

# Power Factor Correction Controller

## FAN7527B

### Description

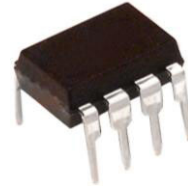
The FAN7527B provides simple and high-performance active Power Factor Correction (PFC). The FAN7527B is optimized for electronic ballasts and low-power, high-density power supplies that require minimum board size, reduced external components, and low power dissipation. Because the R/C filter is included in the current-sense block, an external R/C filter is not necessary. Special circuitry prevents no-load runaway conditions. Regardless of the supply voltage, the output drive clamping circuit limits the overshoot of the power MOSFET gate drive, which improves system reliability.

### Features

- Internal Startup Timer
- Internal R/C Filter Eliminates the Need for External R/C Filter
- Precise Adjustable Output Over-Voltage Protection
- Zero Current Detector
- One Quadrant Multiplier
- Trimmed 1.5% Internal Band Gap Reference
- Under-Voltage Lockout with 3 V of Hysteresis
- Totem-Pole Output with High-State Clamp
- Low Startup and Operating Current
- 8-Pin SOP or 8-Pin DIP
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Electronic Ballast
- SMPS

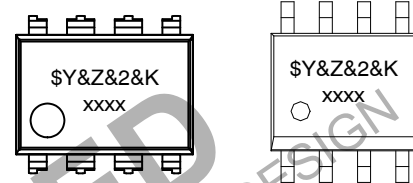


PDIP8 9.42x6.38, 2.54P  
CASE 646CM



SOIC8  
CASE 751EB

### MARKING DIAGRAM



\$Y = onsemi Logo  
 &Z = Assembly Plant Code  
 &2 = 2-Digit Date Code  
 &K = Lot Run Traceability Code  
 xxxx = Specific Device Code

### ORDERING INFORMATION

| Device     | Package            | Shipping <sup>†</sup> |
|------------|--------------------|-----------------------|
| FAN7527BN  | PDIP8<br>(Pb-Free) | 3000 / Tube           |
| FAN7527BMX | SOIC8<br>(Pb-Free) | 2500 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, [BRD8011/D](http://BRD8011/D).

NOTE: Operating Temperature Range of both devices is -25 to +125°C

# FAN7527B

## BLOCK DIAGRAM

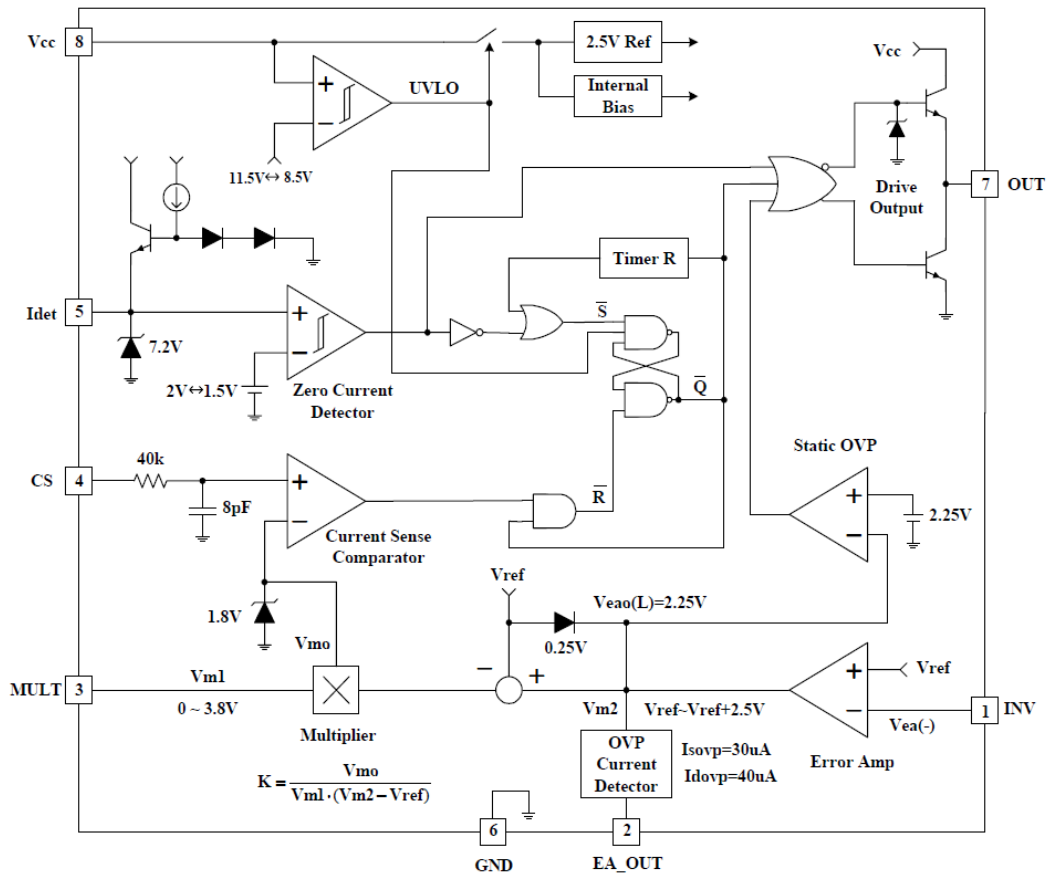
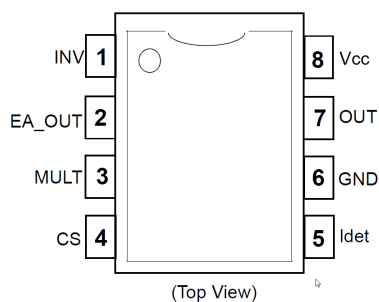


Figure 1. Block Diagram

# FAN7527B

## PIN CONFIGURATION



**Figure 2. Pin Configuration**

## PIN DEFINITIONS

| Pin # | Name            | Description                                                                                                                                                                                 |
|-------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | INV             | Inverting input of the error amplifier. The output of the boost converter should be resistively divided to 2.5 V and connected to this pin.                                                 |
| 2     | EA_OUT          | Output of the error amplifier. Feedback compensation network is placed between this pin and the INV pin.                                                                                    |
| 3     | MULT            | Input to the multiplier stage. The full-wave rectified AC voltage is divided to less than 2 V and is connected to this pin.                                                                 |
| 4     | CS              | Input of the PWM comparator. The MOSFET current is sensed by a resistor and the resulting voltage is applied to this pin. An internal R/C filter is included to reject high-frequency noise |
| 5     | Idet            | Zero Current Detection (ZCD) input                                                                                                                                                          |
| 6     | GND             | Ground                                                                                                                                                                                      |
| 7     | OUT             | Gate driver output. Push-pull output stage is able to drive the power MOSFET with a peak current of 500 mA                                                                                  |
| 8     | V <sub>CC</sub> | Supply voltage of driver and control circuits                                                                                                                                               |

## ABSOLUTE MAXIMUM RATINGS

| Symbol                            | Parameter                                                                                 |       | Min. | Max. | Unit |
|-----------------------------------|-------------------------------------------------------------------------------------------|-------|------|------|------|
| V <sub>CC</sub>                   | Supply Voltage                                                                            |       |      | 30   | V    |
| I <sub>OH</sub> , I <sub>OL</sub> | Peak Drive Output Current                                                                 |       |      | ±500 | mA   |
| I <sub>CLAMP</sub>                | Driver Output Clamping Diodes V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < -0.3 V |       |      | ±10  | mA   |
| I <sub>DET</sub>                  | Detector Clamping Diodes                                                                  |       |      | ±10  | mA   |
| V <sub>IN</sub>                   | Error Amplifier Multiplier and Comparator Input Voltages                                  |       | -0.3 | 6.0  | V    |
| T <sub>J</sub>                    | Operation Junction Temperature                                                            |       |      | +150 | °C   |
| T <sub>OPR</sub>                  | Operating Temperature Range                                                               |       | -25  | +125 | °C   |
| T <sub>STG</sub>                  | Storage Temperature Range                                                                 |       | -65  | +150 | °C   |
| P <sub>D</sub>                    | Power Dissipation                                                                         | SOIC8 |      | 0.8  | W    |
|                                   |                                                                                           | PDIP8 |      | 1.1  | W    |
| Θ <sub>JA</sub>                   | Thermal Resistance Junction–Ambient                                                       | SOIC8 |      | 150  | °C/W |
|                                   |                                                                                           | PDIP8 |      | 110  | °C/W |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## TEMPERATURE CHARACTERISTICS

(-25°C ≤ T<sub>A</sub> ≤ 125°C)

| Symbol            | Parameter                                                   | Min. | Typ. | Max. | Unit   |
|-------------------|-------------------------------------------------------------|------|------|------|--------|
| ΔV <sub>REF</sub> | Temperature Stability Reference Voltage (V <sub>REF</sub> ) |      | 20   |      | mV     |
| ΔK/ΔT             | Temperature Stability for Multiplier Gain (K)               |      | -0.2 |      | % / °C |

# FAN7527B

## ELECTRICAL CHARACTERISTICS

( $V_{CC} = 14\text{ V}$ ,  $-25^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ , unless otherwise stated.)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|------------|------|------|------|------|
|--------|-----------|------------|------|------|------|------|

### UNDER-VOLTAGE LOCKOUT

|              |                         |                     |      |      |      |   |
|--------------|-------------------------|---------------------|------|------|------|---|
| $V_{th(st)}$ | Start Threshold Voltage | $V_{CC}$ Increasing | 10.5 | 11.5 | 12.5 | V |
| $H_{Y(st)}$  | UVLO Hysteresis         |                     | 2    | 3    | 4    | V |

### SUPPLY CURRENT SECTION

|               |                                  |                                      |    |     |     |               |
|---------------|----------------------------------|--------------------------------------|----|-----|-----|---------------|
| $I_{ST}$      | Startup Supply Current           | $V_{CC} = V_{th(st)} - 0.2\text{ V}$ | 10 | 60  | 100 | $\mu\text{A}$ |
| $I_{CC}$      | Operating Supply Current         | Output Not Switching                 |    | 3   | 6   | mA            |
| $I_{CC(OVP)}$ | Operating Current at OVP         | $V_{INV} = 3\text{ V}$               |    | 1.7 | 4.0 | mA            |
| $I_{DCC}$     | Dynamic Operating Supply Current | 50 kHz, $C_I = 1\text{ nF}$          |    | 4   | 8   | mA            |

### ERROR AMPLIFIER SECTION

|                   |                                             |                                                         |       |       |       |                  |
|-------------------|---------------------------------------------|---------------------------------------------------------|-------|-------|-------|------------------|
| $V_{REF}$         | Voltage Feedback Input Threshold            | $I_{REF} = 0\text{ mA}$ , $T_A = 25^{\circ}\text{C}$    | 2.465 | 2.500 | 2.535 | V                |
|                   |                                             | $25^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$  | 2.440 | 2.500 | 2.560 |                  |
| $\Delta V_{FEF1}$ | Line Regulation                             | $14\text{ V} \leq V_{CC} \leq 25\text{ V}$              |       | 0.1   | 10.0  | mV               |
| $\Delta V_{FEF3}$ | Temperature Stability of $V_{REF}$ (Note 1) | $-25^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ |       | 20    |       | mV               |
| $I_{b(ea)}$       | Input Bias Current                          |                                                         | -0.5  |       | 0.5   | $\mu\text{A}$    |
| $I_{SOURCE}$      | Output Source Current                       | $V_{M2} = 4\text{ V}$                                   | -2    | -4    |       | mA               |
| $I_{SINK}$        | Output Sink Current                         | $V_{M2} = 4\text{ V}$                                   | 2     | 4     |       | mA               |
| $V_{EAO(H)}$      | Output Upper Clamp Voltage (Note 1)         | $I_{SOURCE} = 0.1\text{ mA}$                            |       | 6     |       | V                |
| $V_{EAO(L)}$      | Output Lower Clamp Voltage (Note 1)         | $I_{SINK} = 0.1\text{ mA}$                              |       | 2.25  |       | V                |
| $G_V$             | Large Signal Open-Loop Gain (Note 1)        |                                                         | 60    | 80    |       | dB               |
| $PSRR$            | Power Supply Rejection Ratio (Note 1)       | $14\text{ V} \leq V_{CC} \leq 25\text{ V}$              | 60    | 80    |       | dB               |
| $GBW$             | Unity Gain Bandwidth (Note 1)               |                                                         |       | 1     |       | MHz              |
| $SR$              | Slew Rate (Note 1)                          |                                                         |       | 0.6   |       | V/ $\mu\text{s}$ |

### MULTIPLIER SECTION

|                     |                                       |                                                         |           |      |                 |                        |
|---------------------|---------------------------------------|---------------------------------------------------------|-----------|------|-----------------|------------------------|
| $I_{b(m)}$          | Input Bias Current (Pin 3)            |                                                         | -0.5      |      | 0.5             | $\mu\text{A}$          |
| $\Delta V_{M1}$     | M1 Input Voltage Range (Pin 3)        |                                                         |           |      | 3.8             | V                      |
| $\Delta V_{M2}$     | M2 Input Voltage Range (Pin 2)        |                                                         | $V_{REF}$ |      | $V_{REF} + 2.5$ | V                      |
| $K$                 | Multiplier Gain (Note 1)              | $V_{M1} = 1\text{ V}$ , $V_{M2} = 3.5\text{ V}$         | 0.36      | 0.44 | 0.52            | 1 / V                  |
| $V_{OMAX(m)}$       | Maximum Multiplier Output Voltage     | $V_{INV} = 0\text{ V}$ , $V_{M1} = 4\text{ V}$          | 1.65      | 1.80 | 1.95            | V                      |
| $\Delta K/\Delta T$ | Temperature Stability of $K$ (Note 1) | $-25^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ |           | -0.2 |                 | % / $^{\circ}\text{C}$ |

### CURRENT SENSE SECTION

|              |                                        |                                                 |      |      |     |               |
|--------------|----------------------------------------|-------------------------------------------------|------|------|-----|---------------|
| $V_{IO(CS)}$ | Input Offset Voltage (Note 1)          | $V_{M1} = 0\text{ V}$ , $V_{M2} = 2.2\text{ V}$ | -10  | 3    | 10  | mV            |
| $I_{b(CS)}$  | Input Bias Current                     | $0\text{ V} \leq V_{CS} \leq 1.7\text{ V}$      | -1.0 | -0.1 | 1.0 | $\mu\text{A}$ |
| $t_{D(CS)}$  | Current Sense Delay to Output (Note 1) |                                                 |      | 200  | 500 | ns            |

### ZERO CURRENT DETECT SECTION

|                |                          |                                     |      |      |      |   |
|----------------|--------------------------|-------------------------------------|------|------|------|---|
| $V_{TH(DET)}$  | Input Voltage Threshold  | $V_{DET}$ Increasing                | 1.7  | 2.0  | 2.3  | V |
| $H_{Y(DET)}$   | Detect Hysteresis        |                                     | 0.2  | 0.5  | 0.8  | V |
| $V_{CLAMP(L)}$ | Input Low Clamp Voltage  | $I_{DET} = -100\text{ }\mu\text{A}$ | 0.45 | 0.75 | 1.00 | V |
| $V_{CLAMP(H)}$ | Input High Clamp Voltage | $I_{DET} = 3\text{ mA}$             | 6.5  | 7.2  | 7.9  | V |

**ELECTRICAL CHARACTERISTICS** (continued)(V<sub>CC</sub> = 14 V, -25°C ≤ T<sub>A</sub> ≤ 125°C, unless otherwise stated.)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|------------|------|------|------|------|
|--------|-----------|------------|------|------|------|------|

**ZERO CURRENT DETECT SECTION**

|                       |                                             |                              |      |      |     |    |
|-----------------------|---------------------------------------------|------------------------------|------|------|-----|----|
| I <sub>b</sub> (DET)  | Input Bias Current                          | 1 V ≤ V <sub>DET</sub> ≤ 5 V | -1.0 | -0.1 | 1.0 | μA |
| I <sub>CLAMP(D)</sub> | Input High/Low Clamp Diode Current (Note 1) |                              |      |      | ±3  | mA |

**OUTPUT SECTION**

|                      |                                    |                                                 |      |      |     |    |
|----------------------|------------------------------------|-------------------------------------------------|------|------|-----|----|
| V <sub>OH</sub>      | Output Voltage High                | I <sub>O</sub> = -10 mA                         | 10.5 | 11.0 |     | V  |
| V <sub>OL</sub>      | Output Voltage Low                 | I <sub>O</sub> = 10 mA                          |      | 0.8  | 1.0 | V  |
| t <sub>R</sub>       | Rising Time (Note 1)               | C <sub>L</sub> = 1 nF                           |      | 130  | 200 | ns |
| t <sub>F</sub>       | Falling Time (Note 1)              | C <sub>L</sub> = 1 nF                           |      | 50   | 120 | ns |
| V <sub>OMAX(O)</sub> | Maximum Output Voltage             | V <sub>CC</sub> = 20 V, I <sub>O</sub> = 100 μA | 12   | 14   | 16  | V  |
| V <sub>OMIN(O)</sub> | Output Voltage with UVLO Activated | V <sub>CC</sub> = 5 V, I <sub>O</sub> = 100 μA  |      |      | 1   | V  |

**RESTART TIMER SECTION**

|                     |                    |                                                |  |     |  |    |
|---------------------|--------------------|------------------------------------------------|--|-----|--|----|
| t <sub>D(RST)</sub> | Restart Time Delay | V <sub>M1</sub> = 1 V, V <sub>M2</sub> = 3.5 V |  | 150 |  | μs |
|---------------------|--------------------|------------------------------------------------|--|-----|--|----|

**OVER-VOLTAGE PROTECTION SECTION**

|                   |                               |                          |      |      |      |    |
|-------------------|-------------------------------|--------------------------|------|------|------|----|
| I <sub>SOVP</sub> | Soft OVP Detecting Current    |                          | 25   | 30   | 35   | μA |
| I <sub>DOVP</sub> | Dynamic OVP Detecting Current |                          | 35   | 40   | 45   | μA |
| V <sub>OVP</sub>  | Static OVP Threshold Voltage  | V <sub>INV</sub> = 2.7 V | 2.10 | 2.25 | 2.40 | V  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

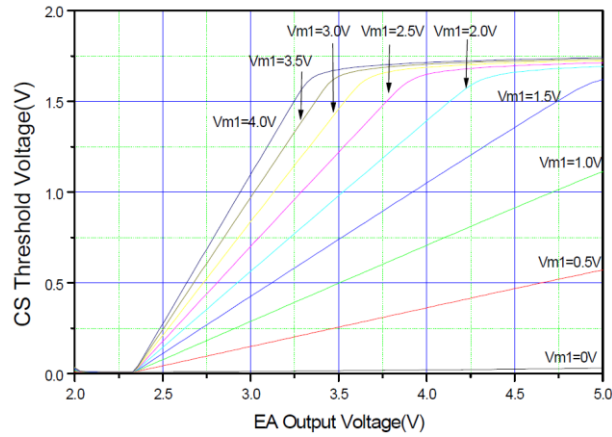
1. These parameters, although guaranteed, are not 100% tested in production.

Multiplier Gain:

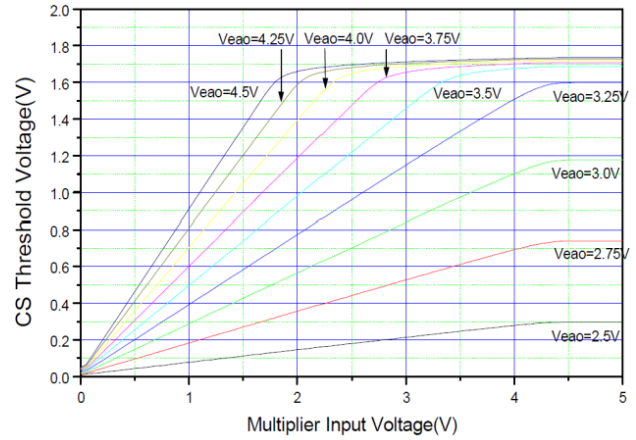
$$K = \frac{\text{Pin4\_Threshold}}{V_{M1} \times (V_{M2} - V_{REF})}$$

where V<sub>M1</sub> = V<sub>PIN3</sub>, V<sub>M2</sub> = V<sub>PIN2</sub>

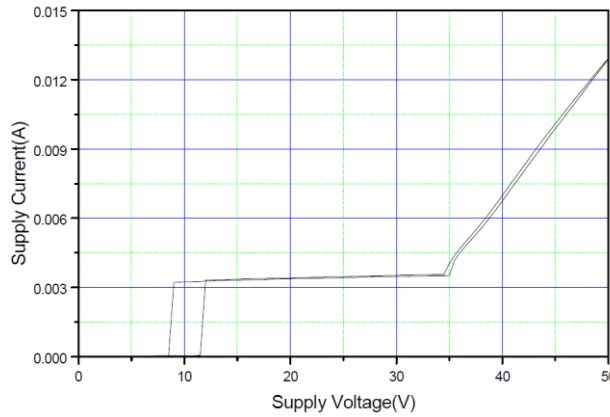
## TYPICAL PERFORMANCE CHARACTERISTICS



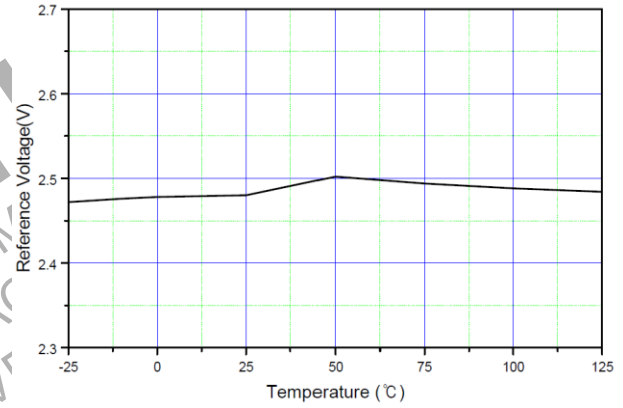
**Figure 3. Error Amplifier Output Voltage vs. Current Sensing Threshold**



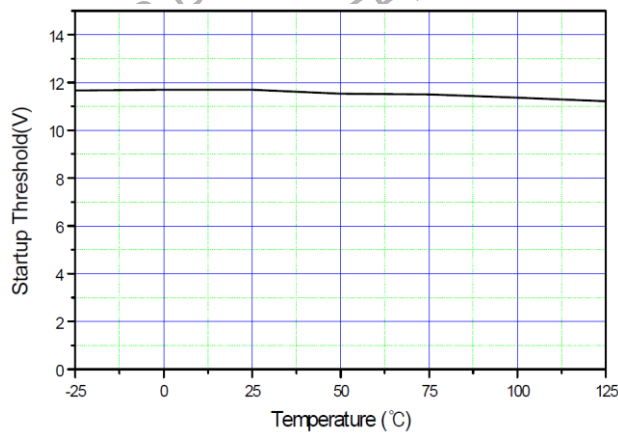
**Figure 4. Multiplier Input Voltage vs. Current Sensing Threshold**



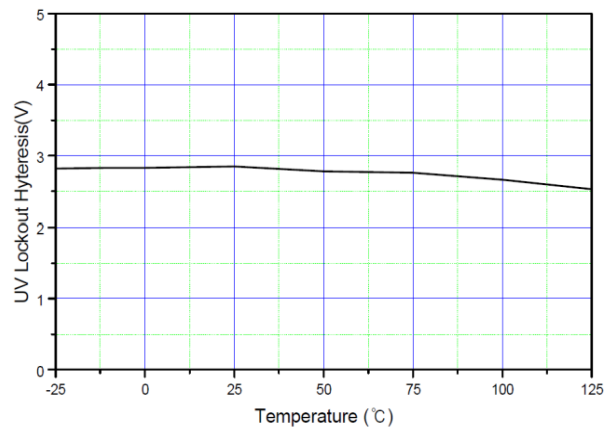
**Figure 5. Supply Current vs. Supply Voltage**



**Figure 6. Reference Voltage vs. Temperature**



**Figure 7. Startup Threshold vs. Temperature**



**Figure 8. UVLO Hysteresis vs. Temperature**

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

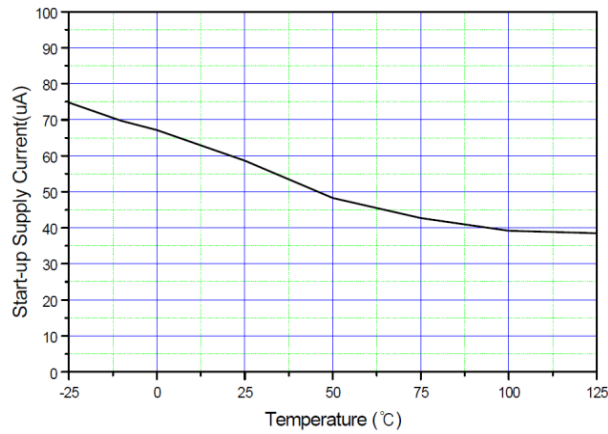


Figure 9. Startup Supply Current vs. Temperature

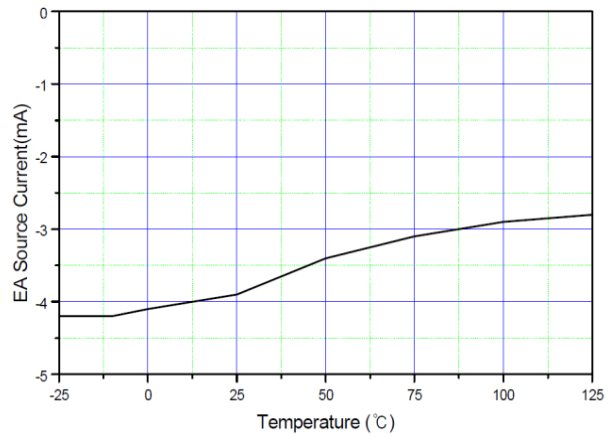


Figure 10. Error Amplifier Source Current

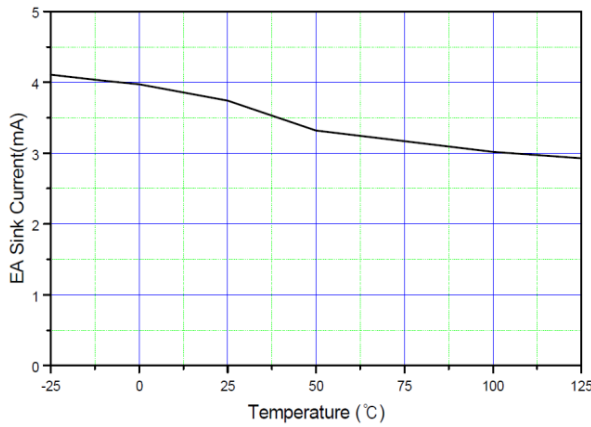


Figure 11. Error Amplifier Sink Current vs. Temperature

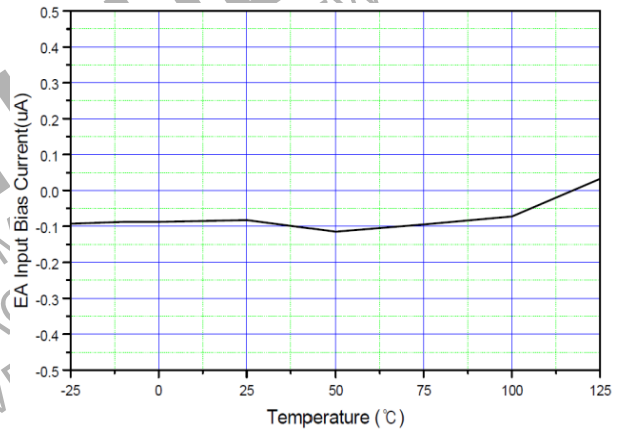


Figure 12. Error Amplifier Input Bias Current vs. Temperature

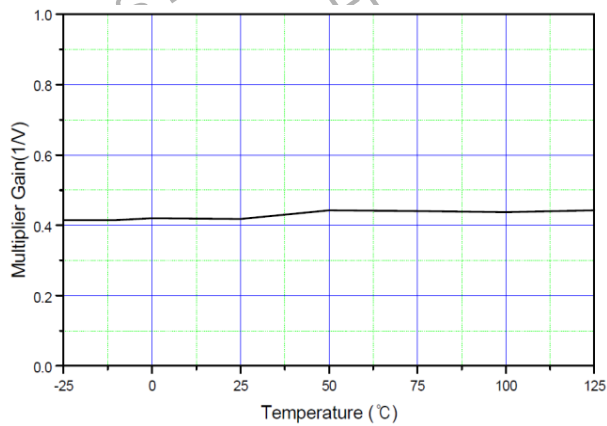


Figure 13. Multiplier Gain vs. Temperature

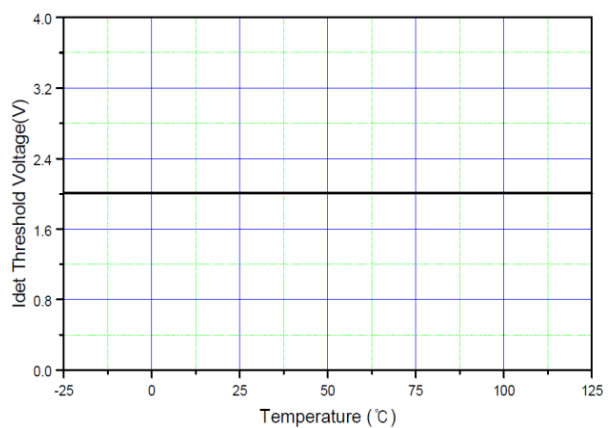


Figure 14.  $I_{DET}$  Threshold Voltage vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

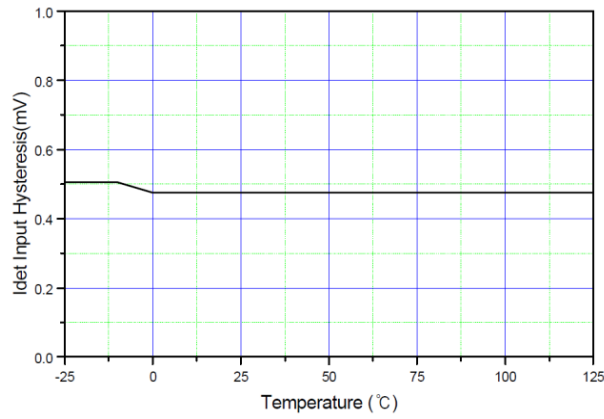


Figure 15. IDet Input Hysteresis vs. Temperature

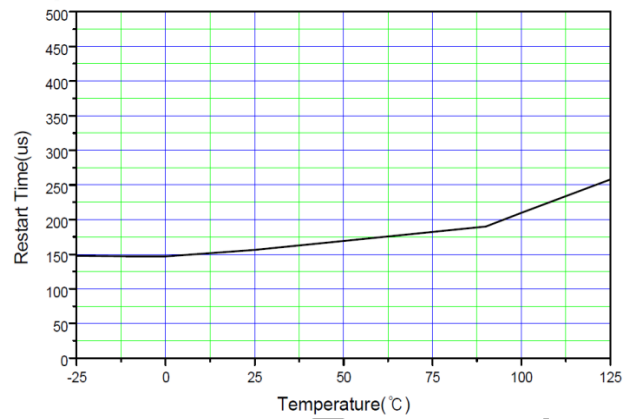


Figure 16. Restart Time vs. Temperature

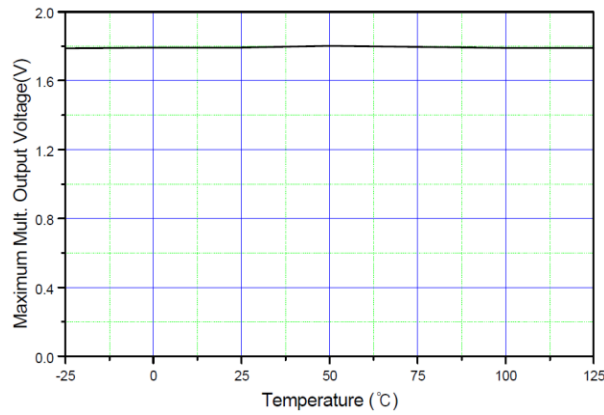


Figure 17. Maximum Multiplier Output Voltage vs. Temperature

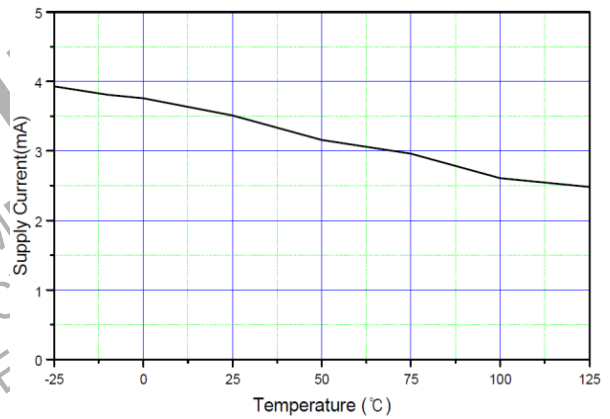
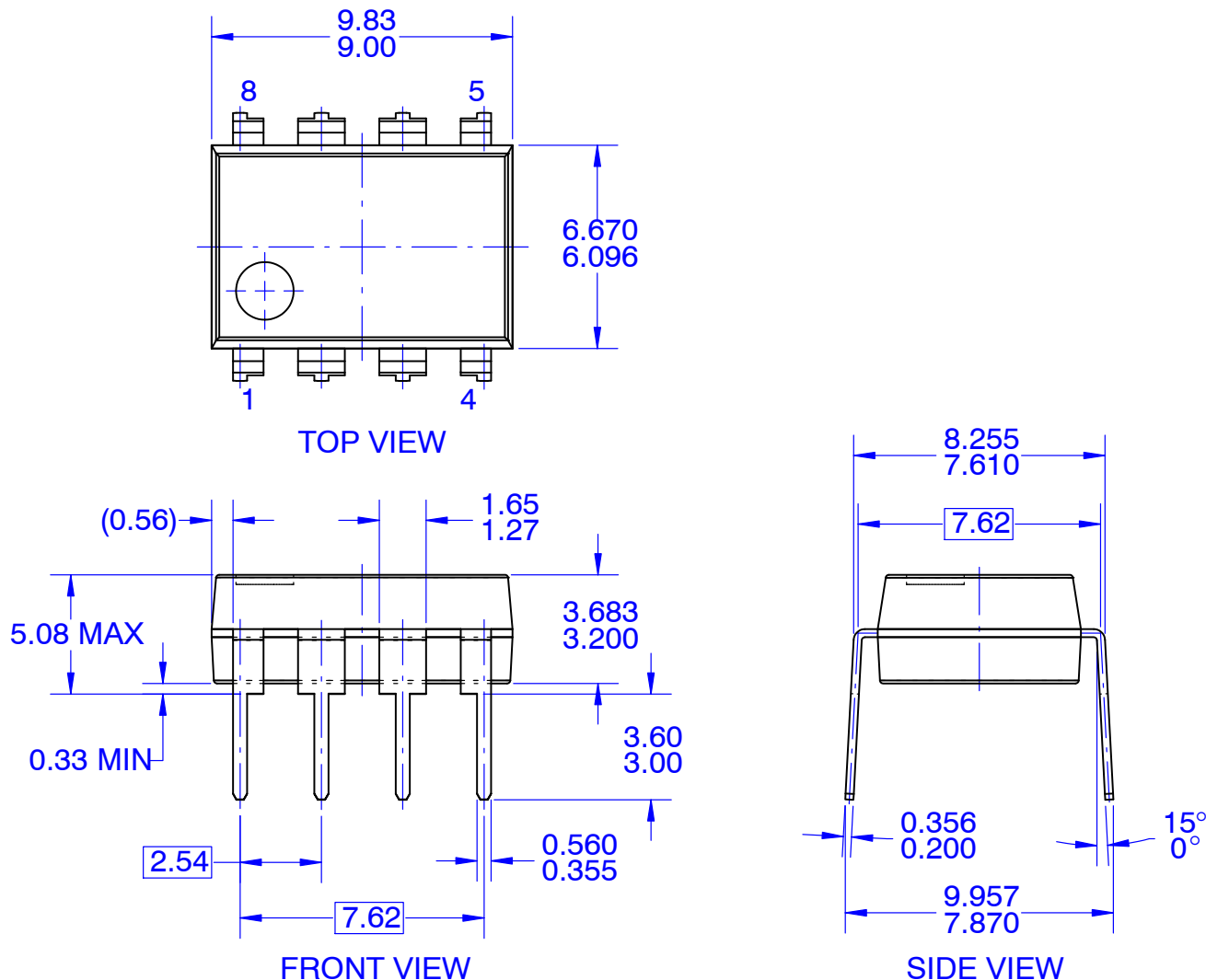


Figure 18. Supply Current vs. Temperature

PDIP8 9.42x6.38, 2.54P  
CASE 646CM  
ISSUE O

DATE 31 JUL 2016



**NOTES:**

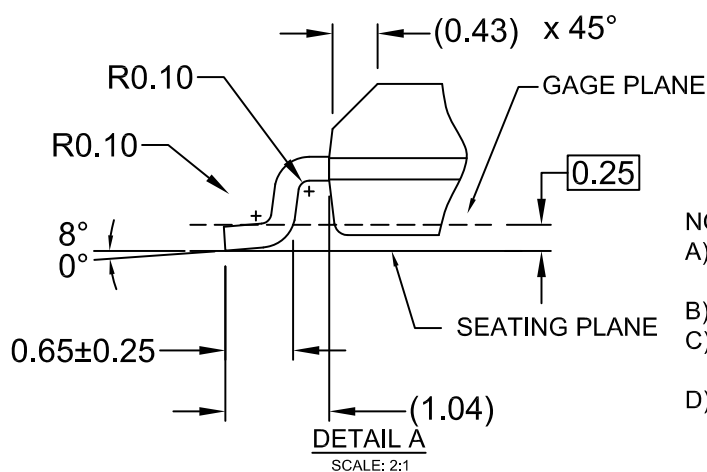
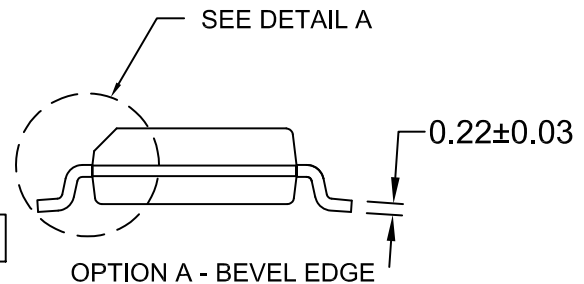
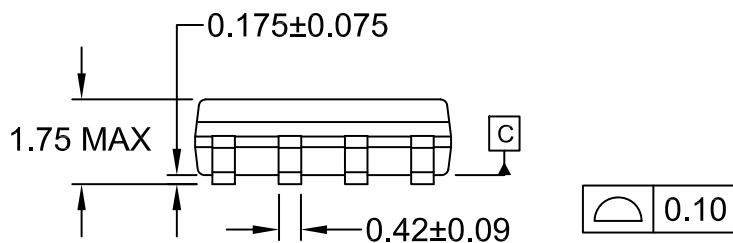
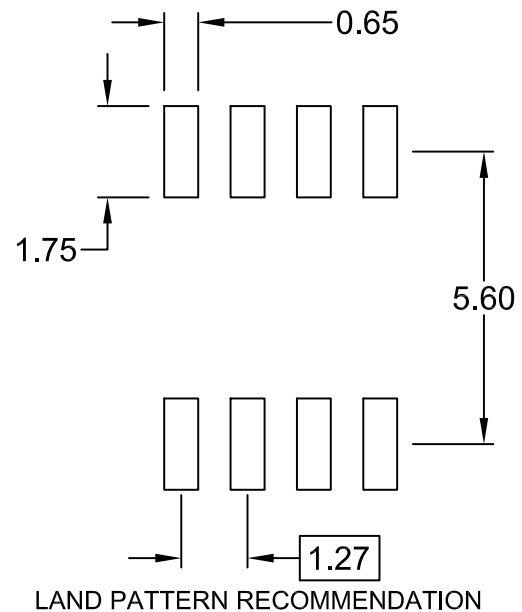
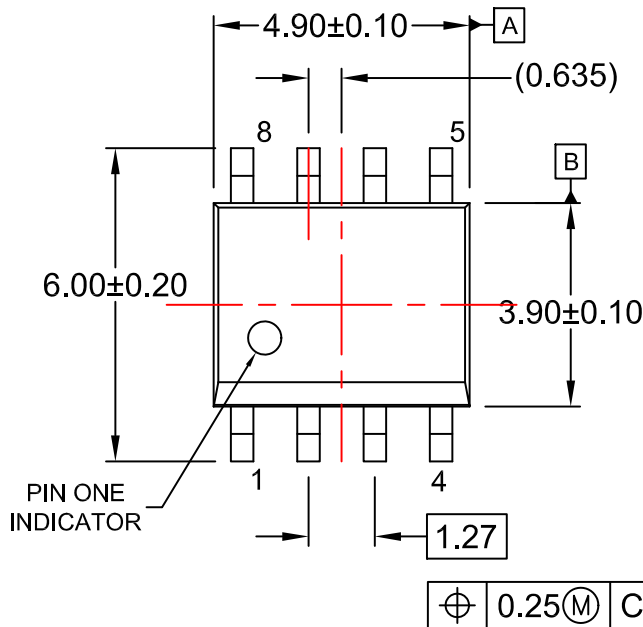
- A. CONFORMS TO JEDEC MS-001, VARIATION BA
- B. ALL DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-2009

|                         |                               |                                                                                                                                                                                     |
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**SOIC8**  
**CASE 751EB**  
**ISSUE A**

DATE 24 AUG 2017



**NOTES:**

- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M

|                         |                    |                                                                                                                                                                                     |
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