SK6055

800mA Dual-rail Ultra-Low Dropout LDO

GENERAL DESCRIPTION

The SK6055 series are CMOS-based low-dropout, low-power linear regulators, capable of delivering 800mA output current with NMOS pass transistor and a separate bias supply voltage (VBIAS).

The SK6055 provides very stable, accurate output voltage with low noise, high ripple rejection and low supply current suitable for space constrained, noise sensitive application.

The SK6055 series consist of an accurate voltage-reference block, an error amplifier, a thermal-shutdown circuit, and a current limit circuit.

The SK6055 series are available in DFN1.2x1.2-4L and DFN1.2×1.2-6L packages.

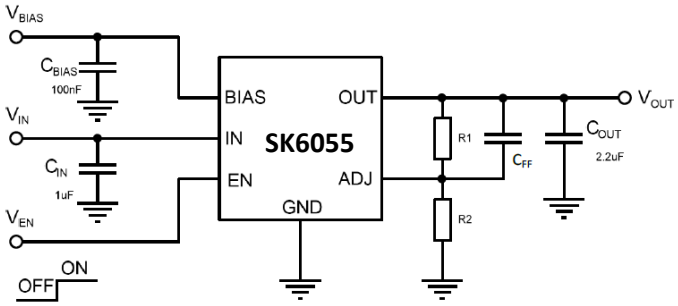
FEATURES

- Wide Input Voltage Range: 0.8V ~ 5.5V
- Wide V_{BIAS} Voltage Range: 2.7V ~ 5.5V
- Adjustable Output Voltage Range:0.8 ~ 3.6V
- Fixed Output Voltage Range: 0.8V ~ 2.1V
- High PSRR: 80dB @1KHz
- Very Low V_{BIAS} Input Current: 80μA (Typ.)
- Ultra-Low Dropout: 125mV@500mA (Typ.)
- Built-in Overcurrent Protection and Thermal Shutdown Circuit
- Built-in Auto-Discharging Circuit
- Built-in Under Voltage Lock-out
- Operating Temperature Range: -40 ~85°C

APPLICATION

- Portable Equipment
- Smartphones, Tablets
- Constant-voltage power supply for cameras, DVRs, STB and camcorders

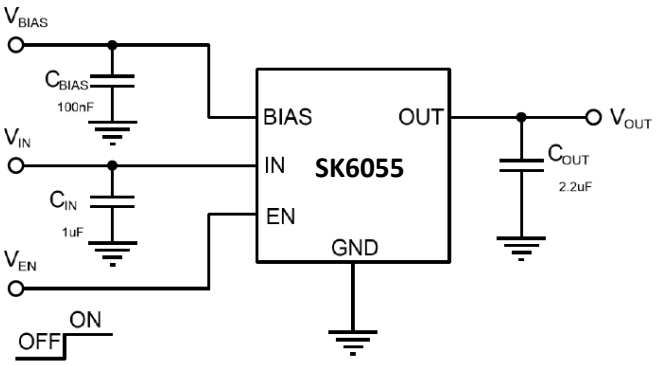
TYPICAL APPLICATION CIRCUITS



V_{OUT} = 0.8V × (1+R1/R2)

R1+R2 < 100kΩ

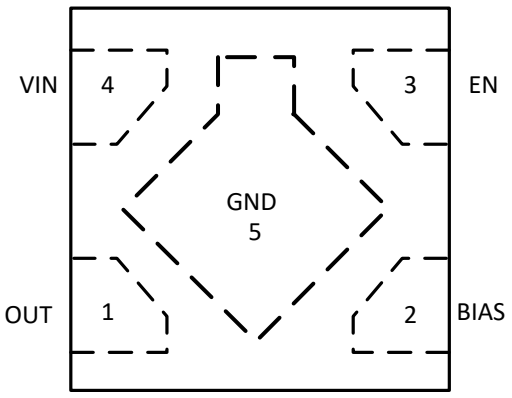
Typical application circuit of adjustable version



Typical application circuit of fixed version

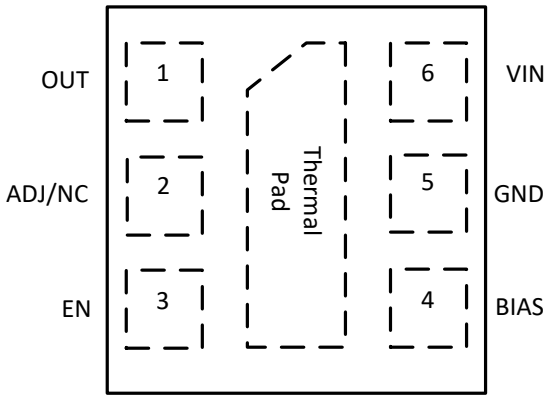
PIN CONFIGURATION

TOP VIEW



DFN1.2 × 1.2-4L

TOP VIEW



DFN1.2 × 1.2-6L

PIN DESCRIPTIONS

Pin No.		Symbol	Pin Description
DFN-4	DFN-6		
1	1	OUT	The power output of the device
2	4	BIAS	Input voltage for controlling circuit
3	3	EN	Enable
4	6	VIN	Input voltage Pin. Large bulk capacitance should be placed closely to this pin. A 1μF ceramic capacitor is recommended at this pin.
5	5	GND	Ground pin. Thermal PAD.
-	2	ADJ/NC	Adjustable Regulator Feedback Input. Connect to output voltage resistor divider central node. / No Connect.
-	Thermal Pad	-	Thermal pad, connect to GND.

ORDERING INFORMATION

Ordering Number	Package	Vout Type	Tape & Reel
SK6055D4-XX	DFN1.2 × 1.2-4L	Fixed	3000
SK6055D6-XX	DFN1.2 × 1.2-6L	Fixed	3000
SK6055D6-ADJ	DFN1.2 × 1.2-6L	Adjustable	3000

XX indicates fixed output voltage. For example, 12 means product outputs 1.2V.
ADJ: Adjustable output voltage rang from 0.8V to 3.6V.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Item	Rating	Unit
Input Voltage(VIN Pin)	-0.3 to 6.0	V
Input Voltage (VBIAS Pin)	-0.3 to 6.0	V
Input Voltage (EN Pin)	-0.3 to 6.0	V
Input Voltage (ADJ Pin)	-0.3 to 6.0	V
Output Voltage	-0.3 to 6.0	V
Maximum Load Current	800	mA
Maximum Power Consumption	640	mW
Operating Temperature Range	-40 to +85	ºC
Storage Temperature Range	-55 to +150	ºC
Operating Junction Temperature	-40 to +150	ºC

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

ESD RATINGS

Item	Rating	Unit
Human Body Model	2000	V
Machine Model	200	V

RECOMMENDED OPERATINGS CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	IN Input Voltage	V_{OUT}+ V_{DROP} to 5.5	V
V_{BIAS}	BIAS Input Voltage	2.7 to 5.5 & V_{BIAS}>=V_{OUT}+1.4V	V
I_{OUT}	Output Current	0 to 800	mA
T_A	Operating Ambient Temperature	-40 to 85	ºC
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 10	µF
C_{BIAS}	Effective Input Ceramic Capacitor Value	0.047 to 4.7	µF
C_{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	µF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

ELECTRICAL CHARACTERISTICS

V_{IN}=V_{OUT}+0.3V,V_{BIAS}=V_{OUT}+1.6V,I_{OUT}=1mA, C_{IN}=1μF,C_{OUT}=2.2μF,C_{BIAS}=0.1uF, TA= -40°C~85°C. Typical values are at. T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}(1)	V_{IN}>V_{OUT}	V_{OUT}+ V_{DROP}		5.5	V
V_{BIAS} Voltage Range	V_{BIAS}	V_{BIAS}≥V_{OUT}+1.6V	2.4		5.5	V
Under-voltage lock-out	V_{UVLO}	V_{BIAS} Rising/Hysteresis		1.6/0.2		V
V_{BIAS} Current	I_{Q_ON}	Active mode: V_{EN}=H		80	110	μA
	I_{Q_OFF}	V_{EN}=L		0.1	0.5	μA
Output Voltage	V_{OUT}	I_{OUT}=1mA~800mA, T_A=25°C	-1		1	%
Dropout Voltage	V_{DROP}	I_{OUT}=500mA,V_{OUT}=1.1V		125	187	mV
		I_{OUT}=800mA,V_{OUT}=1.1V		200	300	
Current Limit	I_{LIM}	V_{OUT}=90%V_{OUT}	800	1150	1550	mA
Load Regulation	Reg_{LOAD}	1mA≤ I_{OUT} ≤800mA		2	20	mV
V_{IN} Line Regulation	Reg_{LINE}	V_{OUT}+0.3V≤V_{IN}≤5 V (I_{OUT}=1mA)		0.01	0.1	%/V
V_{BIAS} Line Regulation		(V_{OUT}+1.6V)<V_{BIAS}< 5.5V , (V_{IN}=V_{OUT}+0.3V, I_{OUT}=1mA)		0.01	0.1	%/V
Ripple Rejection	PSRR(2)	V_{IN} to V_{OUT},f=1kHz, Ripple 0.2Vp-p,I_{OUT}=30mA		80		dB
		V_{BIAS} to V_{OUT},f=1kHz, Ripple 0.2Vp-p, I_{OUT}=30mA		80		
Output Noise	e_N(2)	V_{IN}=1.6V,V_{OUT}=1.1V, f= 10 Hz to 100 kHz		50× V_{OUT}		μ_{VRMS}
EN Pull-down Current	I_{EN}	V_{EN}=5.5V		0.5	1	μA
EN Input Voltage High	V_{ENH}		0.9			V
EN Input Voltage Low	V_{ENL}				0.4	V
Output resistance of auto discharge at off state	R_{DIS}	V_{EN}=0V, V_{OUT}=0.5V		150		Ω
Line transient	V_{TRLN}(2)	V_{IN}=V_{OUT}+0.3V to 5.5V in 10us,I_{OUT}=1mA,T_A=25°C		18	30	mV
		V_{IN}= 5.5V to V_{OUT}+0.3V in 10us, I_{OUT}=1mA,T_A=25°C		18	30	mV
Load transient	V_{TRLD}(2)	I_{OUT}=1mA to 800mA in 10us V_{IN}=V_{OUT}+0.5V,T_A=25°C		120	180	mV
		I_{OUT}=800mA to 1mA in 10us V_{IN}=V_{OUT}+0.5V,T_A=25°C		80	120	mV

ELECTRICAL CHARACTERISTICS (Continued)

V_{IN}=V_{OUT}+0.3V,V_{BIAS}=V_{OUT}+1.6V,I_{OUT}=1mA, C_{IN}=1μF,C_{OUT}=2.2μF,C_{BIAS}=0.1uF, TA= -40°C~85°C. Typical values are at. T_A = 25°C, unless otherwise noted.

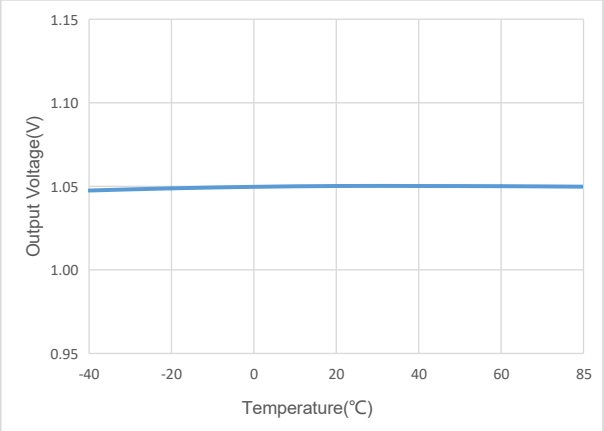
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Turn-On Time	T_{ON}	From assertion of V_{EN} to V_{OUT}=98%$V_{OUT(NOM)}$		120		μs
Thermal Shutdown Temperature	T_{TSD}	Temperature increasing		165		℃
Thermal Shutdown Released Temperature	T_{TSR}	Temperature decreasing		145		℃

Note (1): The maximum input voltage should take into account the maximum power consumption ($PD_{(MAX)}$). The calculation formula is: $P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT}) \times I_{OUT}$.
The maximum power consumption of the circuit is 640mW.

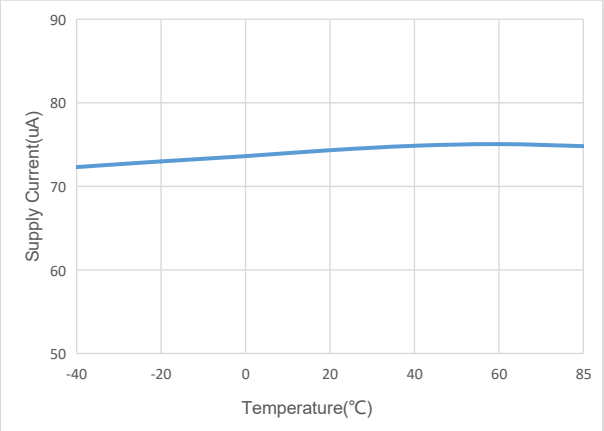
Note (2): Guaranteed by design and characterization.

TYPICAL PERFORMANCE CHARACTERISTICS

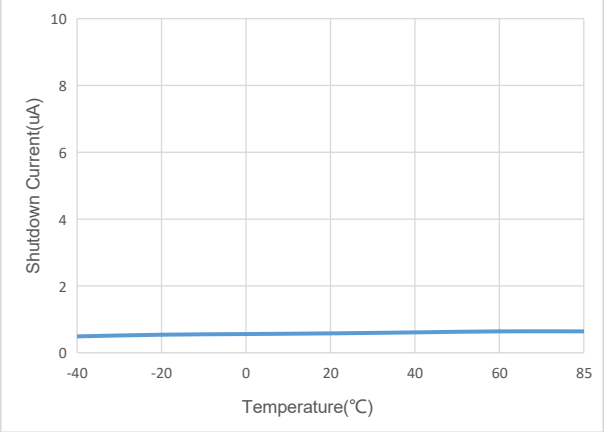
V_{OUT}=1.05V, V_{IN}=V_{OUT}+0.3V, V_{BIAS}=V_{OUT}+1.6V, C_{IN}=1μF, C_{OUT}=2.2μF, C_{BIAS}=1uF, T_A= -40°C~+85°C.



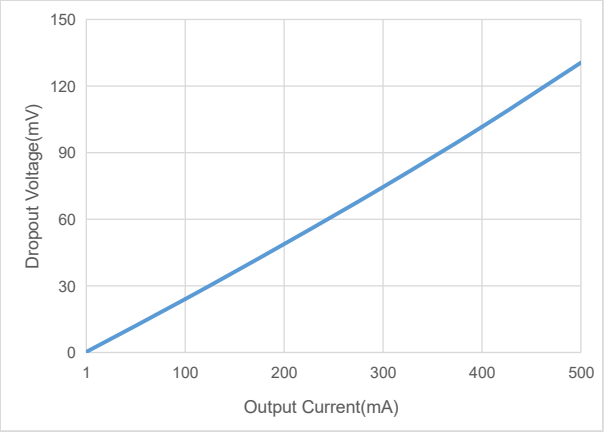
Output Voltage VS Temperature



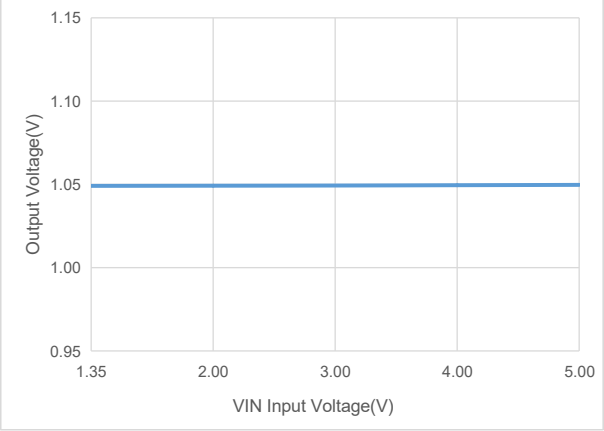
Supply Current VS Temperature



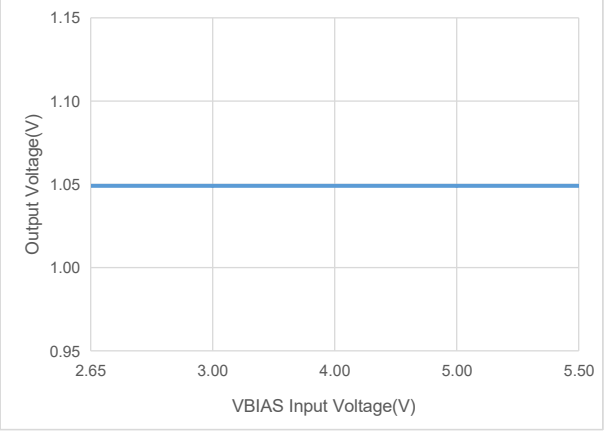
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



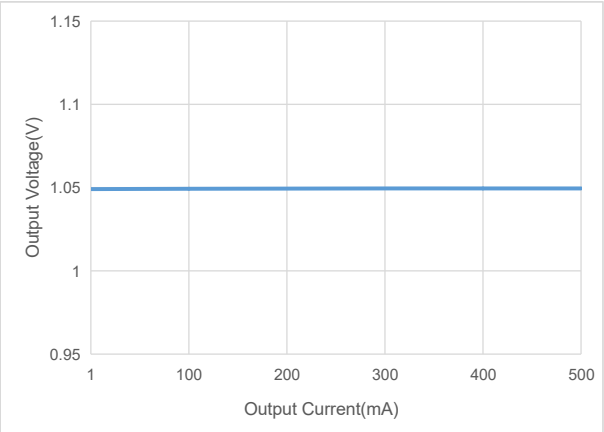
Output Voltage VS VIN Input Voltage



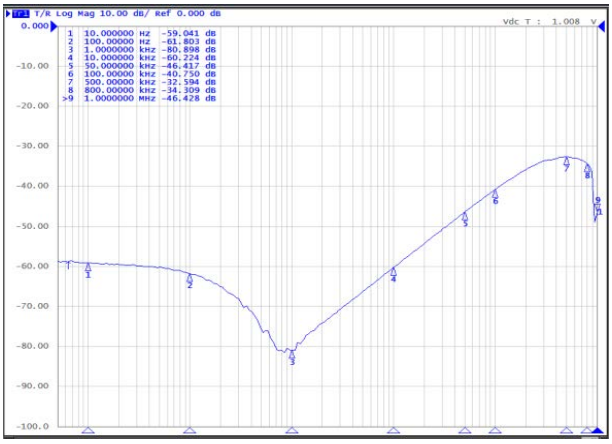
Output Voltage VS VBIAS Input Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

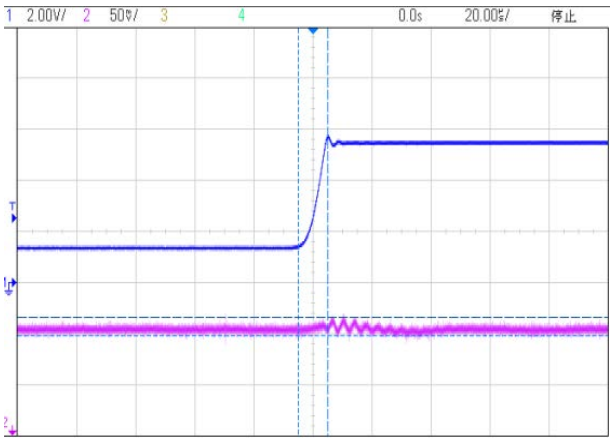
V_{OUT}=1.05V, V_{IN}=V_{OUT}+0.3V, V_{BIAS}=V_{OUT}+1.6V, C_{IN}=1μF, C_{OUT}=2.2μF, C_{BIAS}=1uF, T_A= -40°C~+85°C.



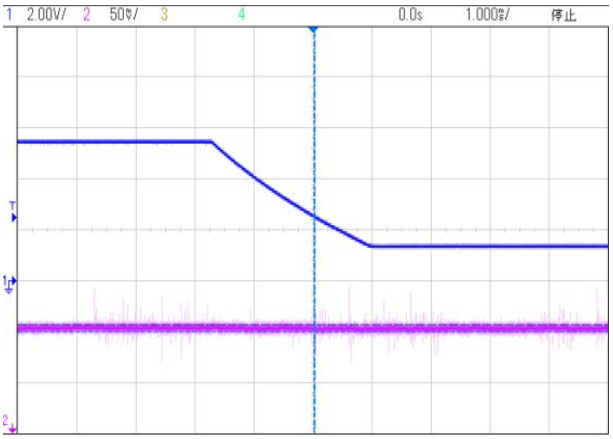
Output Voltage VS Output Current



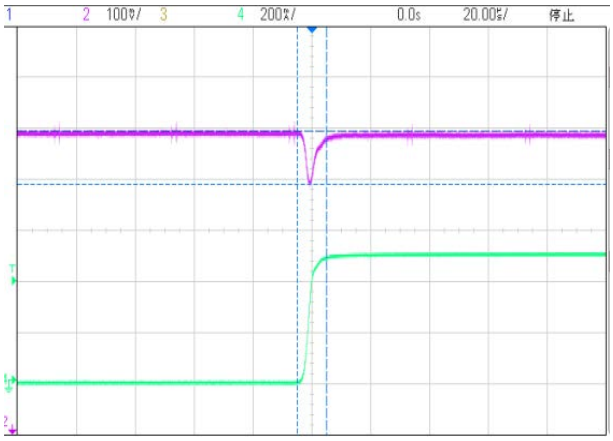
PSRR



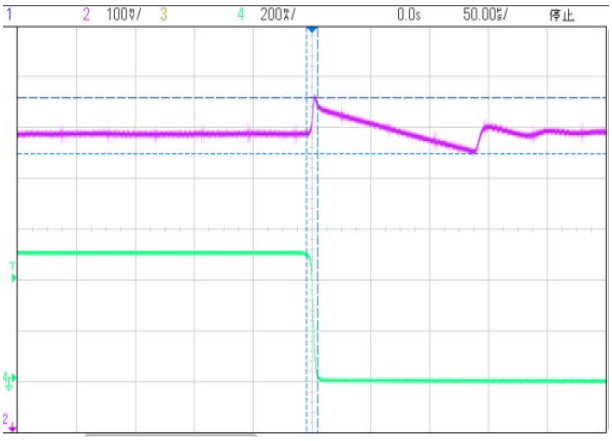
Input Transient(1.35~5.5V t=10us 1mA)



Input Transient(5.5~1.35V)

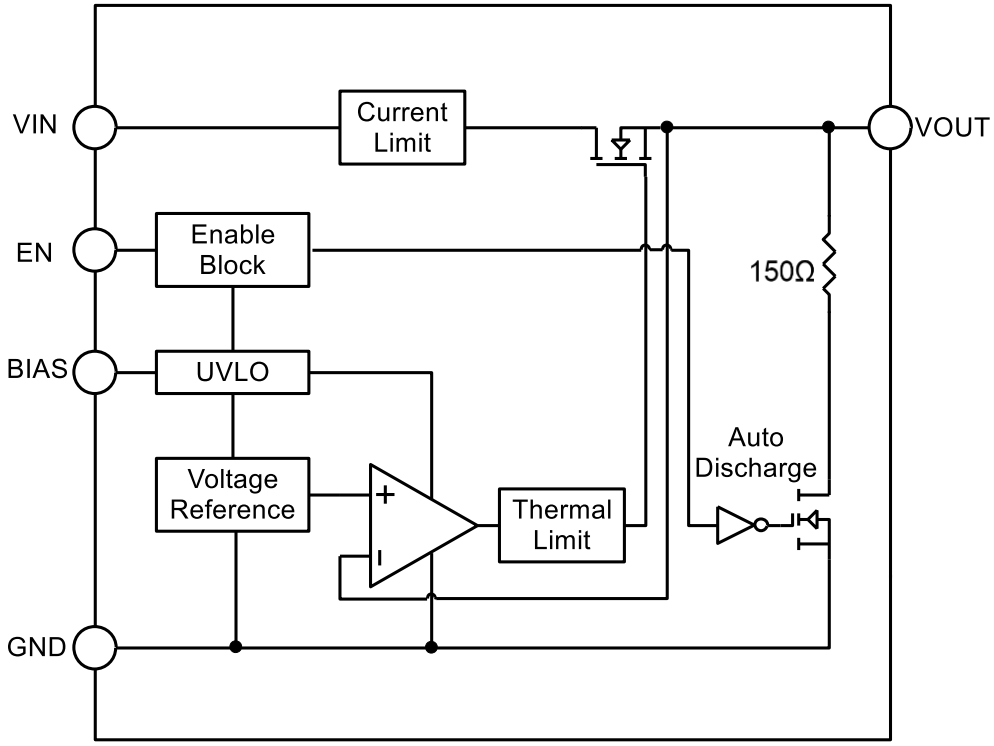


Load Transient(1mA~0.5A t=10us)

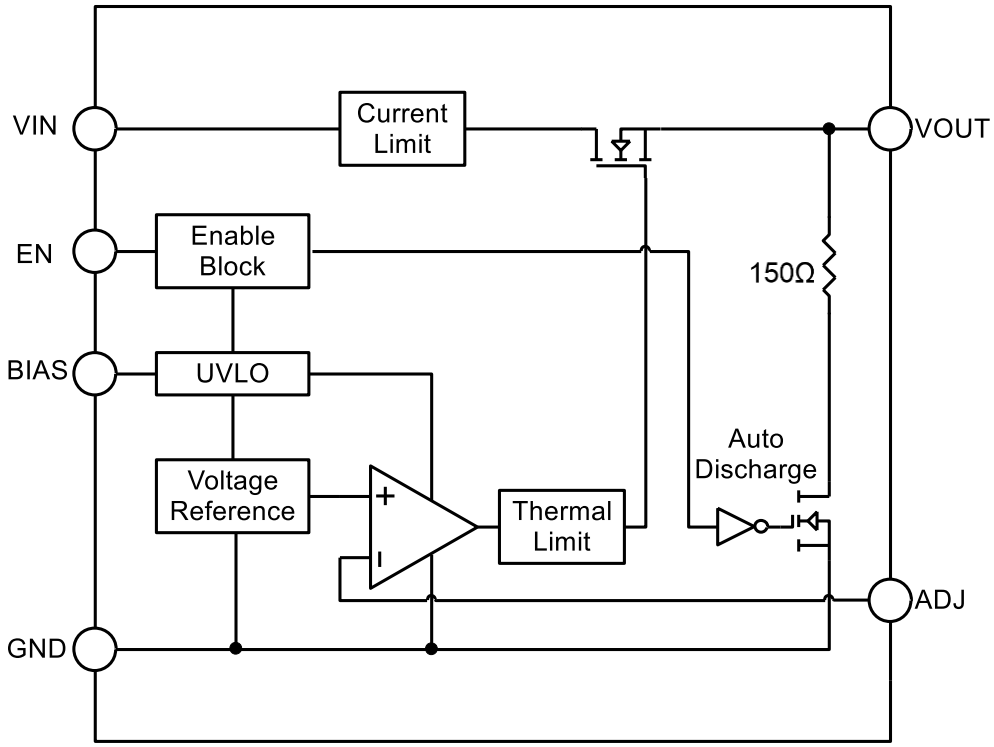


Load Transient(0.5A~1mA t=10us)

BLOCK DIAGRAM



Fixed Version



Adjustable Version

FUNCTIONAL DESCRIPTION

The SK6055 dual−rail ultra-low dropout voltage regulator is using NMOS pass transistor for output voltage regulation from V_{IN}. All the low current internal control circuitry is powered from the V_{BIAS}.

The use of an NMOS pass transistor offers several advantages in applications. Unlike PMOS topology devices, the output capacitor has reduced impact on loop stability. V_{IN} to V_{OUT} operating voltage difference can be very low compared with standard PMOS regulators in very low V_{IN} applications.

The SK6055 offers smooth monotonic start-up.

Output Voltage Adjust (for ADJ version only)

The required output voltage of adjustable devices can be adjusted from 0.8V to 3.6V using two external resistors. The output voltage: $V_{OUT} = 0.8V \times (1 + R1/R2)$.

It is recommended to keep the total serial resistance of resistors (R1 + R2) no greater than 100kΩ.

Input and Output Capacitor

The device is designed to be stable for ceramic output capacitors with effective capacitance in the range from 2.2μF to 4.7μF. The device is also stable with multiple capacitors in parallel, having the total effective capacitance in the specified range. In applications where no low input supplies impedance available (PCB inductance in V_{IN} and/or V_{BIAS} inputs as example), the recommended C_{IN} = 1uF and C_{BIAS} = 0.1μF or greater.

Enable Pin Operation

The SK6055 is turned on by setting the EN pin to “H”. The threshold limits are covered in the electrical characteristics table in this datasheet. When the EN pin is not used, connect the EN pin with V_{BIAS} to keep the LDO in operating mode.

Current Limit Protection

When output current of OUT pin is higher than current limit threshold or the OUT 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 over-current and thermal damage.

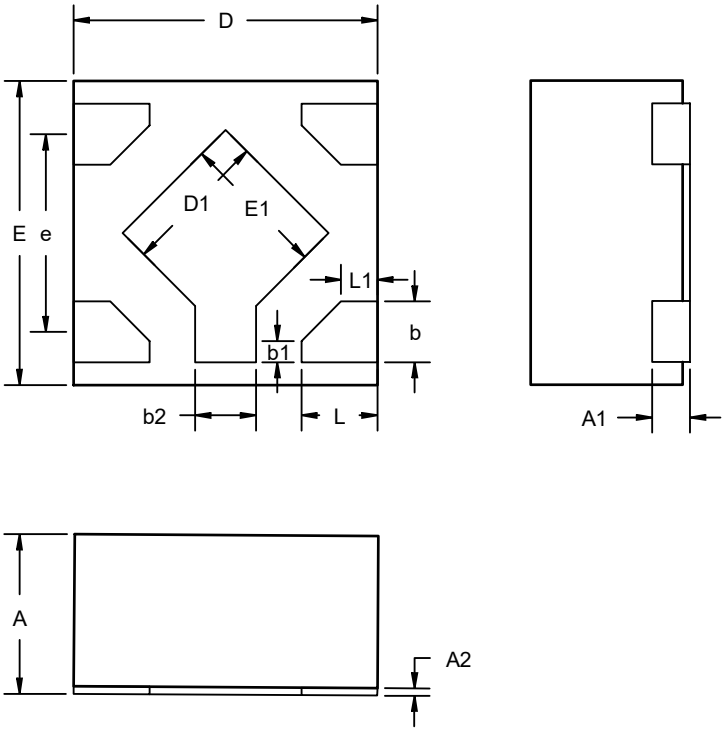
Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately 165°C, allowing the device to cool down. When the junction temperature reduces to approximately 145°C, the output circuit 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.

Auto Discharging

When the EN pin set to “L”, the output circuit will be disable immediately, and the Auto-Discharging circuit will be turned on to discharge the electric charge on output capacitor, and decrease the voltage of OUT in very short time.

PACKAGE DIMENSIONS: DFN1.2 × 1.2-4L

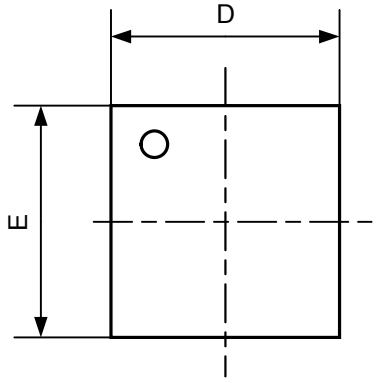


COMMON DIMENSIONS

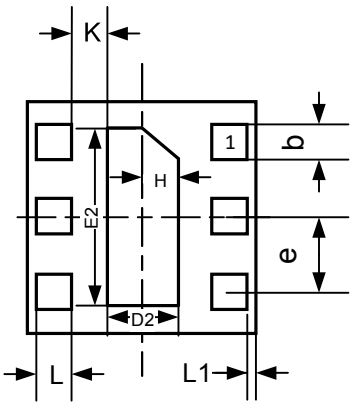
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.35	0.40	0.45
A1		0.13REF	
A2	0.00	0.02	0.05
b	0.25	0.30	0.35
b1		0.12REF	
b2	0.15	0.20	0.25
D	1.15	1.20	1.25
D1	0.58	0.63	0.68
E	1.15	1.20	1.25
E1	0.58	0.63	0.68
e		0.8BSC	
L	0.25	0.30	0.35
L1		0.12REF	

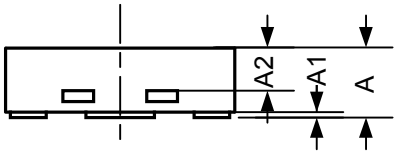
PACKAGE DIMENSIONS: DFN1.2 × 1.2-6L



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Unit: mm

Symbol	Dimensions In Millimeters		
	Min	Nom	Max
A	0.34	0.37	0.40
A1	0.00	0.02	0.05
A2		0.27REF	
b	0.13	0.18	0.23
D	1.10	1.20	1.30
E	1.10	1.20	1.30
D2	0.25	0.30	0.35
E2	0.89	0.94	0.99
e	0.30	0.40	0.50
H		0.15REF	
K	0.15	0.20	0.25
L	0.15	0.20	0.25
L1	0.00	0.05	0.10