

# GS5582

## 1.0MHz, 2A Synchronous Step-Down Converter

### Product Description

The GS5582 is a 1.0MHz constant frequency, current mode step-down converter. It is ideal for portable equipment requiring very high current up to 2A from single-cell Lithium-ion batteries while still achieving over 90% efficiency during peak load conditions.

The GS5582 also can run at 100% duty cycle for low dropout operation, extending battery life in portable systems while light load operation provides very low output ripple for noise sensitive applications.

The GS5582 can supply up to 2A output load current from a 2.6V to 6.5V input voltage and the output voltage can be regulated as low as 0.6V. The high switching frequency minimizes the size of external components while keeping switching losses low.

This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

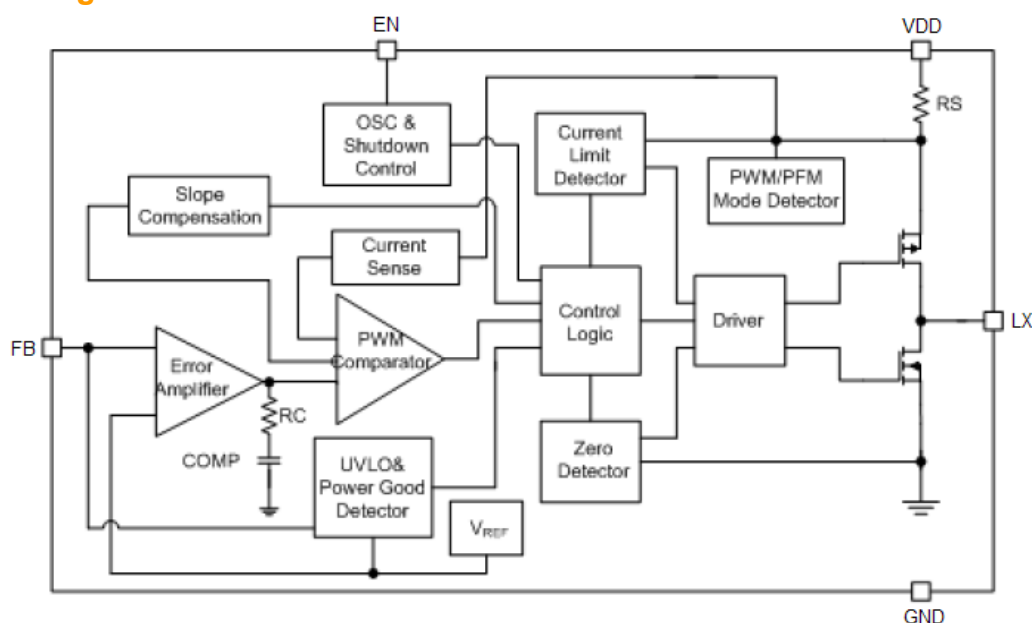
### Features

- High Efficiency: Up to 96%
- 1.0MHz Constant Frequency Operation
- 2A Output Current
- No Schottky Diode Required
- 2.6V to 6.5V Input Voltage Range
- Output Voltage as Low as 0.6V
- PFM Mode for High Efficiency in Light Load
- 100% Duty Cycle in Dropout Operation
- Low Quiescent Current: 40uA
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- <1.0uA Shutdown Current
- Tiny SOT23-5L, SOT23-6L and DFN2x2-6L Packages
- RoHS Compliant, 100%Pb & Halogen Free

### Applications

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDAs
- Portable Instruments
- Digital Still and Video Cameras
- PC Cards

### Block Diagram



## Packages & Pin Assignments

<p><b>GS5582LAF(SOT23-5L)</b></p> <p>(Top View)</p>	<p><b>GS5582LBF(SOT23-5L)</b></p> <p>(Top View)</p>
<p><b>GS5582RF(SOT23-6L)</b></p> <p>(Top View)</p>	<p><b>GS5582FAF(DFN2x2-6L)</b></p> <p>(Top View)</p>
Pin Name	Description
EN	Chip Enable Pin. Drive EN above 1.5V to turn on the part. Drive EN below 0.3V to turn it off. Do not leave EN floating.
GND	Analog ground pin.
LX	Power Switch Output. It is the switch node connection to Inductor. This pin connects to the drains of the internal P-ch and N-ch MOSFET switches.
V <sub>IN</sub>	Analog supply input pin.
NC	No connected.
FB	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage.

## Typical Application Circuit

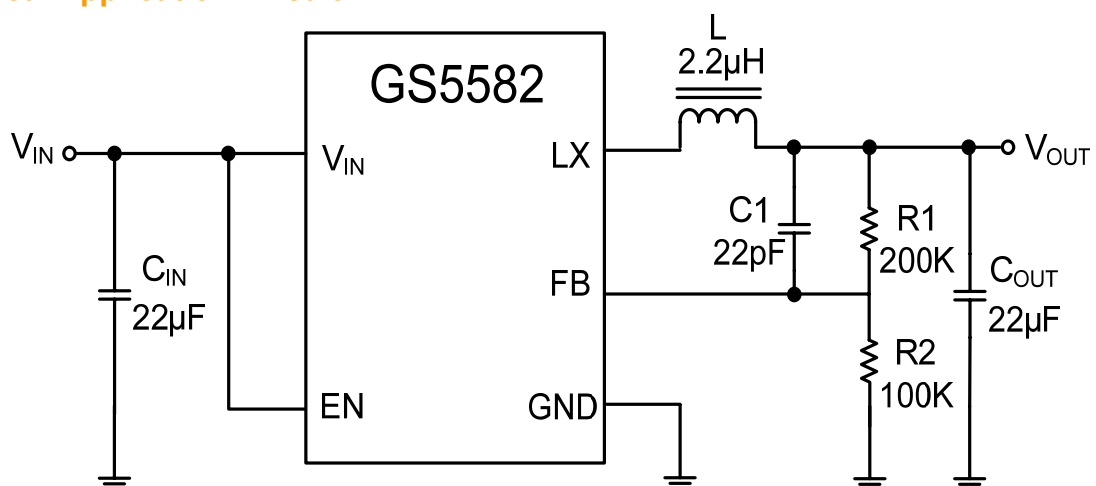
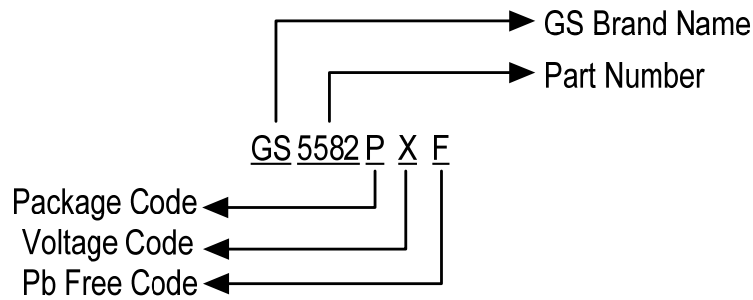


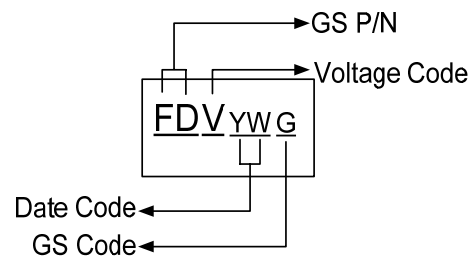
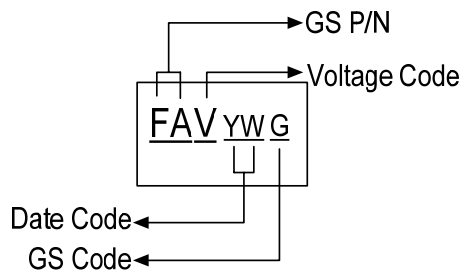
Figure1. GS5582 Adjustable Output Voltage Regulator

## Ordering Information



Part Number	Temperature Range	Output Voltage	Package
GS5582LAF	-40°C to 85°C	ADJ	SOT23-5L
GS5582LBF	-40°C to 85°C	ADJ	SOT23-5L
GS5582RF	-40°C to 85°C	ADJ	SOT23-6L
GS5582FAF	-40°C to 85°C	ADJ	DFN2x2-6L

## Marking Information



Part Number	Package	GS P/N	Voltage Code	Date Code
GS5582LAF	SOT23-5L	FA	A	YW
GS5582LBF	SOT23-5L	FA	B	YW
GS5582RF	SOT23-6L	FD	A	YW
GS5582FAF	DFN2x2-6L	FA	A	YW

## Absolute Maximum Ratings (Note 1)

Symbol	Description	Value	Units
$V_{IN}$	Input Supply Voltage	-0.3 to 7.0	V
	EN,FB Voltages	-0.3 to ( $V_{IN}+0.3$ )	V
$V_{LX}$	LX Voltage	-0.3 to ( $V_{IN}+0.3$ )	V
$T_A$	Operating Temperature Range	-40 to +85	°C
$T_{STG}$	Storage Temperature Range	-65 to +150	°C
$T_{LEAD}$	Lead Temperature(Soldering,10s)	+300	°C
$\theta_{JA}$	Thermal Resistance Junction to Ambient	SOT23-5L	250
		SOT23-6L	250
		DFN2x2-6L	130

### Electrical Characteristics (Note 3)

$V_{IN}=V_{EN}=3.6V$ ,  $V_{OUT}=1.8V$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{IN}$	Input Voltage	-	2.6	-	6.5	V
$V_{UVLO}$	UVLO Threshold	$V_{IN}$ Rising			2.5	V
$I_Q$	Input DC Supply Current	$I_{LOAD}=0mA$ (Note 4)	-	40	75	$\mu A$
$I_{SHDN}$	Input DC Supply Current (Shutdown Mode)	$V_{EN}=0V$ , $V_{IN}=4.2V$ (Note 4)	-	0.1	1.0	
$V_{FB}$	Regulated Feedback Voltage	$T_A=25^\circ C$	0.588	0.600	0.612	V
		$0^\circ C \leq T_A \leq 85^\circ C$	0.586	0.600	0.613	
		$-40^\circ C \leq T_A \leq 85^\circ C$	0.585	0.600	0.615	
$V_{EN}$	EN Threshold	-	0.3	1.0	1.5	V
$I_{EN}$	EN Leakage Current	-	-	$\pm 0.01$	$\pm 1.0$	$\mu A$
$I_{LX}$	LX Leakage Current	$V_{EN}=0V, V_{IN}=V_{LX}=5V$	-	$\pm 0.01$	$\pm 1.0$	$\mu A$
$R_{DS(ON)H}$	On Resistance of PMOS	$I_{LX}=100mA$	-	100	150	m $\Omega$
$R_{DS(ON)L}$	ON Resistance of NMOS		-	90	150	
$I_{PK}$	Peak Current Limit	-	-	3.5	-	A
$REG_{LINE}$	Output Voltage Line Regulation	$V_{IN}=2.6V$ to $5.5V$	-	0.1	-	%/V
$V_{OUT}$	Output Voltage Accuracy	$V_{IN}=2.6V$ to $5.5V$ , $I_{OUT}=10mA$ to $2000mA$	-3	-	+3	% $V_{OUT}$
$REG_{LOAD}$	Output Voltage Load Regulation	$I_{OUT}=10mA$ to $2000mA$	-	0.2	-	%/A
$F_{OSC}$	Oscillation Frequency	$V_{OUT}=100\%, V_{OUT}=0V$	1.0	-	-	MHz
			-	300	-	KHz

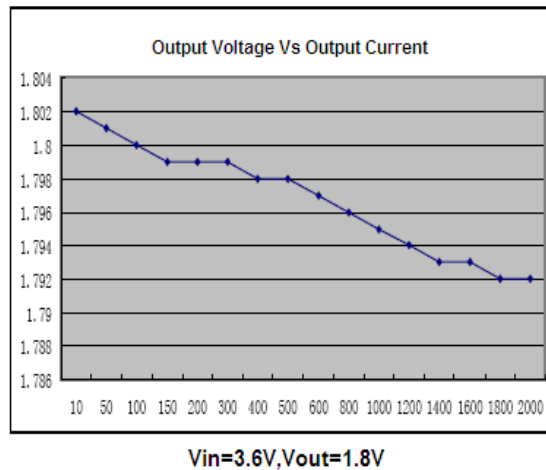
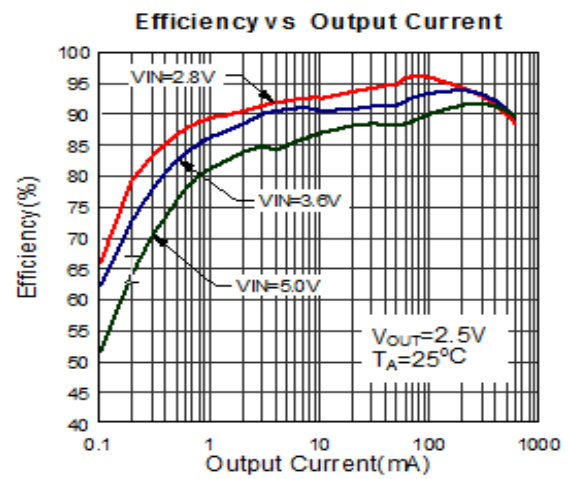
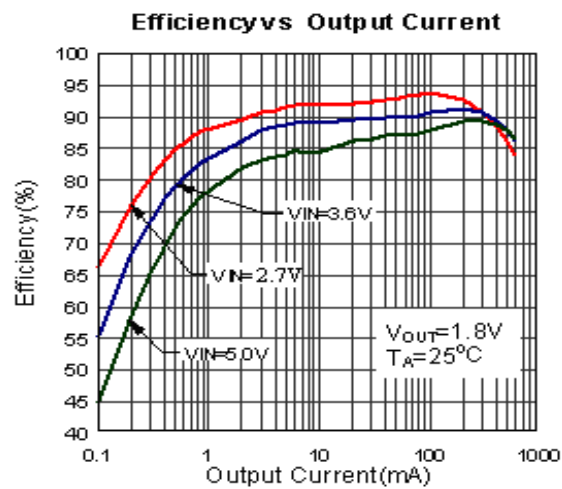
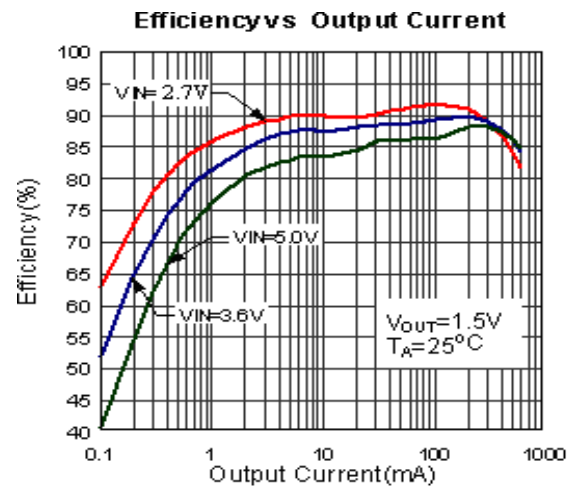
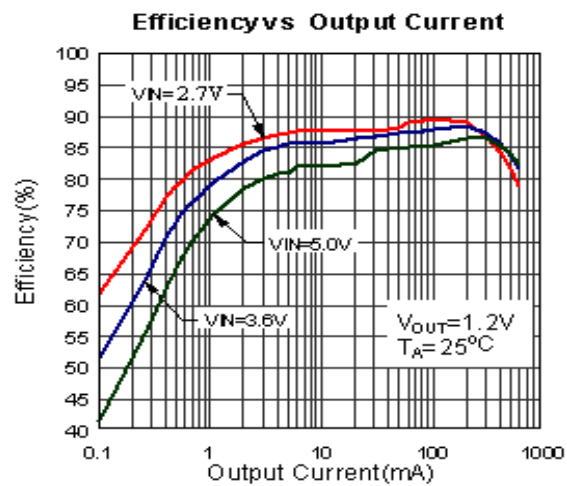
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2:  $T_J$  is calculated from the ambient temperature  $T_A$  and power dissipation  $P_D$  according to the following formula:  $T_J = T_A + (P_D) \times (\theta_{JA})$ .

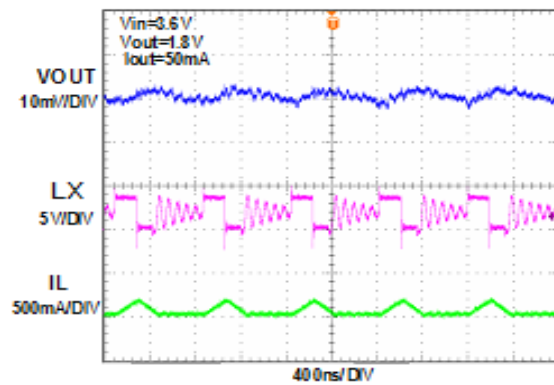
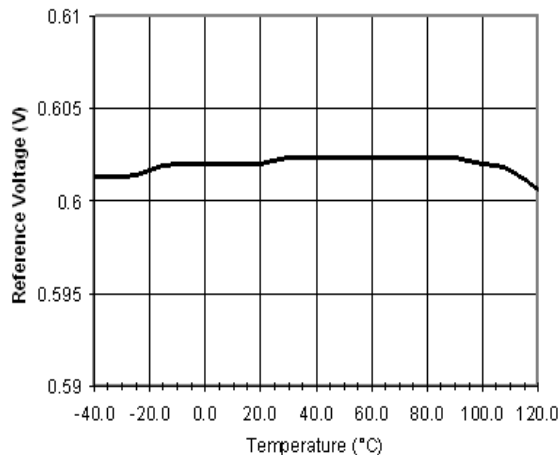
Note 3: 100% production test at  $+25^\circ C$ . Specifications over the temperature range are guaranteed by design and characterization.

Note 4: Dynamic supply current is higher due to the gate charge being delivered at the switching frequency.

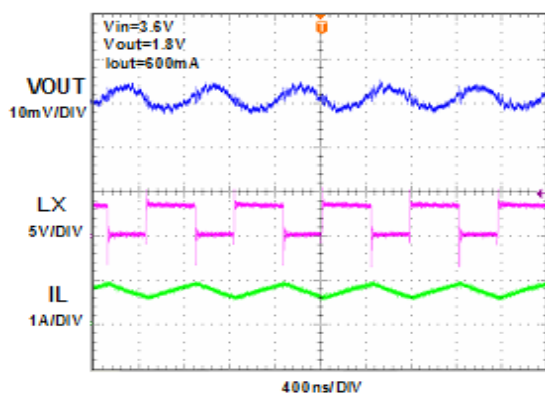
## Typical Performance Characteristics



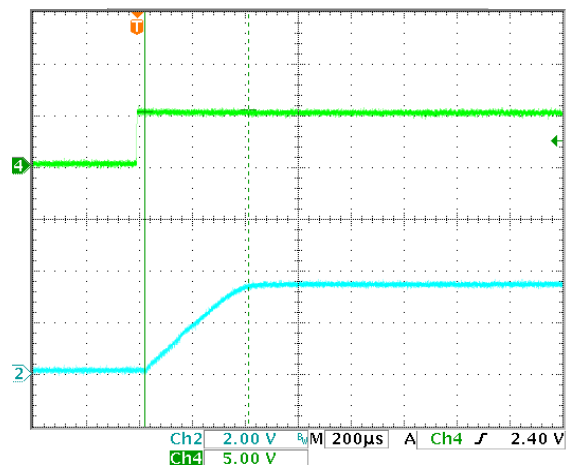
## Typical Performance Characteristics (continue)



PFM MODE



PWM MODE



## Functional Description

The GS5582 is a high output current monolithic switch mode step-down DC-DC converter. The device operates at a fixed 1.0MHz switching frequency, and uses a slope compensated current mode architecture. This step-down DC-DC converter can supply up to 2A output current at  $V_{IN}=3.6V$  and has an input voltage range from 2.6V to 6.5V. It minimizes external component size and optimizes efficiency at the heavy load range. The slope compensation allows the device to remain stable over a wider range of inductor values so that smaller values (1µH to 4.7µH) with lower DCR can be used to achieve higher efficiency. Only a small bypass input capacitor is required at the output. The adjustable output voltage can be programmed with external feedback to any voltage, ranging from 0.6V to near the input voltage. It uses internal MOSFETs to achieve high efficiency and can generate very low output voltages by using an internal reference of 0.6V. At dropout operation, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the low  $R_{DS(ON)}$  drop of the P-channel high-side MOSFET and the inductor DCR.

The internal error amplifier and compensation provides excellent transient response, load and line regulation. Internal soft start eliminates any output voltage overshoot when the enable or the input voltage is applied.

### Setting the Output Voltage

Figure 1 shows the basic application circuit for the GS5582. The GS5582 can be externally programmed. Resistors R1 and R2 in Figure 1 program the output to regulate at a voltage higher than 0.6V. To limit the bias current required for the external feedback resistor string while maintaining good noise immunity, the minimum suggested value for R2 is 59kΩ. Although a larger value will further reduce quiescent current, it will also increase the impedance of the feedback node, making it more sensitive to external noise and interference. Table 1 summarizes the resistor values for various output voltages with R2 set to either 59kΩ for good noise immunity or 316kΩ for reduced no load input current.

The external resistor sets the output voltage according to the following equation:

$$V_{OUT}=0.6V \times \left(1 + \frac{R1}{R2}\right)$$

## Applications Information

### Inductor Selection

For most designs, the GS5582 operates with inductors of 1μH to 4.7μH. Low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{osc}}$$

Where  $\Delta I_L$  is inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current. For optimum voltage-positioning load transients, choose an inductor with DC series resistance in the 50mΩ to 150mΩ range.

### Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. A 22μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

### Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple  $\Delta V_{OUT}$  is determined by:

$$\Delta V_{OUT} \leq \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{osc} \times L} \times \left( ESR + \frac{1}{8 \times f_{osc} \times C \times 3} \right)$$

A 22μF ceramic can satisfy most applications.

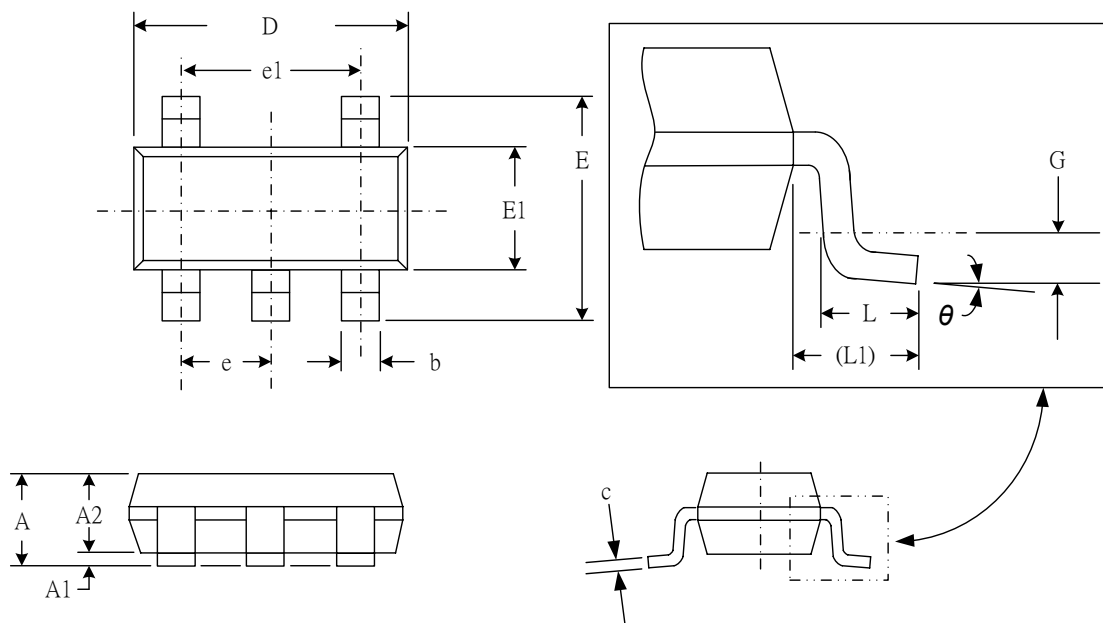
### PCB Layout Recommendations

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the GS5582. Check the following in your layout :

1. The power traces, consisting of the GND trace, the LX trace and the  $V_{IN}$  trace should be kept short, direct and wide.
2. Does the (+) plates of  $C_{IN}$  connect to  $V_{IN}$  as closely as possible. This capacitor provides the AC current to the internal power MOSFETS.
3. Keep the switching node, LX, away from the sensitive  $V_{OUT}$  node.
4. Keep the (-) plates of  $C_{IN}$  and  $C_{OUT}$  as close as possible.

## Package Dimension

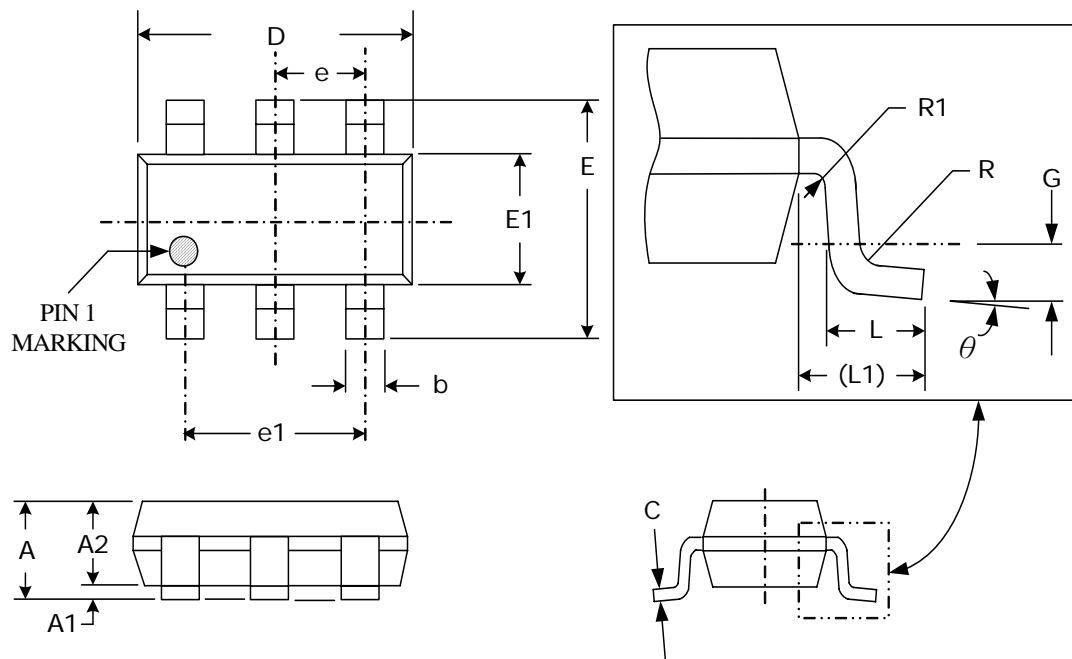
### SOT23-5L PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	0.95	1.45	.037	.057
A1	0.05	0.15	.002	.006
A2	0.90	1.30	.035	.051
b	0.30	0.50	.012	.020
c	0.08	0.20	.003	.008
D	2.80	3.00	.110	.118
E	2.60	3.00	.102	.118
E1	1.50	1.70	.059	.067
e	0.95 (TYP)		.037 (TYP)	
e1	1.90 (TYP)		.075 (TYP)	
L	0.35	0.55	.014	.022
L1	0.60 (TYP)		.024 (TYP)	
G	0.25 (TYP)		.010 (TYP)	
$\theta$	0°	8°	0°	8°

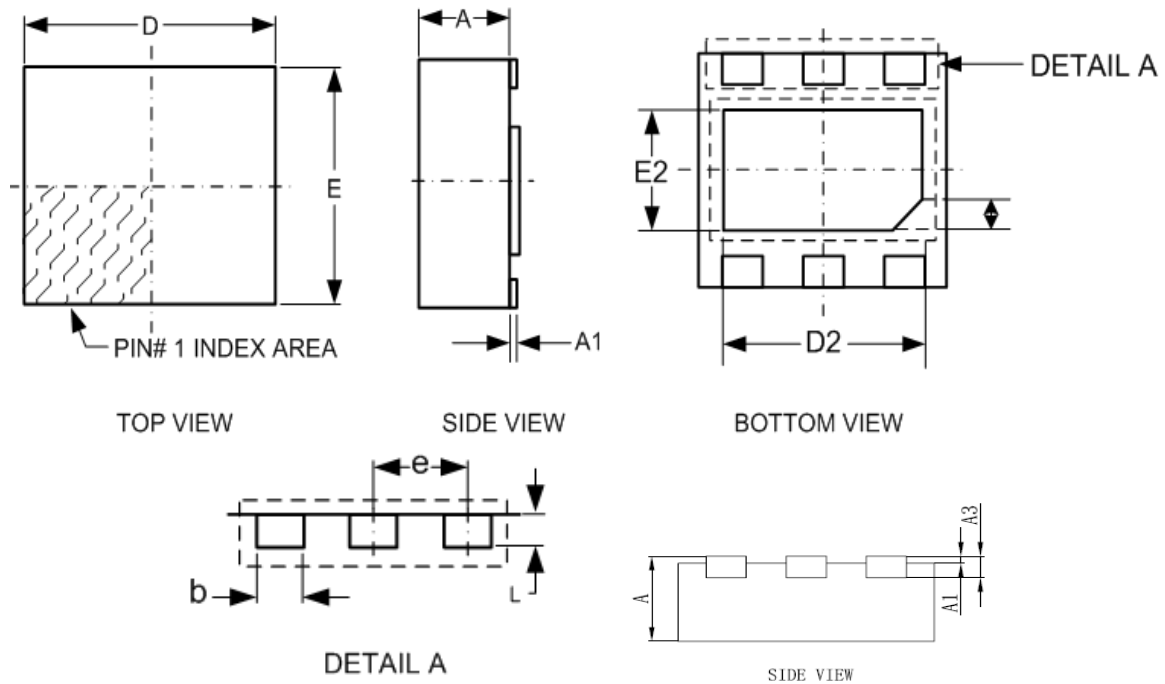


## SOT23-6L PLASTIC PACKAGE



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.10	-	.043
A1	0.00	0.10	0	.004
A2	0.70	1.00	.028	.039
b	0.30	0.50	.012	.020
c	0.08	0.20	.003	.008
D	2.90 (TYP)		.114 (TYP)	
E	2.80 (TYP)		.110 (TYP)	
E1	1.60 (TYP)		.063 (TYP)	
e	0.95 (TYP)		.037 (TYP)	
e1	1.90 (TYP)		.075 (TYP)	
L	0.30	0.60	.014	.022
L1	0.60 (TYP)		.024 (TYP)	
R	0.10	-	.004	-
R1	0.10	0.25	.004	.010
G	0.25 (TYP)		.010 (TYP)	
$\theta$	0°	8°	0°	8°

## DFN2x2-6L(0.75-0.65)







Dimensions						
SYMBOL	Millimeters			Inches		
	MIN	NOM	MAX	MIN	NOM	MAX
<b>A</b>	0.70	0.75	0.80	0.028	0.030	0.031
<b>A1</b>	-	0.02	0.05	-	0.001	0.002
<b>A3</b>	0.18	0.20	0.25	0.007	0.008	0.010
<b>b</b>	0.25	0.30	0.35	0.010	0.012	0.014
<b>D</b>	1.95	2.00	2.05	0.077	0.079	0.081
<b>D2</b>	1.00	-	1.45	0.039	-	0.057
<b>e</b>	0.65 BSC			0.026 BSC		
<b>E</b>	1.95	2.00	2.05	0.077	0.079	0.081
<b>E2</b>	0.50	-	0.85	0.020	-	0.033
<b>L</b>	0.25	0.30	0.40	0.010	0.012	0.016
<b>h</b>	0.1	0.15	0.2	0.004	0.006	0.008



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