1A, Low Power Consumption, High Voltage CMOS LDO Regulator

1 FEATURES

- **Input Voltage Range: 2.5 V to 18 V**
- **Output Voltage Range:**
  - Fixed Option: 1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5.0V
- **Low I_Q: 18µA (TYP)**
- **Up to 1A Load Current**
- **Low Dropout Voltage**
- **Short Current-Limit Protection**
- **Current Limit Protection**
- **Over Temperature Protection**
- **Output Voltage Accuracy: ±2%**
- **SOT-223 Packages**

2 APPLICATIONS

- **Consumer and Industrial Equipment Point of Regulation**
- **Switching Power Supply Post Regulation**
- **Hard Drive Controllers**
- **Battery Chargers**

3 DESCRIPTIONS

The RS1117 is a linear voltage regulator which has the advantage of low noise, highly accurate and low power. The RS1117 allow an input voltage as high as 18V and contains six output voltages of 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V to support a wide variety of applications. Additionally, the RS1117 has internal protection features containing thermal shutdown and foldback current limit that limits the power dissipation of device during high load current faults and shorting events.

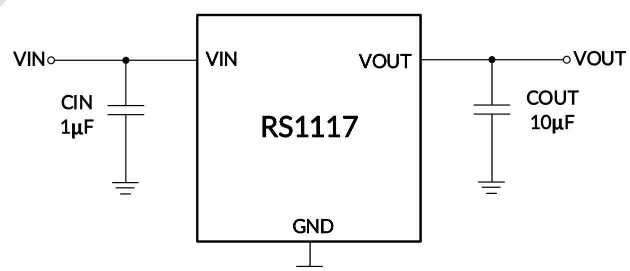
The RS1117 is available in Green SOT-223 packages, for the different application's requirements.

Device Information [(1)]

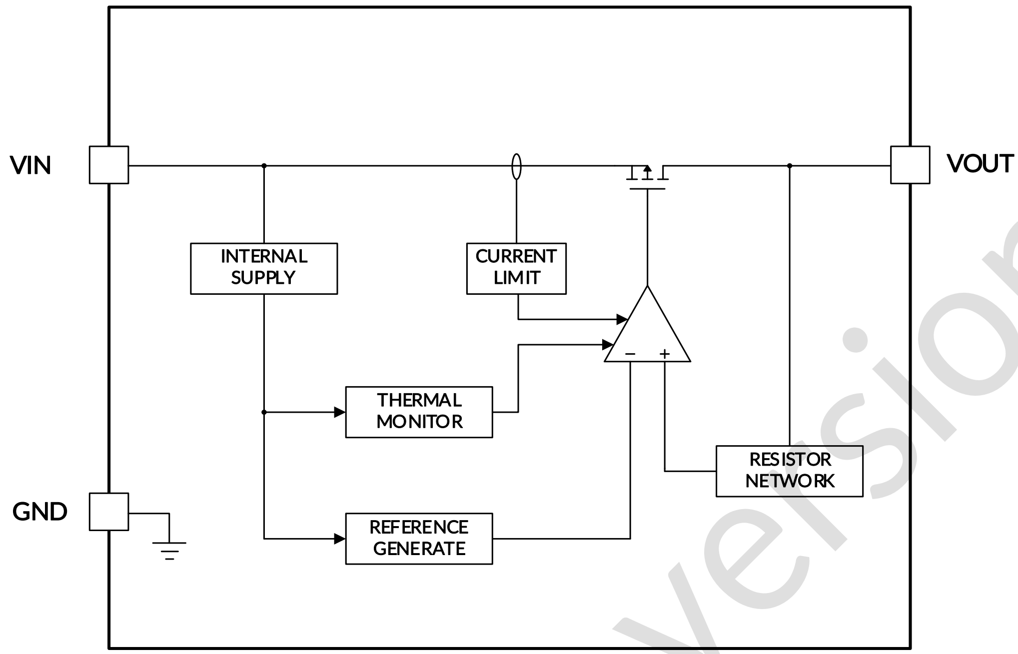
PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS1117	SOT-223	3.50mm×7.00mm

(1) For all available packages, see the orderable addendum at the next page of the data sheet.

4 TYPICAL APPLICATION SCHEMATIC



5 FUNCTIONAL BLOCK DIAGRAM



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6 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2025/01/15	Preliminary version completed
A.0.1	2025/03/21	1. Update Package thermal impedance 2. Update Electrical Characteristics
A.0.2	2025/04/30	1. Update Package thermal impedance 2. Update Figure 17. Load Transient Response
A.0.3	2025/09/08	1. Delete SOT89-3, TO252-2 Package 2. Update SOT-223 Package thermal impedance

7 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	V_{OUT}(V)	V_{OUT} Accuracy	PACKAGE LEAD	PACKAGE MARKING (2)	MSL (3)	PACKAGE OPTION
RS1117-1.2	RS1117-1.2XD3	1.2	±2%	SOT-223	1117A	MSL3	Tape and Reel, 2500
RS1117-1.5	RS1117-1.5XD3	1.5	±2%	SOT-223	1117B	MSL3	Tape and Reel, 2500
RS1117-1.8	RS1117-1.8XD3	1.8	±2%	SOT-223	1117C	MSL3	Tape and Reel, 2500
RS1117-2.5	RS1117-2.5XD3	2.5	±2%	SOT-223	1117D	MSL3	Tape and Reel, 2500
RS1117-3.3	RS1117-3.3XD3	3.3	±2%	SOT-223	1117E	MSL3	Tape and Reel, 2500
RS1117-5.0	RS1117-5.0XD3	5.0	±2%	SOT-223	1117F	MSL3	Tape and Reel, 2500

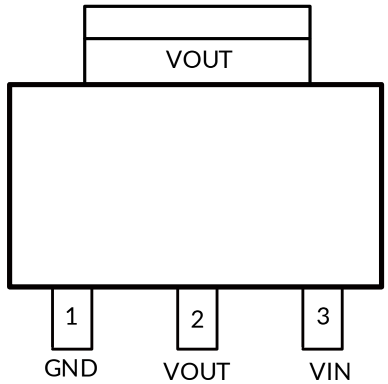
NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

8 PIN CONFIGURATION AND FUNCTIONS (TOP VIEW)



SOT-223

PIN DESCRIPTION

NAME	PIN	FUNCTION
	SOT-223	
GND	1	Ground
VOUT	2	Regulated output voltage. Use the recommended capacitor value as listed in the Recommended Operating Conditions table. Place the output capacitor as close to the OUT and GND pins of the device as possible.
VIN	3	Input voltage supply. Must be closely decoupled to GND with a 1μF or greater capacitor.

9 SPECIFICATIONS

9.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1) (2)

			MIN	MAX	UNIT
V_{IN}	Input voltage		-0.3	20	V
T_J	PN Junction temperature (3)		-40	150	°C
θ_{JA}	Package thermal impedance (4)	SOT-223		80	°C/W
T_{stg}	Storage temperature range		-65	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to the GND pin.
(3) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.
(4) The package thermal impedance is calculated in accordance with JESD-51.

9.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM), ANSI/ESDA/JEDEC JS001-2024	±3000	V
		Charge Device Model (CDM), ANSI/ESDA/JEDEC JS-002-2022	±1000	V

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	TYP	MAX	UNIT
V_{IN}	Input Voltage Range on VIN	2.5		18	V
V_{OUT}	Output voltage	1.2		5	V
I_{OUT}	Output Current Range on IOUT	0		1000	mA
C_{OUT}	Output capacitor	1	10	220	µF
T_J	Junction temperature	-40		125	°C

9.4 Electrical Characteristics

Over operating temperature range (–40°C ≤ T_J ≤ 125°C), V_{IN} = V_{OUT}(nom) + 2V [1], C_{IN} = 1μF, C_{OUT} = 10μF, V_{OUT}=5V, unless otherwise noted. Typical values are at T_J = 25°C.

PARAMETER	SYMBOL	CONDITIONS	MIN[2]	TYP[3]	MAX[2]	UNIT
POWER SUPPLY AND CURRENTS						
Input Voltage [1]	V_{IN}		2.5		18	V
Quiescent Current	I_Q	V_{IN} = 12V, I_{OUT} = 0A		18	40	μA
OUTPUT VOLTAGE						
Output Voltage Range	V_{OUT}		1.2		5.0	V
DC Output Accuracy [1]	ΔV_{OUT}	T_J = 25°C, I_{OUT} = 1mA to 1000mA	-2		2	%
Line Regulation [1]	$\Delta V_{OUT(\Delta VIN)}$	V_{IN} = V_{OUT} + 2V to 18V, I_{OUT} = 10mA		0.003	0.02	%/V
Load Regulation [1][6]	$\Delta V_{OUT(\Delta IOUT)}$	V_{IN}=V_{OUT} + 2V, I_{OUT}=1mA to 1000mA		30	60	mV
Output Voltage Temperature Coefficient [4]	$\frac{\Delta V_{OUT}}{\Delta T_A \times V_{OUT}}$	I_{OUT} = 1mA, T_J = -40°C ~ 85°C		70		ppm/°C
		I_{OUT} = 1mA, T_J = -40°C ~ 125°C		85		ppm/°C
Start time		V_{OUT}=5V, I_{OUT}=100mA		35		μs
Maximum output current [5]	I_{OUTMAX}				1000	mA
DROPOUT VOLTAGE						
Dropout Voltage [6] [7]	V_{DO}	V_{OUT} = 5.0V, I_{OUT} = 100mA		100		mV
		V_{OUT} = 5.0V, I_{OUT} = 500mA		530		mV
		V_{OUT} = 5.0V, I_{OUT} = 1000mA		1100	1500	mV
POWER SUPPLY REJECTION RATIO						
Power Supply Rejection Ratio [8]	PSRR	V_{IN}=12V, V_{OUT} = 5V, I_{OUT} = 100mA, f = 100Hz		58		dB
		f = 1kHz		67		dB
		f = 10kHz		76		dB
		f = 100kHz		65		dB
		f = 1MHz		58		dB
PROTECTIONS						
Over Current Limit	I_{LMT}	V_{IN}=V_{OUT} + 2V, V_{OUT} =0.9*V_{OUT}(nom)	1000	1350		mA
Short-circuit current limit	I_{SC}	V_{OUT}=0V		370		mA
Thermal shutdown threshold [8]	T_{TSD}			160		°C
Thermal shutdown hysteresis [8]	T_{HYS}			25		°C

NOTE:
(1) Minimum V_{IN} = V_{OUT} + V_{DO} or 2.5V, whichever is greater.
(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.
(4) Output voltage temperature coefficient is defined as the worst-case voltage change divided by the total temperature range.
(5) Maximum output current is affected by the PCB layout, size of metal trace, the thermal conduction path between metal layers, ambient temperature and the other environment factors of system. Attention should be paid to the dropout voltage when V_{IN} < V_{OUT} + V_{DROP}.
(6) V_{OUT} voltage at I_{OUTMAX} FT test method: the I_{OUT} lasts for 10ms, then test the V_{OUT} voltage.
(7) V_{DROP} FT test method: test the V_{OUT} voltage at V_{OUTNOM} +$V_{DROPMAX}$ with output current.
(8) Guaranteed by design and characterization, not a FT item.

9.5 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

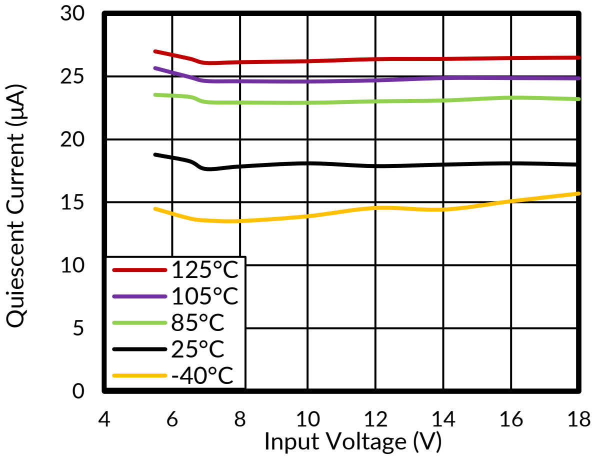


Figure 1. Quiescent Current vs Input Voltage

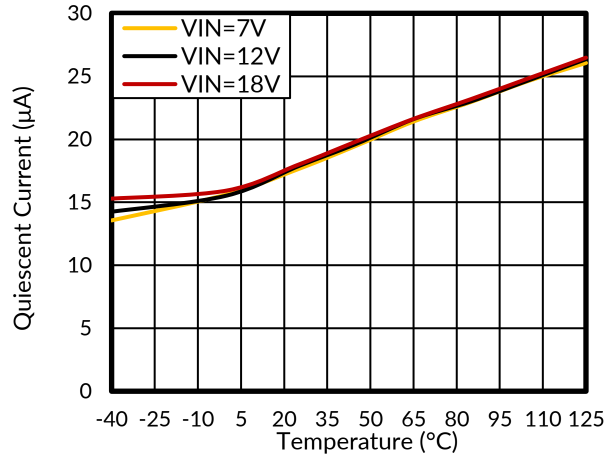


Figure 2. Quiescent Current vs Temperature

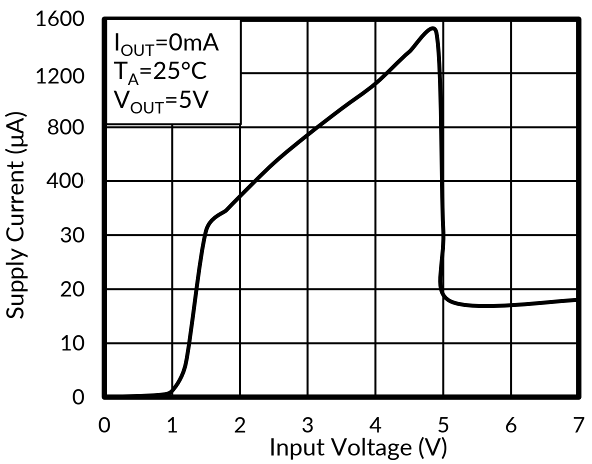


Figure 3. Supply Current vs Input Voltage

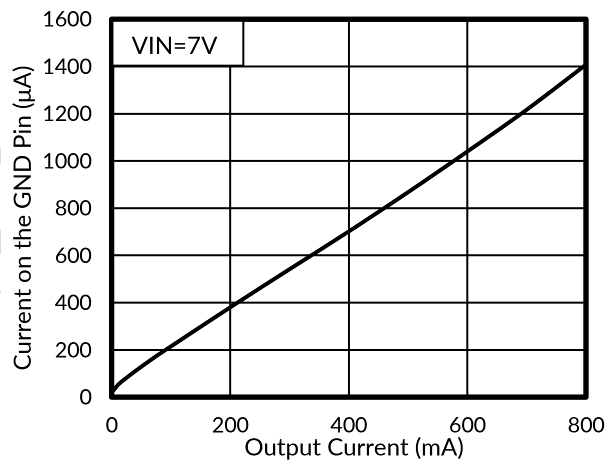


Figure 4. Ground Pin Current vs Output Current

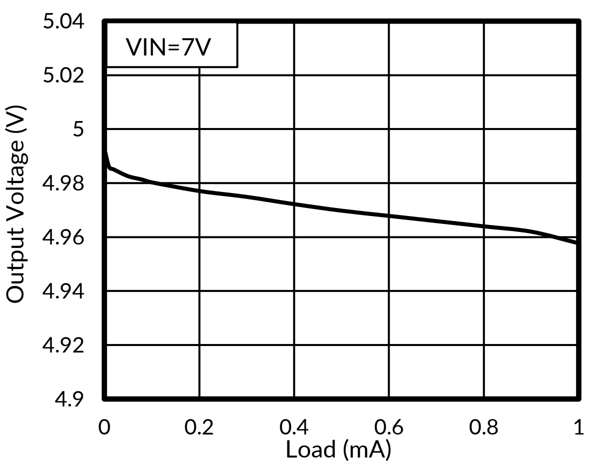


Figure 5. Load Regulation

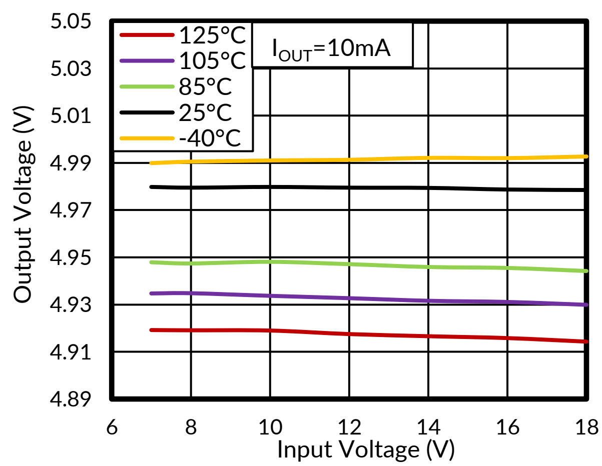


Figure 6. Line Regulation

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

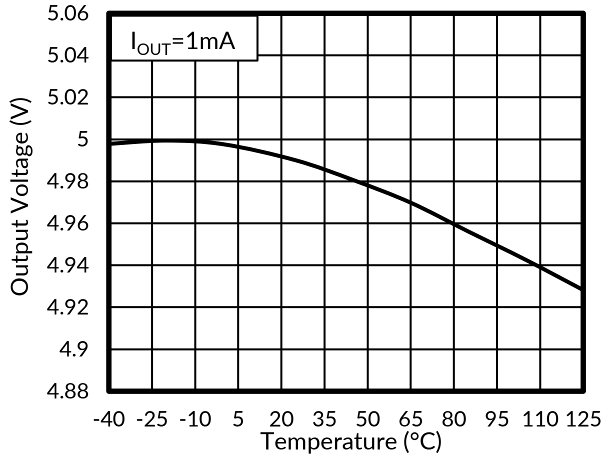


Figure 7. Output Voltage vs Junction Temperature

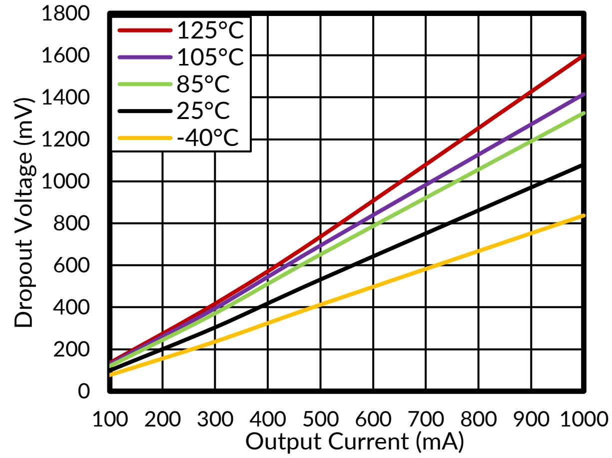


Figure 8. Dropout Voltage vs Output Current

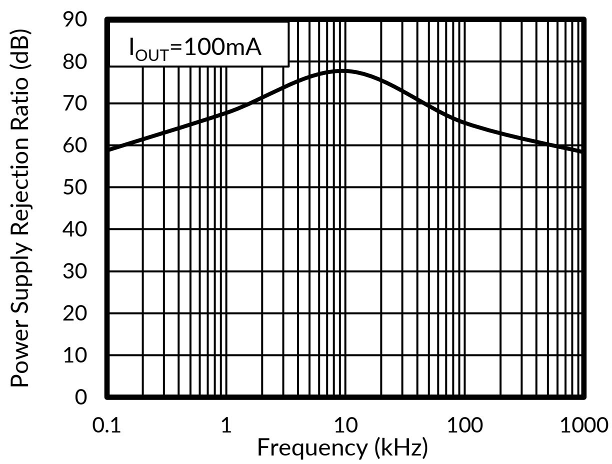


Figure 9. Power Supply Rejection Ratio vs Frequency

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

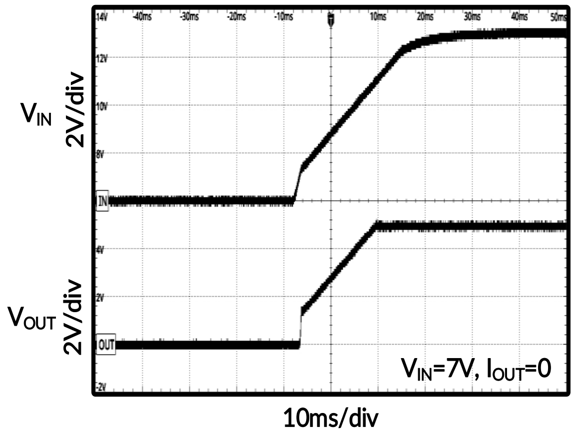


Figure 10. Power On

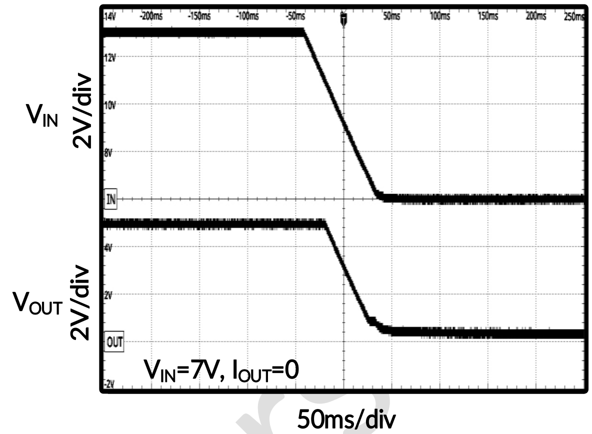


Figure 11. Power Off

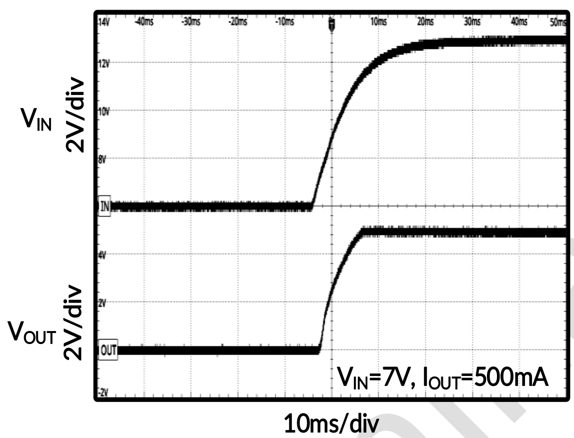


Figure 12. Power On

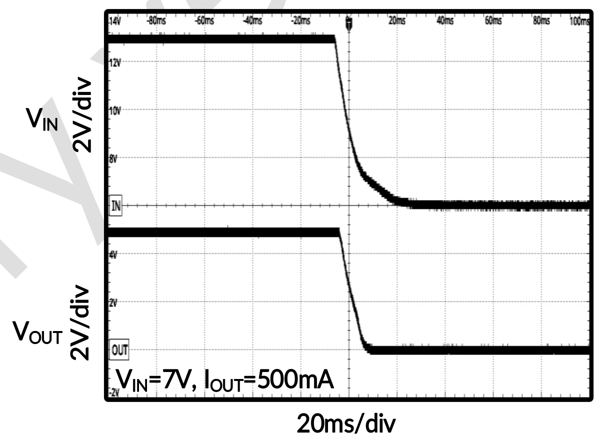


Figure 13. Power Off

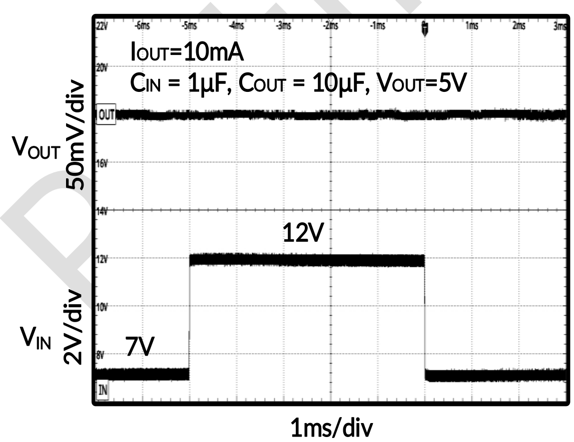


Figure 14. Line Transient Response

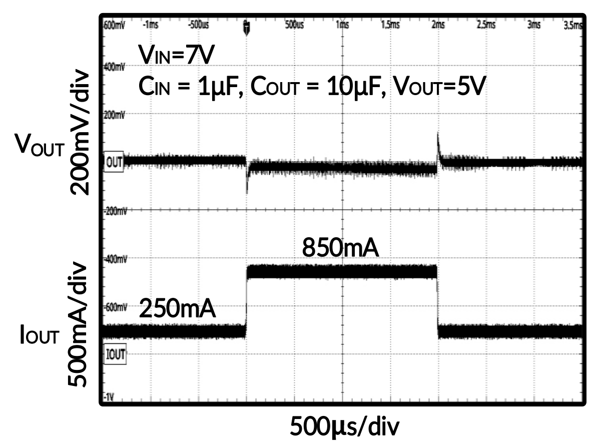


Figure 15. Load Transient Response

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

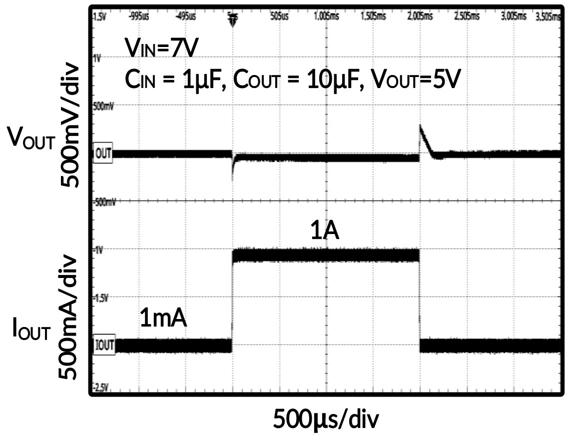


Figure 16. Load Transient Response

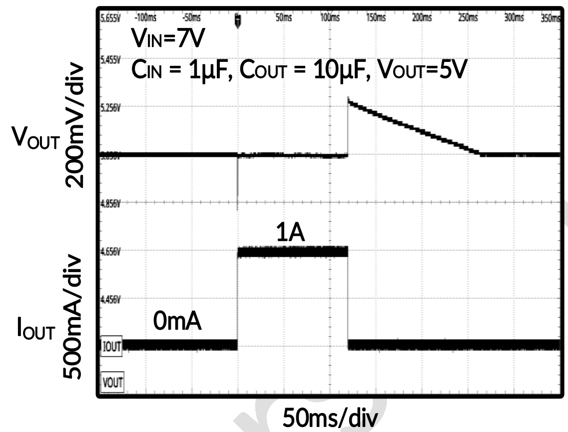


Figure 17. Load Transient Response

10 DETAILED DESCRIPTION

10.1 Overview

The RS1117 is a linear voltage regulator which has the advantage of low noise, highly accurate and low power. The RS1117 allow an input voltage as high as 18V and contains six output voltages of 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V to support a wide variety of applications. Additionally, the RS1117 has internal protection features containing thermal shutdown and foldback current limit that limits the power dissipation of device during high load current faults and shorting events.

10.2 Thermal Overload Protection (T_{SD})

Thermal shutdown disables the output when the junction temperature rises to approximately 160°C which allows the device to cool. When the junction temperature cools to approximately 135°C, the output circuitry enables.

Based on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This thermal cycling limits the dissipation of the regulator and protects it from damage as a result of overheating.

The thermal shutdown circuitry of the RS1117 has been designed to protect against temporary thermal overload conditions. The T_{SD} circuitry was not intended to replace proper heat-sinking. Continuously running the RS1117 device into thermal shutdown may degrade device reliability.

10.3 Current-Limit Protection

The RS1117 monitors the current flowing through the output PMOS and limits the maximum current to prevent load and RS1117 from damages during current overload conditions.

10.4 Short Current-Limit Protection

The short current-limit function reduces the current-limit level down to 370mA(typical) during short circuit conditions.

10.5 Input and Output Capacitor Requirements

Connecting a 1µF low-equivalent series resistance (ESR) capacitor across the input supply near the regulator is good analog design practice. This capacitor counteracts reactive input sources and improves transient response and ripple rejection. A higher value capacitor can be necessary if large, fast, rise-time load transients are anticipated or if the device is located several inches from the power source.

Use an output capacitor within the range specified in the Recommended Operating Conditions table for stability. X5R- and X7R-type capacitors are best because they have minimal variation in value and ESR over temperature.

11 POWER SUPPLY RECOMMENDATIONS

The device is designed to operate from an input voltage supply range between 2.5V and 18V. The input voltage range must provide adequate headroom in order for the device to have a regulated output. This input supply must be well regulated. If the input supply is noisy, additional input capacitors with low ESR can help improve output noise.

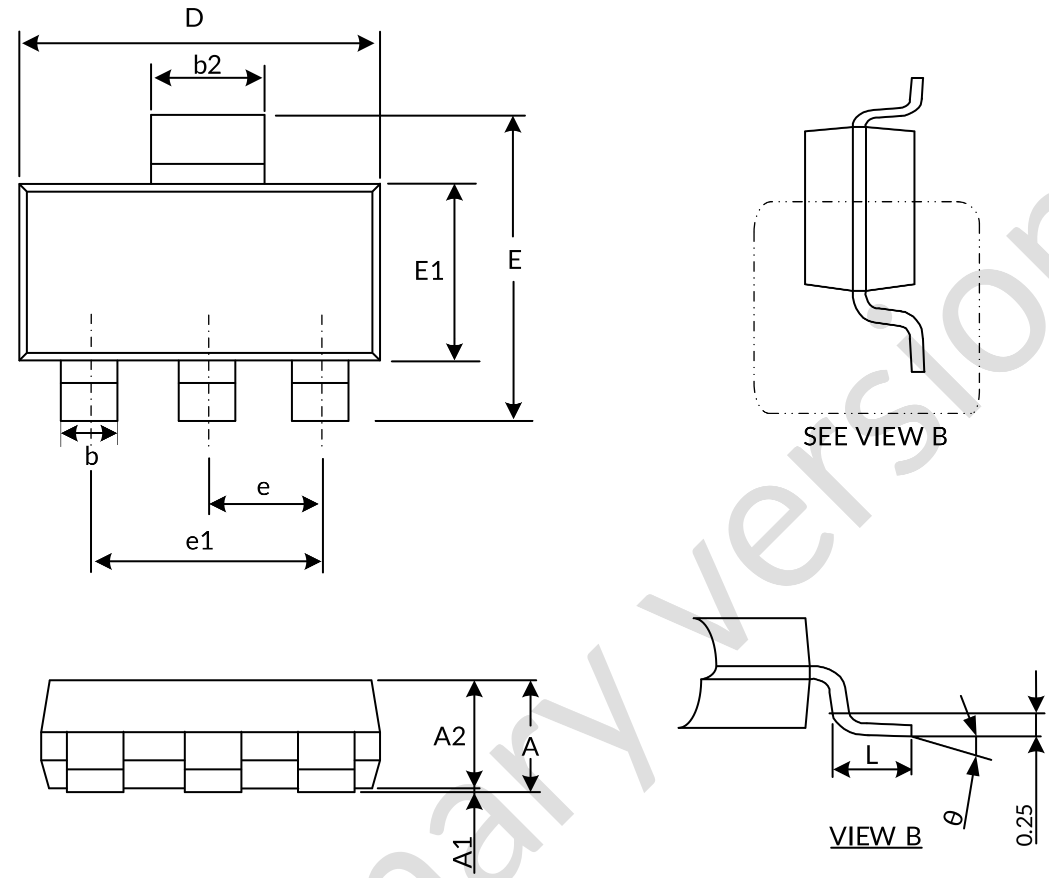
12 LAYOUT

For best overall performance, place all circuit components on the same side of the circuit board and as near as practical to the respective LDO pin connections. Place ground return connections to the input and output capacitor, and to the LDO ground pin as close to each other as possible, connected by a wide, component-side, copper surface. The use of vias and long traces to create LDO component connections is strongly discouraged and negatively affects system performance. This grounding and layout scheme minimizes inductive parasitics, and thereby reduces load-current transients, minimizes noise, and increases circuit stability. A ground reference plane is also recommended and is either embedded in the printed circuit board (PCB) itself or located on the bottom side of the PCB opposite the components. This reference plane serves to assure accuracy of the output voltage, shields the LDO from noise, and behaves similar to a thermal plane to spread (or sink) heat from the LDO device when connected to the exposed thermal pad. In most applications, this ground plane is necessary to meet thermal requirements.

To improve ac performance (such as PSRR, output noise, and transient response), designing the board with separate ground planes for V_{IN} and V_{OUT} is recommended, with each ground plane connected only at the GND pin of the device. In addition, the ground connection for the bypass capacitor must connect directly to the GND pin of the device.

13 PACKAGE OUTLINE DIMENSIONS

SOT-223 (3)



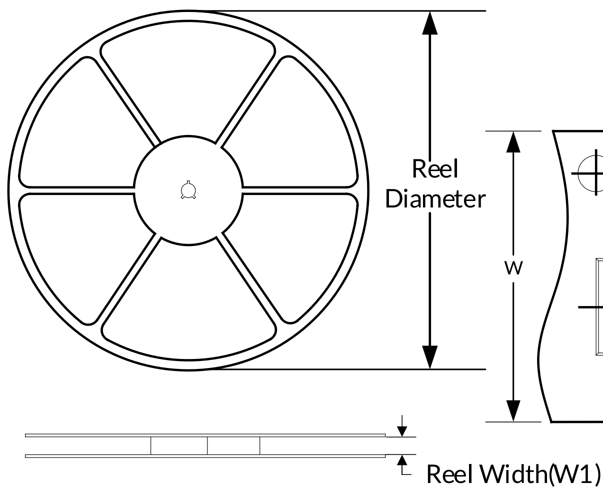
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	-	1.800	-	0.071
A1	0.020	0.100	0.001	0.004
A2	1.550	1.650	0.061	0.065
b	0.660	0.840	0.026	0.033
b2	2.900	3.100	0.114	0.122
D (1)	6.300	6.700	0.248	0.263
E	6.700	7.300	0.263	0.287
E1 (1)	3.300	3.700	0.130	0.145
e	2.300 BSC (2)		0.090 BSC (2)	
e1	4.600 BSC (2)		0.181 BSC (2)	
L	0.900	-	0.035	-

NOTE:

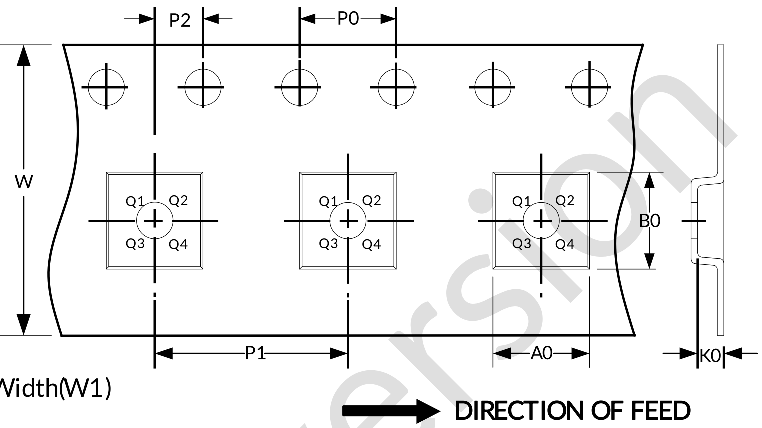
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

14 TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-223	13’’	12.4	6.765	7.335	1.88	4.0	8.0	2.0	12.0	Q3

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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