SK6013S High PSRR Low Noise 300mA RF LDO

GENERAL DESCRIPTION

The SK6013S is low-dropout, low-power linear regulators that offers very high power supply rejection ratio (PSRR) while maintaining very low 40μA ground current, suitable for RF applications. which are ideal for portable equipment such as wireless handsets and PDAs.

The SK6013S uses an advanced CMOS process and a PMOSFET pass device to achieve fast start-up, very low noise, excellent transient response.

The SK6013S is stable with a 1μF ceramic output capacitor, and uses a precision voltage reference and feedback loop to achieve high accuracy.

The SK6013S is available in DFN1×1-4, SOT23-5 and SC70-5 packages.

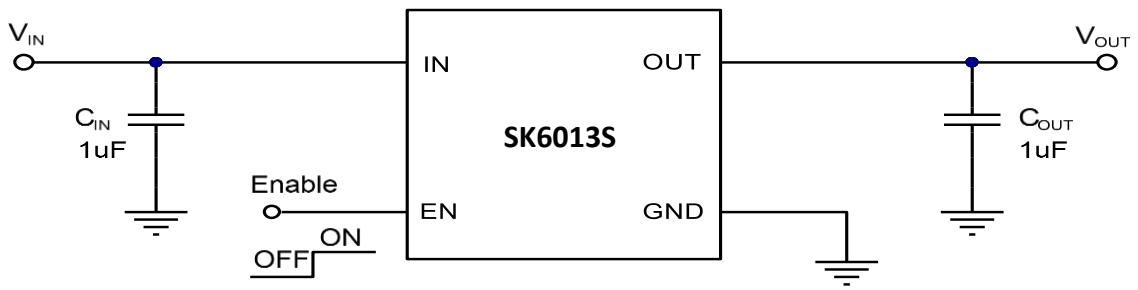
FEATURE

- Wide Input Voltage Range: 2.0V to 6.0V
- Maximum Load Current: 300mA
- Standard Fixed Output Voltage Options: 1.05V ~ 3.45V
- Ultra Low Dropout: 250mV @ I_{OUT}=300mA
- High PSRR: 75dB @1KHz
- Low Noise: 45μVRMS
- Low Quiescent Current: 40uA
- Ultra-Fast Start-Up Time: 25μs
- Excellent Load/Line Transient Response
- Line Regulation: 0.03% typical
- With Auto Discharge

APPLICATIONS

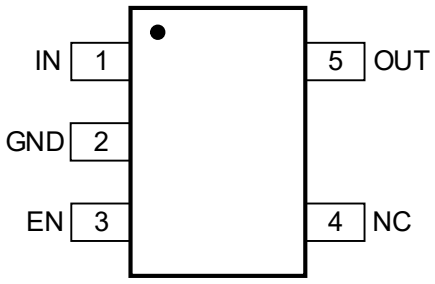
- Smart Phones and Cellular Phones
- PDAs
- MP3/MP4 Player
- Digital Still Cameras
- Portable instruments

TYPICAL APPLICATION CIRCUIT



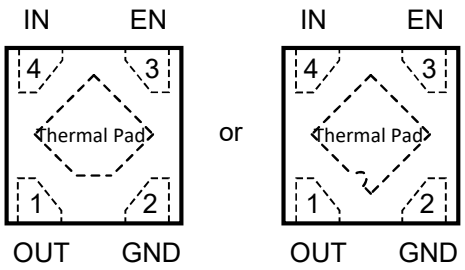
PIN CONFIGURATION

TOP VIEW



SOT23-5L/SC70-5L

TOP VIEW



DFN1×1-4L

PIN DESCRIPTION

PIN Number		PIN Name	Function
SOT23-5L SC70-5L	DFN1×1-4L		
1	4	IN	Supply input pin. Must be closely decoupled to GND with a 1μF or greater ceramic capacitor.
2	2	GND	Ground.
3	3	EN	Enable control input, active high. Do not leave EN floating.
4	-	NC	No connection.
5	1	OUT	Output pin. Bypass a 1μF ceramic capacitor from this pin to ground.
-	Thermal Pad	-	Thermal Pad, connect to GND.

ORDERING INFORMATION

Part Number	Package	Tape & Reel
SK6013SD4-XX	DFN1×1-4L	10000 /Reel
SK6013SS5-XX	SOT23-5L	3000 / Reel
SK6013SC5-XX	SC70-5L	3000 / Reel

Note: XX indicates output voltage. For example 28 means product outputs 2.8V.
SK6013S devices are Pb-free and RoHS compliant.

ABSOLUTE MAXIMUM RATINGS(Note1)

Parameter	Rating	Unit
IN Voltage	-0.3 to 6.5	V
Other Pin Voltage	-0.3 to V_{IN} + 0.3	V
Maximum Load Current	500	mA
Junction to Ambient Thermal Resistance (θ_{JA})	250	°C/W
Operating Junction Temperature	-40 to 125	°C
Storage Temperature	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)	260	°C

Note(1): Stresses beyond "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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RANGE

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.0 to 6.0	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to +85	°C
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 4.7	uF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 4.7	uF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

ELECTRICAL CHARACTERISTICS

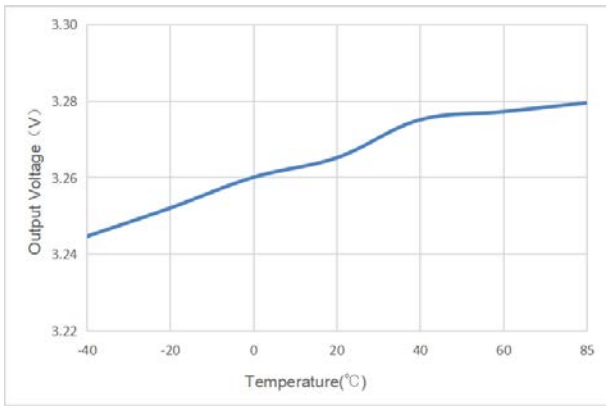
V_{IN} = V_{EN} =3.6 V, T_A = 25 °C unless otherwise noted.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage Operation Range	V_{IN}		2.0		6.0	V
Dropout Voltage	V_{DROP}	V_{OUT} ≥ 2.8 V, I_{OUT} = 300 mA		250	390	mV
Quiescent Current	I_Q	V_{EN} = V_{IN} , I_{OUT}=0mA		40	70	μA
Shutdown Current	I_{SHDN}	V_{EN} = 0V		0.01	1	μA
Regulated Output Voltage	V_{OUT}	I_{OUT} = 1 mA	-2		2	%
Line Regulation	ΔV_{LINE}	V_{IN} = V_{OUT} + 1 V to 5.5 V, I_{OUT} = 10 mA		0.03	0.2	%
Load Regulation	ΔV_{LOAD}	I_{OUT} = 1 mA ~ 300 mA		15	40	mV
Soft-start Time	T_{ON}	from Enable to Power On		25		μs
Current Limit	I_{LIM}		300			mA
Power Supply Rejection Ratio	PSRR	f = 1 kHz, C_{OUT} = 1 μF, I_{OUT} = 20 mA		75		dB
		f = 10 kHz, C_{OUT} = 1 μF, I_{OUT} = 30 mA		65		
Output Noise	e_N	10 Hz to100 kHz, I_{OUT} = 200 mA, V_{OUT} = 1.2 V,C_{OUT} = 1 μF		45		μV_{RMS}
EN Low Threshold	V_{ENL}				0.3	V
EN High Threshold	V_{ENH}		1.5			V
EN pull-down resistance	R_{PD}		0.8	1	1.3	MΩ
EN Pin Input Current	I_{EN}			0	0.1	μA
Over-temperature Shutdown Threshold	T_{TSD}			155		℃
Over-temperature Shutdown Hysteresis	T_{TSR}			20		℃

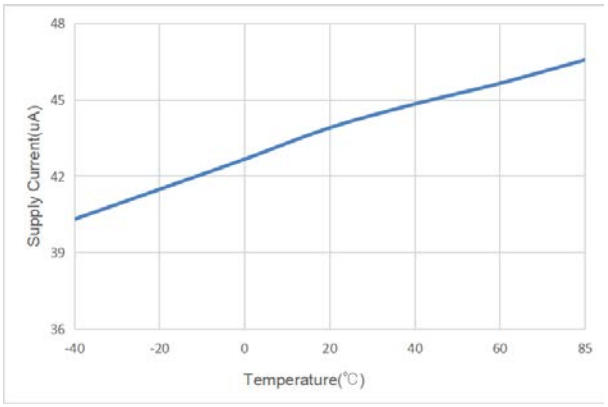
Note: Specifications over the temperature range are guaranteed by design and characterization.

TYPICAL CHARACTERISTICS

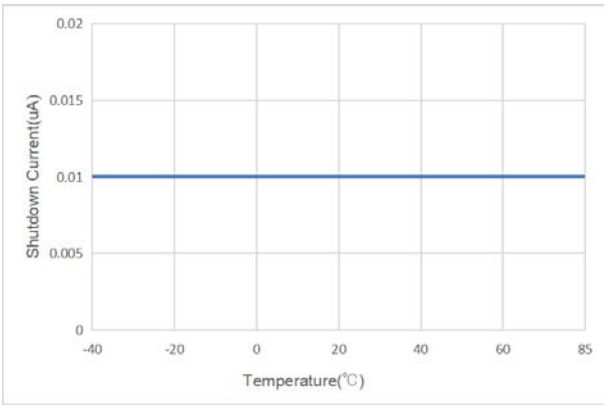
T_A= -40°C ~ +85°C, V_{IN} = 4.3V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0µF, C_{OUT} = Ceramic 1.0µF.



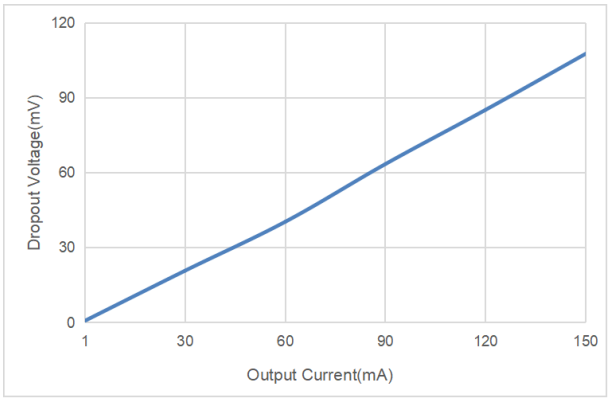
Output Voltage *VS.* Temperature



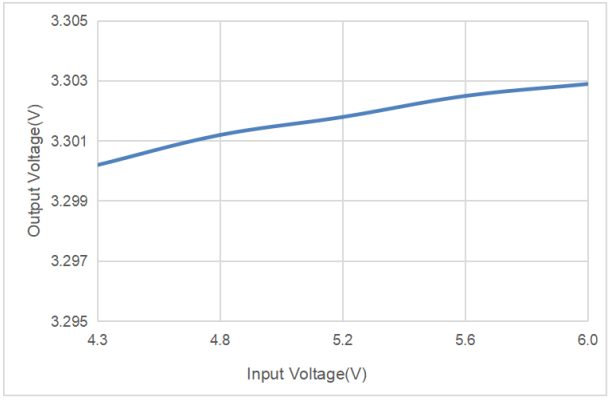
Supply Current *VS.* Temperature



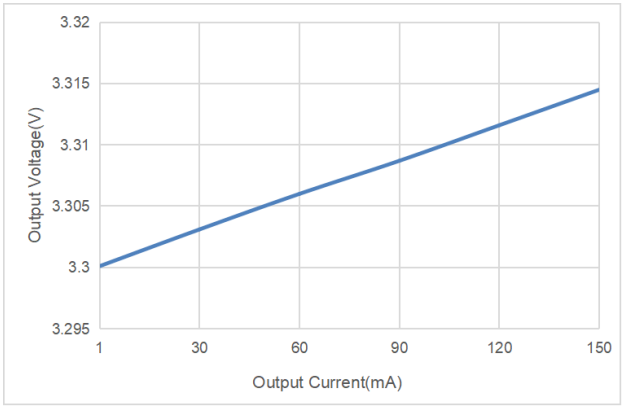
Shutdown Current *VS.* Temperature



Dropout Voltage *VS.* Output Current



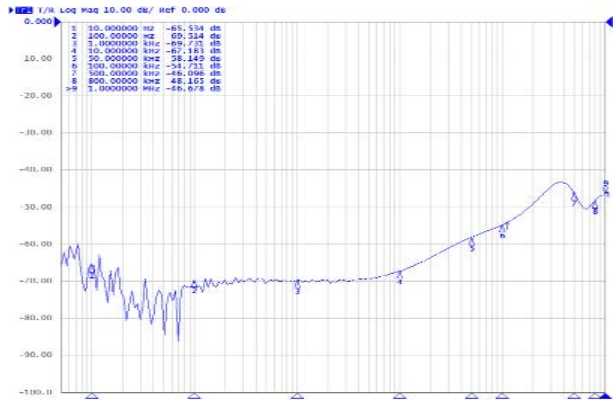
Output Voltage *VS.* V_{IN} Input Voltage



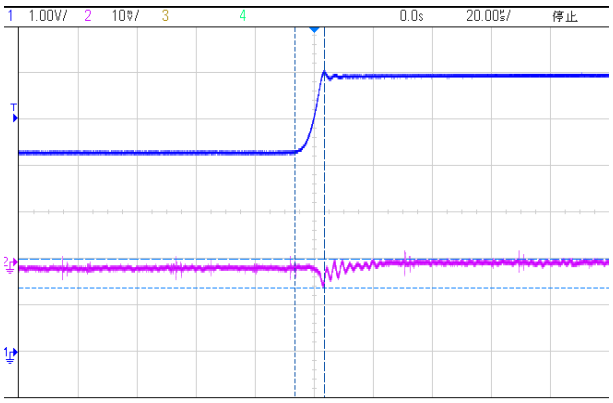
Output Voltage *VS.* Output Current

TYPICAL CHARACTERISTICS (Continued)

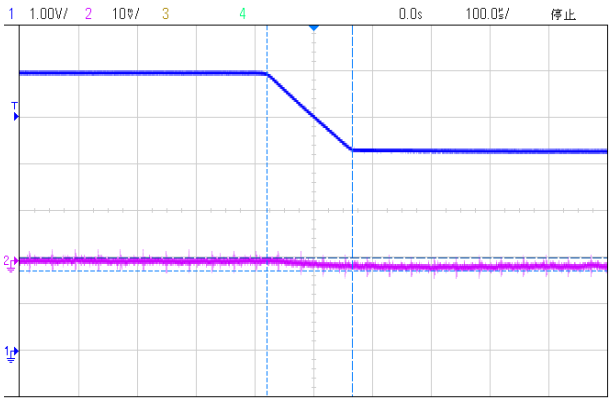
T_A= -40°C~+85°C, V_{IN} = 4.3V, I_{OUT} = 1mA ,C_{IN} = Ceramic 1.0µF, C_{OUT} = Ceramic 1.0µF.



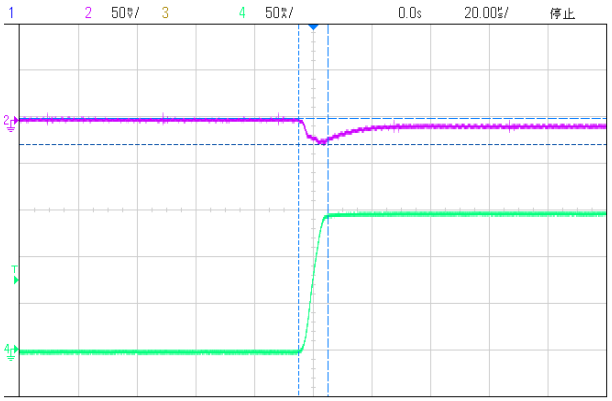
PSRR



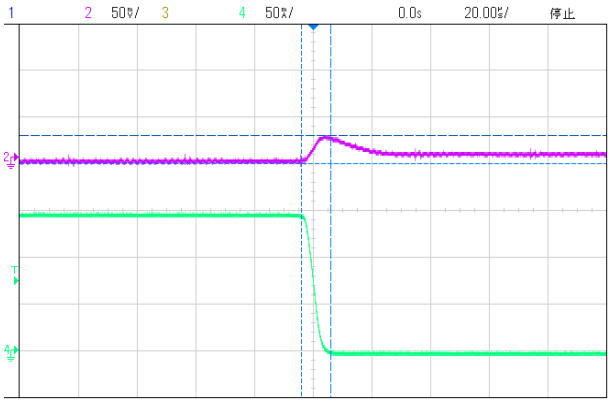
Input Transient(4.3~6V t=10µs 10mA)



Input Transient(6~4.3V t=10µs 10mA)

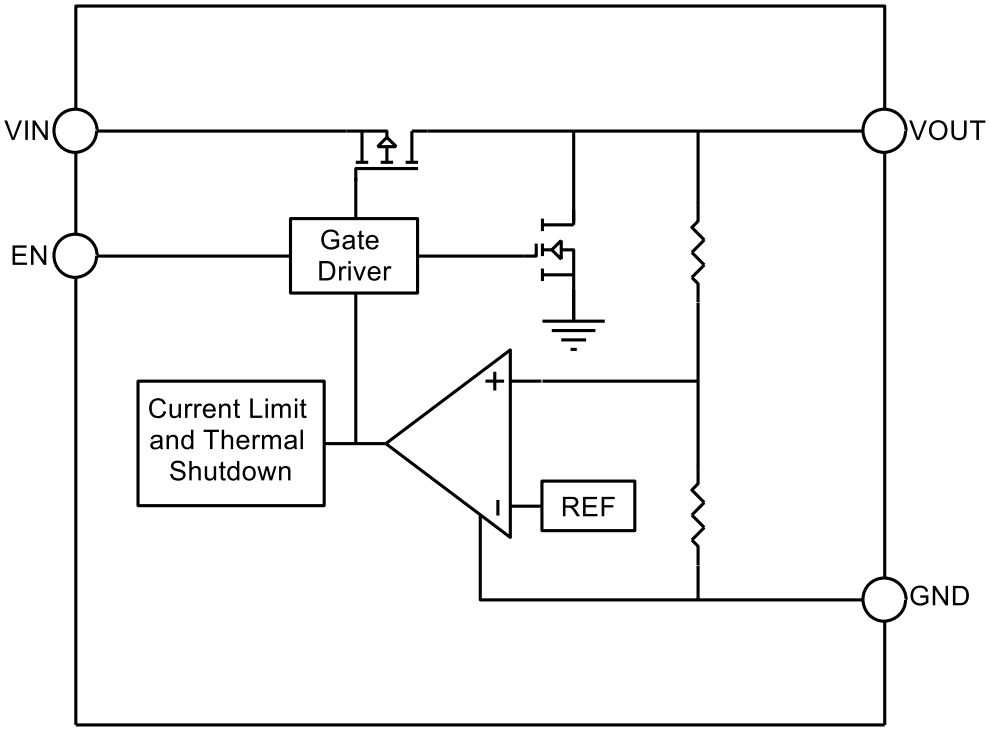


Load Transient(1mA~150mA t=10µs)



Load Transient(150mA~1mA t=10µs)

FUNCTIONAL BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between IN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limitation. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both IN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF to 4.7μF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, and temperature characteristics is X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins.

ON/OFF Input Operation

The SK6013S is turned on by setting the EN pin high, and is turned off by pulling it low. If this feature is not used, the EN pin should be tied to IN pin to keep the regulator output on at all time.

High PSRR and Low Noise

RF circuits such as LNA (low-noise amplifier), up/down-converter, mixer, PLL, VCO, and IF stage, require low noise and high PSRR LDOs. The temperature-compensated crystal oscillator circuit requires very high PSRR at RF power amplifier burst frequency. For instance, minimum 65dB PSRR at 217Hz is recommended for the GSM handsets.

In order to provide good audio quality, the audio power supply for hand-free, game, MP3, and multimedia applications in cellular phones, require low-noise and high PSRR at audio frequency range (20Hz - 20kHz).

The SK6013S, with PSRR of 75dB at 1kHz, is suitable for most of these applications that require high PSRR and low noise.

Ultra Fast Start-up

After enabled, the SK6013S is able to provide full power in as little as tens of microseconds, typically 25μs. This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

Fast Transient Response

Fast transient response LDOs can also extend battery life. TDMA-based cell phone protocols such as Global System for Mobile Communications (GSM) have a transmit/receive duty factor of only 12.5 percent, enabling power savings by putting much of the baseband circuitry into standby mode in between transmit cycles. In baseband circuits, the load often transitions virtually instantaneously from 100μA to 100mA. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDOs.

The SK6013S fast transient response from 0 to 150mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

Cellular phone baseband internal digital circuits typically operate all the time. That requires LDO stays on at all times. However, in the standby mode, the microprocessor consumes only around 100 ~ 300μA. Since the phone stays in standby for the longest percentage of time, using a 40μA quiescent current LDO, instead of 100μA, saves 60μA and can substantially extends the battery standby time.

The SK6013S, consuming only around 40μA for all input range and output loading, provides great power saving in portable and low power applications.

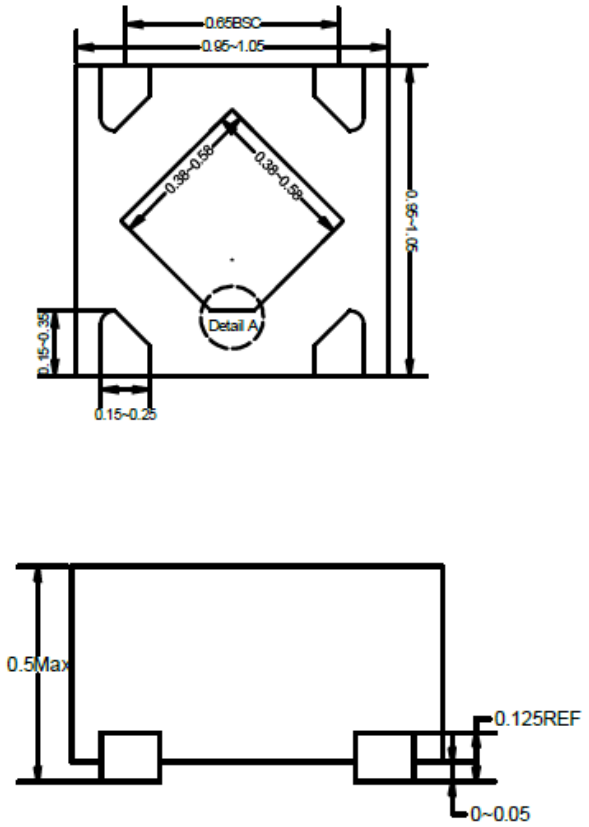
Current Limit Protection

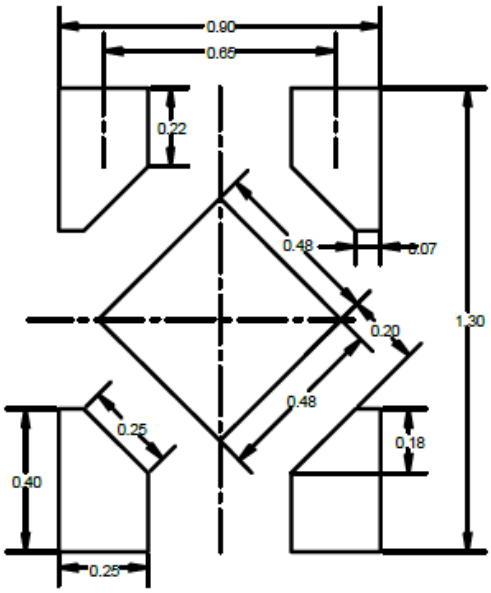
When output current at the OUT pin is higher than current limit threshold or the OUT pin, the current limit protection will be triggered and clamp the output current to approximately 500mA to prevent over-current and to protect the regulator from damage due to overheating.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +155°C, allowing the device to cool down. When the junction temperature reduces to approximately +130°C the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

PACKAGE DIMENSIONS: DFN1×1-4L

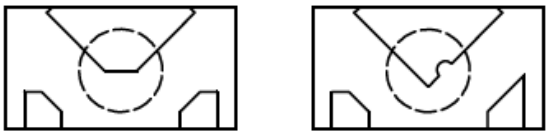




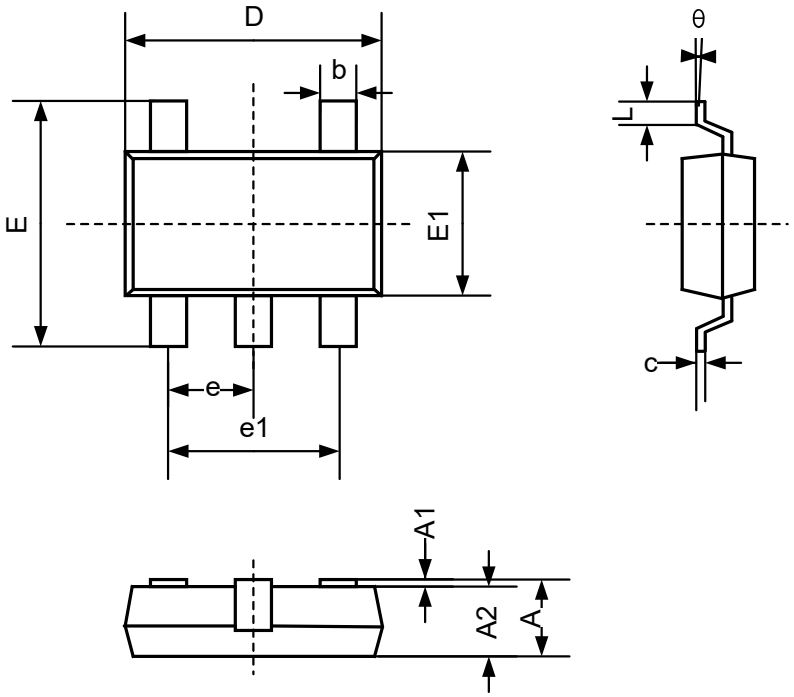
Recommended Land Pattern

Unit: mm

Detail A: (PIN1 shape)

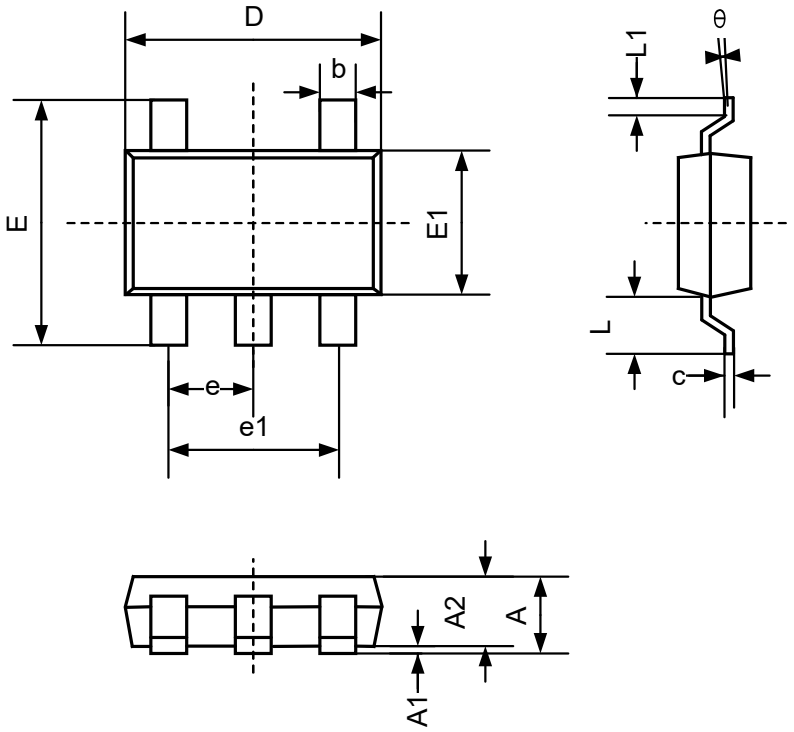


PACKAGE DIMENSIONS: SOT23-5L



Symbol	Dimensions In Millimeters	
	MIN	MAX
A	1.05	1.25
A1	0.00	0.10
A2	1.05	1.15
b	0.30	0.50
c	0.10	0.20
D	2.85	3.05
E	2.65	2.95
E1	1.50	1.70
e	0.95BSC	
e1	1.80	2.00
L	0.30	0.60
θ	0°	8°

PACKAGE DIMENSIONS: SC70-5L



Symbol	Dimensions In Millimeters	
	MIN	MAX
A	0.900	1.100
A1	0.000	0.100
A2	0.900	1.000
b	0.150	0.350
c	0.080	0.150
D	2.000	2.200
E	2.150	2.450
E1	1.150	1.350
e	0.650BSC	
e1	1.200	1.400
L	0.525REF	
L1	0.260	0.460
θ	0°	8°