

Preliminary - August 7, 2000

TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

## DESCRIPTION

The SC1157 is a low-cost, full featured, synchronous voltage-mode controller designed for use in single ended power supply applications where efficiency is of primary concern. Synchronous operation allows for the elimination of heat sinks in many applications. The SC1157 is ideal for implementing DC/DC converters needed to power advanced microprocessors such as Pentium® II (Klamath), in both single and multiple processor configurations. Internal level-shift, high-side drive circuitry, and preset shoot-thru control, allows for use of inexpensive n-channel power switches.

SC1157 features include an integrated 4-bit  $V_{ID}$  DAC, temperature compensated voltage reference, triangle wave oscillator, current limit comparator, frequency shift over-current protection, and an internally compensated error amplifier.

The SC1157 operates at a fixed 140KHz, providing an optimum compromise between efficiency, external component size, and cost.

## FEATURES

- Low cost / full featured
- Synchronous operation
- 4 Bit  $V_{ID}$  DAC programmable output (1% tolerance)
- Designed to meet Intel VRM8.2 (Pentium® II)
- 1.5% Reference

## APPLICATIONS

- Pentium® II Core Supply
- Multiple Microprocessor Supplies
- Voltage Regulator Modules (VRM)
- Programmable Power Supplies
- High Efficiency DC/DC Conversion

## ORDERING INFORMATION

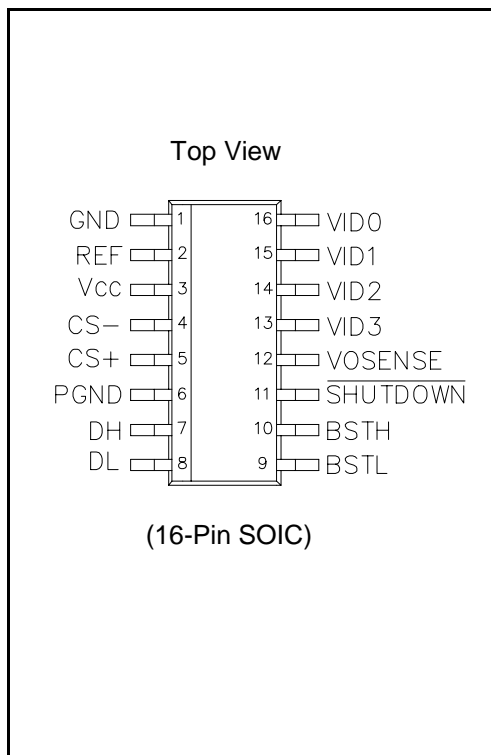
| DEVICE <sup>(1)</sup> | PACKAGE <sup>(2)</sup> | TEMP. RANGE (T <sub>J</sub> ) |
|-----------------------|------------------------|-------------------------------|
| SC1157CS.TR           | SO-16NB                | 0 - 125°C                     |

Note:

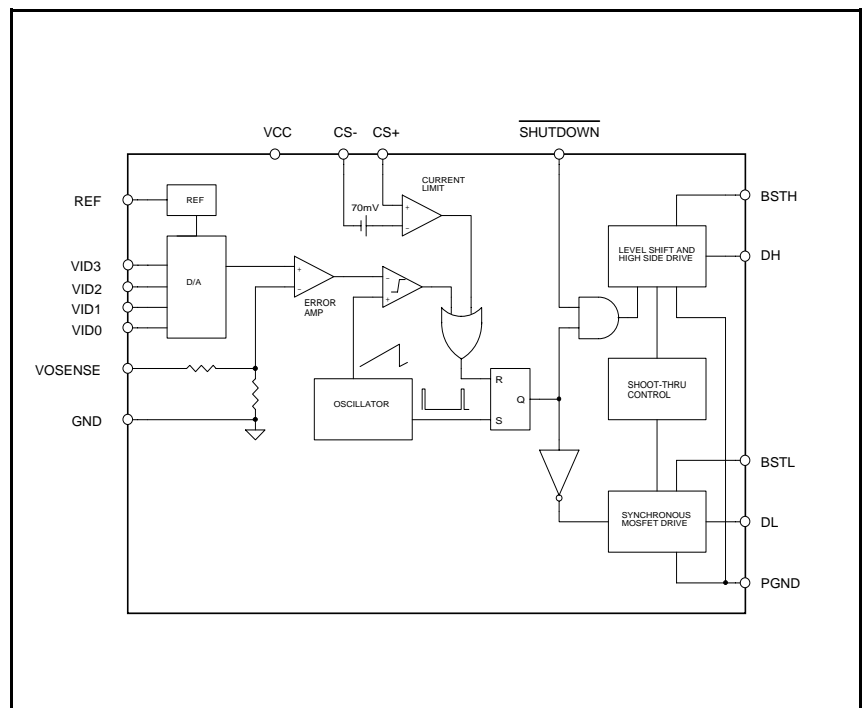
(1) Only available in tape and reel packaging. A reel contains 2500 devices.

(2) "NB" indicates 150 MIL body.

## PIN CONFIGURATION



## BLOCK DIAGRAM



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**ABSOLUTE MAXIMUM RATINGS**

| Parameter                              | Symbol            | Maximum     | Units |
|--|-------------------|-------------|-------|
| V <sub>CC</sub> to GND                 | V <sub>IN</sub>   | -0.3 to 7   | V     |
| PGND to GND                            |                   | ± 1         | V     |
| BST to GND                             |                   | -0.3 to 15  | V     |
| Thermal Resistance Junction to Case    | θ <sub>JC</sub>   | 30          | °C/W  |
| Thermal Resistance Junction to Ambient | θ <sub>JA</sub>   | 130         | °C/W  |
| Operating Temperature Range            | T <sub>A</sub>    | 0 to 70     | °C    |
| Storage Temperature Range              | T <sub>STG</sub>  | -65 to +150 | °C    |
| Lead Temperature (Soldering) 10 sec    | T <sub>LEAD</sub> | 300         | °C    |
| ESD Rating (Human Body Model)          | ESD               | 1.5         | kV    |

**ELECTRICAL CHARACTERISTICS**

 Unless specified: V<sub>CC</sub> = 4.75V to 5.25V; GND = PGND = 0V; FB = V<sub>O</sub>; 0mV < (CS(+)-CS(-)) < 60mV; T<sub>J</sub> = 25°C

| PARAMETER                  | CONDITIONS  | MIN          | TYP   | MAX | UNITS |
|----------------------------|---|--------------|-------|-----|-------|
| Output Voltage             |   | See Table 1. |       |     |       |
| Supply Voltage             | V <sub>CC</sub>   | 4.5          |       | 7   | V     |
| Supply Current             | V <sub>CC</sub> = 5.0                                     |              | 8     | 15  | mA    |
| Load Regulation            | I <sub>O</sub> = 0.3A to 15A <sup>(1)</sup>               |              | 1     |     | %     |
| Line Regulation            | All VID codes <sup>(1)</sup>                              |              | ±0.15 |     | %     |
| Gain (A <sub>OL</sub> )    | V <sub>OSENSE</sub> to V <sub>O</sub>                     |              | 35    |     | dB    |
| Current Limit Voltage      |   | 60           | 70    | 80  | mV    |
| Oscillator Frequency       |   | 125          | 140   | 155 | kHz   |
| Buffered Reference Voltage | I <sub>REF</sub> ≤ 1mA                                    |              | 1.25  |     | V     |
| Oscillator Max Duty Cycle  |   | 90           | 95    |     | %     |
| DH Sink/Source Current     | BST <sub>H</sub> - DH = 4.5V, DH - PGND <sub>H</sub> = 3V | 1            |       |     | A     |
| DL Sink/Source Current     | BST <sub>L</sub> - DL = 4.5V, DL - PGND <sub>L</sub> = 3V | 1            |       |     | A     |
| Dead Time                  |   | 50           | 100   |     | ns    |
| VID Pin Source current     | VIDx ≤ 2.4V   | 30           | 100   |     | uA    |

**NOTE:**

- (1) Specification refers to application circuit (Figure 1.).
- (2) This device is ESD sensitive. Use of standard ESD handling precautions is required.

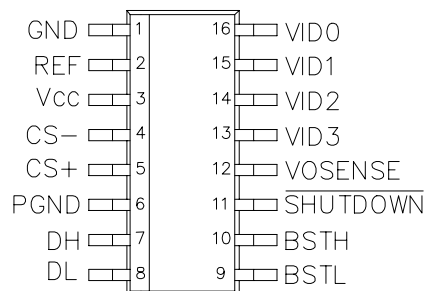
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**PIN DESCRIPTION**

| Pin # | Pin Name            | Pin Function   |
|-------|---------------------|--|
| 1     | GND                 | Small Signal Analog and Digital Ground                                 |
| 2     | REF                 | Buffered Reference output  |
| 3     | V <sub>CC</sub>     | Chip Supply Voltage  |
| 4     | CS(-)               | Current Sense Input (negative)   |
| 5     | CS(+)               | Current Sense Input (positive)   |
| 6     | PGND                | Power Ground for High and Low Side Drivers                             |
| 7     | DH                  | High Side Driver Output  |
| 8     | DL                  | Low Side Driver Output   |
| 9     | BSTL                | V <sub>CC</sub> for Low Side Driver (Boost)                            |
| 10    | BSTH                | V <sub>CC</sub> for High Side Driver (Boost)                           |
| 11    | SHUTDOWN            | Logic Low shuts down the converter; High or open for normal operation. |
| 12    | VOSENSE             | Top end of internal feedback chain                                     |
| 13    | VID3 <sup>(1)</sup> | Programming Input (MSB)  |
| 14    | VID2 <sup>(1)</sup> | Programming Input  |
| 15    | VID1 <sup>(1)</sup> | Programming Input  |
| 16    | VID0 <sup>(1)</sup> | Programming Input (LSB)  |

**NOTE:**

(1) All logic level inputs and outputs are open collector TTL compatible.

**PIN CONFIGURATION**


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**OUTPUT VOLTAGE TABLE**

 Unless specified:  $V_{CC} = 4.75V$  to  $5.25V$ ;  $GND = PGND = 0V$ ;  $FB = V_O$ ;  $0mV < (CS(+)) - CS(-) < 60mV$ ;  
 $T_J = 0^{\circ}C$  to  $85^{\circ}C$ 

| PARAMETER                     | CONDITIONS                                      | VID<br>3210 | MIN   | TYP   | MAX   | UNITS |
|-------------------------------|---|-------------|-------|-------|-------|-------|
| Output Voltage <sup>(1)</sup> | $I_O = 2A$ in Application Circuit<br>(Figure 1) | 1111        | 1.287 | 1.300 | 1.313 | V     |
|                               |   | 1110        | 1.337 | 1.350 | 1.364 |       |
|                               |   | 1101        | 1.386 | 1.400 | 1.414 |       |
|                               |   | 1100        | 1.436 | 1.450 | 1.465 |       |
|                               |   | 1011        | 1.485 | 1.500 | 1.515 |       |
|                               |   | 1010        | 1.535 | 1.550 | 1.566 |       |
|                               |   | 1001        | 1.584 | 1.600 | 1.616 |       |
|                               |   | 1000        | 1.634 | 1.650 | 1.667 |       |
|                               |   | 0111        | 1.683 | 1.700 | 1.717 |       |
|                               |   | 0110        | 1.733 | 1.750 | 1.768 |       |
|                               |   | 0101        | 1.782 | 1.800 | 1.818 |       |
|                               |   | 0100        | 1.832 | 1.850 | 1.869 |       |
|                               |   | 0011        | 1.881 | 1.900 | 1.919 |       |
|                               |   | 0010        | 1.931 | 1.950 | 1.970 |       |
|                               |   | 0001        | 1.980 | 2.000 | 2.020 |       |
|                               |   | 0000        | 2.030 | 2.050 | 2.070 |       |

**NOTE:**

(1) All VID codes not specifically listed are invalid and cause shutdown exactly as if the shutdown pin had been asserted.

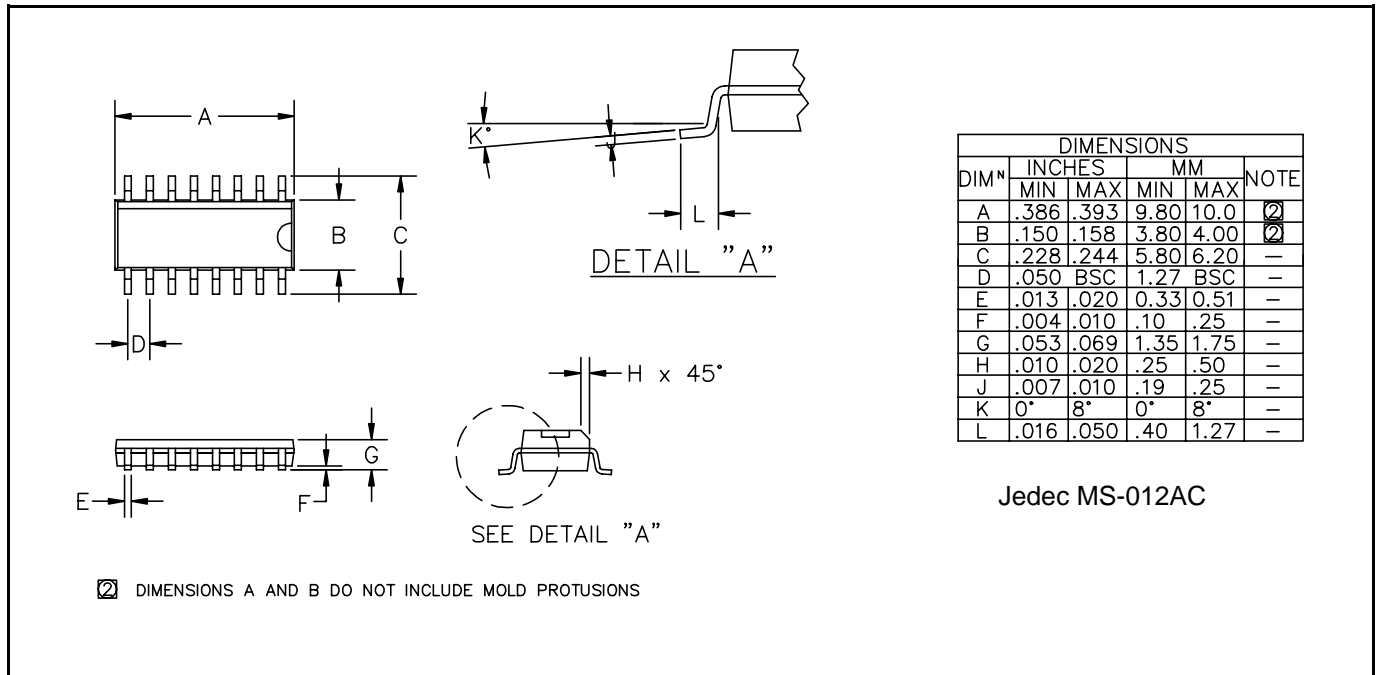
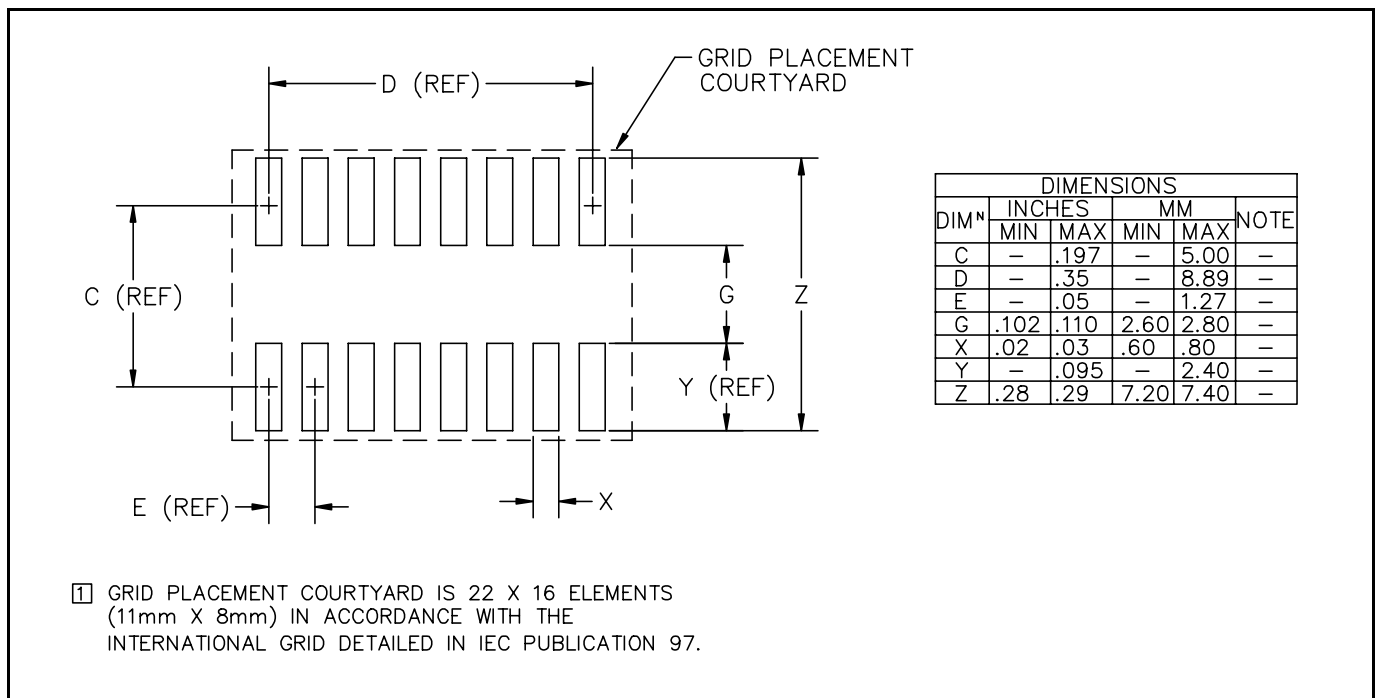
**THEORY OF OPERATION**

The voltage at the VOSENSE pin is applied, through the internal precision resistor feedback chain, to the inverting input of the error amplifier. The non-inverting input of the error amplifier is supplied with a DC voltage derived by the DAC from the internal trimmed bandgap voltage reference. The output of the error amplifier is compared to the triangular output of the internal oscillator to generate a fixed frequency, variable duty cycle pulse train. The internal oscillator uses an on-chip capacitor and precision trimmed current sources to set the frequency to 100 kHz.

The generated pulse train is gated with the output of the current limit latch and the inhibit signal to produce a drive signal for the upper FET. It is also inverted to produce a drive signal for the lower FET. These FET drive signals are modified by the "shoot-through control" circuitry so that the top FET turn-on is delayed until the bottom FET has turned off, and visa-versa.

The current limit latch is set (ending the upper FET drive pulse early) if the current limit comparator indicates an overcurrent condition. The latch is reset at the start of each oscillator period.

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**OUTLINE DRAWING SO-16**

**LAND PATTERN SO-16**


ECN00-1243