SK6215E

15V 500mA, 1μA Low IQ, 80dB High PSRR, Low-Dropout Voltage Regulator

GENERAL DESCRIPTION

The SK6215E is an ultra-small, low dropout linear regulator that can source 500mA of output current.

The SK6215E series is designed to provide high PSRR, high input voltage, and excellent load and line transient performance.

The SK6215E has thermal shutdown, current limit, and short circuit protections for added safety. Shutdown mode is enabled by pulling the EN pin low.

The SK6215E is available in SOT23-3, SOT23-5, SOT89-3 and SOT89-5 packages.

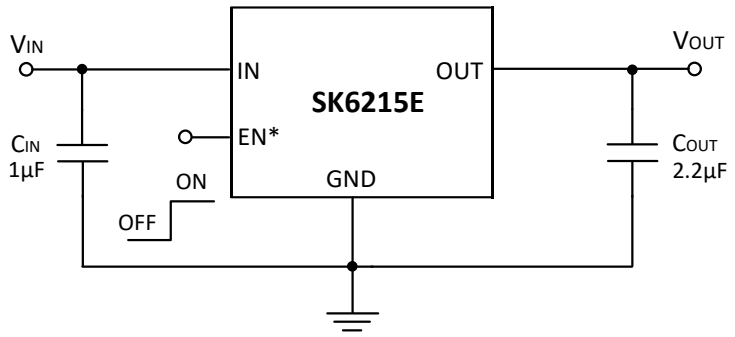
FEATURES

- Operating Input Voltage Range: 1.9~15V
- Maximum Output Current: 500mA
- Ultra-Low Quiescent Current: 1μA
- High PSRR: 80dB @1kHz
- Low Dropout Voltage: 120mV@100mA, When V_{OUT}=3.6V
- Fixed Output Voltages: 1.8V ~ 5.0V
- Output Voltage Accuracy: ±2%
- Fast Transient Response
- Current Limit Protection
- Short Circuit Protection
- Thermal Shutdown Protection

APPLICATIONS

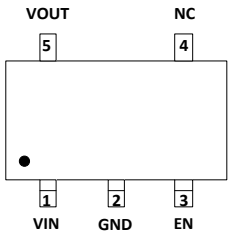
- Battery-powered Equipment
- Smoke Detector and Sensor
- Micro Controller Applications
- Home Appliance

TYPICAL APPLICATION CIRCUIT

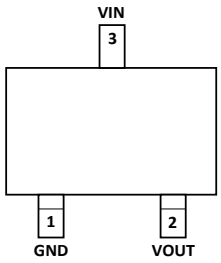


*: EN for SOT23-5 and SOT89-5 only

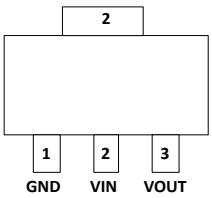
PIN CONFIGURATION



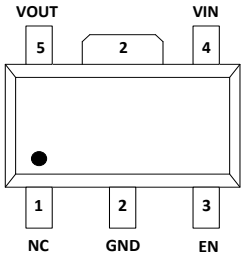
SOT23-5L



SOT23-3L



SOT89-3L



SOT89-5L

PIN DESCRIPTIONS

SOT23-5	SOT23-3	SOT89-3	SOT89-5	PIN	Description
1	3	2	4	VIN	Input Pin
2	1	1	2	GND	Ground Pin
3	-	-	3	EN	Enable pin
4	-	-	1	NC	No Connection
5	2	3	5	VOUT	Output Pin

ORDERING INFORMATION

Model	Package	Ordering Number	TAPE & REEL
SK6215E	SOT23-3	SK6215ES3-XX	3000/REEL
	SOT23-5	SK6215ES5-XX	3000/REEL
	SOT89-3	SK6215ET3B-XX	1000/REEL
	SOT89-5	SK6215ET5-XX	1000/REEL

Note: XX indicates output voltage. For example 33 means product outputs 3.3V.
SK6215E devices are Pb-free and RoHS compliant.

ABSOLUTE MAXIMUM RATINGS

Parameter	Description	Min	Max	Unit
Input Voltage	VIN to GND	-0.3	18	V
	VOUT to GND	-0.3	7	V
	VIN to VOUT	-0.3	18	V
	EN to GND	-0.3	18	V
Current	Peak output current	Internally limited		
Temperature	Operating Temperature Range	-40	125	°C
	Storage Temperature	-40	150	°C
Thermal Resistance (Junction to Ambient)	SOT89-3, SOT89-5	130		°C/W
	SOT23-3, SOT23-5	200		°C/W
Power Dissipation	SOT89-3, SOT89-5	900		mW
	SOT23-3, SOT23-5	600		mW

Note: Exceeding the range specified by the rated parameters will cause damage to the chip, and the working state of the chip beyond the range of rated parameters cannot be guaranteed. Exposure outside the rated parameter range will affect the reliability of the chip.

ESD RATINGS

Parameter	Description	Range	Unit
V_{ESD}	Human Body Model(HBM)	4	KV
	Charged Device Model(CDM)	2	KV

Note:
JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
JEDEC document JEP157 states that 200-V CDM allows safe manufacturing with a standard ESD control process.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Unit
V_{IN}	Input Voltage	1.9 to 15	V
I_{OUT}	Output Current	0 to 500	mA
T_A	Operating Ambient Temperature	-40 to 85	°C

ELECTRICAL CHARACTERISTICS

T_A=25°C, C_{IN}=1μF, V_{IN}=V_{SET}+1.0V, C_{OUT}=2.2μF, V_{OUT}=3.6V, unless otherwise noted.

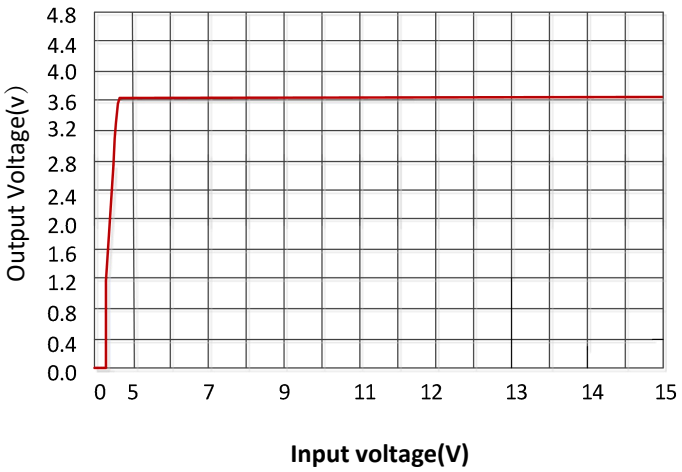
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating input voltage	V_{OUT}=1.8V	1.9		15	V
I_{GND}	Quiescent Current	V_{IN}=12V, No load		1	1.2	μA
$I_{ShutDown}$	Shutdown Current	V_{IN}=12V, V_{EN}=0V			0.3	μA
V_{OUT}	Output Voltage	V_{IN}=12V, I_{OUT}=10mA, T_A = +25°C	0.98* V_{SET}	V_{SET}	1.02* V_{SET}	V
I_{OUT_MAX}	Output Current	V_{IN}=V_{OUTNOM}+1V		500		mA
V_{DROP}	Dropout Voltage(Note1)	I_{OUT}=100mA , V_{IN}=V_{OUT}-0.1V		120		mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}=V_{OUT}+1V, 1mA≤I_{OUT}≤500mA		0.1		mV/mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=1mA, V_{OUT}+0.5V≤V_{IN}≤12V		0.2		mV/V
V_{EN_H}	Enable high threshold	Vin=5V, Vout=3.3V	0.7			V
V_{EN_L}	Enable low threshold	Vin=5V, Vout=3.3V			0.4	
I_{LIMIT}	Current Limit	V_{IN}=7V		900		mA
I_{SHUT}		V_{IN}=7V		160		mA
T_{SHDN}	Thermal Shutdown Temperature	Shutdown, temperature increasing		140		°C
		Reset, temperature decreasing		120		
PSRR		V_{IN}=5.3V, I_{OUT}=10mA F=1Khz, V_{OUT}=3.3V		80		dB
R_{DIS}	Output discharge resistance	V_{IN}=4.0V, V_{EN}=0V		3		KΩ

Note (1): Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

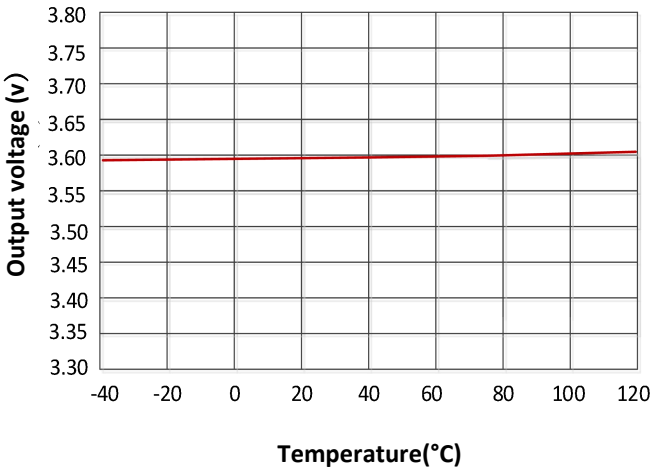
TYPICAL PERFORMANCE CHARACTERISTICS

T_A=25°C, C_{IN}=1μF, V_{IN}=V_{SET}+1V, C_{OUT}=2.2μF, V_{OUT}=3.6V, unless otherwise noted.

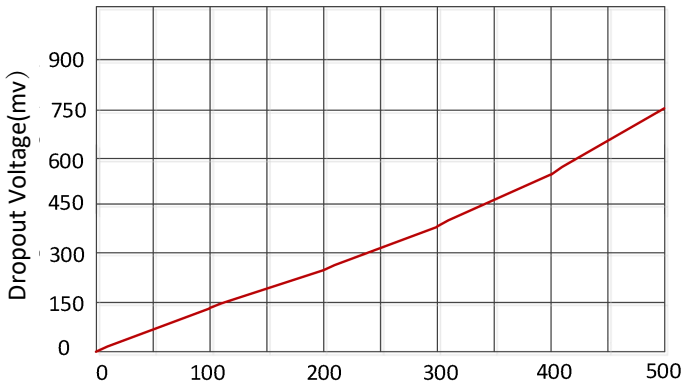
Output Voltage vs.Input voltage



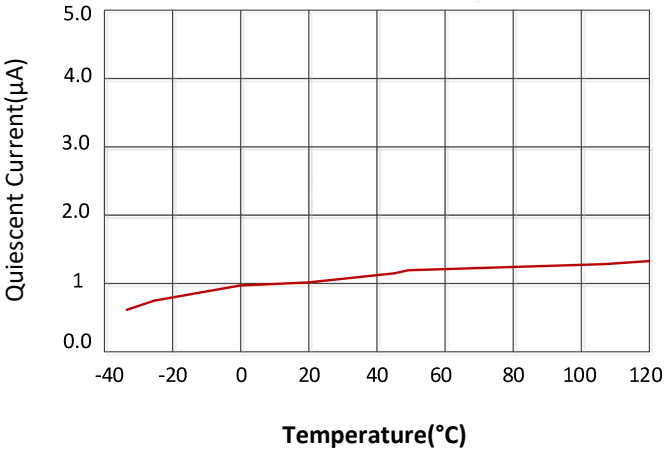
Output voltage vs.Temperature



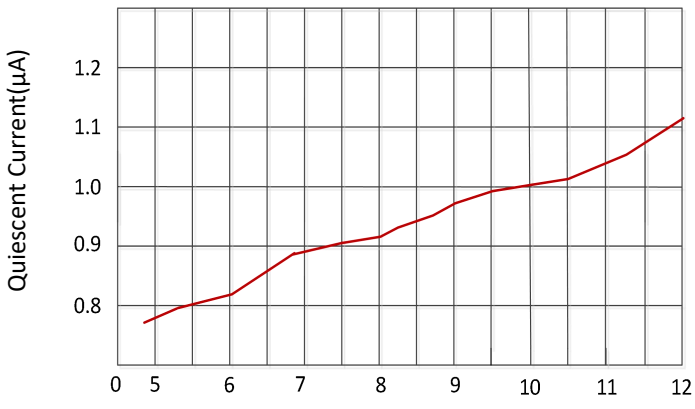
Dropout Voltage vs.Output Current



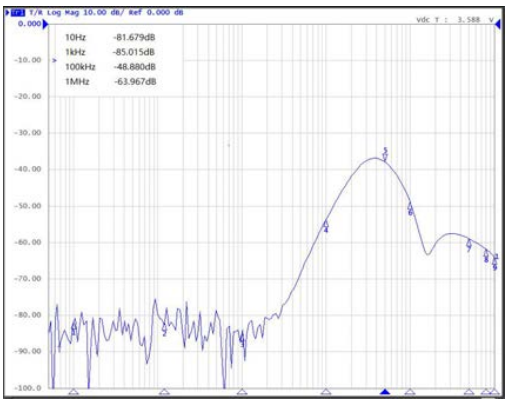
Quiescent Current vs.Temperature



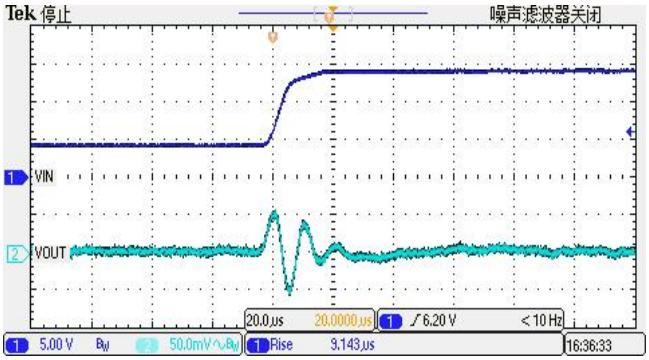
Quiescent Current vs.Input voltage



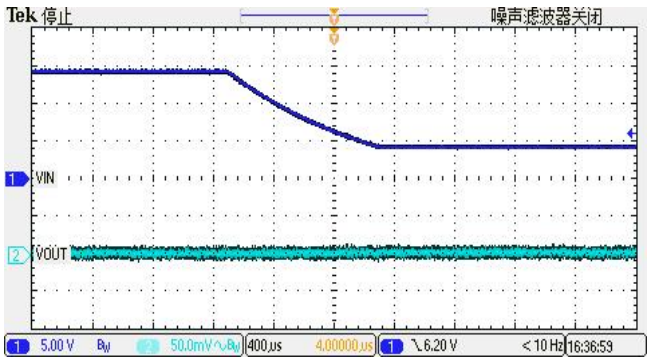
PSRR vs.frequency



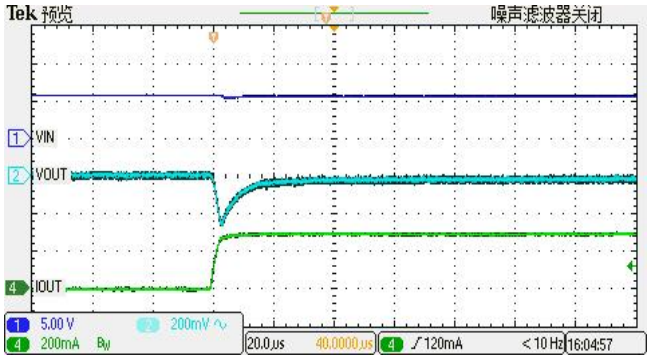
VIN=5.6V Vout=3.6V Iout=10mA



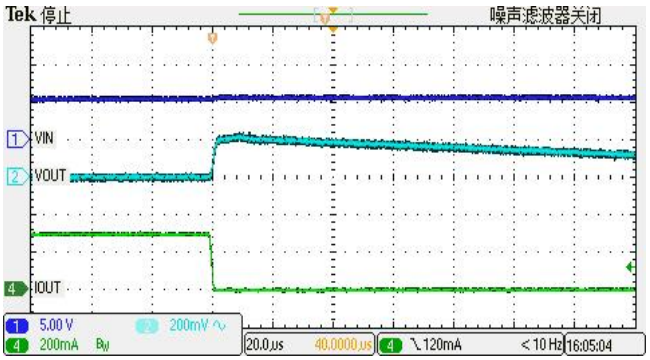
Line Transient Response



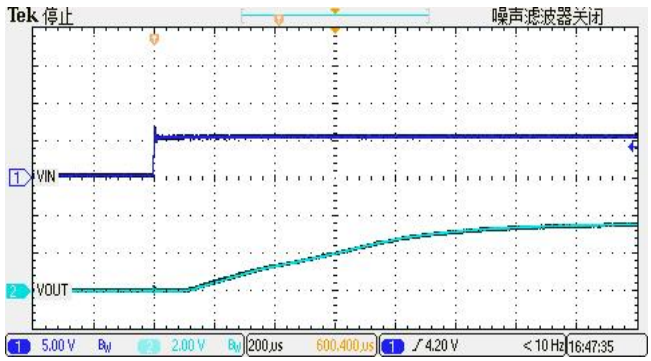
Line Transient Response



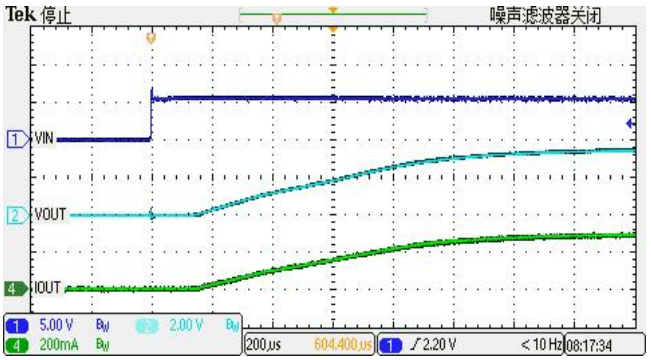
Load Transient Response



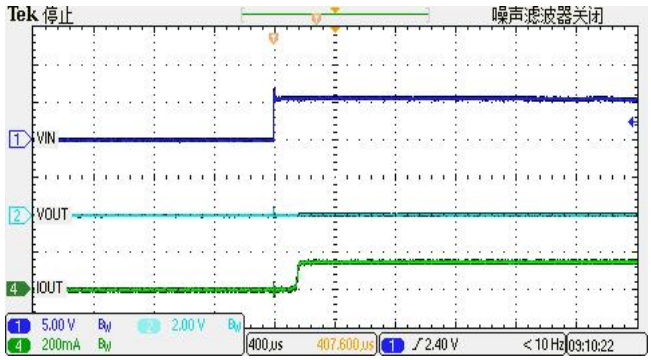
Load Transient Response



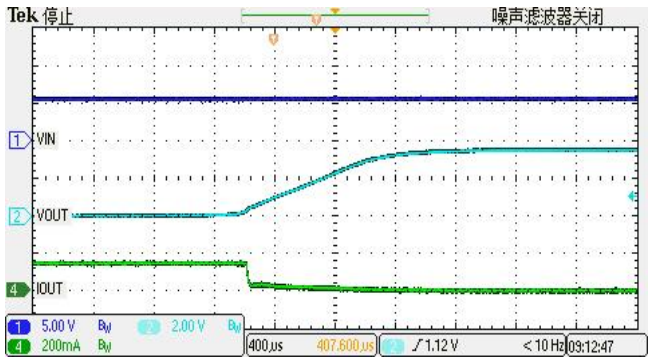
Start Up



Start Up

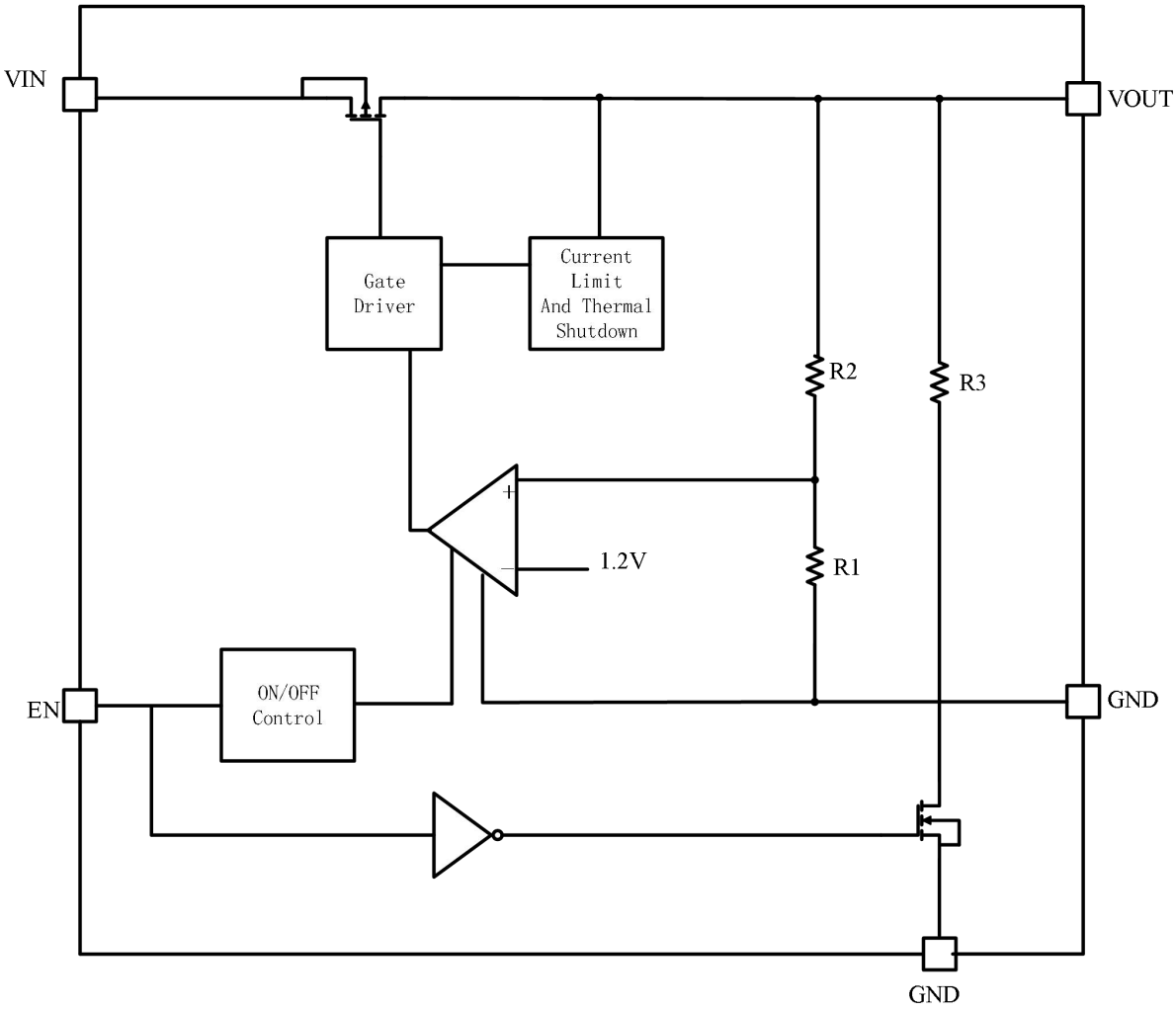


Short Circuit Protection



Short Circuit Protection

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Input Capacitor and Output Capacitor

A 1μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. 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 VIN and GND.

An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 2.2μF, ceramic capacitor is recommended, and temperature characteristics are X5R or X7R. Place output capacitor as close as possible to VOUT and GND pins.

Current Limit and Short Circuit Protection

When output current at VOUT pin is higher than current limit threshold or the VOUT pin is direct short to GND, the current limit protection will be triggered and clamp the output current at a pre-designed level to prevent overcurrent and thermal damage.

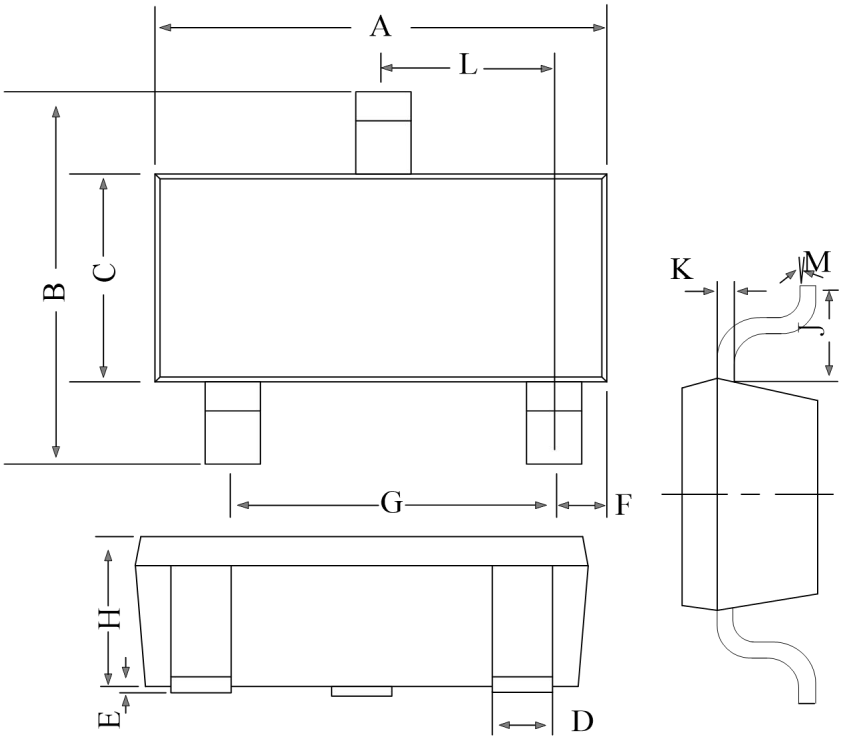
Power Dissipation and Thermal Protection

The SK6215E has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, and it will shut down the power MOSFET to prevent the LDO from damage. As soon as excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will lease the control of the power MOSFET, and the LDO device goes to normal operation. Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum junction temperature is dependent on power dissipation, package, the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature. During normal operation, LDO junction temperature should not exceed 125°C, or else it may result in deterioration of the properties of the chip. Using below equations to calculate the power dissipation and estimate the junction temperature.

The power dissipation can be calculated using Equation 1.

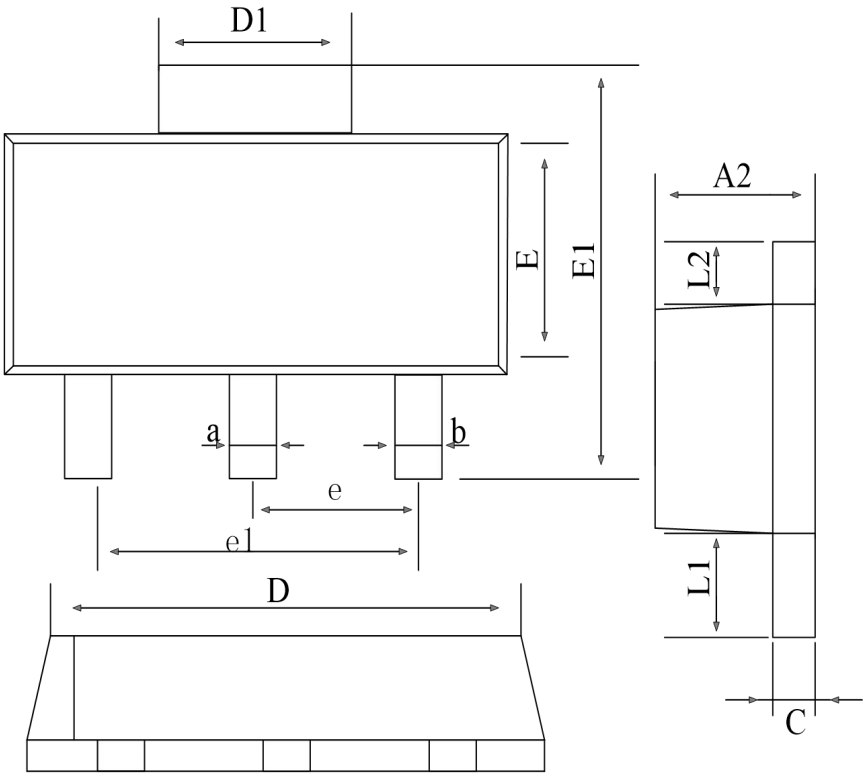
$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} \qquad (1)$$

PACKAGE DIMENSIONS: SOT23-3L



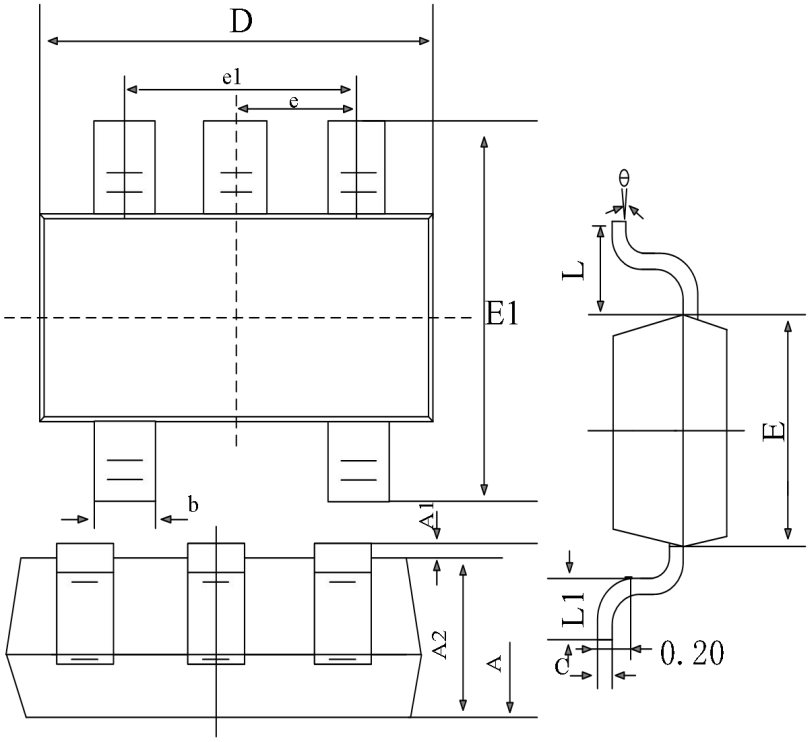
Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	2.85	2.95	3.05
B	2.65	2.80	2.95
C	1.50	1.60	1.70
D	0.30	0.40	0.50
E	0.00	0.05	0.10
F	0.45	0.50	0.55
G	1.90 BSC		
H	1.00	1.15	1.30
K	0.10	0.15	0.20
J	0.40	-	-
L	0.85	1.00	1.15
M	0°	-	10°

PACKAGE DIMENSIONS: SOT89-3L



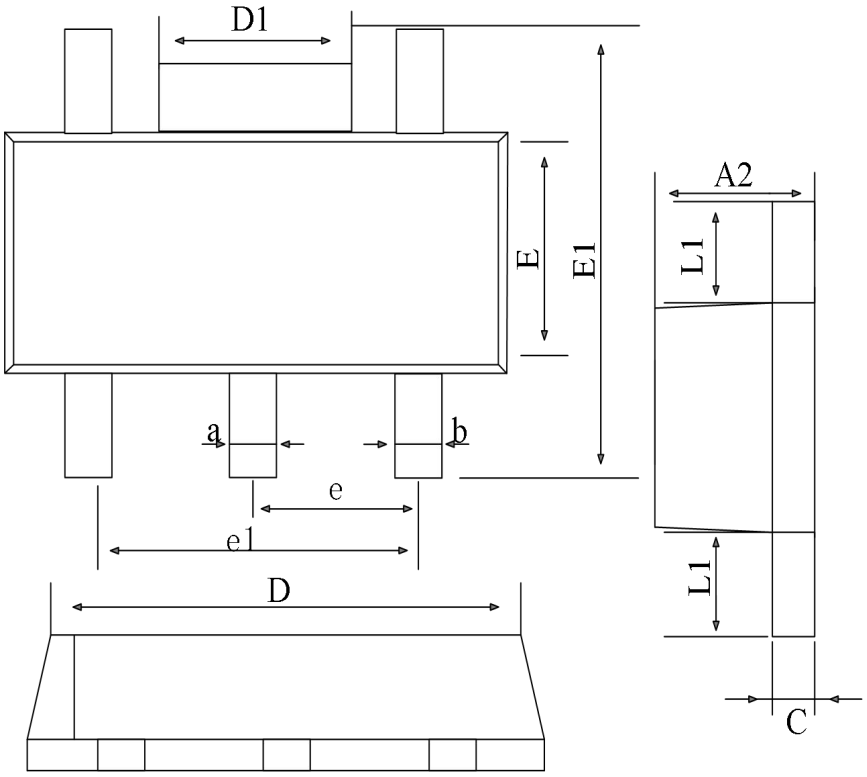
Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A2	1.40	1.50	1.60
a	0.45	0.50	0.55
b	0.38	0.43	0.48
c	0.36	0.41	0.46
D	4.40	4.50	4.60
D1	1.60	1.70	1.80
E	2.40	2.50	2.60
E1	4.00	4.15	4.30
e	1.00	1.50	2.00
e1	2.95	3.00	3.05
L1	0.80	0.90	1.00
L2	0.65	0.70	0.75

PACKAGE DIMENSIONS: SOT23-5L



Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	1.05	1.15	1.25
A1	0.00	0.05	0.10
A2	1.05	1.10	1.15
b	0.30	0.40	0.50
b1	0.29	0.38	0.47
C	0.10	0.15	0.20
C1	0.10	0.14	0.18
D	2.85	2.95	3.05
E	1.50	1.60	1.70
E1	2.65	2.80	2.95
e	0.95(BSC)		
e1	1.80	1.90	2.00
L	0.30	0.45	0.60
L1-L1`	0.00	0.06	0.12
θ	0°	-	8°

PACKAGE DIMENSIONS: SOT89-5L



Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A2	1.40	1.50	1.60
a	0.45	0.50	0.55
b	0.38	0.43	0.48
C	0.36	0.41	0.46
D	4.40	4.50	4.60
D1	1.60	1.70	1.80
E	2.40	2.50	2.60
E1	4.30	4.40	4.50
e	1.00	1.50	2.00
e1	2.95	3.00	3.05
L1	0.80	0.90	1.00