

## PRECISION GENERAL-PURPOSE REGULATOR

### DESCRIPTION

This monolithic integrated circuit is a versatile, general-purpose voltage regulator designed as a substantially improved replacement for the popular SG723 device. The SG1532 series regulators retain all the versatility of the SG723 but have the added benefits of operation with input voltages as low as 4.5 volts and as high as 50 volts; a low noise, low voltage reference; temperature compensated, low threshold current limiting; and protective circuits which include thermal shutdown and independent current limiting of both the reference and output voltages. A separate remote shutdown terminal is included. In the dual-in-line package an open collector output is available for low input-output differential applications.

These devices are available in both hermetic 14-pin cerdip and 10-pin TO-96 packages. In the T-package, these units are interchangeable with the LAS-1000 and LAS-1100 regulators. The SG1532 is rated for operation over the ambient temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  while the SG2532 and SG3532 are intended for industrial applications of  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

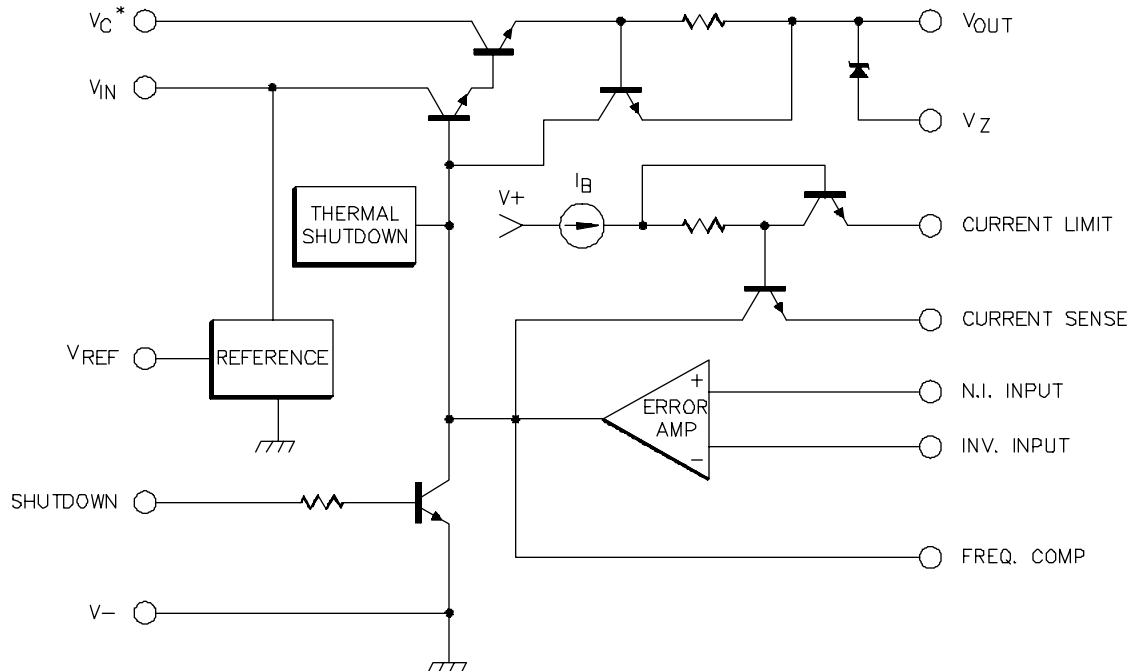
### FEATURES

- Input voltage range of 4.5V to 50V
- 2.5V low noise reference
- Independent shutdown terminal
- Improved line and load regulation
- 80mV current limit sense voltage
- Fully protected including thermal shutdown
- Useful output current to 150mA

### HIGH RELIABILITY FEATURES -SG1532

- ◆ Available to MIL-STD-883
- ◆ LMI level "S" processing available

### BLOCK DIAGRAM



\*  $V_C$  IS INTERNALLY CONNECTED TO  $V_{IN}$  FOR T PACKAGE

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Pulse (50 ms) Input Voltage from $V_{IN}$ to $V_-$ .....	50V	Current from $V_{REF}$ .....	25mA
Continuous Input Voltage from $V_{IN}$ to $V_-$ .....	40V	Operating Junction Temperature	
Input to Output Voltage Differential .....	40V	Hermetic (T, J, L-Packages) .....	150°C
Maximum Output Current .....	250mA	Storage Temperature Range .....	-65°C to 150°C
Current from $V_Z$ (J, L-Package only) .....	100mA	Lead Temperature (Soldering, 10 Seconds) .....	300°C

Note 1. Exceeding these ratings could cause damage to the device.

## THERMAL DATA

J Package:

Thermal Resistance-Junction to Case,  $\theta_{JC}$  .....

Thermal Resistance-Junction to Ambient,  $\theta_{JA}$  .....

T Package:

Thermal Resistance-Junction to Case,  $\theta_{JC}$  .....

Thermal Resistance-Junction to Ambient,  $\theta_{JA}$  .....

L Package:

Thermal Resistance-Junction to Case,  $\theta_{JC}$  .....

Thermal Resistance-Junction to Ambient,  $\theta_{JA}$  .....

Note A. Junction Temperature Calculation:  $T_J = T_A + (P_D \times \theta_{JA})$ .

Note B. The above numbers for  $\theta_{JC}$  are maximums for the limiting thermal resistance of the package in a standard mounting configuration. The  $\theta_{JA}$  numbers are meant to be guidelines for the thermal performance of the device/pc-board system. All of the above assume no ambient airflow.

## RECOMMENDED OPERATING CONDITIONS (Note 2)

Input Voltage Range

SG1532/SG2532 .....

SG3532 .....

Output Current Range .....

Reference Current .....

Zener Current (J & L-Packages only) .....

Operating Ambient Temperature Range

SG1532 .....

SG2532/SG3532 .....

Note 2. Range over which the device is functional.

## ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, these specifications apply over the operating ambient temperatures for SG1532 with  $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , SG2532 with  $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ , SG3532 with  $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ ,  $V_{IN} = 10\text{V}$ ,  $V_{OUT} = 5\text{V}$ , and  $I_{OUT} = 1\text{mA}$ . Low duty cycle pulse testing techniques are used which maintains junction and case temperatures equal to the ambient temperature.)

Parameter	Test Conditions	SG1532/SG2532			SG3532			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Voltage Range	$T_A = 25^\circ\text{C}$	4.5		50	4.5		40	V
		4.7		50	4.7		40	V
Output Voltage Range		2.0		38	2.0		38	V
Max Output Current	$R_{SC} = 0, V_{OUT} = 0, T_A = 25^\circ\text{C}$		175	250		175	250	mA
Min ( $V_{IN} - V_{OUT}$ )	$I_{OUT} = 100\text{mA}, T_A = 25^\circ\text{C}$		1.7	2.0		1.7	2.0	V
Reference Voltage	$T_A = 25^\circ\text{C}$	2.40	2.50	2.60	2.40	2.50	2.60	V
		2.35		2.65	2.35		2.65	V
Temperature Stability (Note 4)			0.005	0.015		0.005	0.015	%/°C
Ref Short Circuit Current	$V_{REF} = 0, T_A = 25^\circ\text{C}$		15	25		15	25	mA
Line Regulation (Note 3)	$8\text{V} \leq V_{IN} \leq 40\text{V}$		0.005	0.01		0.005	0.02	%/V
	$8\text{V} \leq V_{IN} \leq 20\text{V}, I_{OUT} = 25\text{mA}$		0.01	0.02		0.01	0.03	%/V
Load Regulation (Note 3)	$1\text{mA} \leq I_{OUT} \leq 25\text{mA}$		0.002	0.004		0.002	0.004	%/mA
	$1\text{mA} \leq I_{OUT} \leq 100\text{mA}$		0.002	0.005		0.002	0.005	%/mA
Current Limit Sense Voltage	$R_{SC} = 100\Omega, V_{OUT} = 0\text{V}$	0.06	0.08	0.10	0.06	0.08	0.10	V
Shutdown Voltage Threshold		0.40	0.70	1.0	0.40	0.70	1.0	V
Shutdown Source Current	$V_{OUT} = \text{high}$	100	200	300	100	200	300	$\mu\text{A}$
Zener Voltage	$I_{OUT} = 10\text{mA}, (\text{J and L-Packages only})$	6.0	6.4	7.2	6.0	6.4	7.2	V
Standby Current	$V_{IN} = 40\text{V}$		2.5	3.5		2.5	3.5	mA
Error Amplifier Offset Voltage			2.0	10		2.0	15	mV
Error Amplifier Input Bias Current			4.0	15		4.0	20	$\mu\text{A}$

**ELECTRICAL CHARACTERISTICS** (continued)

Parameter	Test Conditions	SG1532/SG2532			SG3532			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Open Loop Gain	$T_A = 25^\circ\text{C}$	66	68		60	68		dB
Ripple Rejection	$f = 120\text{Hz}, T_A = 25^\circ\text{C}$		66			66		dB
Output Noise (Note 4)	$10\text{Hz} \leq f \leq 100\text{KHz}, T_A = 25^\circ\text{C}$		50			50		$\mu\text{V}_{\text{RMS}}$
Long Term Stability (Note 4)	$V_{\text{IN}} = 30\text{V}, T_A = 125^\circ\text{C}$		0.3	1.0		0.3	1.0	%/Khr
Thermal Shutdown (Note 4)			175			175		$^\circ\text{C}$

Note 3. Applies for constant junction temperature. Temperature drift effects must be taken into account separately when the unit is operating under conditions of high dissipation.

Note 4. These parameters, although guaranteed, are not tested in production.

**CHARACTERISTIC CURVES**

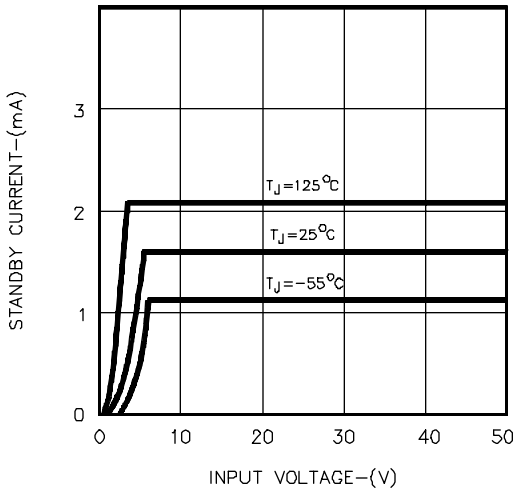


FIGURE 1. STANDBY CURRENT

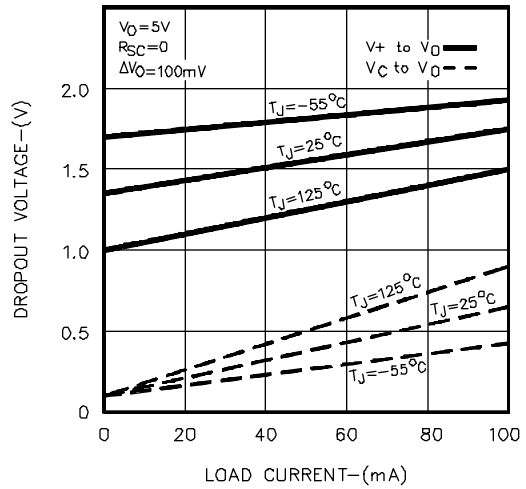


FIGURE 2. MINIMUM INPUT-OUTPUT VOLTAGE

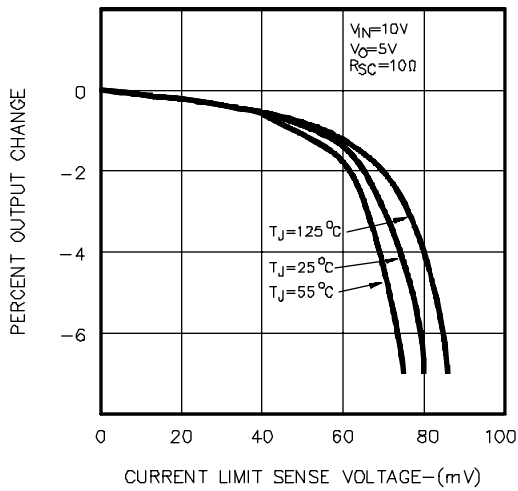


FIGURE 3. CURRENT LIMITING

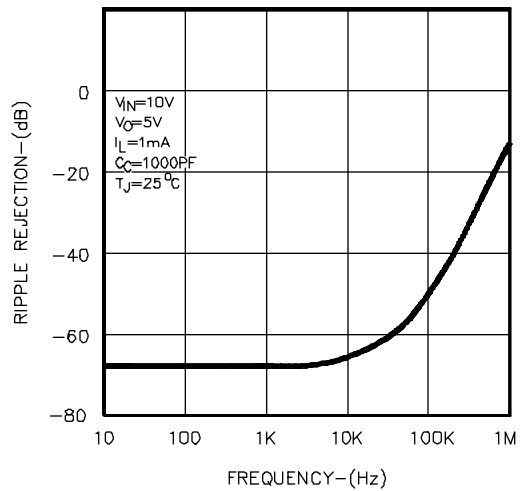


FIGURE 4. RIPPLE REJECTION

CHARACTERISTIC CURVES (continued)

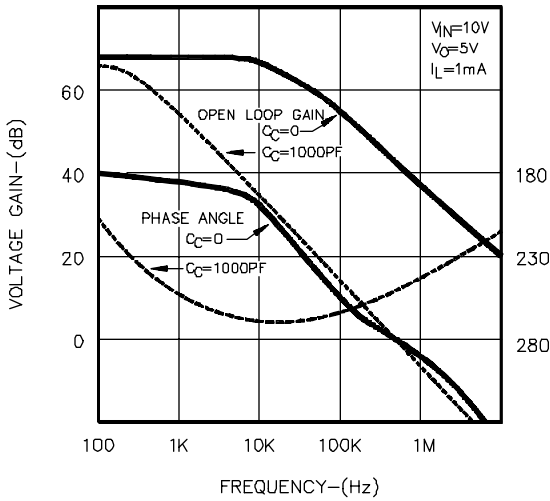


FIGURE 5. FREQUENCY RESPONSE

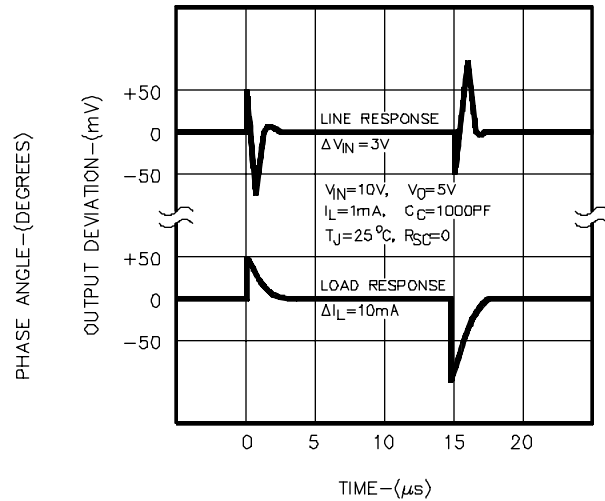


FIGURE 6. TRANSIENT RESPONSE

APPLICATION INFORMATION

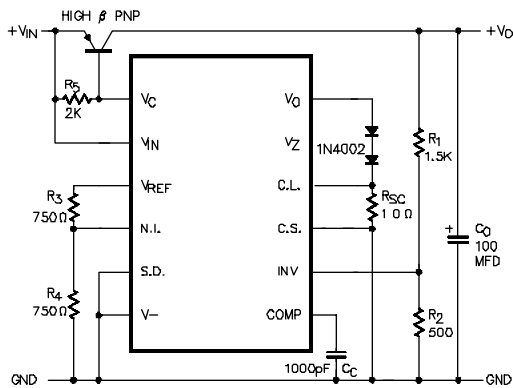


FIGURE 7 - 90% EFFICIENT LINEAR REGULATOR

Output Voltage = 5V  
 Min ( $V_{in} - V_{OUT}$ ) at 2A = 0.4V  
 Load Reg 0-2A = 20mV  
 Max Output Current = 3A  
 Line Reg 6-30V = 10 mV

Notes:

For output voltages above 8V and load currents which allow PNP base current to be limited to 25mA, the internal zener may be used, eliminating the need for the two external diodes and the divider on  $V_{REF}$ .

$R_{SC}$  can be eliminated if the 200mA current limit on  $V_{OUT}$  is adequate. Overall current limiting is dependent upon PNP Beta. For greater accuracy, load current may be sensed in the ground line.

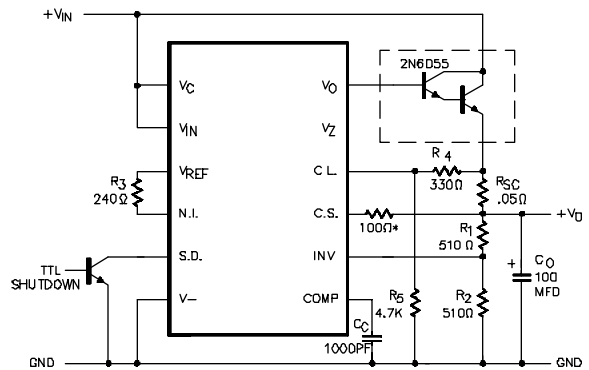


FIGURE 8 - HIGH CURRENT REGULATOR WITH FOLDBACK CURRENT LIMITING AND REMOTE SHUTDOWN

Output Voltage = 5V  
 Max Output Current = 8A  
 Min  $V_{in}$  at No Load = 6.9V  
 Min  $V_{in}$  at 5A = 8.2V  
 Line Reg 10-30V = 3mV  
 Load Reg 0-5A = 17mV  
 Short Circuit Current = 1.8A

Note:

\* 100 $\Omega$  surge limiting resistor should be used for output voltages above 8V.

APPLICATION INFORMATION

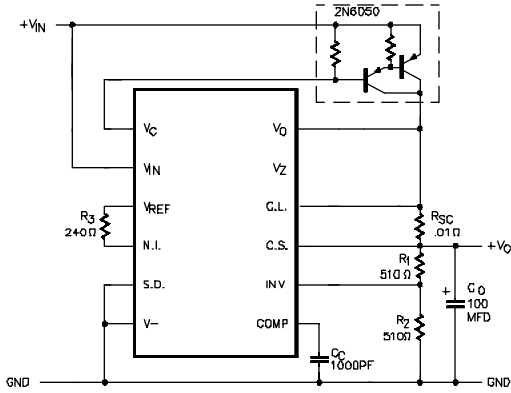


FIGURE 9 - HIGH EFFICIENCY LOW VOLTAGE REGULATOR

Output Voltage = 5V  
 Max Output Current = 9A  
 Min  $V_{IN}$  at 5A = 7.0V  
 Line Reg 7-20V = 10mV  
 Load Reg 0-5A = 25mV  
 Constant Current Limiting

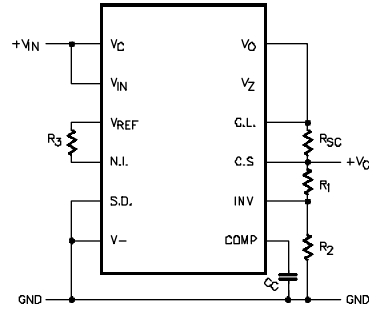


FIGURE 10 - BASIC LOW CURRENT REGULATOR

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

$$I_{SC} = \frac{\text{Sense Voltage}}{R_{SC}}$$

$$C_C = 1000 \text{ pF}$$

$$I_{OUT} \leq 100 \text{ mA}$$

$$R_3 = \frac{R_1 R_2}{R_1 + R_2}$$

CONNECTION DIAGRAMS & ORDERING INFORMATION (See Notes Below)

Package	Part No.	Ambient Temperature Range	Connection Diagram
14-PIN CERAMIC DIP J - PACKAGE	SG1532J/883B SG1532J/DESC SG1532J SG2532J SG3532J	-55°C to 125°C -55°C to 125°C -55°C to 125°C 0°C to 70°C 0°C to 70°C	
10-PIN METAL CAN T - PACKAGE	SG1532T/883B SG1532T/DESC SG1532T SG2532T SG3532T	-55°C to 125°C -55°C to 125°C -55°C to 125°C 0°C to 70°C 0°C to 70°C	(Notes 3 & 4) 
20-PIN CERAMIC LEADLESS CHIP CARRIER L- PACKAGE	SG1532L/883B SG1532L	-55°C to 125°C -55°C to 125°C	

Note 1. Contact factory for JAN and DESC product availability.  
 Note 2. All packages are viewed from the top.

Note 3.  $V_Z$  output is not available in T-package.  
 Note 4. Pin 5 is connected to case.