# GL2596

## 3A STEP-DOWN VOLTAGE REGULATOR

## Description

GL2596 of regulators provides all the active functions for a step-down (buck) switching regulator, and drives 3A load with excellent line and load regulation. GL2596's is available in fixed output voltages of 3.3V, 5V, 12V, and a versatile Adjustable output version.

These regulators are simple to use and require a minimum number of external components. Features include internal frequency compensation and a fixed-frequency oscillator. The GL2596 is high-efficiency replacements for popular three-terminal linear regulators, and is requiring a smaller heatsink or even no heatsink.

GL2596 performs well with standard inductors from several manufacturers, and simplifying the design of switch-mode power supplies.GL2596 guarantees 4% tolerance on output voltage within specified input voltages and output load conditions, and 15% on the oscillator frequency.

External shutdown is included with 100uA (typical) standby current. The output switch has cycle-by-cycle current limiting as well as thermal shutdown for full protection under fault conditions.

GL2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a 5-lead TO-263 surface mount package and DFN-8 package.

## Features

- 3.3V, 5V, 12V and Adjustable output versions
- Adjustable version output voltage range 1.23V to 37V ±4% max over line and load conditions
- 3A output current
- Input voltage range up to 40V
- Requires only 4 external components
- High efficiency
- TTL shutdown capability
- Low power standby mode, IQ typically 100 μA
- Thermal shutdown, current limit protection
- Uses standard inductors
- 150 kHz fixed frequency internal oscillator

## Application

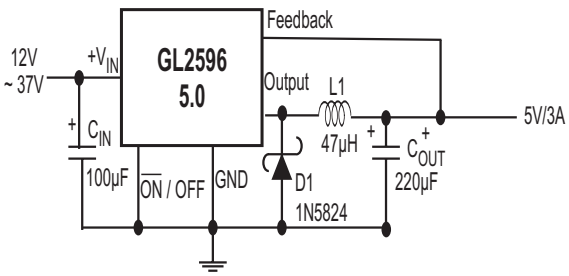
**Pre-regulator for linear regulators**

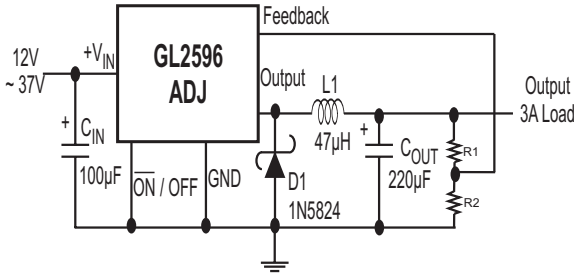
**On-card/board switching regulators**

**High-efficiency step-down buck regulator**

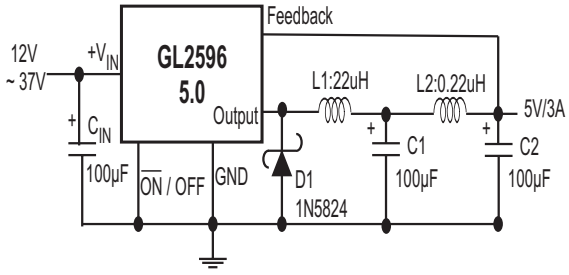
**Positive to negative converter (buck-boost)**

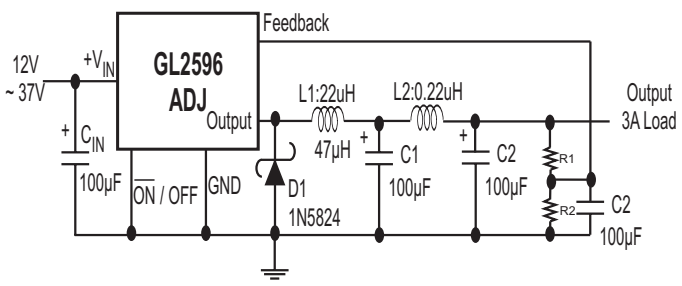
## TYPICAL APPLICATIONS



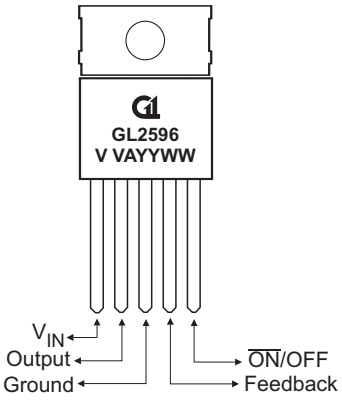

## Low Noise APPLICATIONS



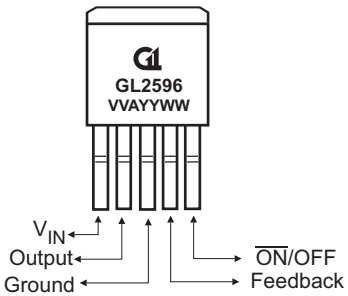



## ◆ MARKING INFORMATION & PIN CONFIGURATIONS

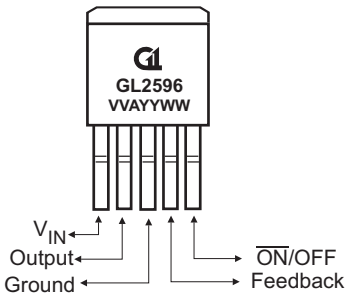
**TO-220-5**



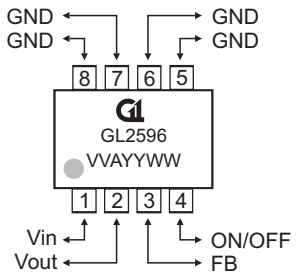

**TO-263-5(D²PAK)**




**TO-263-5P(TD2P-5)**




**SOP- 8F**




V V / VVV= Output Voltage
(33=3.3V , 120=12V, A=Adj)
A = Assembly Location
YY = Year
W W = Weekly

## ◆ ORDERING INFORMATION (Green Package Products are available now!)

| Ordering Number | Output Voltage | Package | Shipping |
|---|---|---|---|
| GL2596-ASF8DR | Adj | SOP-8FD | 2500 Units / Reel |
| GL2596-ATA5R | Adj | TO-263-5 | 800 Units/ Tape & Reel |
| GL2596-ATA5PR | Adj | TD2P-5 | 800 Units/ Tape & Reel |
| GL2596-ATB5T | Adj | TO-220-5 | 50 Units / Tube |
| GL2596-3.3SF8DR | 3.3 | SOP-8FD | 2500 Units / Ree |
| GL2596-3.3TA5R | 3.3 | TO-263-5 | 800 Units/ Tape & Reel |
| GL2596-3.3TA5PR | 3.3 | TD2P-5 | 800 Units/ Tape & Reel |
| GL2596-3.3TB5T | 3.3 | TO-220-5 | 50 Units / Tube |
| GL2596-5.0SF8DR | 5.0 | SOP-8FD | 2500 Units / Ree |
| GL2596-5.0TA5R | 5.0 | TO-263-5 | 800 Units/ Tape & Reel |
| GL2596-5.0TA5PR | 5.0 | TD2P-5 | 800 Units/ Tape & Reel |
| GL2596-5.0TB5T | 5.0 | TO-220-5 | 50 Units / Tube |
| GL2596-12SF8DR | 12 | SOP-8FD | 2500 Units / Ree |
| GL2596-12TA5R | 12 | TO-263-5 | 800 Units/ Tape & Reel |
| GL2596-12TA5PR | 12 | TD2P-5 | 800 Units/ Tape & Reel |
| GL2596-12TB5T | 12 | TO-220-5 | 50 Units / Tube |

* For detail Ordering Number identification, please see last page.

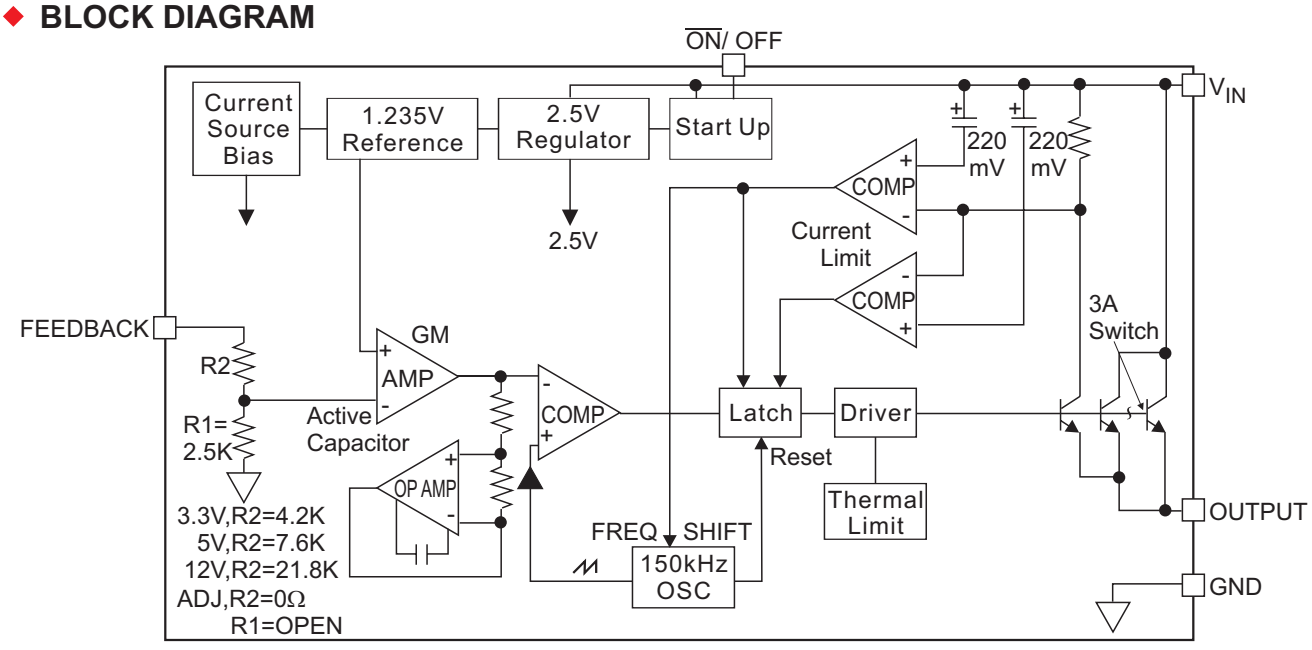
## ◆ ABSOLUTE MAXIMUM RATINGS

| Rating | Value | Unit |
|---|---|---|
| Maximum Supply Voltage | 45 | V |
| $\overline{ON}$/OFF Pin Input Voltage/ Feed back pin voltage | -0.3 ≤ V ≤ +25 | V |
| Output Voltage to Ground (Steady State) | -0.9 | V |
| Power Dissipation | Internally Limited | - |
| Storage Temperature Range | -65 to + 150 | °C |
| Maximum Junction Temperature | +150 | °C |
| Minimum ESD Rating (C=100pF, R=1.5kΩ) | 2 | kV |
| Lead Temperature (Soldering, 10 sec.) | +260 | °C |
| Lead Temperature<br>S Package<br>Vapor Phase (60 secretary.)<br>Infrared (10 secretary.)<br>T Package (Soldering, 10 secretary.)<br>Maximum Junction Temperature | <br><br>+215<br>+245<br>+260<br>+150 | °C |

## ◆ OPERATING CONDITIONS

| Rating | Value | Unit |
|---|---|---|
| Temperature Range | - 40 ≤ $T_J$ ≤+125 | °C |
| Supply Voltage | 4.5 to 40 | V |

## ◆ BLOCK DIAGRAM



## ELECTRICAL CHARACTERISTICS: GL2596-3.3

(Specifcations with standard type face are for $T_J$ = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | 4.75 ≤ $V_{IN}$≤40V, 0.2A≤ $I_{LOAD}$≤3A | $V_{OUT}$ | 3.168/**3.135** | 3.3 | 3.432/**3.465** | V |
| Efficiency | $V_{IN}$ = 12V, $I_{LOAD}$ = 3.0A | η | - | 73 | - | % |

## ELECTRICAL CHARACTERISTICS: GL2596-5.0

(Specifcations with standard type face are for $T_J$ = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | 7V ≤ $V_{IN}$ ≤ 40V, 0.2A ≤ $I_{LOAD}$≤3A | $V_{OUT}$ | 4.800/**4.750** | 5.0 | 5.200/**5.250** | V |
| Efficiency | $V_{IN}$ = 12V, $I_{LOAD}$ = 3.0A | η | - | 80 | - | % |

## ELECTRICAL CHARACTERISTICS: GL2596-12

(Specifcations with standard type face are for $T_J$ = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Output Voltage | 15V ≤ $V_{IN}$ ≤ 40V, 0.2A ≤ $I_{LOAD}$≤3A | $V_{OUT}$ | 11.52/**11.40** | 12.0 | 12.48/**12.60** | V |
| Efficiency | $V_{IN}$ = 15V, $I_{LOAD}$ = 3.0A | η | - | 90 | - | % |

## ELECTRICAL CHARACTERISTICS: GL2596-ADJ

(Specifcations with standard type face are for $T_J$ = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

| Parameter | Conditions ≤ | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Feedback Voltage | 4.5V ≤ $V_{IN}$ ≤ 40V, 0.2A≤ $I_{LOAD}$≤3A<br>$V_{OUT}$ = 3V | $V_{OUT}$ | 1.193/**1.180** | 1.230 | 1.267/**1.280** | V |
| Efficiency | $V_{IN}$ = 12V, $I_{LOAD}$ = 3A, $V_{OUT}$=3V | η | - | 73 | - | % |

## ◆ ELECTRICAL CHARACTERISTICS: All Output Voltage Versions

(Specifications with standard type face are for $T_J$ = 25°C, and those with **boldface type** apply over full Operating Temperature Range.
Unless otherwise specified, $V_{IN}$= 12V for the 3.3V, 5.0V and ADJ version and $V_{IN}$= 24V for 12V version. $I_{LOAD}$ = 500 mA)

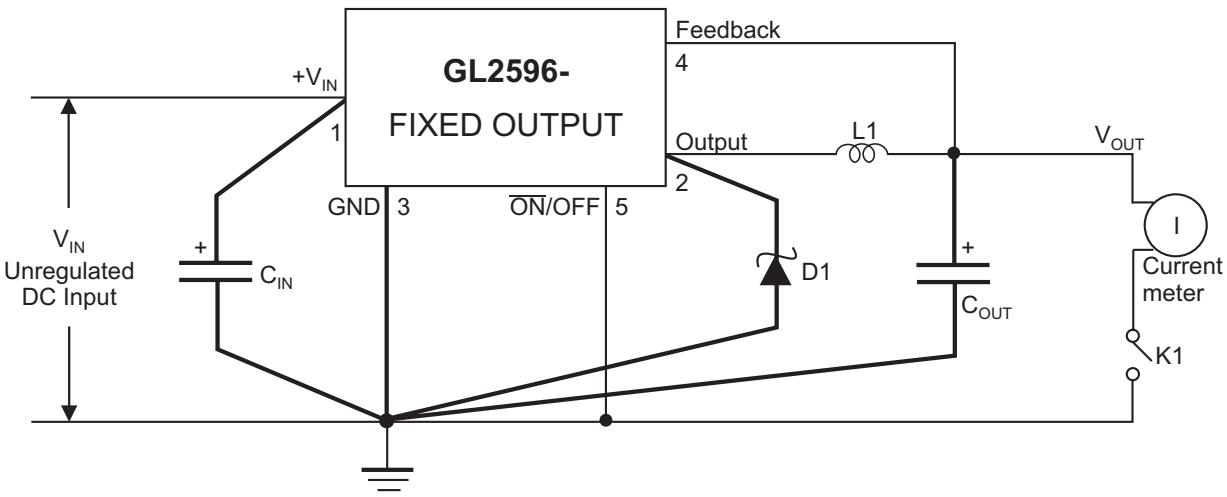
| Parameter | Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Feedback Bias Current | $V_{FB}$ = 1.3V (Adjustable Version Only) | $I_b$ | - | 15 | 50 / **100** | nA |
| Oscillator Frequency | (Note 6) | $f_o$ | 127/**110** | 150 | 173 / **173** | kHz |
| Saturation Voltage | $I_{OUT}$ = 3A (Notes 7, 8) | $V_{SAT}$ | - | 1.16 | 1.4 / **1.5** | V |
| Max Duty Cycle (ON) | (Note 8) | DC | | 100 | - | % |
| Min Duty Cycle (OFF) | (Note 9) | DC | | 0 | - | % |
| Current Limit | Peak Current (Notes 7, 8) | $I_{CL}$ | 3.4 | 4.5 | 6.0 | A |
| Output Leakage Current | (Notes 7, 9, 10) Output = 0 V | $I_L$ | - | - | 50 | μA |
| | (Notes 10) Output = -0.9V | | - | 2 | 30 | mA |
| Quiescent Current | (Note 9) | $I_Q$ | - | 5 | 10 | mA |
| Standby Quiescent Current | $\overline{ON}$/OFF Pin = 5V (OFF) (Note 10) | $I_{STBY}$ | - | 100 | 200 / **250** | μA |
| Thermal Resistance | TO-263 Package, Junction to Ambient (Note 11) | $\theta_{JA}$ | - | 50 | - | °C/W |
| | TO-263 Package, Junction to Ambient (Note 12) | $\theta_{JA}$ | - | 30 | - | |
| | TO-263 Package, Junction to Ambient (Note 13) | $\theta_{JA}$ | - | 20 | - | |
| $\overline{ON}$/OFF Pin Logic Input Level | Low (ON) | $V_{IH}$ | - | 1.3 | **0.6** | V |
| | High (OFF) | $V_{IL}$ | **2.0** | 1.3 | - | V |
| $\overline{ON}$/OFF Pin Input Current | $V_{LOGIC}$ = 2.5V (OFF) | $I_H$ | - | 5 | 15 | μA |
| | $V_{LOGIC}$ = 0.5V (ON) | $I_L$ | - | 0.02 | 5 | μA |

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.
**Note 2:** The human body model is a 100 pF capacitor discharged through a 1.5k resistor into each pin.
**Note 3:** Typical numbers are at 25°C and represent the most likely norm.
**Note 4:** All limits guaranteed at room temperature (stand are type face) and at temperature extremes (bold type face). All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).
**Note 5:** External components such as the catch diode, inductor, input and output capacitors, and voltage programming resistors can affect switching regulator system performance. When the GL2596 is used as shown in the Figure 1 test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.
**Note 6:** The switching frequency is reduced when the second stage current limit is activated.
**Note 7:** No diode, inductor or capacitor connected to out put pin.
**Note 8:** Feedback pin removed from output and connected to 0V to force the output transistor switch ON.
**Note 9:** Feedback pin removed from output and connected to 12V for the 3.3V, 5V, and the ADJ. version, and 15V for the 12V version, to force the output transistor switch OFF.
**Note 10:** $V_{IN}$ = 40V.
**Note 11:** Junction to ambient thermal resistance with the TO-263 package tab soldered to a single printed circuit board with 0.5 $in^2$ of (1 oz.) copper area.
**Note 12:** Junction to ambient thermal resistance with the TO-263 package tab soldered to a single sided printed circuit board with 2.5 $in^2$ of (1 oz.) copper area.
**Note 13:** Junction to ambient thermal resistance with the TO-263 package tab soldered to a double sided printed circuit board with 3 $in^2$ of (1 oz.) copper area on GL2596 side of the board, and approximately 16 $in^2$ of copper on the other side of the p-c board.

## ◆ TEST CIRCUIT AND LAYOUT GUIDELINES

Careful layout is important with any switching regulator. Rapidly switching currents associated with wiring inductance generate voltage transients which can cause problems. To minimize inductance and ground loops, the lengths of the leads indicated by heavy lines in Figure 1 below should be kept as short as possible. Single-point grounding (as indicated in Figure 1) or ground plane construction should be used for best results. When using the Adjustable version, place the programming resistors as close as possible to GL2596, to keep the sensitive feedback wiring short.

**Figure 1(a). Fixed Output Voltage Versions**



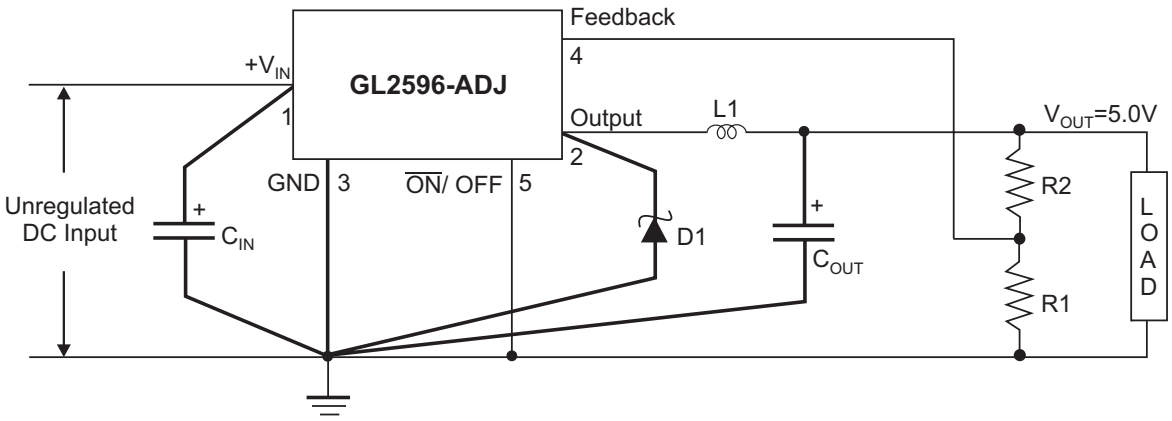

$C_{IN}$ - 470μF, 50V, Aluminum Electrolytic

$C_{OUT}$ - 220μF, 25V, Aluminum Electrolytic

D1 - 5A, 40V Schottky

L1 - 68μH, 3L Electronic Corp.TC-680M-3A-5026

**Figure 1(b). Adjustable Output Voltage Versions**




$$V_{OUT} = V_{REF} \left( 1 + \frac{R_2}{R_1} \right)$$

$$R_2 = R_1 \left( \frac{V_{OUT}}{V_{REF}} - 1 \right)$$

where $V_{REF}$ = 1.23V, $R_1$ aproximetly 1kΩ, 1%

$C_{IN}$ - 470μF, 50V , Aluminum Electrolytic

$C_{OUT}$ - 220μF, 25V, Aluminum Electrolytic

D1 - 5A, 40V Schottky

L1 - 68μH, 3L Electronic Corp. TC-680M-3A-5026

R1 - 1kΩ, 1%

$V_{OUT}$ = 5V, R2 = 3.06kΩ, 1%

## ◆ Typical Performance Characteristics

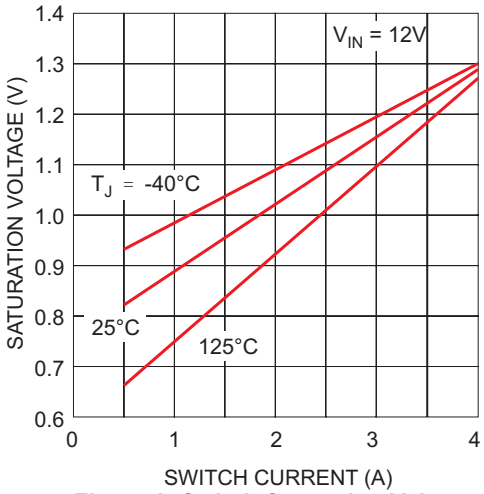



**Figure 2. Switch Saturation Voltage**

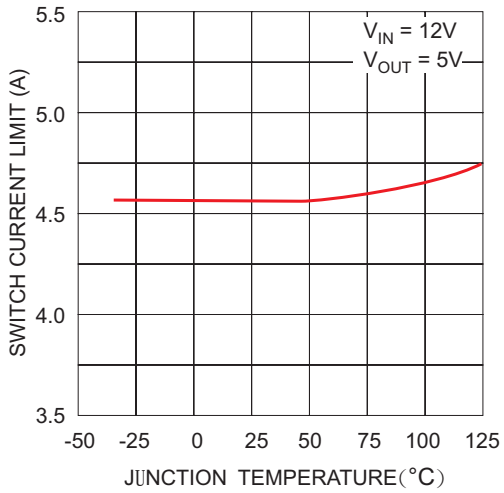



**Figure 3. Switch Current Limit**

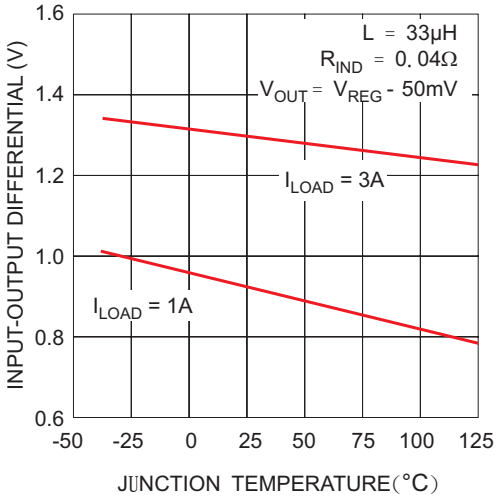



**Figure 4. Dropout Voltage**

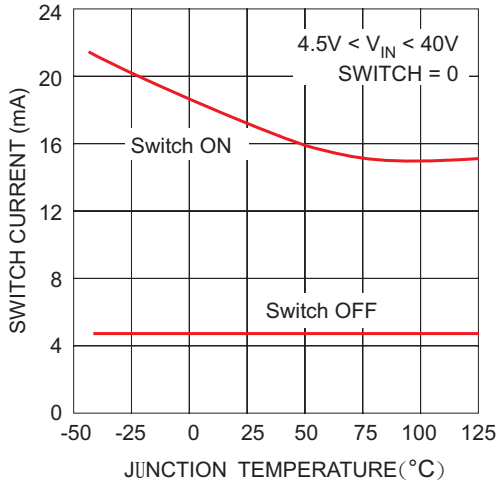



**Figure 5. Operating Quiescent Current**

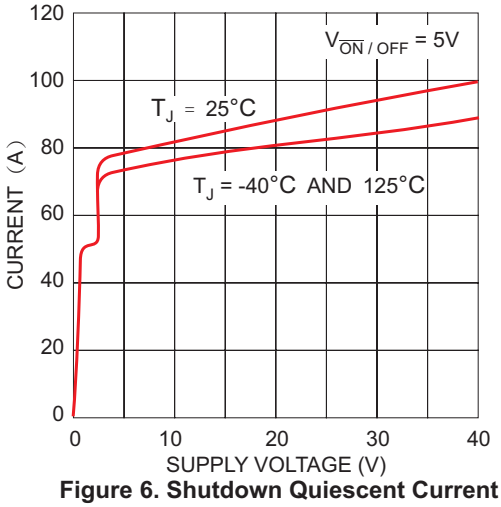



**Figure 6. Shutdown Quiescent Current**

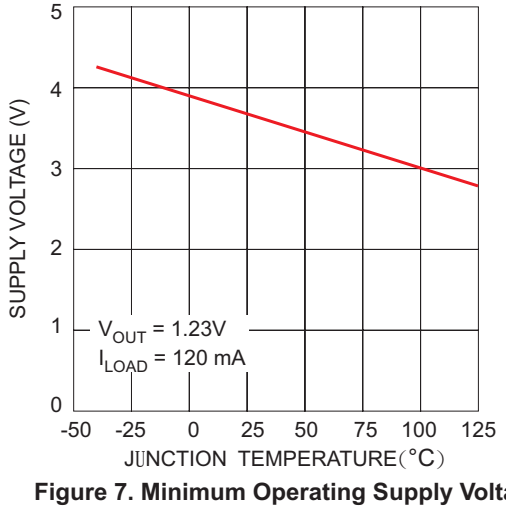



**Figure 7. Minimum Operating Supply Voltage**

## Typical Performance Characteristics

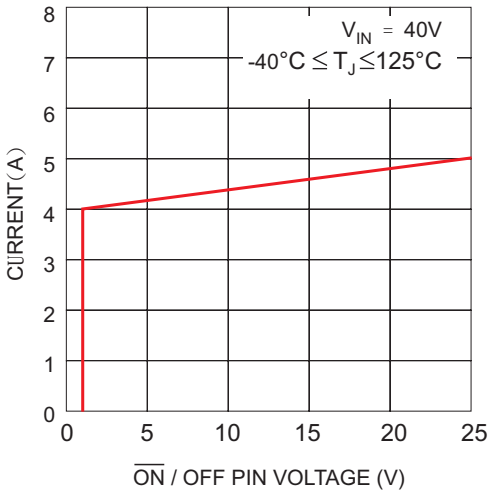



Figure 8. $\overline{ON}$ / OFF Pin Current (Sinking)

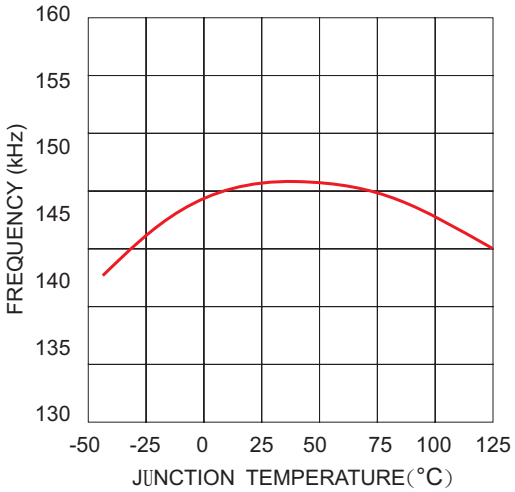
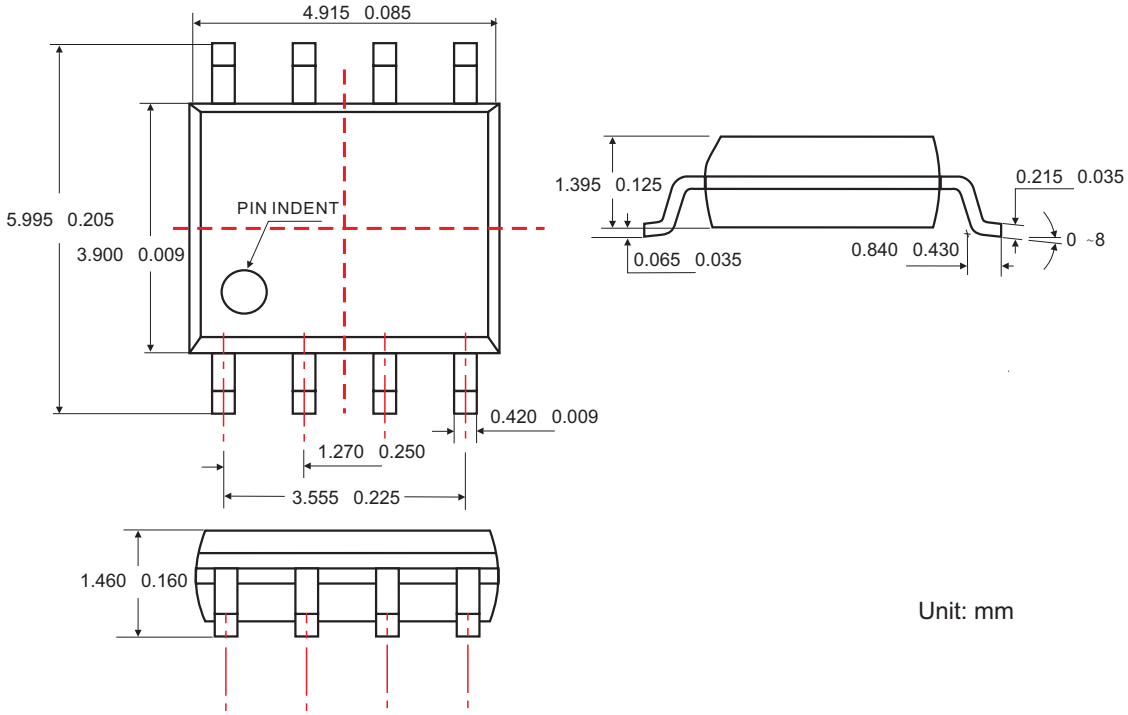


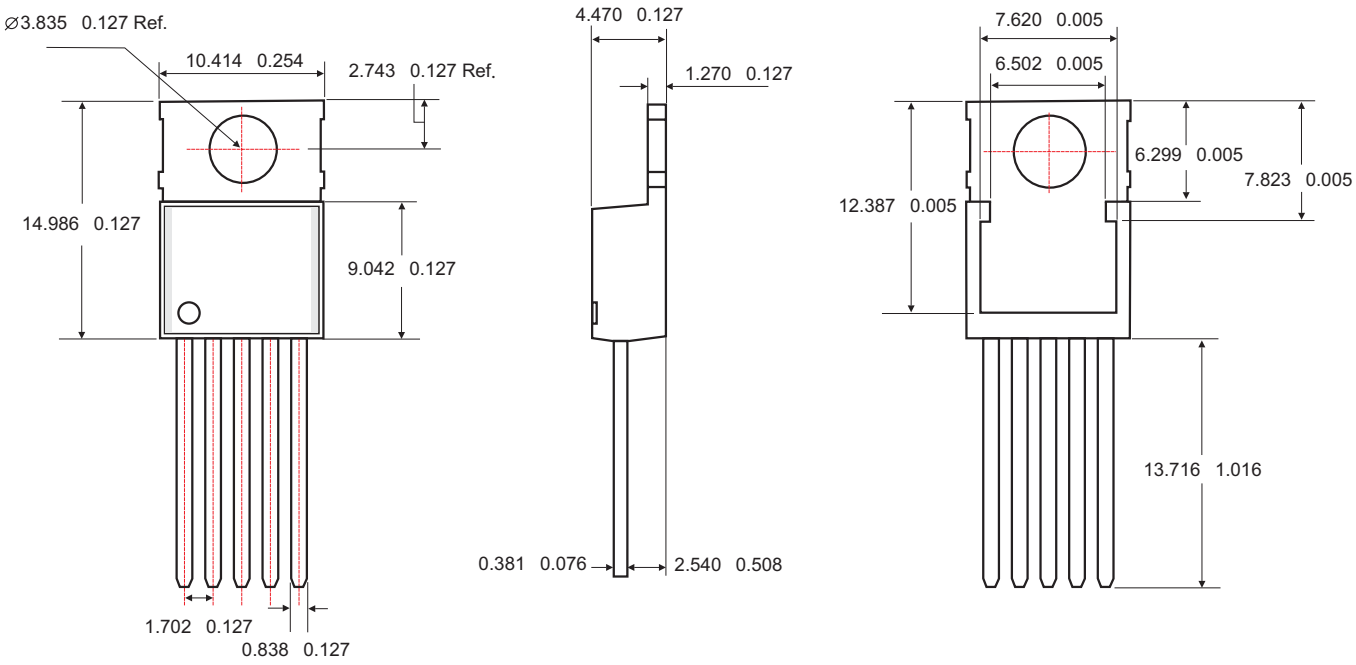

Figure 9. Switching Frequency

## SOP-8FD PACKAGE OUTLINE DIMENSIONS



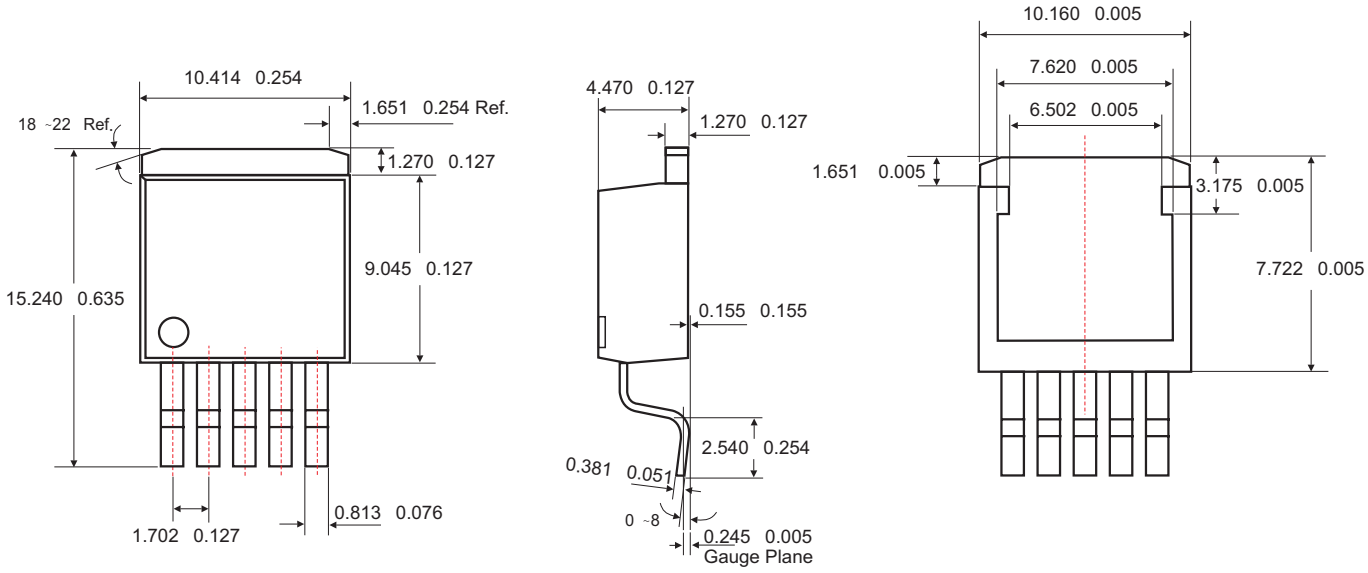

Unit: mm

## TO-220-5 PACKAGE OUTLINE DIMENSIONS



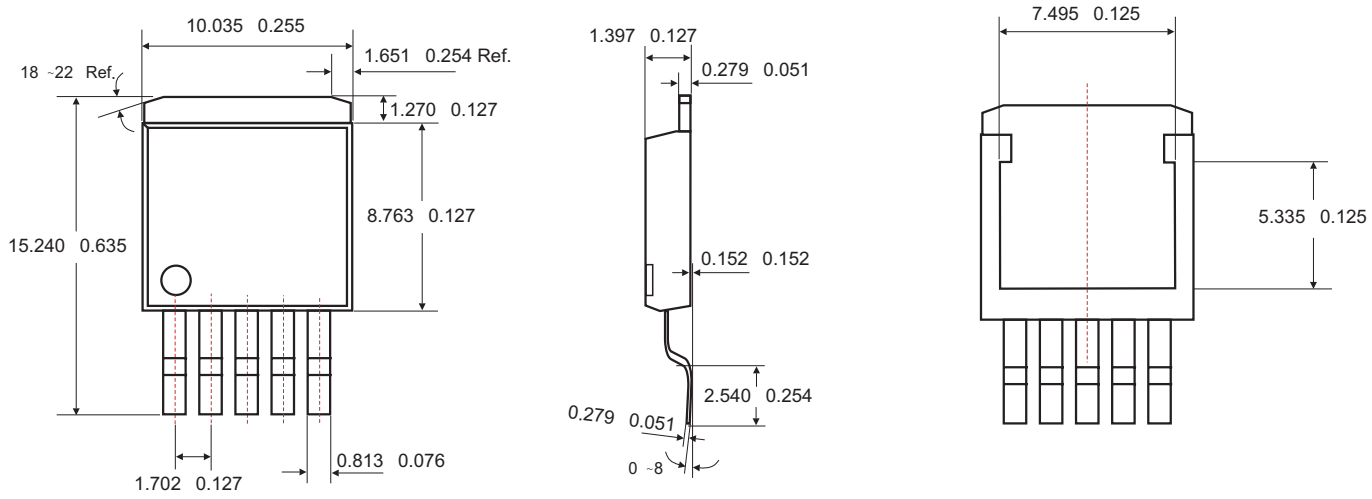

Unit: mm

## TO-263-5 PACKAGE OUTLINE DIMENSIONS




Unit: mm

## TD2P-5 PACKAGE OUTLINE DIMENSIONS




Unit: mm

## ORDERING NUMBER

**GL2596 A TB5 T**

- GL2596 → Circuit Type
- A → Output Voltage
- TB5 → Package
  - TA5: TO-263-5
  - TA5P: TD2P-5
  - TB5: TO-220-5
  - SF8D: SOP-8FD
- T → Shipping
  - R: Tape & Reel
  - T: Tube