



1.5A STEP-DOWN VOLTAGE REGULATOR

Description

GL2594 of regulators provides all the active functions for a step-down (buck) switching regulator, and drives 1.5A load with excellent line and load regulation. GL2594'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 GL2594 is high-efficiency replacements for popular three-terminal linear regulators, and is requiring a smaller heatsink or even no heatsink.

GL2594 performs well with standard inductors from several manufacturers, and simplifying the design of switch-mode power supplies. GL2594 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.

GL2594 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 standard SOP-8F surface mount package.

Features

- ◆ 3.3V, 5V, 12V and Adjustable output versions
- ◆ Adjustable version output voltage range 1.23V to 37V \pm 4% max over line and load conditions
- ◆ 1.5A 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 μ A
- ◆ Thermal shutdown, current limit protection
- ◆ Uses standard inductors
- ◆ 150 kHz fixed frequency internal oscillator

Application

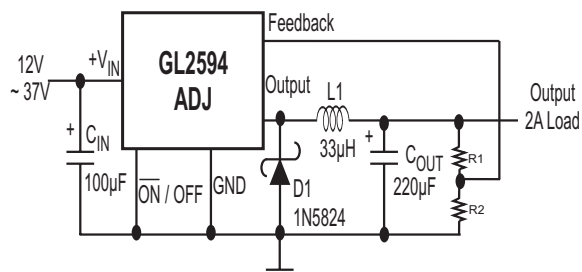
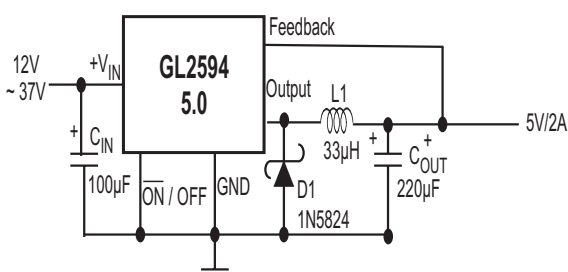
Pre-regulator for linear regulators

On-card/board switching regulators

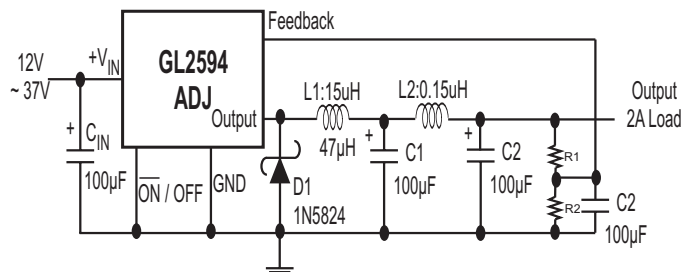
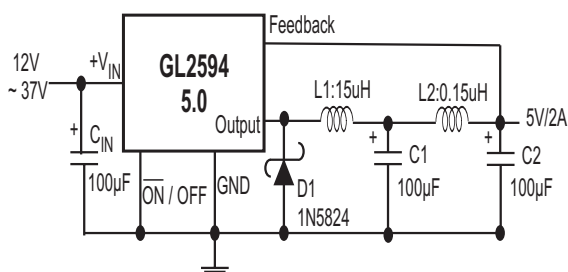
High-efficiency step-down buck regulator

Positive to negative converter (buck-boost)

TYPICAL APPLICATIONS



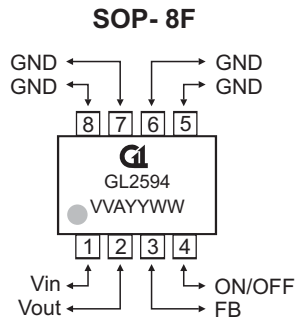
Low Noise APPLICATIONS





1.5A STEP-DOWN VOLTAGE REGULATOR

◆ MARKING INFORMATION & PIN CONFIGURATIONS



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

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

Ordering Number	Output Voltage	Package	Shipping
GL2594-ASF8R	A d j	SOP-8F	2,500 Units/ Tape & Reel
GL2594-3.3SF8R	3.3	SOP-8F	2,500 Units/ Tape & Reel
GL2594-5.0SF8R	5.0	SOP-8F	2,500 Units/ Tape & Reel
GL2594-12SF8R	12	SOP-8F	2,500 Units/ Tape & Reel
GL2594-15SF8R	15	SOP-8F	2,500 Units/ Tape & Reel

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

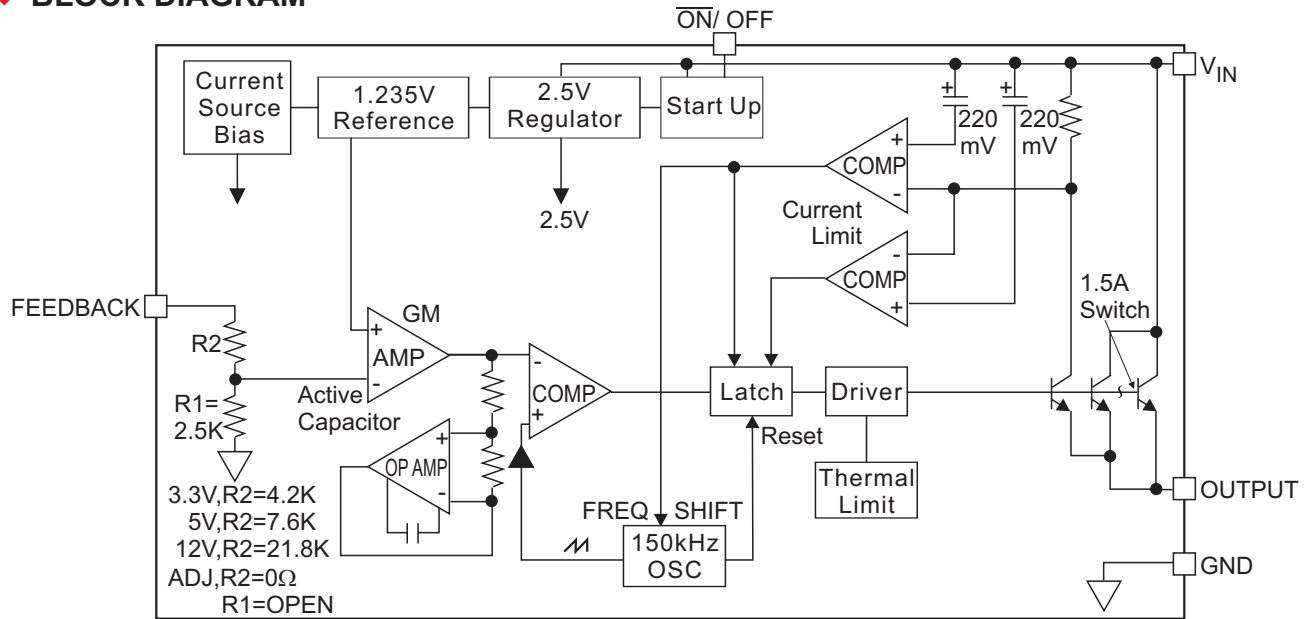
◆ ABSOLUTE MAXIMUM RATINGS

Rating	Value	Unit
Maximum Supply Voltage	45	V
ON/OFF Pin Input Voltage/ Feed back pin voltage	$-0.3 \leq V \leq +25$	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 S Package Vapor Phase (60 secretary.) Infrared (10 secretary.) T Package (Soldering, 10 secretary.) Maximum Junction Temperature	+215 +245 +260 +150	°C

◆ OPERATING CONDITIONS

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

◆ BLOCK DIAGRAM



◆ ELECTRICAL CHARACTERISTICS: GL2594-3.3

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	$4.75 \leq V_{IN} \leq 40\text{V}$, $0.2\text{A} \leq I_{LOAD} \leq 1.5\text{A}$	V_{OUT}	3.168/ 3.135	3.3	3.432/ 3.465	V
Efficiency	$V_{IN} = 12\text{V}$, $I_{LOAD} = 1.5\text{A}$	η	-	73	-	%

◆ ELECTRICAL CHARACTERISTICS: GL2594-5.0

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	$7\text{V} \leq V_{IN} \leq 40\text{V}$, $0.2\text{A} \leq I_{LOAD} \leq 1.5\text{A}$	V_{OUT}	4.800/ 4.750	5.0	5.200/ 5.250	V
Efficiency	$V_{IN} = 12\text{V}$, $I_{LOAD} = 1.5\text{A}$	η	-	80	-	%

◆ ELECTRICAL CHARACTERISTICS: GL2594-12

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	$15\text{V} \leq V_{IN} \leq 40\text{V}$, $0.2\text{A} \leq I_{LOAD} \leq 1.5\text{A}$	V_{OUT}	11.52/ 11.40	12.0	12.48/ 12.60	V
Efficiency	$V_{IN} = 15\text{V}$, $I_{LOAD} = 1.5\text{A}$	η	-	90	-	%



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**ELECTRICAL CHARACTERISTICS: GL2594-ADJ**

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions \leq	Symbol	Min	Typ	Max	Unit
Feedback Voltage	$4.5\text{V} \leq V_{\text{IN}} \leq 40\text{V}$, $0.2\text{A} \leq I_{\text{LOAD}} \leq 1.5\text{A}$ $V_{\text{OUT}} = 3\text{V}$	V_{OUT}	1.193/ 1.180	1.230	1.267/ 1.280	V
Efficiency	$V_{\text{IN}} = 12\text{V}$, $I_{\text{LOAD}} = 1.5\text{A}$, $V_{\text{OUT}} = 3\text{V}$	η	-	73	-	%

ELECTRICAL CHARACTERISTICS: All Output Voltage Versions

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

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Feedback Bias Current	$V_{\text{FB}} = 1.3\text{V}$ (Adjustable Version Only)	I_b	-	15	50 / 100	nA
Oscillator Frequency	(Note 6)	f_o	127/ 110	150	173 / 173	kHz
Saturation Voltage	$I_{\text{OUT}} = 1.5\text{A}$ (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	$\overline{\text{ON}}/\text{OFF}$ Pin = 5V (OFF) (Note 10)	I_{STBY}	-	100	200 / 250	μA
$\overline{\text{ON}}/\text{OFF}$ Pin	Low (ON)	V_{IH}	-	1.3	0.6	V
Logic Input Level	High (OFF)	V_{IL}	2.0	1.3	-	V
$\overline{\text{ON}}/\text{OFF}$ Pin Input Current	$V_{\text{LOGIC}} = 2.5\text{V}$ (OFF)	I_H	-	5	15	μA
	$V_{\text{LOGIC}} = 0.5\text{V}$ (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 GL2594 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.

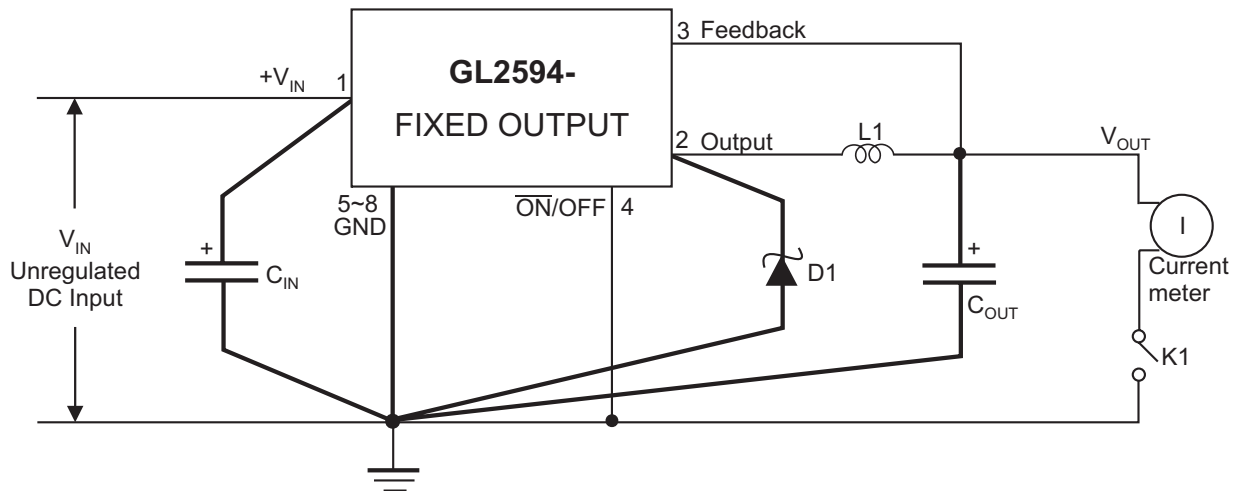
Note 10: $V_{\text{IN}} = 40\text{V}$.

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♦ 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 GL2594, to keep the sensitive feedback wiring short.

Figure 1(a). Fixed Output Voltage Versions



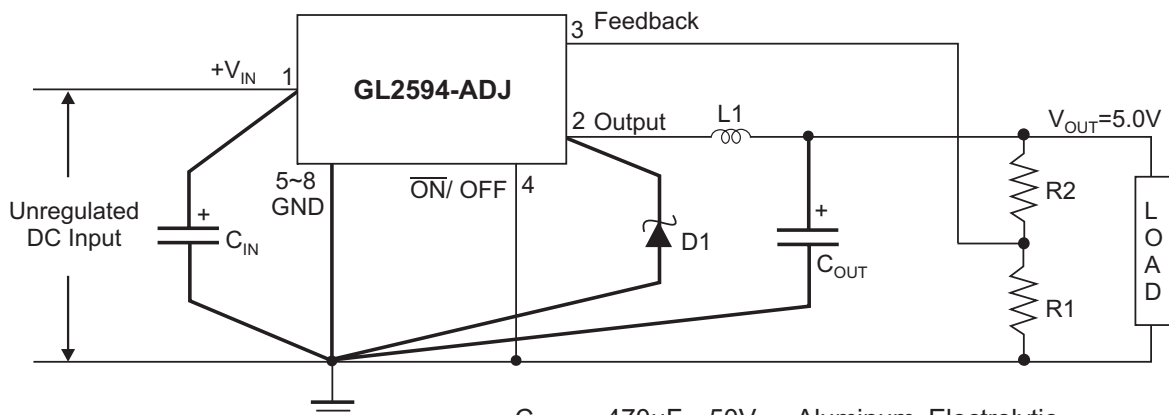
C_{IN} - 470 μ F, 50V, Aluminum Electrolytic

C_{OUT} - 220 μ F, 25V, Aluminum Electrolytic

D1 - 2A, 40V Schottky

L1 - 33 μ H, 3L Electronic Corp. TC-680M-2A-5026

Figure 1(b). Adjustable Output Voltage Versions



C_{IN} - 470 μ F, 50V, Aluminum Electrolytic

C_{OUT} - 220 μ F, 25V, Aluminum Electrolytic

D1 - 2A, 40V Schottky

L1 - 33 μ H, 3L Electronic Corp. TC-680M-2A-5026

R1 - 1k Ω , 1%

V_{OUT} = 5V, R2 = 3.06k Ω , 1%

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

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

where V_{REF} = 1.23V, R_1 approximately 1k Ω , 1%

◆ Typical Performance Characteristics

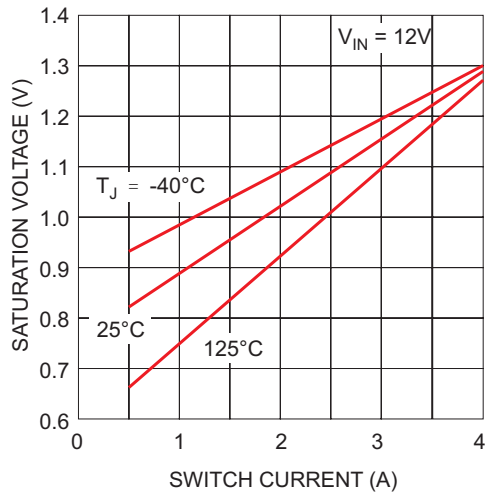


Figure 2. Switch Saturation Voltage

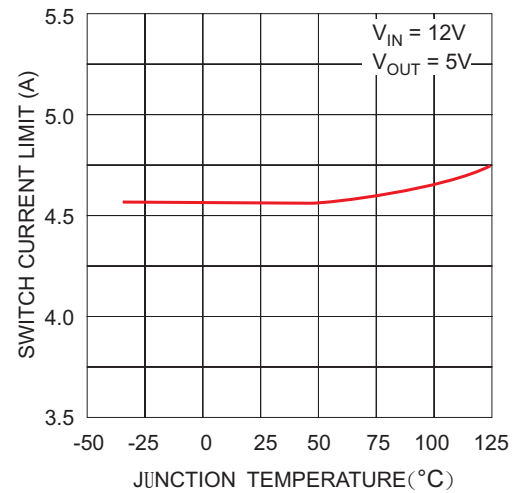


Figure 3. Switch Current Limit

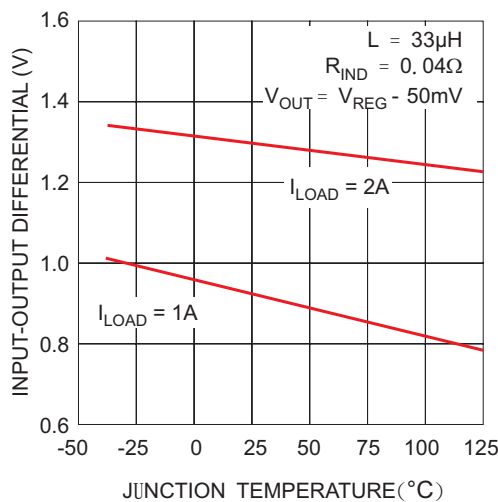


Figure 4. Dropout Voltage

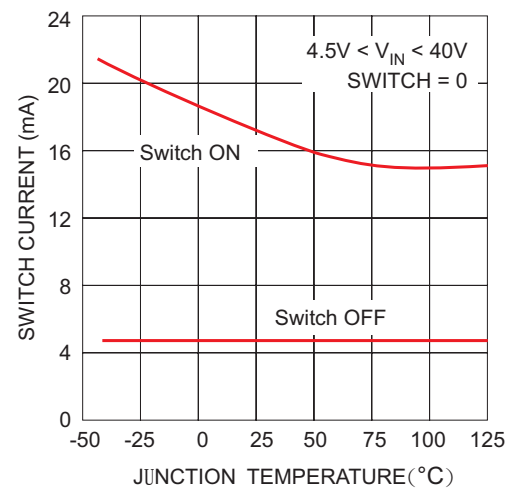


Figure 5. Operating Quiescent Current

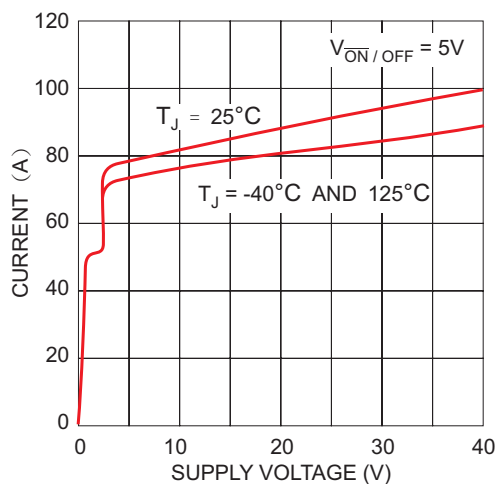


Figure 6. Shutdown Quiescent Current

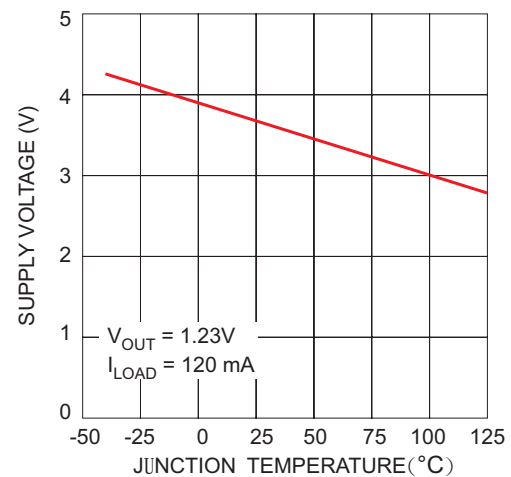


Figure 7. Minimum Operating Supply Voltage

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◆ Typical Performance Characteristics

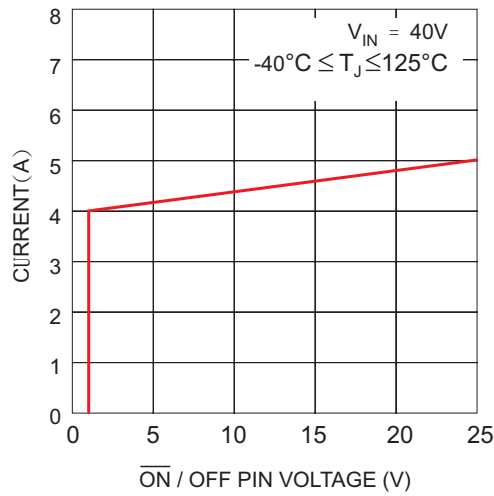


Figure 8. \overline{ON} / OFF Pin Current (Sinking)

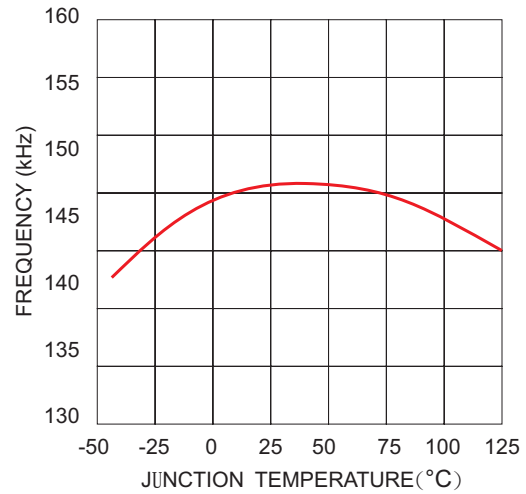
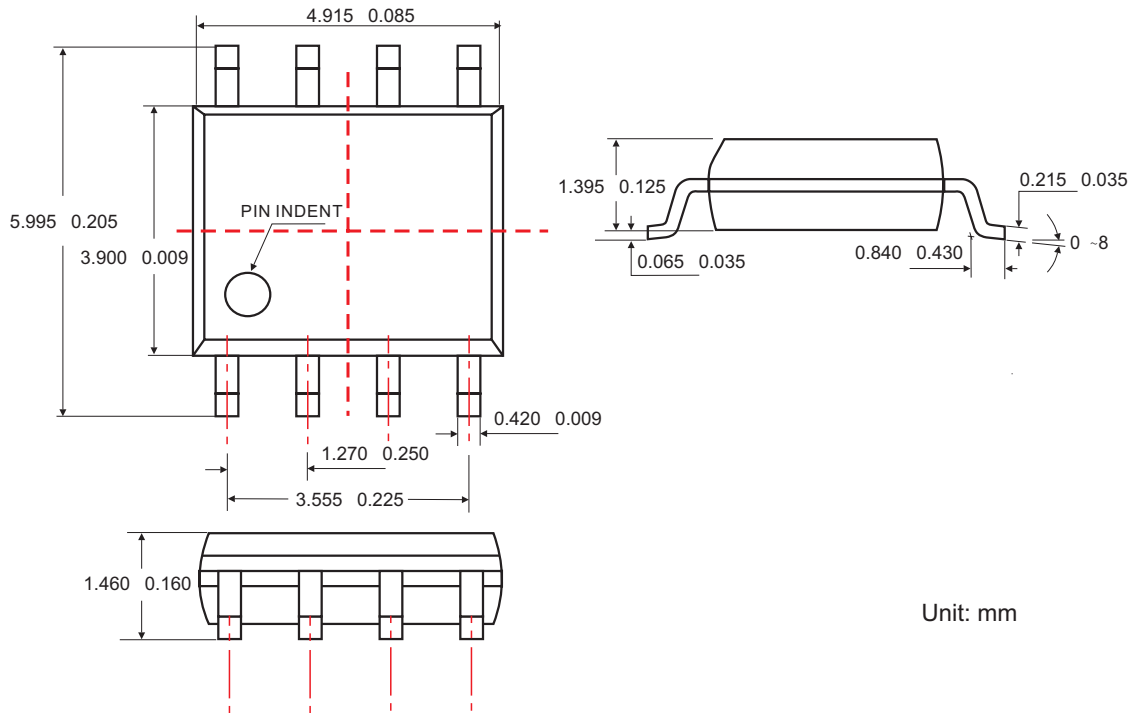


Figure 9. Switching Frequency

◆ SOP-8F PACKAGE OUTLINE DIMENSIONS



Unit: mm

◆ ORDERING NUMBER

GL2594 A SF8 T

Circuit Type

Output Voltage

Shipping
R: Tape & Reel
T: Tube

Package
SF8:SOP-8F