FAIRCHILD
A Schlumberger Company

SH323 • SH223 • SH123
5 A, 3 V
Voltage Regulator

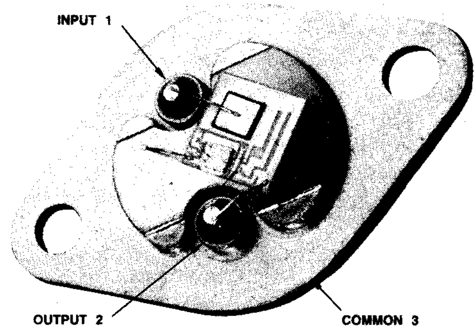
Hybrid Products

Description

The SH232 is a hybrid regulator with 5.0 V fixed output and 3.0 A output capability. It has the inherent characteristics of the monolithic 3-terminal regulators, i.e., full thermal overload, short circuit and safe area protection. All devices are packaged in hermetically sealed TO-3s providing 50 W power dissipation. If the safe operating area is exceeded, the device shuts down rather than failing or damaging other system components (Note 1). This feature eliminates costly output circuitry and overly conservative heat sinks typical of high-current regulators built from discrete components.

- 3.0 A OUTPUT CURRENT
- INTERNAL CURRENT AND THERMAL OVERLOAD PROTECTION
- INTERNAL SHORT CIRCUIT PROTECTION
- LOW DROPOUT VOLTAGE (TYPICALLY 2.0 V @ 3.0 A)
- 50 W POWER DISSIPATION
- STEEL TO-3 PACKAGE
- ALL PIN-FOR-PIN COMPATIBLE WITH THE LM323, SG323

Connection Diagram
2-Pin Metal Package

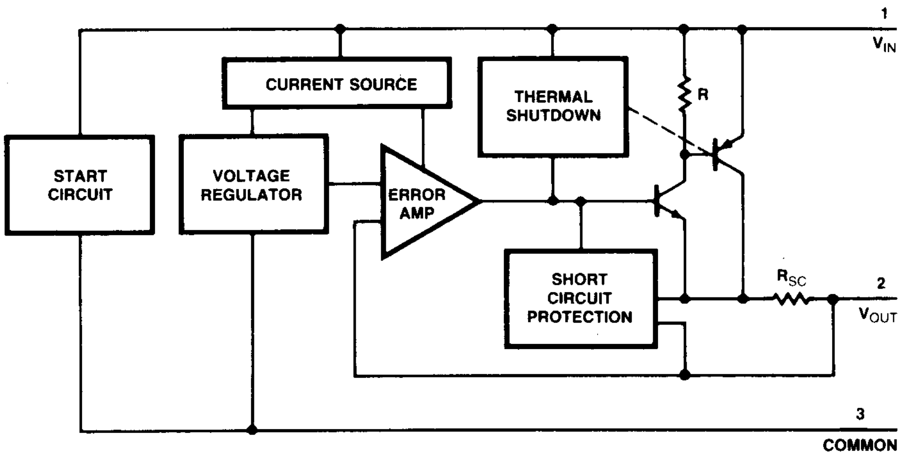


(Top View)

Order Information

Type	Package	Code	Part No.
SH323	Metal	GN	SH323SC
SH223	Metal	GN	SH223SV
SH123	Metal	GN	SH123SM

Block Diagram



Absolute Maximum Ratings

Input Voltage	40 V	Military Temperature Range	
Input-to-Output Voltage		SH123SM	−55°C to +150°C
Differential		Commercial Temperature Range	
Output Short Circuited	35 V	SH323SC	0°C to +150°C
Internal Power Dissipation	50 W @ 25°C Case	Storage Temperature Range	−55°C to +150°C
Operating Junction Temperature	150°C	Pin Temperature	
Industrial Temperature Range		(Soldering, 60 s)	300°C
SH223SV	−25°C to +150°C		

Electrical Characteristics T_J = 25°C, V_{IN} = 10 V, I_{OUT} = 2.0 A unless otherwise specified.

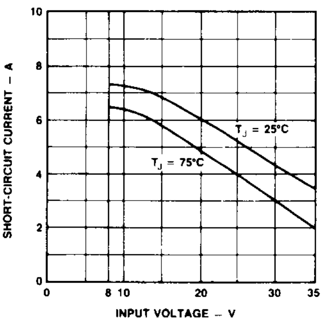
		Limits				
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Unit**	**Condition**
V_{OUT}	Output Voltage	4.85	5.0	5.25	V	I_{OUT} = 2.0 A
ΔV_{OUT}	Line Regulation (Note 2)		10	25	mV	V_{IN} = 7.5 to 25 V
ΔV_{OUT}	Load Regulation (Note 2)		10	50	mV	10 mA $\leq I_{OUT} \leq$ 3.0 A
I_Q	Quiescent Current		3.0	10	mA	I_{OUT} = 0
RR	Ripple Rejection	60			dB	I_{OUT} = 1.0 A, f = 120 Hz, 5.0 $V_{pk\text{-}pk}$
V_n	Output Noise		40		μV_{RMS}	10 Hz $\leq$ f $\leq$ 100 kHz, V_{IN} = 10 V
V_{DD}	Dropout Voltage (Note 3)		2.0	2.3	V	I_{OUT} = 3 A
I_{OS}	Short Circuit Current Limit		7.0	12.0	A_{pk}	V_{IN} = 10 V

Notes

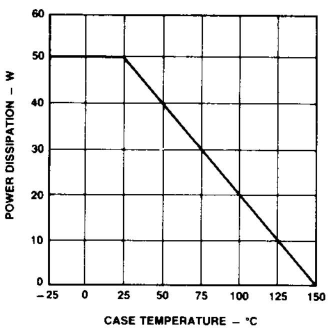
1. This voltage regulator offers output transistor safe area protection. However, to maintain full protection, the device must be operated within the maximum input-to-output voltage differential ratings, as listed on this data sheet under "Absolute Maximum Ratings." For applications violating these limits, device will not be fully protected.
2. Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width ≤ 1 ms and a duty cycle ≤ 5%. Full Kelvin connection methods must be used to measure these parameters.
3. Dropout Voltage is the input-output voltage differential that causes the output voltage to decrease by 5% of its initial value.

Typical Performance Curves

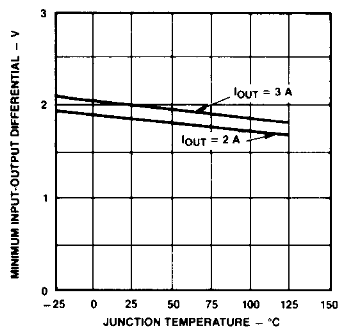
Short Circuit Current



Maximum Power Dissipation

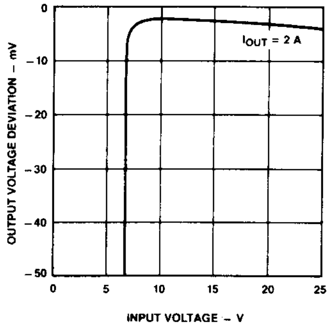


Dropout Voltage

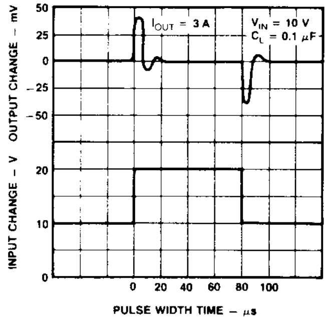


Typical Performance Curves (Cont.)

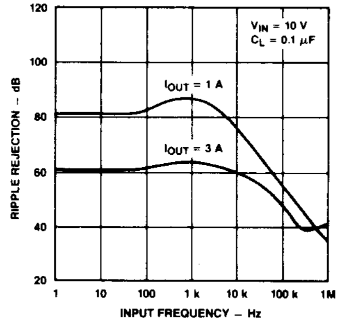
Line Regulation



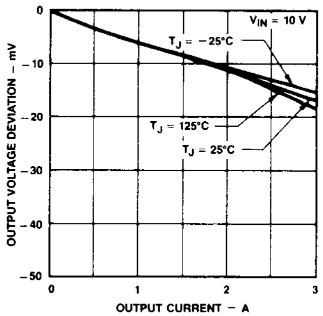
Line Transient Response



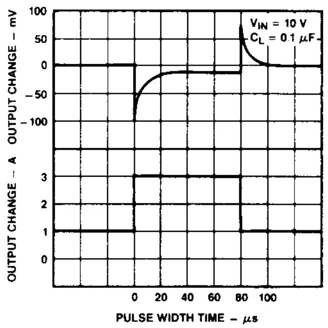
Ripple Rejection



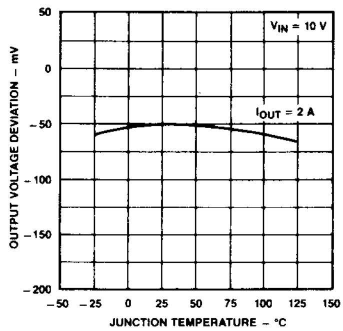
Load Regulation



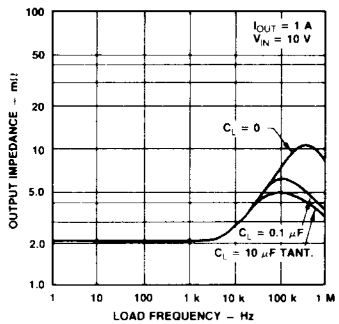
Load Transient Response



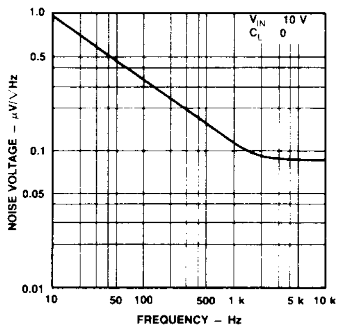
V_{OUT} vs Junction Temperature



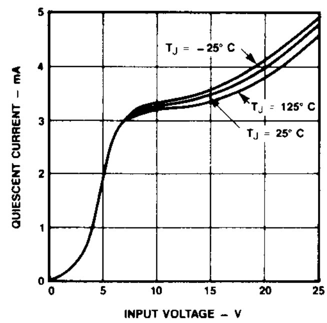
Output Impedance



Output Noise Voltage

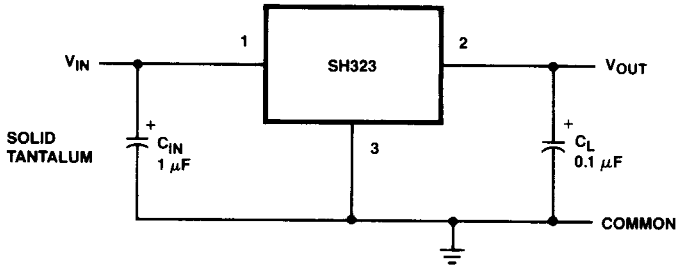


Quiescent Current



Test Circuit

Fixed Output Voltage



Design Considerations

This device has thermal overload protection from excessive power and internal short circuit protection which limits the circuit's maximum current. Thus, the device is protected from overload abnormalities. Although the internal power dissipation is limited, the junction temperature must be kept below the maximum specified temperature (150°C). It is recommended by the manufacturer that the maximum junction temperature be kept as low as possible for increased reliability. To calculate the maximum junction temperature or heat sink required, the following thermal resistance values should be used.

Package	Typ θ_{JC}	Max θ_{JC}
TO-3	1.8	2.5

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JC} + \theta_{CA}}$$

$$\theta_{CA} = \theta_{CS} + \theta_{SA}$$

Solving for T_J:

$$T_J = T_A + P_D(\theta_{JC} + \theta_{CA})$$

Where:

T_J = Junction Temperature
T_A = Ambient Temperature
P_D = Power Dissipation
θ_{JC} = Junction-to-case thermal resistance
θ_{CA} = Case-to-ambient thermal resistance
θ_{CS} = Case-to-heat sink thermal resistance
θ_{SA} = Heat sink-to-ambient thermal resistance

The device is designed to operated without external compensation components. However, the amount of external filtering of this voltage regulator depends upon the circuit layout. If in a specific application the regulator is more than four inches from the filter capacitor, a 1 μF solid tantalum capacitor should be used at the input. A 0.1 μF capacitor should be used at the output to reduce transients created by fast switching loads, as seen in the basic test circuit. These filter capacitors must be located as close to the regulator as possible.

Caution: Permanent damage can result from forcing the output voltage higher than the input voltage. A protection diode from output to input should be used if this condition exists.