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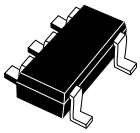
ST716

Datasheet

24 V input, 170 °C high temperature, 25 mA LDO linear regulator



SOT323-5L

Maturity status link
ST716

Features

- No embedded thermal protection
  - see section 5.2 for thermal management
- Temperature range: from -40 °C to 170 °C
- 2.5 V to 24 V input voltage
- Low-dropout voltage (500 mV typ. at 25 mA)
- Very low quiescent current (3.8 µA typ. at full load)
- 25 mA guaranteed output current
- Output voltages 3.3 V
- Compatible with ceramic output capacitors from 0.47 µF to 10 µF
- Internal current limit
- Packages: SOT323-5L

Applications

- Oil and Gas
- Down-hole perforation
- Industrial

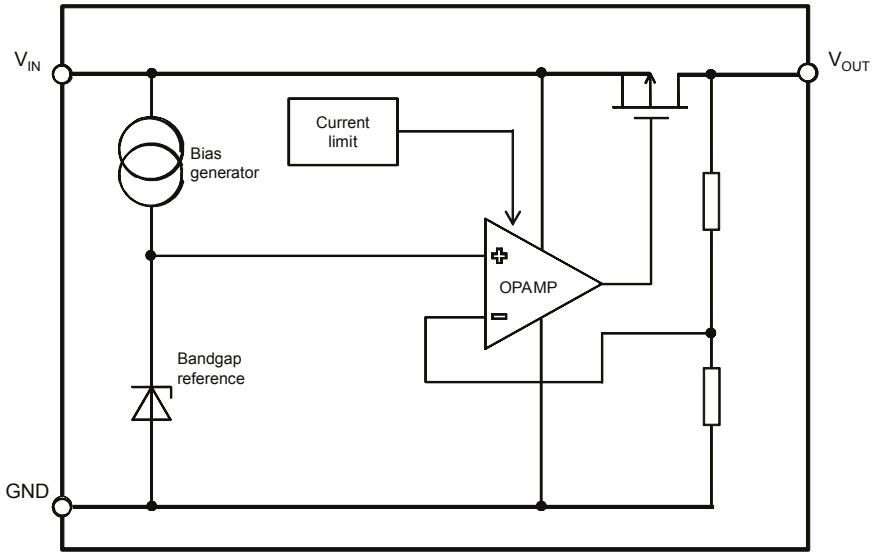
Description

The ST716 is a high voltage, ultra low quiescent current and low drop linear regulator capable of providing an output current in excess of 25 mA.

The device operates over an input voltage range from 2.5 V to 24 V, and is stable with output ceramic capacitors. Fault condition protection includes short-circuit current limitation. The ultra low quiescent current of 3.8 µA at full load makes it highly suitable for low power applications and battery-powered systems. The ST716 is available in SOT323-5L.

1 Schematic diagram

Figure 1. **Block diagram - fixed version**



2 Pin configuration

Figure 2. **Pin connection**

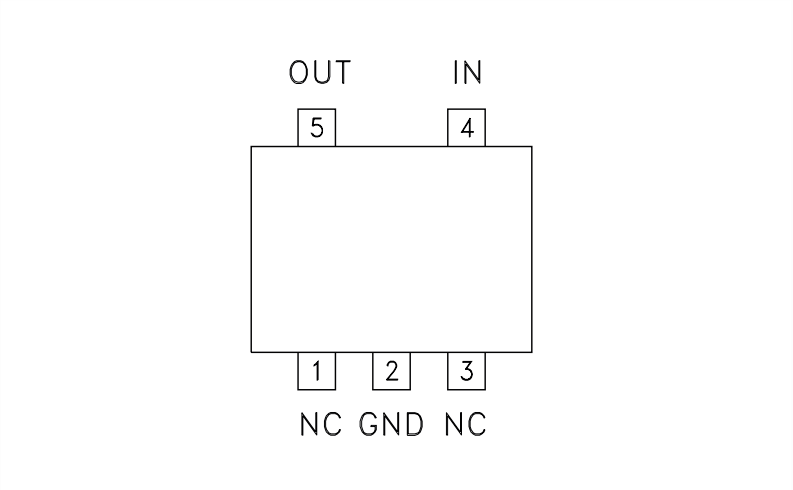


Table 1. **Pin description (SOT323-5L)**

Symbol	Pin for fixed	Function
IN	4	Input voltage
NC	1.3	Not internally connected
GND	2	Common ground
OUT	5	Output voltage

3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	-0.3 to 26	V
V_{OUT}	DC output voltage	-0.3 to V_{IN} +0.3	V
I_{OUT}	Continuous output current	According to package power dissipation	A
P_D(1)	Maximum power dissipation, SOT323-5L packages	0.45	W
T_{STG}	Storage temperature range	-65 to 170	°C
T_{OP}	Operating junction temperature range	-40 to 170	°C

1. P_D is based on an operating temperature of 25 °C or less. It must be derated according to the operating temperature.

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJA}	Thermal resistance junction-ambient	245	°C/W

4 Electrical characteristics

T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ +1 V, C_{IN} = 0.1 µF, C_{OUT} = 1 µF, I_{OUT} = 1 mA, V_{OUT} = 3.3 V unless otherwise specified.

Table 4. Electrical characteristics - fixed version

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage	I_{OUT} = 25 mA, T_J = -40 °C to 150 °C		V_{OUT}+V_{DROP}		24	V
I_{OUT}	Output current	V_{IN} = 4.3 to 24 V, T_J = -40 °C to 150 °C		0		25	mA
V_{OUT}	V_{OUT} total accuracy	V_{IN} = V_{OUT} +1 to 24 V, I_{OUT} = 0 to 25 mA, T_J = -40 °C to 150 °C		-5		+5	%
ΔV_{OUT}	Line regulation	V_{IN} = 4.3 to 24 V, I_{OUT} = 1 mA, T_J = -40 °C to 150 °C			0.001	0.004	%/V
ΔV_{OUT}	Load regulation	I_{OUT} = 100 µA to 25 mA, T_J = -40 °C to 150 °C			0.002	0.003	%/mA
V_{DROP}	Dropout voltage	I_{OUT} = 25 mA, T_J = -40 °C to 150 °C			500	1000	mV
e_N	Output noise voltage	200 Hz to 100 kHz, I_{OUT} = 10 mA, C_{OUT} = 10 µF, T_J = -40 °C to 150 °C				210	μV_{RMS}
SVR	Supply voltage rejection	V_{IN} = V_{OUTNOM} +1 V+/- V_{RIPPLE}, V_{RIPPLE} = 0.2 V, I_{OUT} = 1 mA, C_{OUT} = 10 µF	f = 1 kHz		38		dB
		T_J = -40 °C to 125 °C	f = 100 kHz		57		
I_Q	Quiescent current	I_{OUT} = 0 mA to 25 mA,			3.75	5.5	µA
		T_J = -40 °C to 125 °C	V_{IN} = 24 V		4.15	6.5	
T_{ON}	Turn-on time (1)	V_{IN} = 4.2 V, C_{OUT} = 10 µF, I_{OUT} = 25 mA, T_J = -40 °C to 150 °C			0.7		ms
C_{OUT}	Output capacitor	Capacitance f = 100 kHz		0.47			µF

1. *Turn-on time is time measured between the input, just exceeding 90% of its final value, and the output voltage, just reaching 95% of its nominal value.*

5 Application information

5.1 External capacitor requirements

A 0.1 µF or a larger input bypass capacitor, connected between IN and GND and located close to the device, is recommended. In this manner, the transient response and noise rejection of the power supply, as a whole, improve. A higher value of the input capacitor may be necessary if large, fast-rise-time load transients are present in the application and if the device is several inches away from the power source.

The ST716 requires an output capacitor connected between OUT and GND to stabilize the internal control loop. Any capacitor (including ceramic and tantalum) with a value higher than 0.47 µF, stabilizes this loop.

5.2 Power dissipation and junction temperature

For a reliable operation, junction temperature must not exceed 170 °C. This limits the power dissipation the regulator can handle in any application. To guarantee that the junction temperature is within acceptable limits, calculate the maximum allowable dissipation, $P_{D\ (max)}$, and the dissipation, P_D, which must be less than or equal to $P_{D\ (max)}$.

The device does not shut down when we exceed the maximum power that the package can handle. Junction temperature must be kept below 170 °C using the above formulas.

The maximum power dissipation limit is given by the following equation:

Equation 1

$$P_{D\ (max)} = (T_{JMAX} - T_A) / R_{thJA}$$

where:

T_{JMAX} is the maximum allowable junction temperature

R_{thJA} is the thermal resistance junction-to-ambient for the package, T_A is the ambient temperature

The regulator dissipation is calculated by the following equation:

Equation 2

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

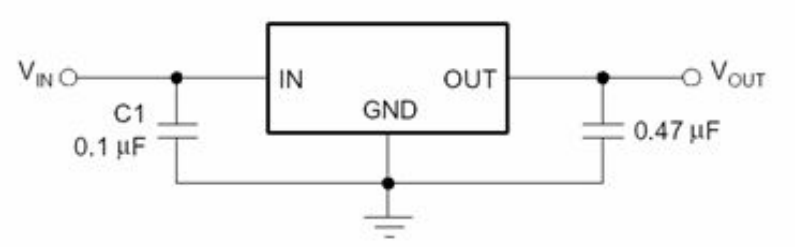
Power dissipation coming from quiescent current is negligible.

The ST716 features the internal current limit. During normal operation, it limits the output current to approximately 350 mA. When the current limit engages, the output voltage scales back linearly until the overcurrent condition ends. Do not exceed the power dissipation ratings of the package.

The device does not shut down when we exceed the maximum power that the package can handle. Junction temperature must be kept below 170 °C using the above formulas.

6 Typical application

Figure 3. **Application circuit, fixed version**



7 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

7.1 SOT323-5L package information

Figure 4. **SOT323-5L package outline**

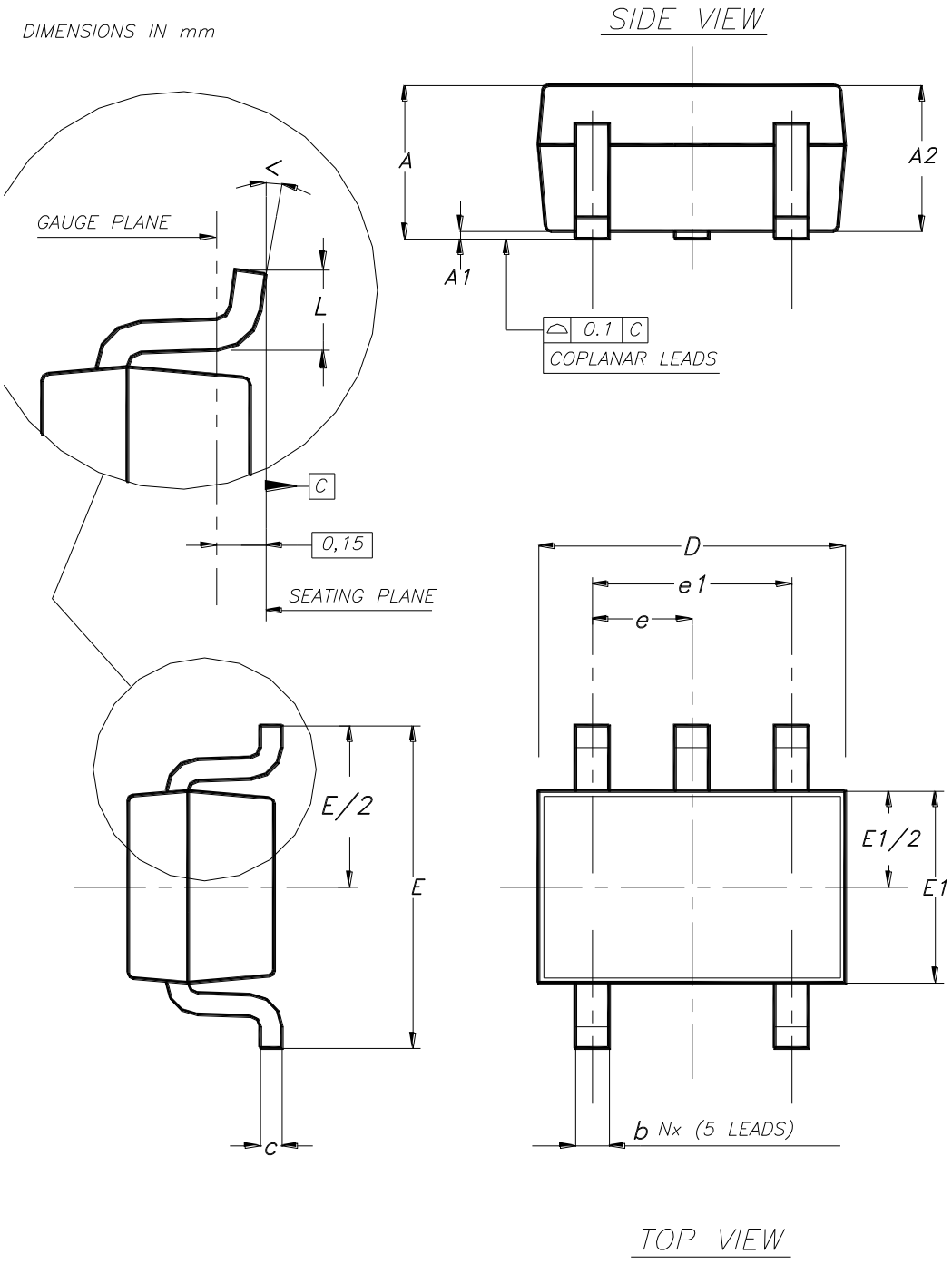


Table 5. **SOT323-5L package mechanical data**

Dimension	mm		
	Min.	Typ.	Max.
A	0.80		1.10
A1	0		0.10
A2	0.80	0.90	1
b	0.15		0.30
c	0.10		0.22
D	1.80	2	2.20
E	180	2.10	2.40
E1	1.15	1.25	1.35
e		0.65	
e1		1.30	
L	0.26	0.36	0.46
<	0°		8°

Revision history

Table 6. **Document revision history**

Date	Version	Changes
12-Apr-2023	1	Initial release.

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