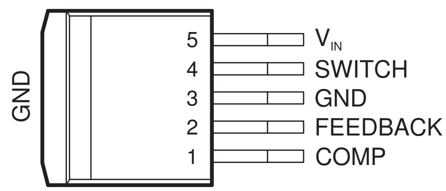
## FEATURES

- **Few External Components Required (As Few As Six)**
- **Current Limit, Undervoltage Lockout, and Thermal Shutdown**
- **Wide Input Voltage Range: 3 V to 40 V**
- **100-kHz Internal Oscillator Allows for Use of Small Magnetics**
- **Current-Mode Operation for Faster Transient Response, Line Regulation, and Cycle-by-Cycle Current Limiting**
- **Soft-Start Capability Provides Controlled Startup Current**
- **Improved Replacement for LM2577 Series**

## APPLICATIONS

- **Simple Boost Converter**
- **Flyback Converters, Single/Multiple Outputs**
- **SEPIC Converter With $V_{IN}$ Higher or Lower Than Output Voltage**
- **Transformer-Coupled Forward Converters**

**KTT (TO-263) PACKAGE**
**(TOP VIEW)**




## DESCRIPTION/ORDERING INFORMATION

The TL3577 series are easy-to-use devices that incorporate all the active circuitry required to implement either step-up (boost), flyback, forward converter, or SEPIC converter switching regulators. The internal 3-A 65-V switch allows the TL3577 to provide an output voltage of up to 60 V as a simple boost regulator; higher output voltages can be achieved with the TL3577 configured as a flyback or forward converter.

Requiring few external components, The TL3577 features a wide input voltage range of 3 V to 40 V and offers an adjustable output voltage. Basic protection features include undervoltage lockout, thermal protection, and soft start, which is provided to reduce input current during startup. Current-mode control provides cycle-by-cycle current limiting, as well as faster line and load regulation. The internal 100-kHz oscillator allows for use of smaller magnetics and filter components, when compared with similar regulators running at 52 kHz. A standard series of inductors and capacitors optimized for use with these regulators is available from several manufacturers and are listed in this data sheet.

The TL3577 is characterized for operation over the virtual junction temperature range of –40°C to 125°C.

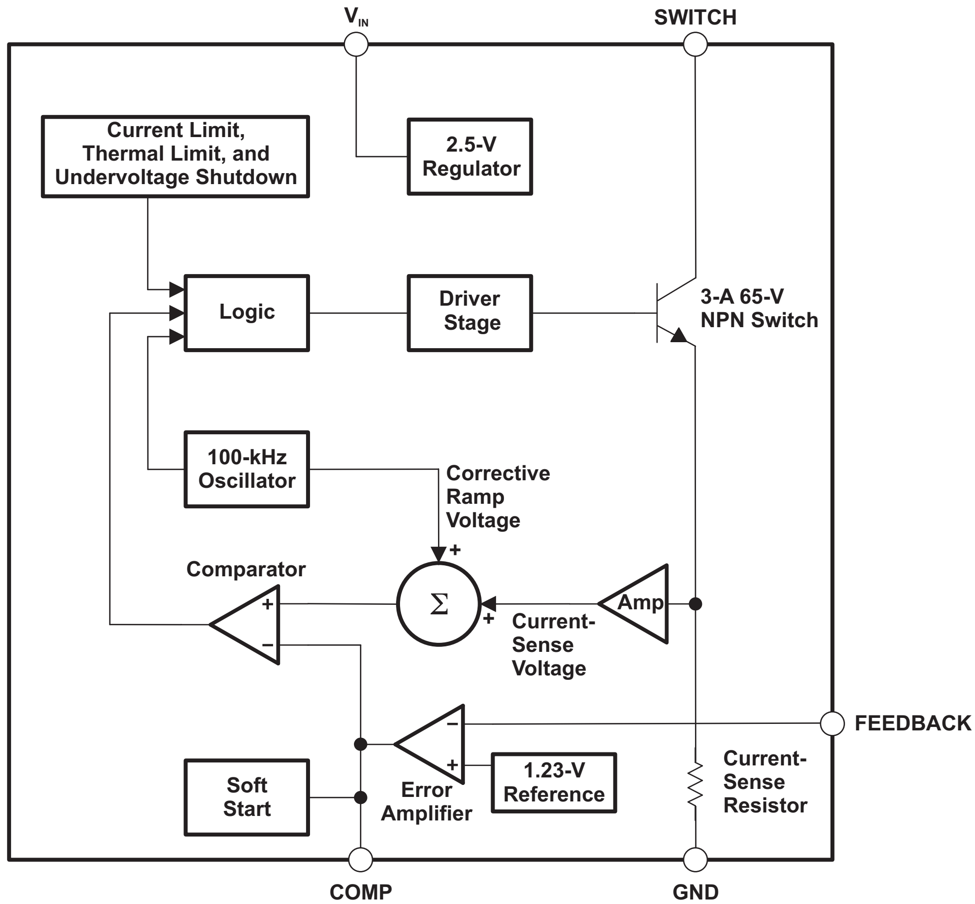
### ORDERING INFORMATION

| $T_J$ | $V_O$ (NOM) | PACKAGE(1) | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|---|
| –40°C to 125°C | ADJ | TO-263 – KTT | Reel of 500 | TL3577-ADJIKTTR | TL3577ADJI |

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

## FUNCTIONAL BLOCK DIAGRAM



## Absolute Maximum Ratings(1)

over operating free-air temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{IN}$ | Supply voltage | | 45 | V |
| $V_{SW}$ | Output SWITCH voltage | | 65 | V |
| $I_{SW}$ | Output SWITCH current | | 6 | A |
| $T_J$ | Maximum junction temperature | | 150 | °C |
| $T_{stg}$ | Storage temperature range | –65 | 150 | °C |
| $T_J$ | Junction temperature | | 150 | °C |

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## Package Thermal Data(1)

| PACKAGE | BOARD | $\theta_{JA}$ | $\theta_{JC}$ | $\theta_{JCB}$ |
|---|---|---|---|---|
| TO-263 (KTT) | High K, JESD 51-5 | 31.8 | 35.0 | 1.13 |

(1) Maximum power dissipation is a function of $T_J$(max), $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.

## Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $V_{IN}$ | Supply voltage | 3 | 40 | V |
| $V_{SW}$ | Output SWITCH voltage | 0 | 60 | V |
| $I_{SW}$ | Output SWITCH current | | 3 | A |
| $T_J$ | Operating virtual junction temperature | –40 | 125 | °C |

## Electrical Characteristics

$V_{IN}$ = 5 V, $V_{FEEDBACK}$ = $V_{REF}$, $I_{SWITCH}$ = 0 (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | $T_J$ | TL3577-ADJ MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output voltage | $V_{IN}$ = 5 V to 10 V, $I_{LOAD}$ = 100 mA to 800 mA, See Figure 1 | 25°C | 11.6 | 12 | 12.4 | V |
| | | | Full range | 11.4 | | 12.6 | |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | Line regulation | $V_{IN}$ = 3.5 V to 10 V, $I_{LOAD}$ = 200 mA, See Figure 1 | 25°C | | 20 | 50 | mV |
| | | | Full range | | | 100 | |
| $\frac{\Delta V_{OUT}}{\Delta I_{LOAD}}$ | Load regulation | $I_{LOAD}$ = 100 mA to 800 mA, See Figure 1 | 25°C | | 20 | 50 | mV |
| | | | Full range | | | 100 | |
| η | Efficiency | $I_{LOAD}$ = 800 mA, See Figure 1 | 25°C | | 80 | | % |
| $I_{CC}$ | Input supply current | $V_{FEEDBACK}$ = 1.5 V (SWITCH Off) | 25°C | | 7.5 | 10 | mA |
| | | | Full range | | | 14 | |
| | | $I_{SWITCH}$ = 2 A, $V_{COMP}$ = 2 V (maximum duty cycle) | 25°C | | 45 | 70 | |
| | | | Full range | | | 85 | |
| $V_{UV}$ | Input supply undervoltage lockout | $I_{SWITCH}$ = 100 mA | 25°C | | 2.7 | 2.85 | V |
| | | | Full range | | | 2.95 | |
| $f_O$ | Oscillator frequency | Measured at SWITCH, $I_{SWITCH}$ = 100 mA | 25°C | 85 | 100 | 115 | kHz |
| | | | Full range | 80 | | 120 | |
| $V_{REF}$ | Reference voltage | Measured at FEEDBACK, $V_{IN}$ = 3 V to 40 V, $V_{COMP}$ = 1 V | 25°C | 1.214 | 1.23 | 1.246 | V |
| | | | Full range | 1.206 | | 1.254 | |
| $\frac{\Delta V_{REF}}{\Delta V_{IN}}$ | Reference voltage line regulation | $V_{IN}$ = 3 V to 40 V | 25°C | | 0.5 | | mV |
| $I_B$ | Error amplifier input bias current | $V_{COMP}$ = 1 V | 25°C | | 100 | 300 | nA |
| | | | Full range | | | 800 | |
| $G_M$ | Error amplifier transconductance | $I_{COMP}$ = –30 μA to 30 μA, $V_{COMP}$ = 1 V | 25°C | 2400 | 3700 | 4800 | μmho |
| | | | Full range | 1600 | | 5800 | |
| $A_{VOL}$ | Error amplifier voltage gain | $V_{COMP}$ = 1.1 V to 1.9 V, $R_{COMP}$ = 1 MΩ(1) | 25°C | 500 | 800 | | V/V |
| | | | Full range | 250 | | | |
| | Error amplifier output swing | Upper limit, $V_{FEEDBACK}$ = 1 V | 25°C | 2.2 | 2.4 | | V |
| | | | Full range | 2 | | | |
| | | Lower limit, $V_{FEEDBACK}$ = 1.5 V | 25°C | | 0.3 | 0.4 | |
| | | | Full range | | | 0.55 | |
| | Error amplifier output current | $V_{FEEDBACK}$ = 1 V to 1.5 V, $V_{COMP}$ = 1 V | 25°C | ±130 | ±200 | ±300 | μA |
| | | | Full range | ±90 | | ±400 | |
| $I_{SS}$ | Soft-start current | $V_{FEEDBACK}$ = 1 V, $V_{COMP}$ = 0 | 25°C | 2.5 | 5 | 7.5 | μA |
| | | | Full range | 1.5 | | 9.5 | |
| D | Maximum duty cyle | $V_{COMP}$ = 1.5 V, $I_{SWITCH}$ = 100 mA | 25°C | 88 | 90 | | % |
| | | | Full range | 84 | | | |
| $\frac{\Delta I_{SWITCH}}{\Delta V_{COMP}}$ | Switch transconductance | | 25°C | | 12.5 | | A/V |
| $I_L$ | Switch leakage current | $V_{SWITCH}$ = 65 V, $V_{FEEDBACK}$ = 1.5 V (SWITCH off) | 25°C | | 10 | 300 | μA |
| | | | Full range | | | 600 | |
| $V_{SAT}$ | Switch saturation voltage | $I_{SWITCH}$ = 2 A, $V_{COMP}$ = 2 V (maximum duty cycle) | 25°C | | 0.5 | 0.7 | V |
| | | | Full range | | | 0.9 | |
| | NPN switch current limit | $V_{COMP}$ = 2 V | 25°C | 3.7 | 4.3 | 5.3 | A |
| | | | Full range | 3 | | 6 | |

(1) A 1-MΩ resistor is connected to the compensation pin (which is the error amplifier output) to ensure accuracy in measuring $A_{VOL}$. In actual applications, this load resistance should be ≥10 MΩ, resulting in $A_{VOL}$ that is typically twice the specified minimum limit.

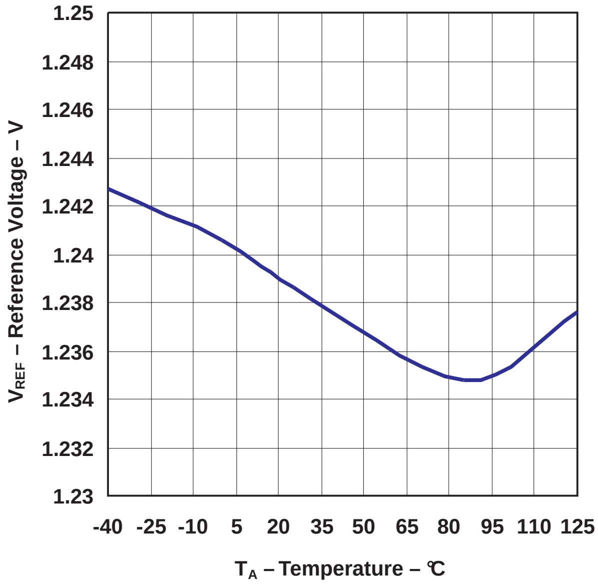
## Electrical Characteristics (continued)

$V_{IN}$ = 5 V, $V_{FEEDBACK}$ = $V_{REF}$, $I_{SWITCH}$ = 0 (unless otherwise noted)

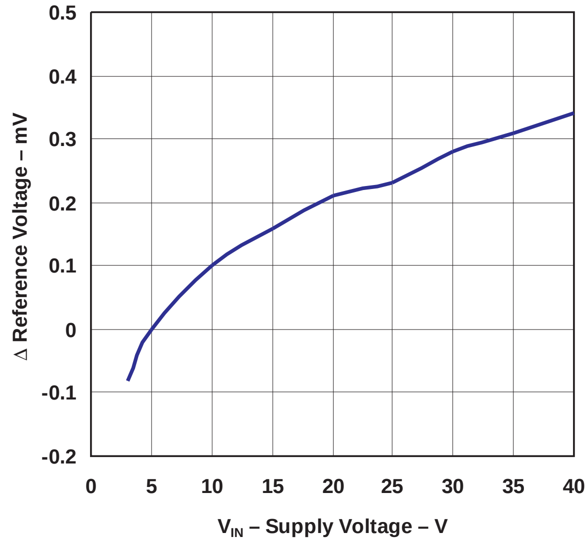
| PARAMETER | TEST CONDITIONS | $T_J$ | TL3577-ADJ | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | |
| COMP current | $V_{COMP}$ = 0 V | 25°C | | 25 | 40 | μA |
| | | Full range | | | 50 | |

## TYPICAL CHARACTERISTICS

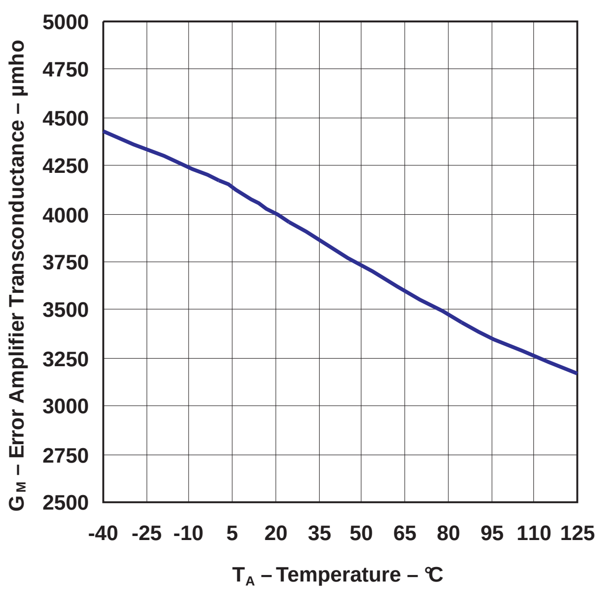
REFERENCE VOLTAGE
vs
TEMPERATURE



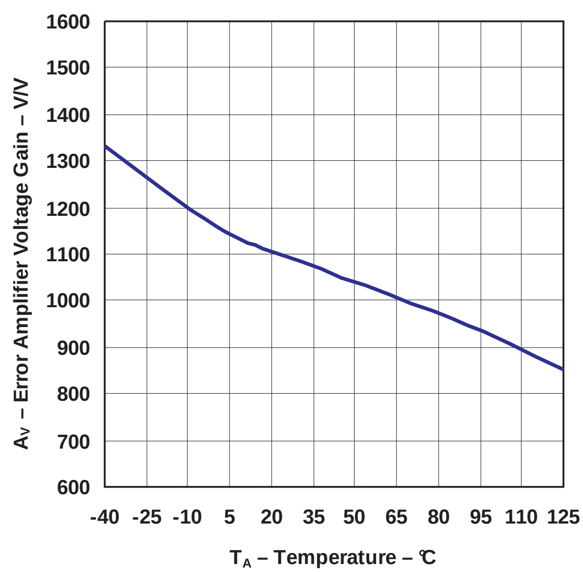

Δ REFERENCE VOLTAGE
vs
SUPPLY VOLTAGE




ERROR AMPLIFIER TRANSCONDUCTANCE
vs
TEMPERATURE

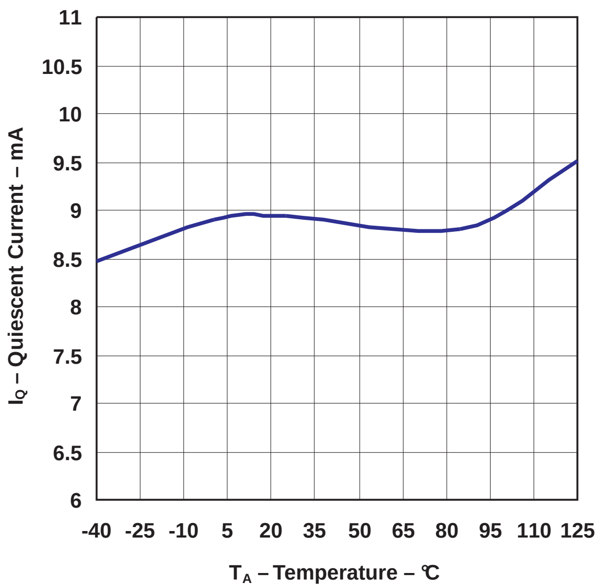



ERROR AMPLIFIER VOLTAGE GAIN
vs
TEMPERATURE

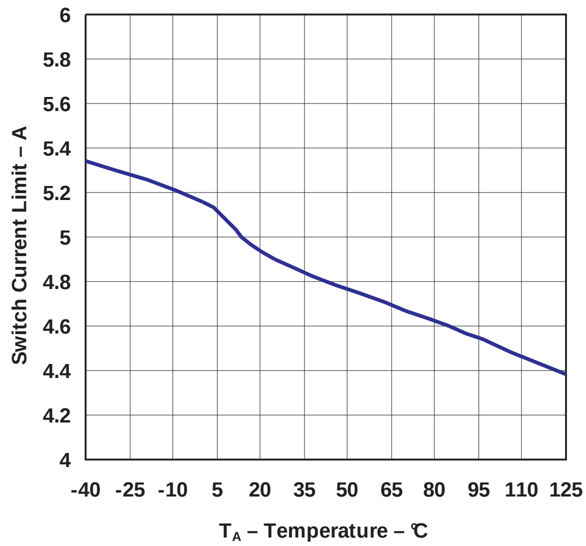


## TYPICAL CHARACTERISTICS (continued)

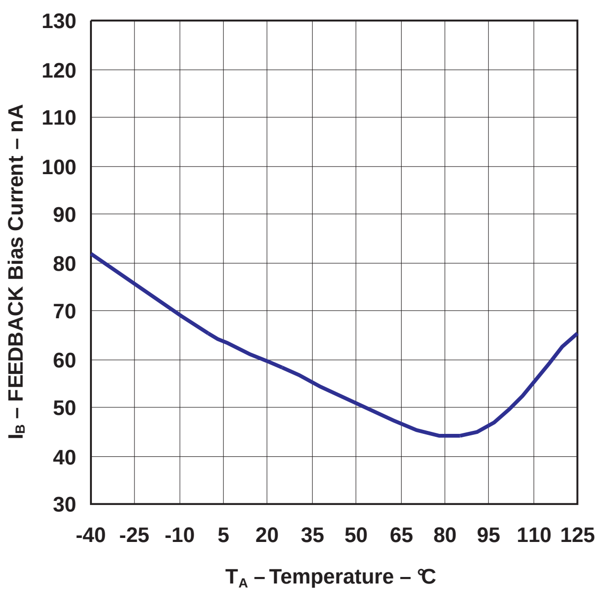
**QUIESCENT CURRENT vs TEMPERATURE**



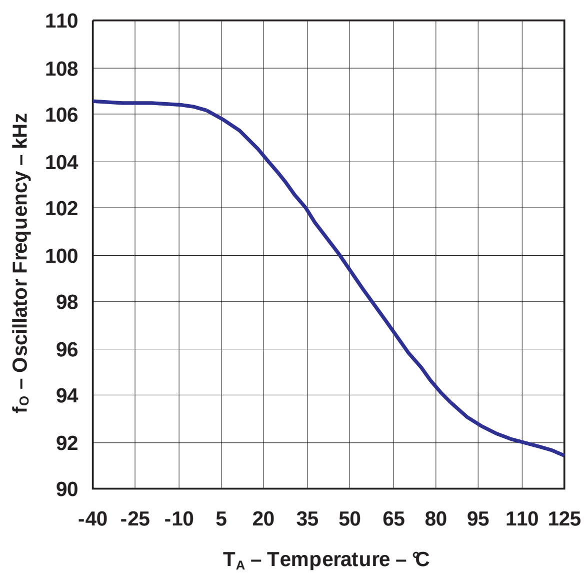

**SWITCH CURRENT LIMIT vs TEMPERATURE**




**FEEDBACK BIAS CURRENT vs TEMPERATURE**

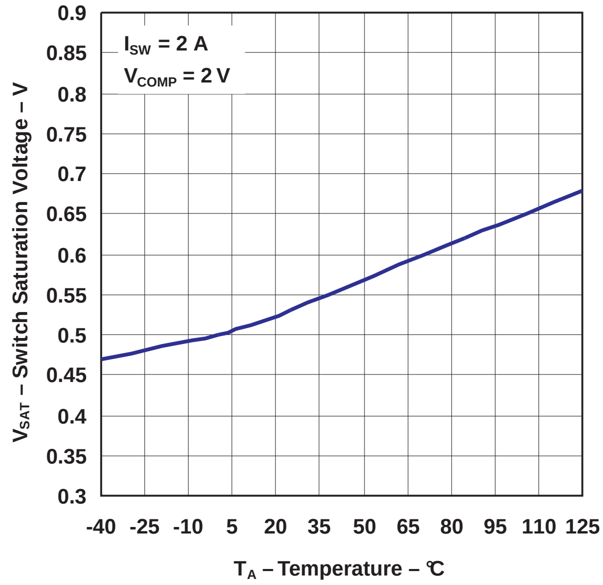



**OSCILLATOR FREQUENCY vs TEMPERATURE**

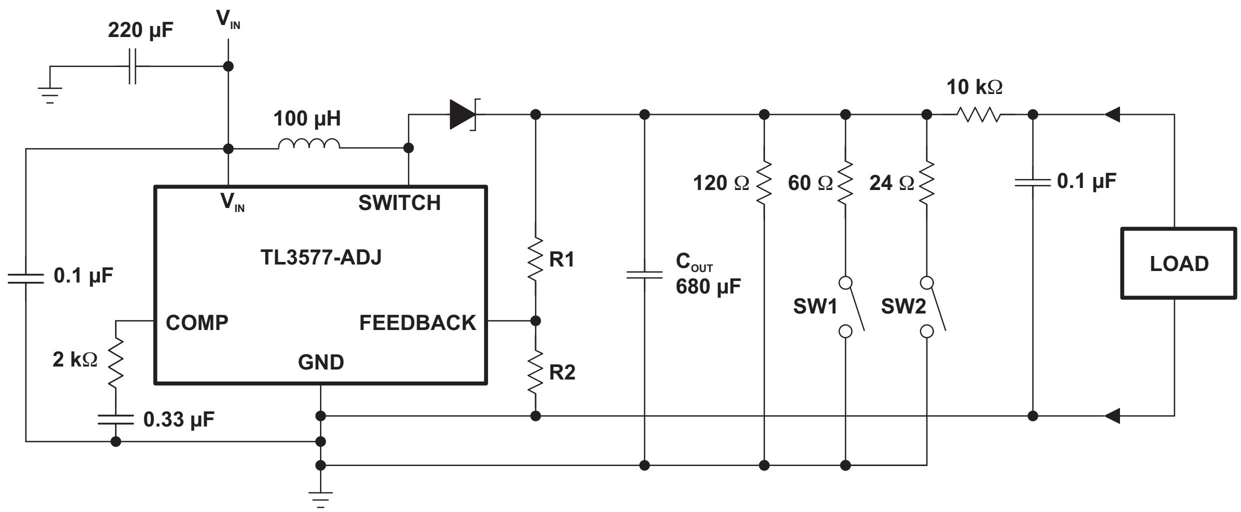


## TYPICAL CHARACTERISTICS (continued)

SWITCH SATURATION VOLTAGE
vs
TEMPERATURE



## PARAMETER MEASUREMENT INFORMATION




A. R1 = 48.7 kΩ in series with 511 Ω

B. R2 = 5.62 kΩ (1%)

**Figure 1. Test Circuit**

## APPLICATION INFORMATION

Figure 2 shows a typical application of the TL3577 in a boost regulator.

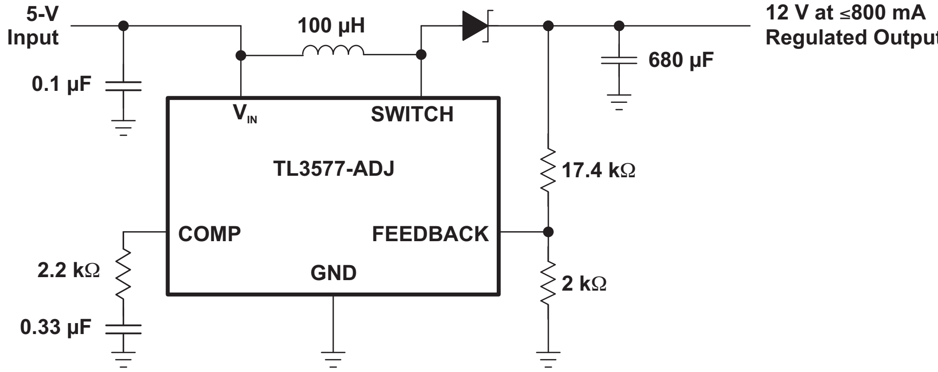



**Figure 2. Typical Application – Boost Regulator**

Figure 3 shows a typical application of the TL3577 in a flyback regulator.

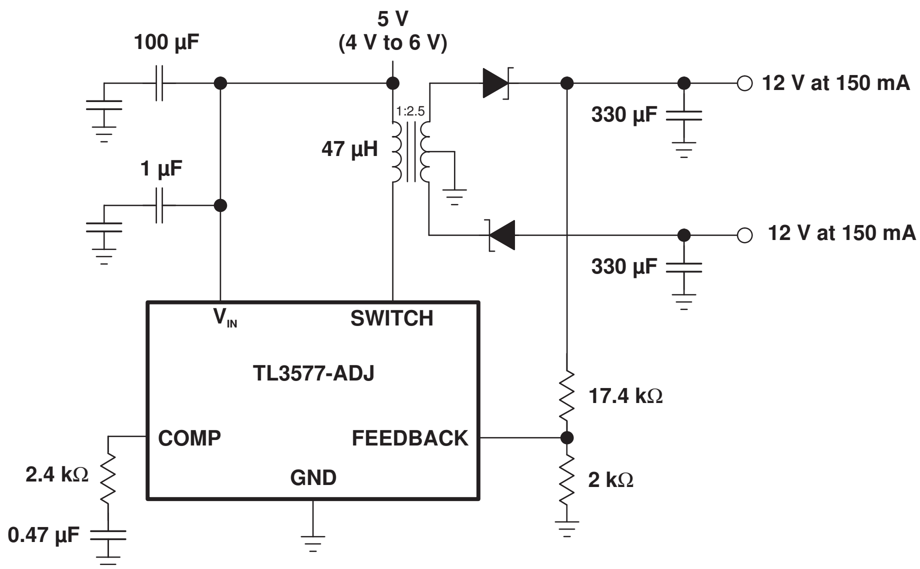
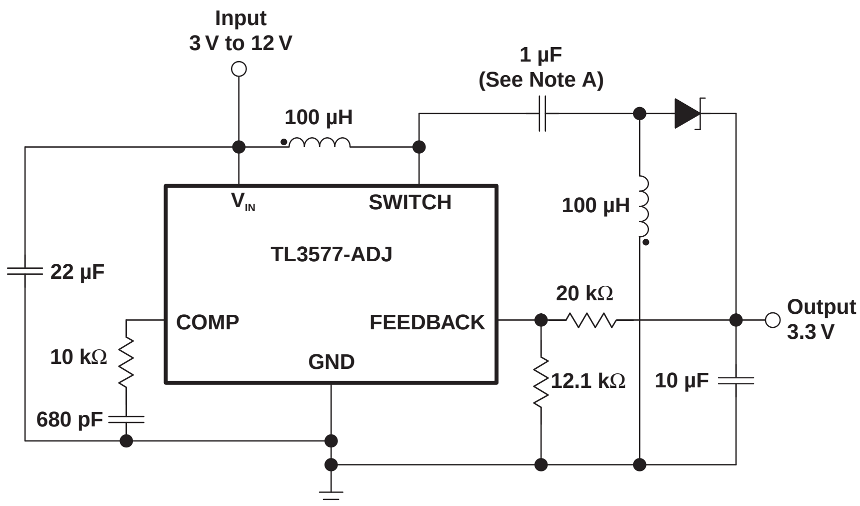



**Figure 3. Typical Application – Flyback Regulator**

## APPLICATION INFORMATION (continued)

Figure 4 shows a typical application of the TL3577 in a SEPIC regulator.




A. Low ESR. Voltage rating must be at least $V_{IN}$ + $V_{OUT}$.

**Figure 4. Typical Application – SEPIC Regulator**

## APPLICATION INFORMATION (continued)

### Step-Up (Boost) Regulator

Figure 2 shows a step-up switching regulator utilizing the TL3577. The regulator produces an output voltage higher than the input voltage. The TL3577 turns its switch on and off at a fixed frequency of 100 kHz, thus storing energy in the inductor (L). When the NPN switch is on, the inductor current is charged at a rate of $V_{IN}$/L. When the switch is off, the voltage at the SWITCH terminal of the inductor rises above $V_{IN}$, discharging the stored current through the output diode (D) into the output capacitor ($C_{OUT}$) at a rate of ($V_{OUT}$ – $V_{IN}$)/L. The energy stored in the inductor is thus transferred to the output. The output voltage is controlled by the amount of energy transferred, which is controlled by modulating the peak inductor current. This modulation is accomplished by feeding a portion of the output voltage to an error amplifier that amplifies the difference between the feedback voltage and an internal 1.23-V precision reference voltage. The output of the error amplifier is compared to a voltage that is proportional to the switch current or the inductor current during the switch-on time. A comparator terminates the switch-on time when the two voltages are equal and, thus, controls the peak switch current to maintain a constant output voltage. Figure 5 shows voltage and current waveforms for the circuit. Formulas for calculation are shown in Table 1.

### Step-Up Regulator Design Procedure

Given:

$V_{IN(min)}$ = Minimum input supply voltage
$V_{OUT}$ = Regulated output voltage

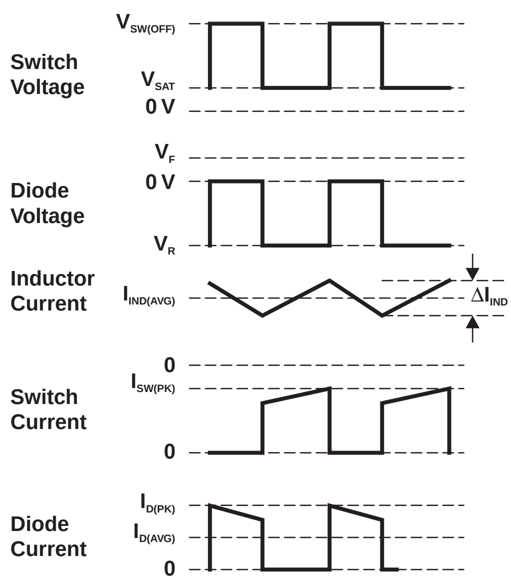



**Figure 5. Step-Up Regulator Waveforms**

**Table 1. Step-up Regulator Formulas(1)**

| | | |
|---|---|---|
| Duty cycle | D | $\frac{V_{OUT} + V_F - V_{IN}}{V_{OUT} + V_F - V_{SAT}} \approx \frac{V_{OUT} - V_{IN}}{V_{OUT}}$ |
| Average inductor current | $I_{IND(AVG)}$ | $\frac{I_{LOAD}}{1 - D}$ |
| Inductor current ripple | $\Delta I_{IND}$ | $\frac{V_{IN} - V_{SAT}}{L} \bullet \frac{D}{100{,}000}$ |
| Peak inductor current | $I_{IND(PK)}$ | $\frac{I_{LOAD}}{1 - D} + \frac{\Delta I_{IND}}{2}$ |
| Peak switch current | $I_{SW(PK)}$ | $\frac{I_{LOAD}}{1 - D} + \frac{\Delta I_{IND}}{2}$ |
| Switch voltage when off | $V_{SW(OFF)}$ | $V_{OUT} + V_F$ |
| Diode reverse voltage | $V_R$ | $V_{OUT} - V_{SAT}$ |
| Average diode current | $I_{D(AVG)}$ | $I_{LOAD}$ |
| Peak diode current | $I_{D(PK)}$ | $\frac{I_{LOAD}}{1 - D} + \frac{\Delta I_{IND}}{2}$ |
| Power dissipation | $P_D$ | $0.25\ \Omega \left(\frac{I_{LOAD}}{1 - D}\right)^2 D + \frac{I_{LOAD} \bullet D \bullet V_{IN}}{50\ (1 - D)}$ |

(1) $V_F$ = forward-biased diode voltage, $I_{LOAD}$ = output load

First, determine if the TL3577 can provide these values of $V_{OUT}$ and $I_{LOAD(max)}$ when operating with the minimum value of $V_{IN}$. The upper limits for $V_{OUT}$ and $I_{LOAD(max)}$ are given by the following equations.

$V_{OUT} \leq 60$ V and

$V_{OUT} \leq 10 \times V_{IN}$

$I_{LOAD(max)} \leq (2.1\ A \times V_{IN(min)})/V_{OUT}$

These limits must be greater than or equal to the values specified in this application.

### 1. Output Voltage Section

Resistors R1 and R2 are used to select the desired output voltage. These resistors form a voltage divider and present a portion of the output voltage to the error amplifier, which compares it to an internal 1.23-V reference. Select R1 and R2 such that:

$R1/R2 = (V_{OUT}/1.23\ V) - 1$

### 2. Inductor Selection (L)

#### *A. Preliminary Calculations*

To select the inductor, the calculation of the following three parameters is necessary:

$D_{max}$, the maximum switch duty cycle ($0 \leq D \leq 0.9$):

$Dmax = V_{OUT} + V_F - V_{IN(min)}/V_{OUT} + V_F - 0.6\ V$

where, typically, $V_F = 0.5$ V for Schottky diodes and $V_F = 0.8$ V for fast-recovery diodes.

E • T, the product of volts • time that charges the inductor:

$E \bullet T = D_{max} \times (V_{IN(min)} - 0.6V)10^6/100{,}000\ Hz\ (V\mu s)$

$I_{IND,DC}$, the average inductor current under full load:

$I_{IND,DC} = (1.05 \times I_{LOAD(max)})/(1 - D_{max})$

### *B. Identify Inductor Value*

1. From Figure 6, identify the inductor code for the region indicated by the intersection of E • T and $I_{IND,DC}$. This code gives the inductor value in microhenries. The L or H prefix signifies whether the inductor is rated for a maximum E • T of 90 Vμs (L) or 250 Vμs (H).
2. If D < 0.85, go to step C. If D ≥ 0.85, calculate the minimum inductance needed to ensure the switching regulator's stability:

   If $L_{min}$ is smaller than the inductor values found in step B1, go on to step C. Otherwise, the inductor value found in step 1, above, is too low; an appropriate inductor code should be obtained from Figure 6 as follows:

   a. Find the lowest-value inductor that is greater than $L_{min}$.

   b. Find where E • T intersects this inductor value to determine if it has an L or H prefix. If E • T intersects both the L and H regions, select the inductor with an H prefix.

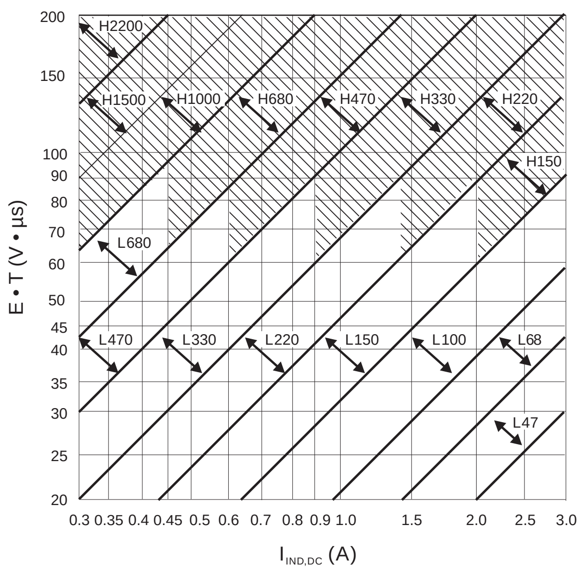
### *C. Inductor Selection*

Select an inductor from Table 2 which cross references the inductor codes to the part numbers of the three different manufacturers. The inductors listed in Table 2 have the following characteristics:

**AIE** (ferrite, pot-core inductors): Benefits of this type are low electromagnetic interference (EMI), small physical size, and very low power dissipation (core loss).

**Pulse** (powdered iron, toroid core inductors): Benefits are low EMI and ability to withstand E • T and peak current above rated value better than ferrite cores.

**Renco** (ferrite, bobbin-core inductors): Benefits are low cost and best ability to withstand E • T and peak current above rated value. Be aware that these inductors generate more EMI than the other types, and this may interfere with signals sensitive to noise.




A. This chart assumes that the inductor ripple current inductor is approximately 20% to 30% of the average inductor current (when the regulator is under full load). Greater ripple current causes higher peak switch currents and greater output ripple voltage. Lower ripple current is achieved with larger value inductors. The factor of 20% to 30% is chosen as a convenient balance between the two extremes.

**Figure 6. Inductor Selection Graph**

**Table 2. Standardized Inductors and Manufacturer's Part Numbers**

| Inductor Code | Manufacturer's Part Number | | |
|---|---|---|---|
| | AIE(1) | Pulse(2) | Renco(3) |
| L47 | 415 - 0932 | PE - 53112 | RL2442 |
| L68 | 415 - 0931 | PE - 92114 | RL2443 |
| L100 | 415 - 0930 | PE - 92108 | RL2444 |
| L150 | 415 - 0953 | PE - 53113 | RL1954 |
| L220 | 415 - 0922 | PE - 52626 | RL1953 |
| L330 | 415 - 0926 | PE - 52627 | RL1952 |
| L470 | 415 - 0927 | PE - 53114 | RL1951 |
| L680 | 415 - 0928 | PE - 52629 | RL1950 |
| H150 | 415 - 0936 | PE - 53115 | RL2445 |
| H220 | 430 - 0636 | PE - 53116 | RL2446 |
| H330 | 430 - 0635 | PE - 53117 | RL2447 |
| H470 | 430 - 0634 | PE - 53118 | RL1961 |
| H680 | 415 - 0935 | PE - 53119 | RL1960 |
| H1000 | 415 - 0934 | PE - 53120 | RL1959 |
| H1500 | 415 - 0933 | PE - 53121 | RL1958 |
| H2200 | 415 - 0945 | PE - 53122 | RL2448 |

(1) AIE Magnetics, Div. Vernitron Corp., (813) 347-2181 2801 72nd Street North, St. Petersburg, FL 33710
(2) Pulse Engineering, (619) 674-8100 12220 World Trade Drive, San Diego, CA 92128
(3) Renco Electronics, Inc., (516) 586-5566 60 Jeffryn Blvd. East, Deer Park, NY 11729

### 3. Compensation Network ($R_C$, $C_C$) and Output Capacitor ($C_{OUT}$) Selection

The compensation network consists of resistor $R_C$ and capacitor $C_C$, which form a simple pole-zero network and stabilize the regulator. The values of $R_C$ and $C_C$ depend upon the voltage gain of the regulator, $I_{LOAD(max)}$, the inductor L, and output capacitance $C_{OUT}$. A procedure to calculate and select the values for $R_C$, $C_C$, and $C_{OUT}$ that ensures stability is described below. It should be noted, however, that this may not result in optimum compensation. To guarantee optimum compensation, a standard procedure for testing loop stability is recommended, such as measuring $V_{OUT}$ transient responses to pulsing $I_{LOAD}$.

#### *A. Calculate the maximum value for $R_C$.*

$R_C \le (750 \times I_{LOAD(max)} \times V_{OUT}^2)/V_{IN(min)}^2$

Select a resistor less than or equal to this value, not to exceed 3 kΩ.

#### *B. Calculate the minimum value for $C_{OUT}$ using the following two equations.*

$C_{OUT} \ge (0.19 \times L \times R_C \times I_{LOAD(max)})/(V_{IN(min)} \times V_{OUT})$ and

$C_{OUT} \ge (V_{IN(min)} \times R_C \times (V_{IN(min)} + (3.74 \times 10^5 \times L))/(487{,}800 \times V_{OUT}^3)$

The larger of these two values is the minimum value that ensures stability.

***C. Calculate the minimum value of $C_C$.***

$C_C \geq 58.5 \times V_{OUT}^2 \times C_{OUT} \times R_C^2 \times V_{IN(min)}$

The compensation capacitor also is used in the soft-start function of the regulator. When the input voltage is applied to the part, the switch duty cycle is increased slowly at a rate defined by the compensation capacitor and the soft-start current, thus eliminating high input currents. Without the soft-start circuitry, the switch duty cycle would instantly rise to about 90% and draw large currents from the input supply. For proper soft starting, the value for $C_C$ should be equal to or greater than 0.22 µF.

Table 3 lists several types of aluminum electrolytic capacitors that could be used for the output filter. Use the following parameters to select the capacitor:

*Working Voltage (WVDC)*: Choose a capacitor with a working voltage at least 20% higher than the regulator output voltage.

*Ripple Current*: This is the maximum RMS value of current that charges the capacitor during each switching cycle. For step-up and flyback regulators, the formula for ripple current is:

$I_{RIPPLE(rms)} = (I_{LOAD(max)} \times D_{max})/(1 - D_{max})$

Choose a capacitor that is rated at least 50% higher than this value at 100 kHz.

*Equivalent Series Resistance (ESR)*: This is the primary cause of output ripple voltage, and it also affects the values of $R_C$ and $C_C$ needed to stabilize the regulator. As a result, the preceding calculations for $C_C$ and $R_C$ are only valid if the ESR does not exceed the maximum value specified by the following equations.

$ESR \leq (0.01 \times 15\ V)/I_{RIPPLE(P\text{-}P)}$ and $\leq (8.7 \times 10^{-3} \times V_{IN})/I_{LOAD(max)}$ where

$I_{RIPPLE(P\text{-}P)} = (1.15 \times I_{LOAD(max)})/(1 - D_{max})$

Select a capacitor with an ESR, at 100 kHz, that is less than or equal to the lower value calculated. Most electrolytic capacitors specify ESR at 120 kHz, which is 15% to 30% higher than at 100 kHz. Also, note that ESR increases by a factor of 2 when operating at –20°C.

In general, low values of ESR are achieved by using large-value capacitors (C ≥ 470 µF) and capacitors with high WVDC, or by paralleling smaller-value capacitors.

### 4. Input Capacitor Selection ($C_{IN}$)

To reduce noise on the supply voltage caused by the switching action of a step-up regulator (ripple current noise), $V_{IN}$ should be bypassed to ground. A good quality 0.1-µF capacitor with low ESR should provide sufficient decoupling. If the TL3577 is located far from the supply-source filter capacitors, an additional electrolytic (47 µF, for example) is required.

**Table 3. Aluminum Electrolytic Capacitors Recommended for Switching Regulators**

| | |
|---|---|
| **Nichicon** – Types PF, PX, or PZ<br>927 East State Parkway, Schaumburg, IL 60173<br>(708) 843-7500 | **United Chemi-CON** – Types LX, SXF, or SXJ<br>9801West Higgens, Rosemont, IL 60018<br>(708) 696-2000 |

### 5. Output Diode Selection (D)

In the step-up regulator, the switching diode must withstand a reverse voltage and be able to conduct the peak output current of the TL3577. Therefore, a suitable diode must have a minimum reverse breakdown voltage greater than the circuit output voltage and should also be rated for average and peak current greater than $I_{LOAD(max)}$ and $I_{D(pk)}$. Because of their low forward-voltage drop (and higher regulator efficiencies), Schottky barrier diodes often are used in switching regulators. Refer to Table 4 for recommended part numbers and voltage ratings of 1-A and 3-A diodes.

**Table 4. Diode Selection Chart(1)**

| $V_{OUT(max)}$ (V) | Schottky | | Fast Recovery | |
|---|---|---|---|---|
| | **1 A** | **3 A** | **1 A** | **3 A** |
| 20 | 1N5817<br>MBR120P | 1N5820<br>MBR320P | | |
| 30 | 1N5818<br>MBR130P<br>11DQ03 | 1N5821<br>MBR330P<br>31DQ03 | | |
| 40 | 1N5819<br>MBR140P<br>11DQ04 | 1N5822<br>MBR340P<br>31DQ04 | | |
| 50 | MBR150<br>11DQ05 | MBR350<br>31DQ05 | 1N4933<br>MUR105 | |
| 100 | | | 1N4934<br>MUR110<br>10DL1 | MR851<br>30DL1<br>MR831 |

(1) MBRxxx and MURxxx are manufactured by Motorola.
1DDxxx, 11Cxx and 31Dxx are manufactured by International Rectifier

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TL3577-ADJIKTTR | ACTIVE | DDPAK/ TO-263 | KTT | 5 | 500 | Green (RoHS & no Sb/Br) | CU SN | Level-3-245C-168 HR |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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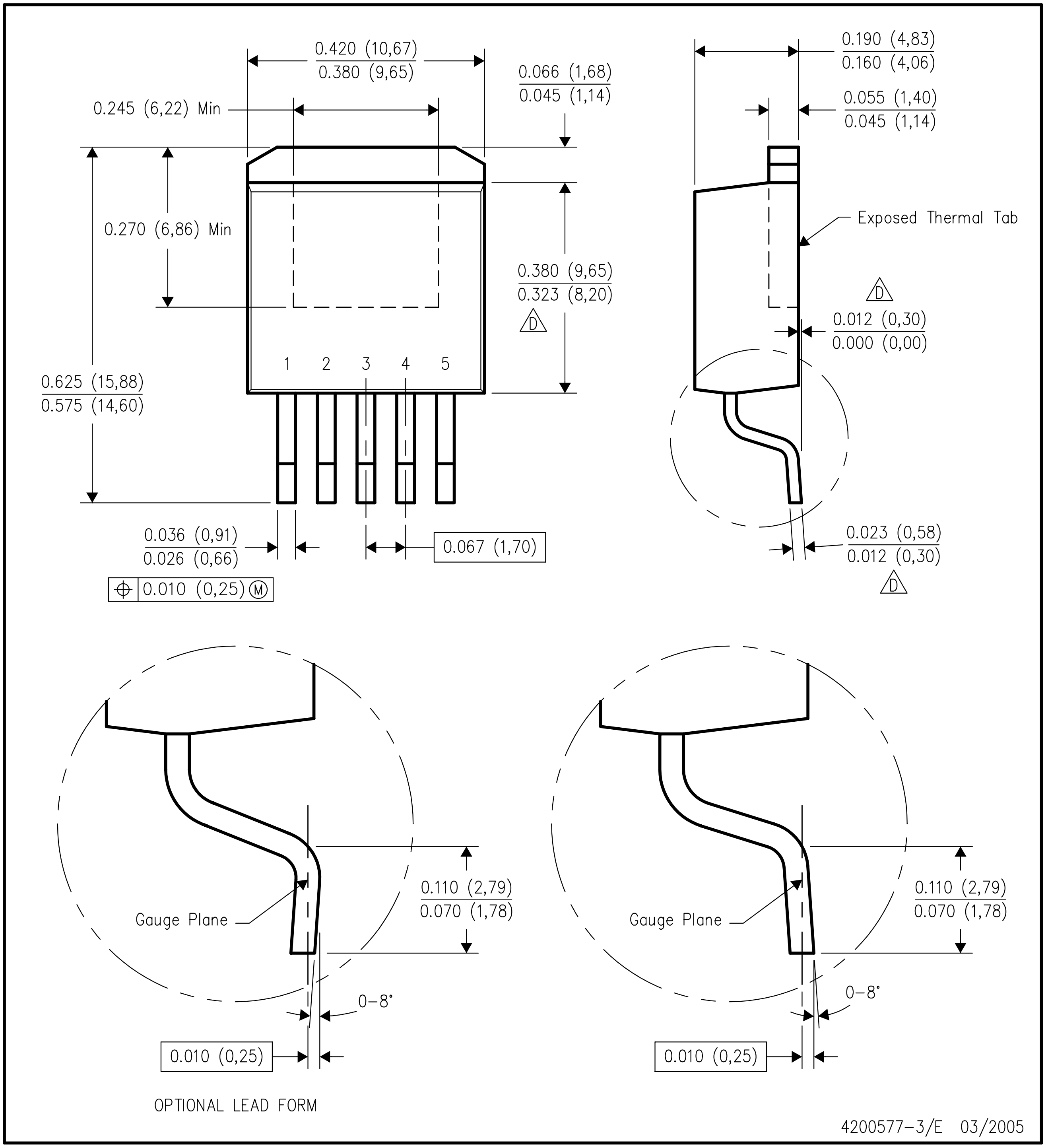
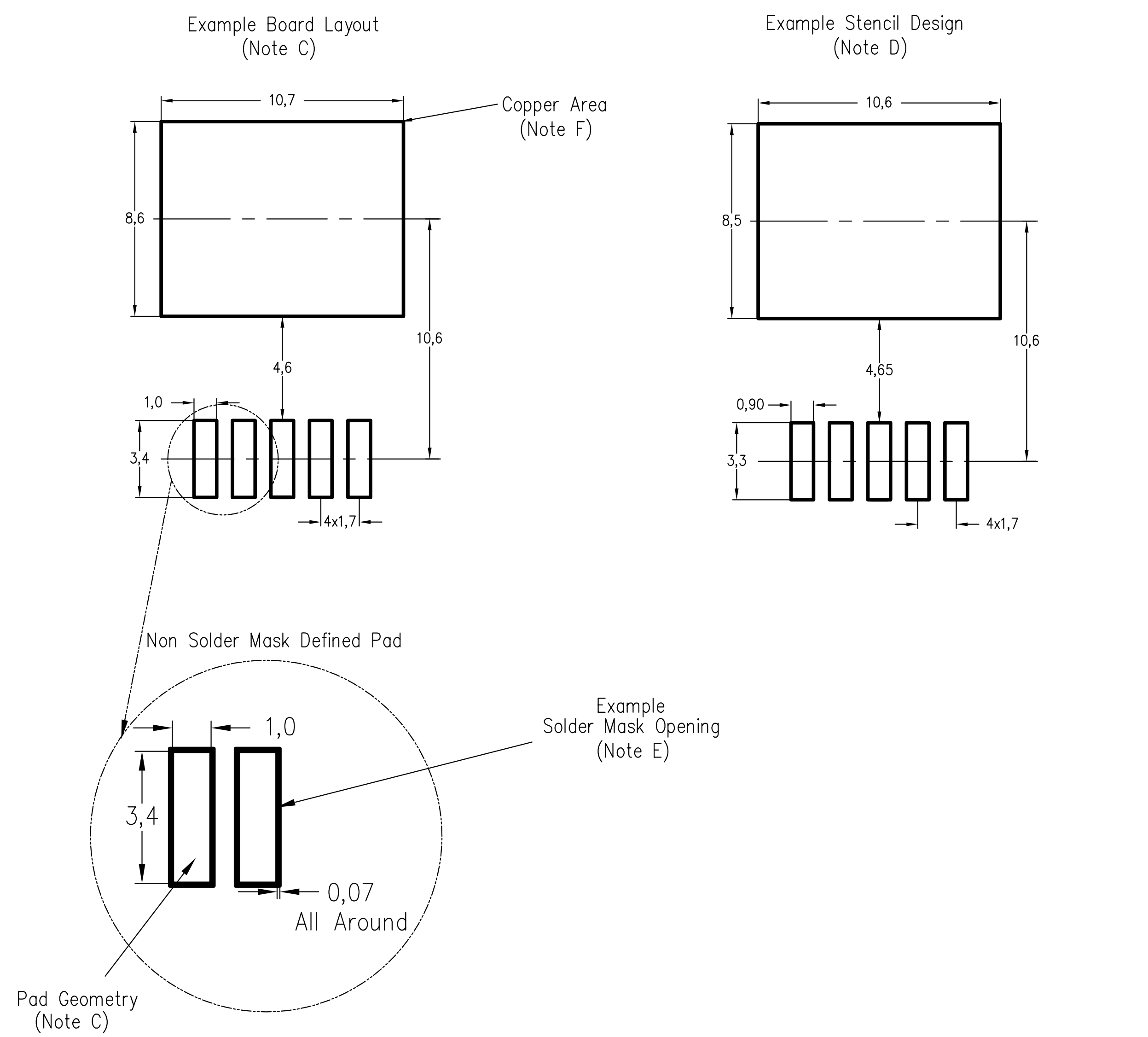
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## KTT (R–PSFM–G5) PLASTIC FLANGE–MOUNT PACKAGE




NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion. Mold flash or protrusion not to exceed 0.005 (0,13) per side.
- D. Falls within JEDEC TO–263 variation BA, except minimum lead thickness, maximum seating height, and minimum body length.

# KTT (R–PSFM–G5)

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–SM–782 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
F. This package is designed to be soldered to a thermal pad on the board. Refer to the Product Datasheet for specific thermal information, via requirements, and recommended thermal pad size. For thermal pad sizes larger than shown a solder mask defined pad is recommended in order to maintain the solderable pad geometry while increasing copper area.