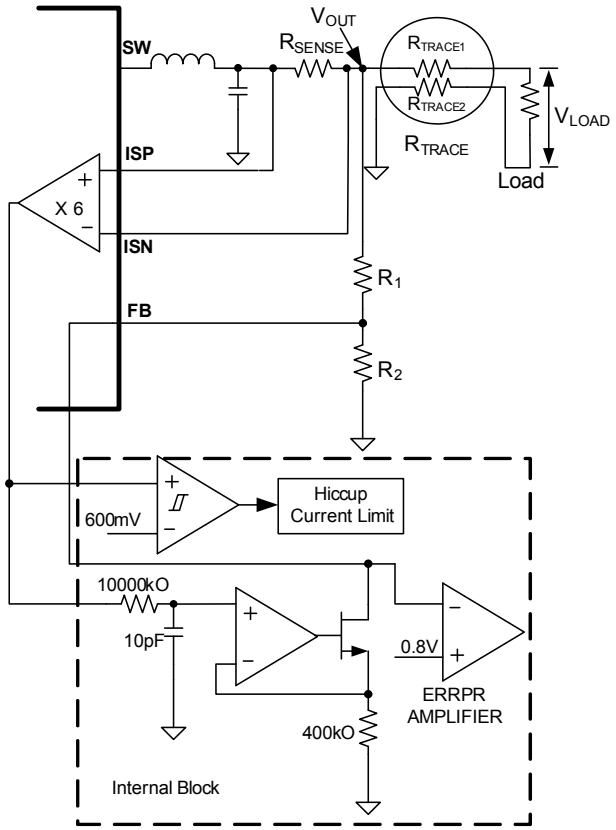



**Figure 2—Output Line Drop Compensation**

### Setting the Output Voltage

The external resistor divider is used to set the output voltage (see the typical application circuit on the front page). The feedback resistor R1 is decided by output line drop compensation. R2 is then given by:

$$R2 = \frac{R1}{\frac{V_{OUT}}{0.8V} - 1} \quad (8)$$

### Selecting the Inductor

A 10μH to 47μH inductor with a DC current rating of at least 25% percent higher than the maximum load current is recommended for most applications. For highest efficiency, the inductor DC resistance should be less than 200mΩ. For most designs, the inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}} \quad (9)$$

Where $\Delta I_L$ is the inductor ripple current.

Choose inductor current ripple to be approximately 30% of the maximum load current, 3A. The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2} \quad (10)$$

Under light load conditions below 100mA, larger inductance is recommended for improving efficiency.

### Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input and also the switching noise from the device. The input capacitor impedance at the switching frequency should be less than the input source impedance to prevent high frequency switching current from passing to the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 4.7μF capacitor is sufficient.

### Selecting the Output Capacitor

The output capacitor keeps output voltage small and ensures regulation loop stability. The output capacitor impedance should be low at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended.

### Setting the Output OVP Threshold

The output OVP threshold is set by connecting an external resistor divider (R3, R4 see the typical application circuit on the front page) at OVP pin. Choose R3 to be 39kΩ for lower power dissipation. Then, R4 is given by:

$$R4 = \frac{R3}{\frac{V_{OVP}}{V_{OVREF}} - 1} (k\Omega) \quad (11)$$

Where, $V_{OVREF}$ is the OVP reference, 1.23V. $V_{OVP}$ is over voltage protection threshold.

### Setting the Current Limit

The hiccup current limit can be set by the DC resistance (DCR) of the inductor, as shown in Figure 3a.

For more accurate sensing, use a more accurate sense resistor.

In Figure 3a, the output current limit is set as:

$$I_{OUT\_L} = \frac{100mV}{DCR} \quad (12)$$

Where, DCR is the DC resistance of the inductor winding. $R_a$ and $C_a$ is a low pass filter.

In Figure 3b, the output current limit is set as:

$$I_{OUT\_L} = \frac{100mV}{R_{SENSE}} \quad (13)$$

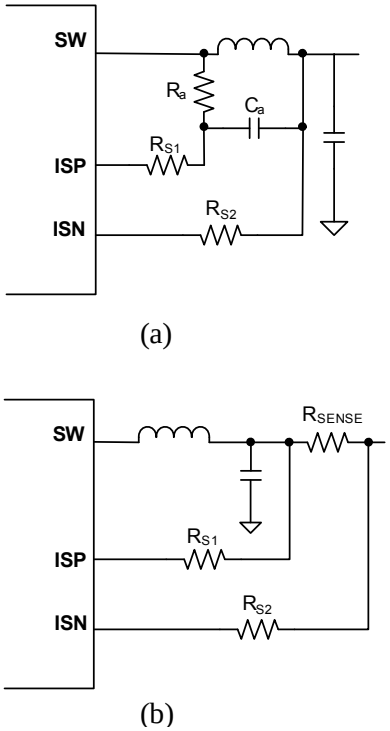



**Figure 3—Current Sensing Methods**

### Programming the Short Circuit Current Limit

The hiccup current limit at output short condition can be programmed to be lower by external resisters ($R_{S1}$, $R_{S2}$, $R_{S1}$=$R_{S2}$), as shown in figure 4.

When output voltage is lower than 200mV, the current limit is described by:

$$I_{OUT\_SL} \times R_{SENSE} + 6.2\mu A \times R_{S1} = 100mV \quad (14)$$

The current limit at output short condition is:

$$I_{OUT\_SL} = \frac{100mV - 6.2\mu A \times R_{S1}}{R_{SENSE}} \quad (15)$$

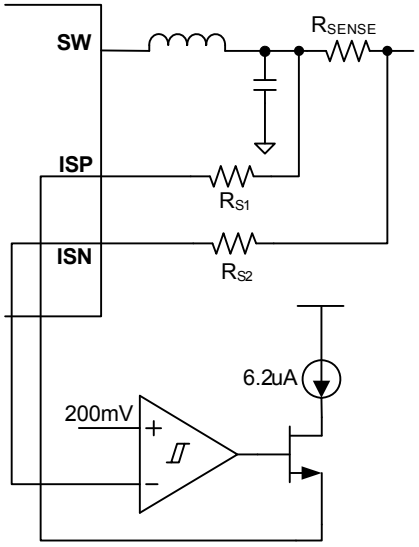



**Figure 4—Short Circuit Current Limit**

### External Bootstrap Diode

It is recommended that an external bootstrap diode be added when the system has a 5V fixed input or the power supply generates a 5V output. This helps improve the efficiency of the regulator. The bootstrap diode can be a low cost one such as IN4148 or BAT54.

This diode is also recommended for high duty cycle operation (when $\frac{V_{OUT}}{V_{IN}}$ >65%) and high output voltage ($V_{OUT}$>12V) applications.

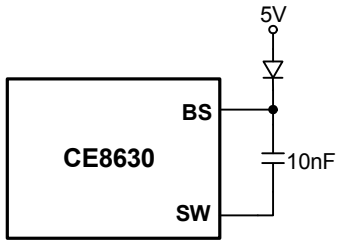



**Figure 5—External Bootstrap Diode**

### PC Board Layout

The high frequency path (IN, SW and GND) should be placed very close to the device with short, direct and wide traces. The input capacitor needs to be as close as possible to the IN and GND pins. The external feedback resistors should be placed next to the FB pin. Keep the switching node SW short and away from the feedback network.

### Design Example

Below is a design example following the application guidelines for the specifications:

| | |
|---|---|
| $V_{IN}$ | 8 to 40V |
| $V_{OUT}$ | 5V |
| $V_{OVP}$ | 6V |
| $F_{SW}$ | 100kHz |
| $I_{OUT-L}$ | 3A |

The detailed application schematic is shown in Figure 6. The typical performance and circuit waveforms have been shown in the Typical Performance Characteristics section. For more possible applications of this device, please refer to related Evaluation Board Data Sheets.

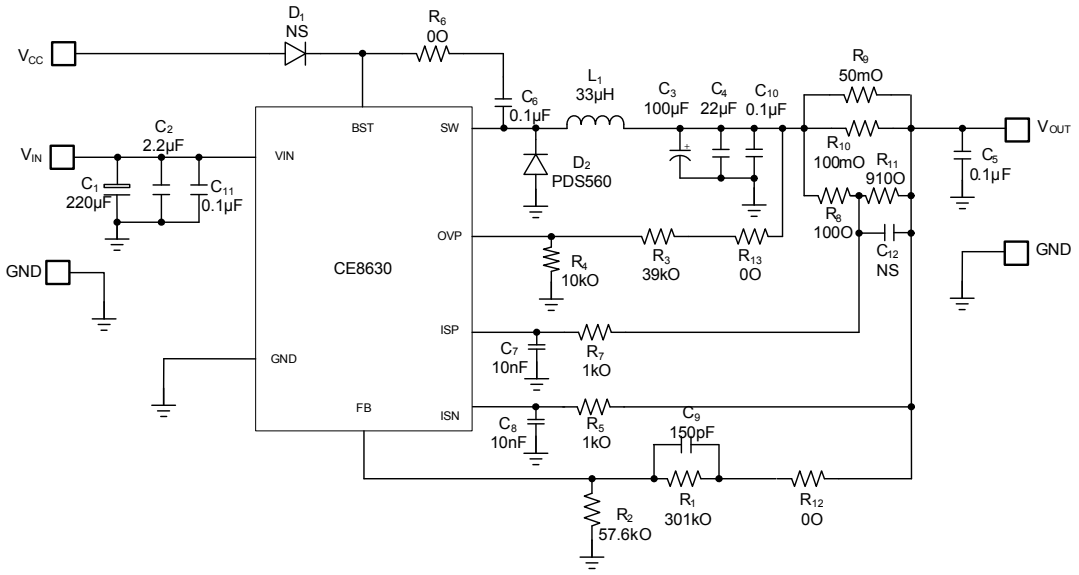
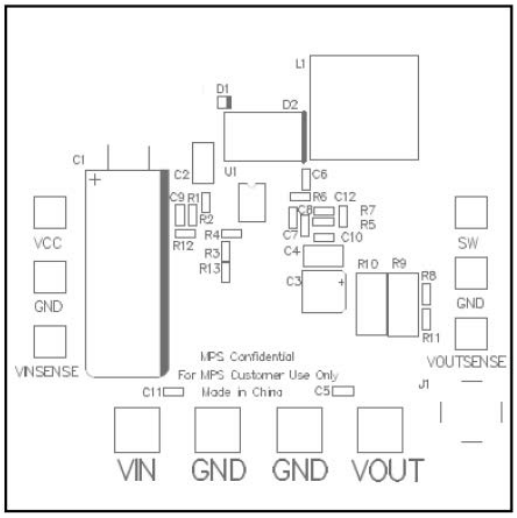



**Figure 6—Detailed Application Schematic**

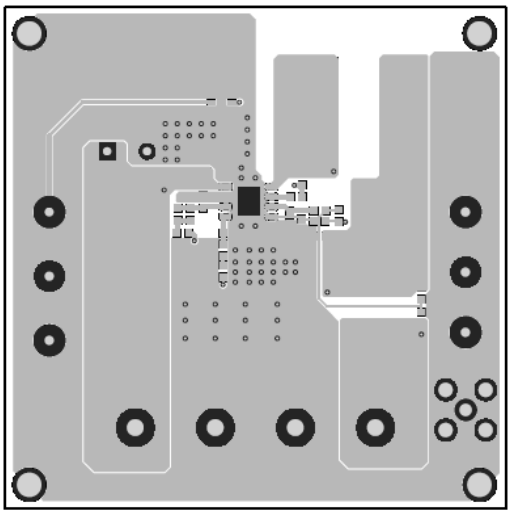
## BILL OF MATERIALS

| Qty | RefDes | Value | Description | Package | Manufacturer | Manufacturer P/N |
|---|---|---|---|---|---|---|
| 1 | C1 | 220μF | Electronic Cap., 63V | DIP | Rubycon | 220uF/63V |
| 1 | C2 | 2.2μF | Ceramic Cap., 100V, X7R | 1210 | muRata | GRM32ER72A225KA35L |
| 1 | C3 | 100μF | Electronic Cap., 16V | SMD | Sanyo | 16SVPC100MV |
| 1 | C4 | 22μF | Ceramic Cap., 16V, X7R | 1210 | muRata | GRM32ER71C226KE18L |
| 3 | C5, C6, C10 | 100nF | Ceramic Cap., 50V, X7R | 0603 | muRata | GRM188R71H104KA93D |
| 2 | C7,C8 | 10nF | Ceramic Cap., 50V, X7R | 0603 | TDK | C1608X7R1H103K |
| 1 | C9 | 150pF | Ceramic Cap., 50V, X7R | 0603 | TDK | C1608C0G1H151J |
| 1 | C11 | 0.1μF | Ceramic Cap., 100V, X7R | 0603 | muRata | GRM188R72A104KA35D |
| 0 | C12 | NS | Do Not Stuff | | | |
| 0 | D1 | NS | Do Not Stuff | | | |
| 1 | D2 | 5A,60V | Diode | PowerDI TM5 | Diodes | PDS560 |
| 1 | L1 | 33μH | Inductor, 5.5A/45mΩ | SMD | SMD | 7447709330 |
| 1 | R1 | 301kΩ | Film Res., 1% | 0603 | Yageo | RC0603FR-07301KL |
| 1 | R2 | 57.6kΩ | Film Res., 1% | 0603 | Yageo | RC0603FR-0757K6L |
| 1 | R3 | 39kΩ | Film Res., 1% | 0603 | Yageo | RC0603FR-0739KL |
| 1 | R4 | 10kΩ | Film Res., 1% | 0603 | Yageo | RC0603FR-0710KL |
| 2 | R5,R7 | 1kΩ | Film Res., 1% | 0603 | Royalohm | 0603F1001T5E |
| 1 | R8 | 100Ω | Film Res., 1% | 0603 | Yageo | RC0603FR-07100RL |
| 1 | R11 | 910Ω | Film Res., 1% | 0603 | Yageo | RC0603FR-07910RL |
| 3 | R6, R12,R13 | 0Ω | Film Res., 5% | 0603 | Royalohm | 0603J0000T5E |
| 1 | R9 | 50mΩ | Sense Res., 1% | 2512 | CYNTEC | RL3264-6-R050-FN |
| 1 | R10 | 100mΩ | Sense Res., 1% | 2512 | CYNTEC | RL3264-6-R0100-FN |
| 1 | U1 | | DC-DC Converter | SOIC8E | MPS | MP2497DN |

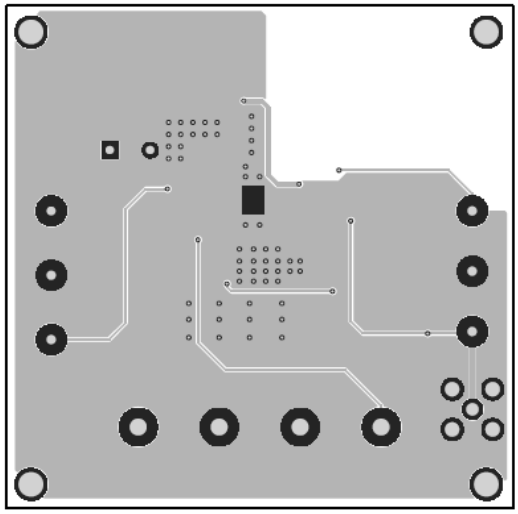
# PRINTED CIRCUIT BOARD LAYOUT




**Top Silk Layer**



**Top Layer**



**Bottom Layer**

# QUICK START GUIDE

1. The output voltage of this board is set to 5V. The board layout accommodates most commonly used inductors and output capacitors.
2. Attach the positive and negative ends of the load to the VOUT and GND pins, respectively.
3. Attach the input voltage (8V ≤ $V_{IN}$ ≤ 40V) and input ground to the VIN and GND pins, respectively.
4. The output current limit is set as:

$$I_{OUT\_L} = \frac{100mV}{R_{SENSE}} \times \frac{R8 + R11}{R11} \qquad (R_{SENSE} = R9 // R10)$$

5. The output line compensation is set via R1

$$R1 = \frac{R_{TRACE} \times 400k\Omega}{6 \times R_{SENSE}} \times \frac{R8 + R11}{R11}$$

   Where, the $R_{TRACE}$ is the resistance of the output line.

6. The output voltage $V_{OUT}$ can be set by R2. The formula is:

$$R2 = R1 \times \frac{V_{FB}}{V_{OUT} - V_{FB}}$$

   Where $V_{FB}$ = 0.8V

   For example, for $V_{OUT}$ = 5V, R1=301kΩ:

$$R2 = R1 \times \frac{V_{FB}}{V_{OUT} - V_{FB}} = 301k\Omega \times \frac{0.8V}{5V - 0.8V} = 57.6k\Omega$$

   For the closest standard 1% value.

7. The short circuit current limit is set as:

$$I_{OUT\_SL} = \frac{100mV - 6.2uA \times R7}{R_{SENSE}} \times \frac{R8 + R11}{R11}$$

8. RC filter connected to ISN and ISP pin is better to be set as RC⩾$10^{-5}$s, and it should meet

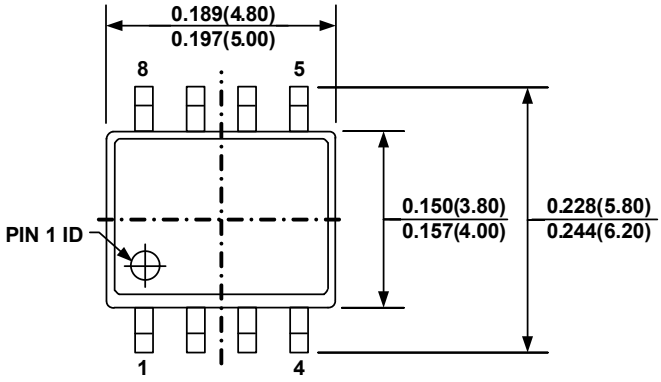
$$R7 + \frac{R8 \times R11}{R8 + R11} = R5, \ C7 = C8$$

9. When the OVP pin voltage is higher than 1.23V, the part will shutdown. The R3 is set as:

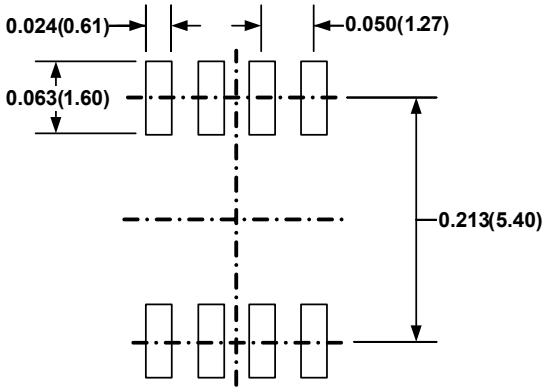
$$R3 = \frac{(V_{OUT} - 1.23V) \times R4}{1.23V}$$

# PACKAGE INFORMATION

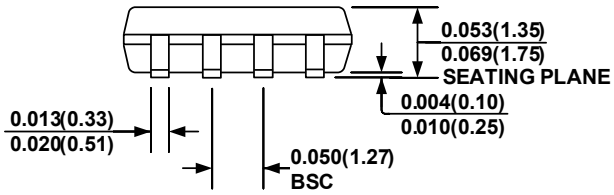
## SOP8



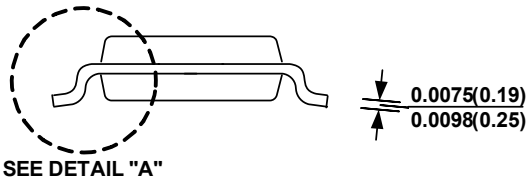

TOP VIEW



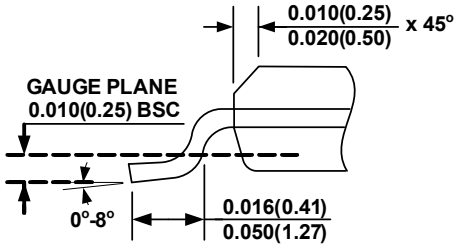

RECOMMENDED LAND PATTERN




FRONT VIEW




SIDE VIEW



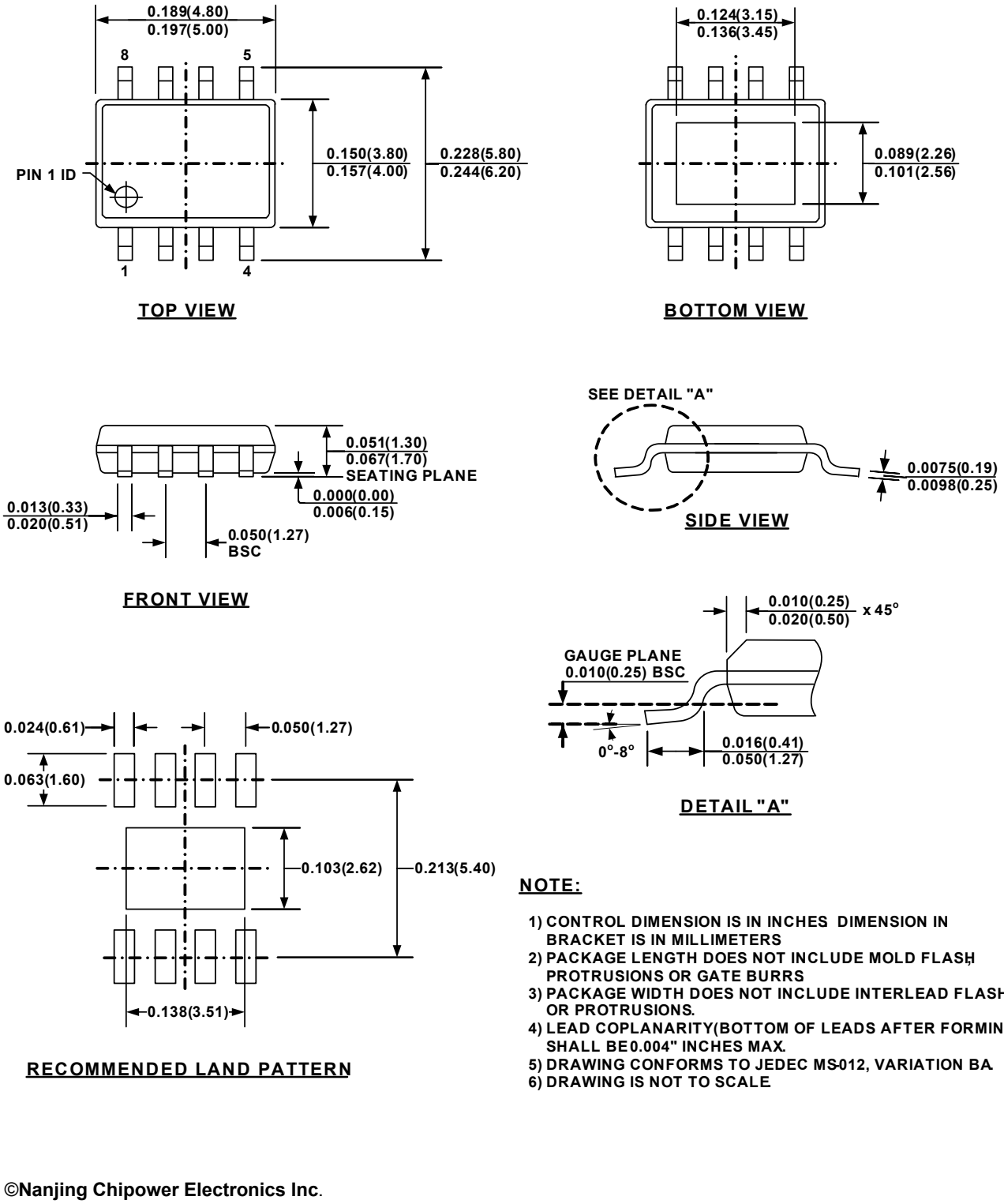

DETAIL "A"

**NOTE:**

1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
4) LEAD COPLANARITY(BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
5) DRAWING CONFORMS TO JEDEC MS-012, VARIATION AA.
6) DRAWING IS NOT TO SCALE

# PACKAGE INFORMATION

## SOP8-PP (EXPOSED PAD)

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6) DRAWING IS NOT TO SCALE