SK601302 6V 500mA, Ultra High PSRR, Low Noise LDO

GENERAL DESCRIPTION

The SK601302 series are a group of positive voltage regulators manufactured by CMOS technologies with high ripple rejection, ultra-low noise, low power consumption and low dropout voltage, which can prolong battery life in portable electronics.

The SK601302 series work with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications.

The SK601302 series consume less than 0.1μA in shutdown mode and have fast turn-on time less than 50μS. The series are very suitable for the battery-powered equipment, such as RF applications and other systems requiring a quiet voltage source.

The SK601302 series are available in TDFN1×1-4L and SOT23-5 Packages.

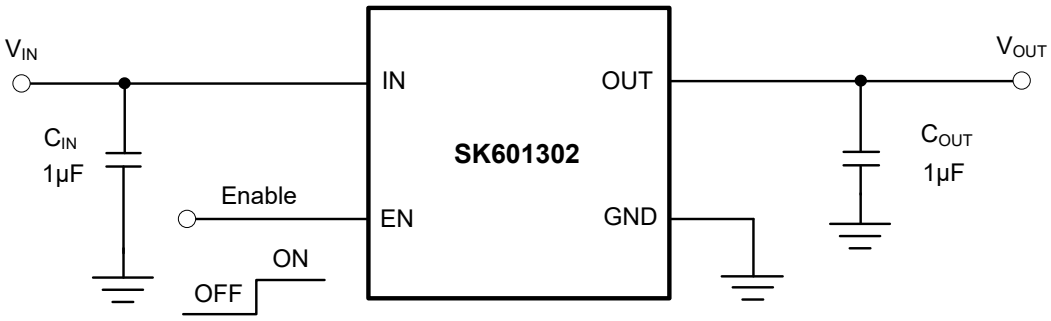
FEATURES

- Operating Input Voltage Range: 1.4V ~ 6.0V
- 500mA Maximum Output Current
- High PSRR: 80dB @1kHz
- Low Quiescent Current： 35μA (typ.)
- Low Dropout Voltage: 240mV @100mA, when V_{OUT}=2.8V
- Fixed Output Voltage Range: 0.8V ~ 5.0V
- Excellent Line and Load Transient Response
- High Accuracy: ±1% （Typ.）
- Low Output Noise: 40μVRMS (10Hz~100kHz)
- Built-in Current Limit Protection
- Thermal shutdown Protection
- Short-Circuit Protection
- TTL- Logic-Controlled Shutdown Input
- With Output Automatic Discharge

APPLICATIONS

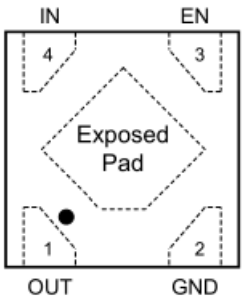
- Portable Electronic Devices
- Smoke Detectors
- IP Cameras
- Wireless LAN Devices
- Smartphones and Tablets
- Digital Cameras and Audio Devices

TYPICAL APPLICATION CIRCUIT



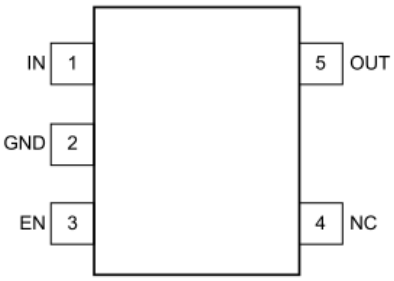
PIN CONFIGURATION

TOP VIEW



TDFN1×1-4L

TOP VIEW



SOT23-5

PIN DESCRIPTIONS

Pin Number		Pin Name	Description
SOT23-5	TDFN1×1-4L		
1	4	IN	Input Supply Voltage Pin. It is recommended to use a 1μF or larger ceramic capacitor from IN pin to ground to get good power supply decoupling. This ceramic capacitor should be placed as close as possible to IN pin.
2	2	GND	Ground.
3	3	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. This pin must be pulled high by an external resistor connected to IN pin if EN pin is not used.
4	-	NC	No Connection.
5	1	OUT	Regulator Output Pin. It is recommended to use a ceramic capacitor with effective capacitance in the range of 1μF to 10 μF to ensure stability. This ceramic capacitor should be placed as close as possible to OUT pin.
-	Exposed Pad	GND	Exposed Pad. Connect it to a large ground plane to maximize thermal performance.

ORDERING INFORMATION

Model	Package	Ordering Number	Tape & Reel
SK601302	TDFN1X1-4L	SK601302D4-XX	3000/REEL 10000/REEL
	SOT23-5L	SK601302S5-XX	3000/REEL

Note: XX indicates output voltage. For example, 28 means product outputs 2.8V.

SK601302 devices are Pb-free and RoHS compliant.

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameters	Min	Max	Unit
VIN Voltage	-0.3	7	V
EN Voltage	-0.3	7	V
VOUT Voltage(2)	-0.3	VIN+0.3	V
Output Current	-	600	mA
Power Dissipation	-	400	mW
Operating free air temperature range	-40	85	°C
Operating junction temperature,TJ	-40	150	°C
Storage temperature, Tstg	-65	150	°C
Lead Temperature（Soldering，10sec.)	-	260	°C

Note (1): Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. 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.

Note (2): All voltage values are with respect to network ground terminal

ESD RATINGS

Parameters	Description	Value	Unit
ESD-HBM	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V
ESD-CDM	Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±200	V

Note:

JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

THERMAL INFORMATION

Symbol	Description	SOT23-5	TDFN-1×1-4L	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance(Note 1 & 2)	210	210	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	141.4	103.6	°C/W
$R_{\theta JB}$	Junction-to-board(Bottom) thermal resistance	44.5	110.6	°C/W
ψ_{JT}	Junction-to-top characterization parameter	34.5	3.0	°C/W
ψ_{JB}	Junction-to-board characterization parameter	43.9	103.3	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board.

RECOMMENDED OPERATING CONDITIONS

Parameters	Min	Max	Unit
VIN Voltage (V_{IN})	1.4	6	V
VOUT Voltage (V_{OUT})	0.8	5	V
Output current (I_{OUT})	-	500	mA
T_A	-40	85	°C

Note: All limits specified at room temperature (T_A=25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

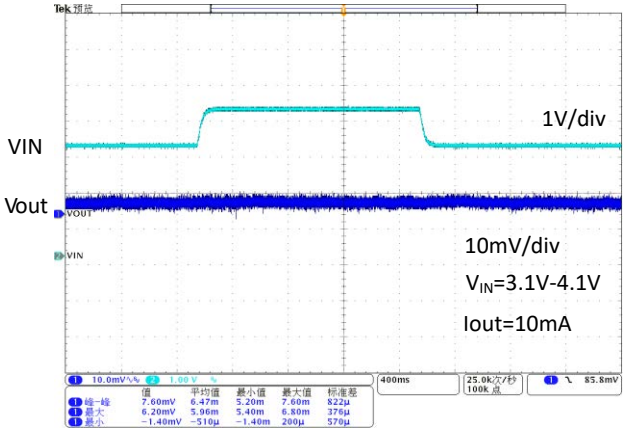
ELECTRICAL CHARACTERISTICS

V_{IN}=V_{OUT}+1V, C_{IN}=C_{OUT}=1μF, T_A=25°C, unless otherwise specified.

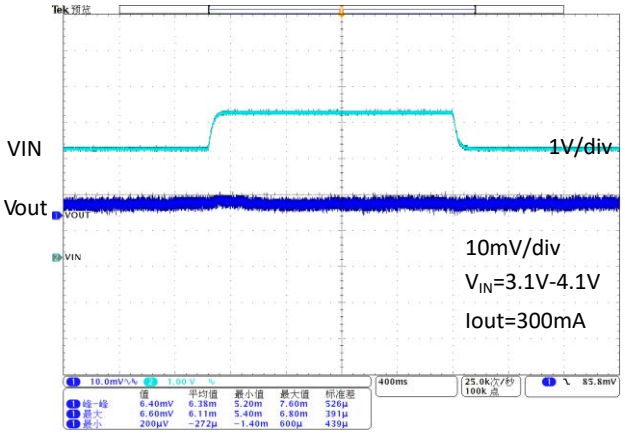
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Input Voltage	V_{IN}	-	1.4	-	6	V
Output Voltage	V_{OUT}	I_{OUT}=1mA	V_{OUT}* 0.99	-	V_{OUT}* 1.01	V
Supply Current	I_Q	I_{OUT}=0mA		35		μA
Standby Current	I_{SHDN}	V_{EN}=0V		0.1	1	μA
Output Current	I_{OUT}	-		500		mA
Dropout Voltage	V_{DROP}	I_{OUT}=300mA, V_{OUT}=1.8V		410		mV
		I_{OUT}=300mA, V_{OUT}=2.8V		270		mV
		I_{OUT}=300mA, V_{OUT}=3.3V		250		mV
		I_{OUT}=500mA, V_{OUT}=1.8V		710		mV
		I_{OUT}=500mA, V_{OUT}=2.8V		470		mV
		I_{OUT}=500mA V_{OUT}=3.3V		430		mV
Load Regulation	ΔV_{OUT}	V_{IN}= V_{OUT} +1V, 1mA≤I_{OUT}≤500mA		10		mV
Line Regulation	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$	I_{OUT} =100mA V_{OUT} +1V≤V_{IN}≤6V		0.01	0.2	%/V
Output Voltage Temperature Characteristics	$\frac{\Delta V_{OUT}}{\Delta T \times V_{OUT}}$	I_{OUT} =10mA -40≤T_A≤+85°C		50		ppm
Short Current	Ishort	V_{OUT}=0V		130		mA
Power Supply Rejection Rate	PSRR	F=100HZ Iout=50mA		75		dB
		F=1KHZ Iout=50mA		80		
		F=10KHZ Iout=50mA		70		
EN Rising Threshold	$V_{EN(R)}$	1.8V≦V_{IN}≦5.5V	1.4			V
EN Falling Threshold	$V_{EN(F)}$	1.8V≦V_{IN}≦5.5V			0.3	V
Over-Temperature Protection	T_{SD}			160		°C
Over-Temperature Protection hysteresis	△T_{SD}			20		°C
Auto-Discharge Resistance	$R_{DISCHRG}$	V_{IN}=5V, V_{OUT}=3.0V, V_{CE}=V_{SS}		100		Ω

TYPICAL PERFORMANCE CHARACTERISTICS

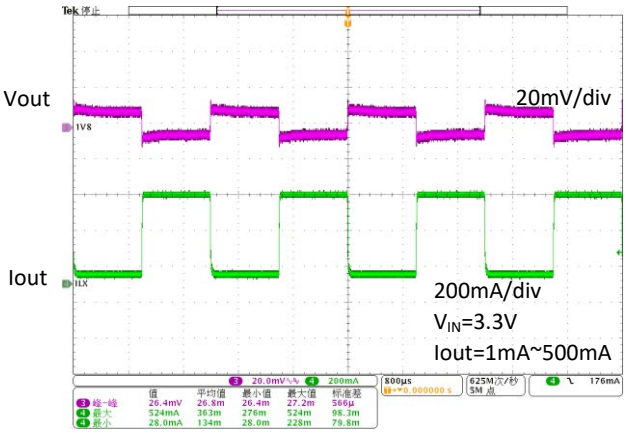
T_A=+25°C, V_{IN}=($V_{OUT(SET)}$+1V), V_{EN}=V_{IN}, C_{IN}=C_{OUT}=1μF, unless otherwise noted.



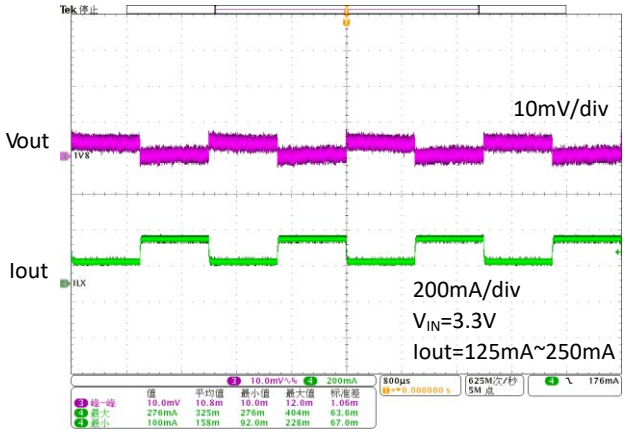
V_{OUT}=2.8V, Line Transient Response



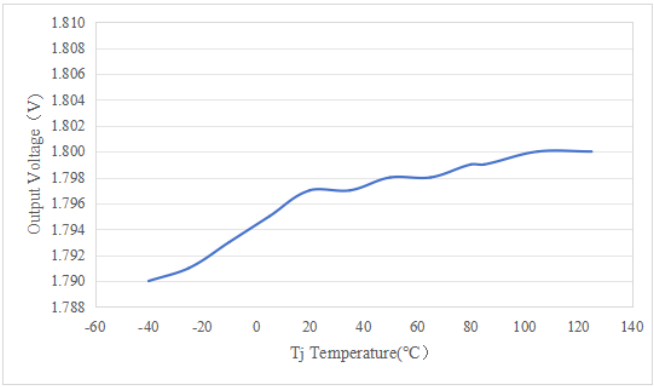
V_{OUT}=2.8V, Line Transient Response



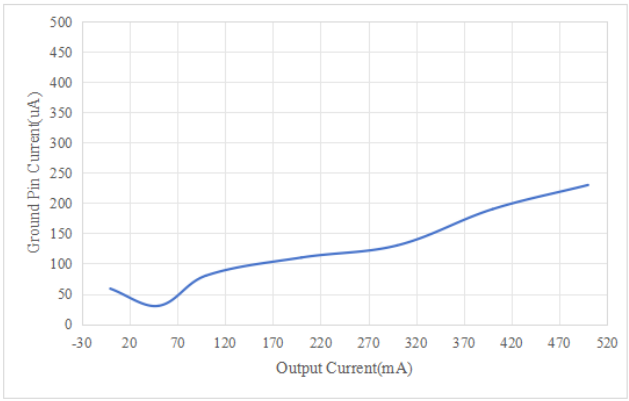
V_{OUT}=2.8V, Load Transient Response



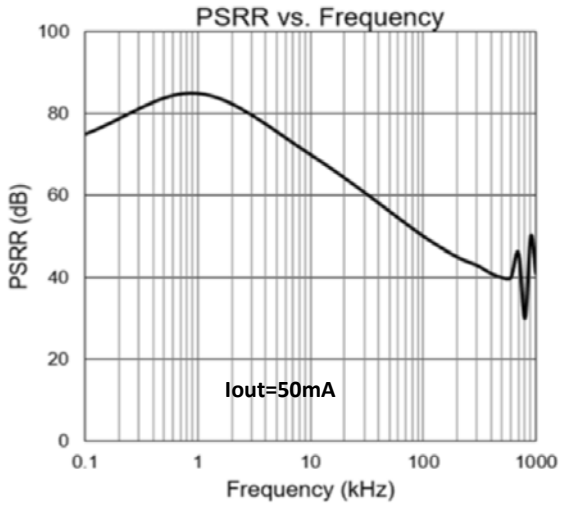
V_{OUT}=2.8V, Load Transient Response



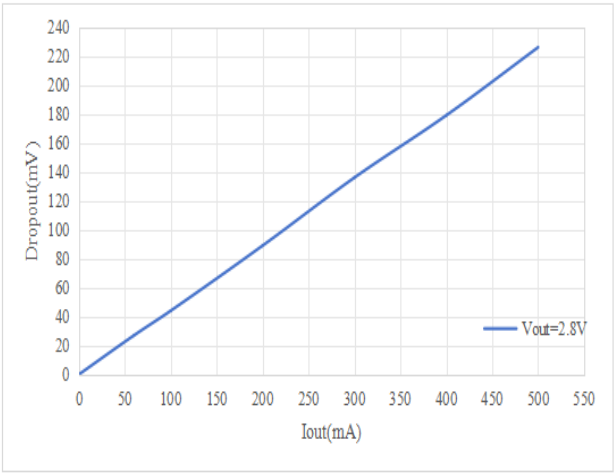
Output Voltage vs. Temperature



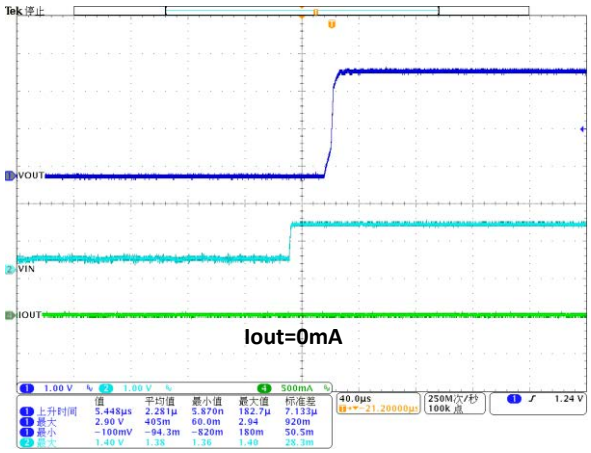
Output Current vs Ground Current



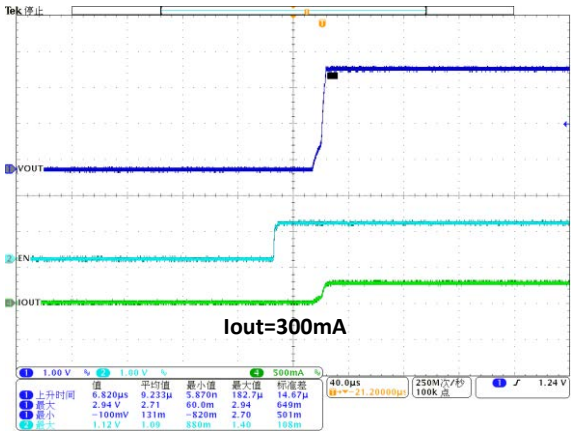
Power Supply Rejection Ratio vs. Frequency



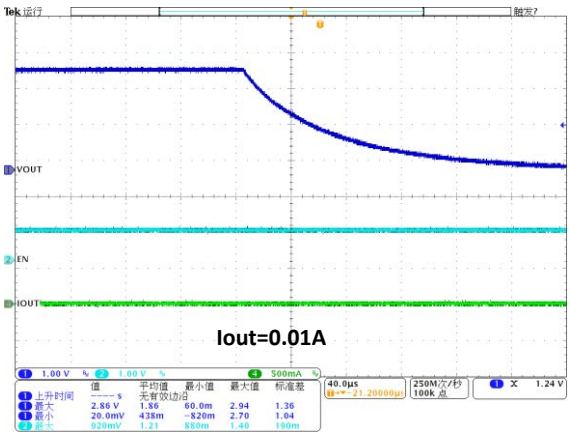
Dropout vs Output Current



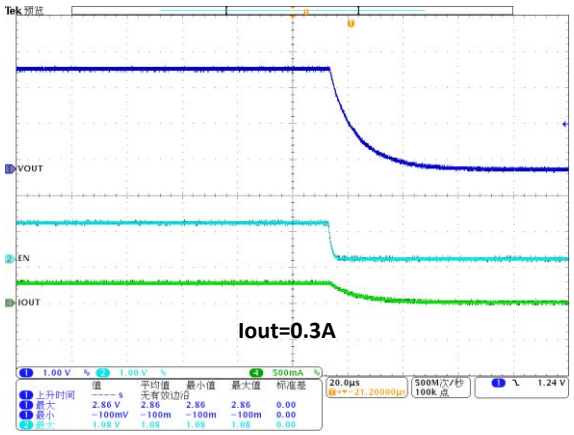
EN Start Up with Load



EN Start Up with Load

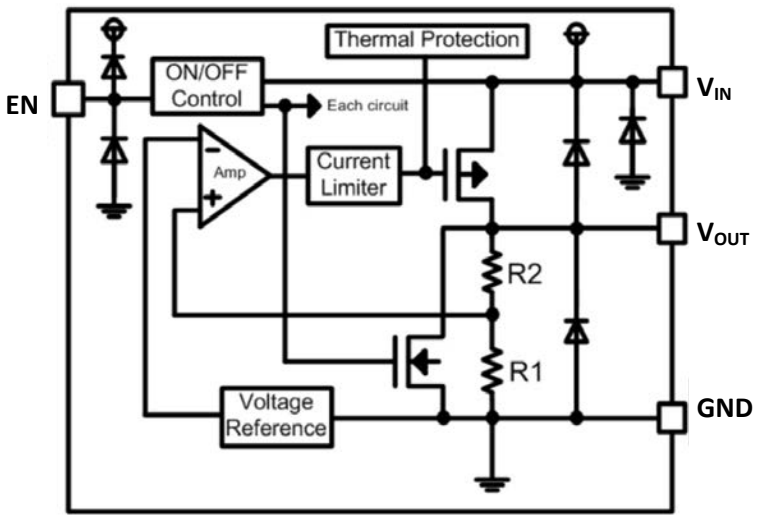


EN Start Down with Load



EN Start Down with Load

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Feature Description

The SK601302 series are a group of positive voltage regulators manufactured by CMOS technologies with high ripple rejection, ultra-low noise, low power consumption and low dropout voltage, which can prolong battery life in portable electronics.

The SK601302 series work with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications.

The SK601302 series consume less than 0.1μA in shutdown mode and have fast turn-on time less than 50μS. The series are very suitable for the battery-powered equipment, such as RF applications and other systems requiring a quiet voltage source.

Thermal Shutdown

The internal thermal-shutdown circuitry forces the device to stop switching if the junction temperature exceeds 160℃ typically. Once the junction temperature falls below the falling threshold, the device returns to normal operation automatically.

Output Current Limit and Short-Circuit Protection

When overload events happen, the output current is internally limited to 700mA (TYP). When the OUT pin is shorted to ground, the short-circuit protection will limit the output current to 130mA (TYP).

APPLICATION INFORMATION

The SK601302 is a low VIN, ultra-low noise and low dropout LDO and provides 500mA output current. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply.

The high performance also makes the SK601302 useful in a variety of applications. The SK601302 provides the protection functions for output overload, output short-circuit condition and overheating.

The SK601302 provides an EN pin as an external chip enable control to enable/disable the device. When the regulator is in shutdown state, the shutdown current consumes as low as 0.03μA (TYP).

Input Capacitors Selection

The input decoupling capacitor should be placed as close as possible to the IN pin to ensure the device stability. 1μF or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance. When VIN is required to provide large current instantaneously, a large effective input capacitor is required. Multiple input capacitors can limit the input tracking inductance. Adding more input capacitors is available to restrict the ringing and to keep it below the device absolute maximum ratings.

Output Capacitors Selection

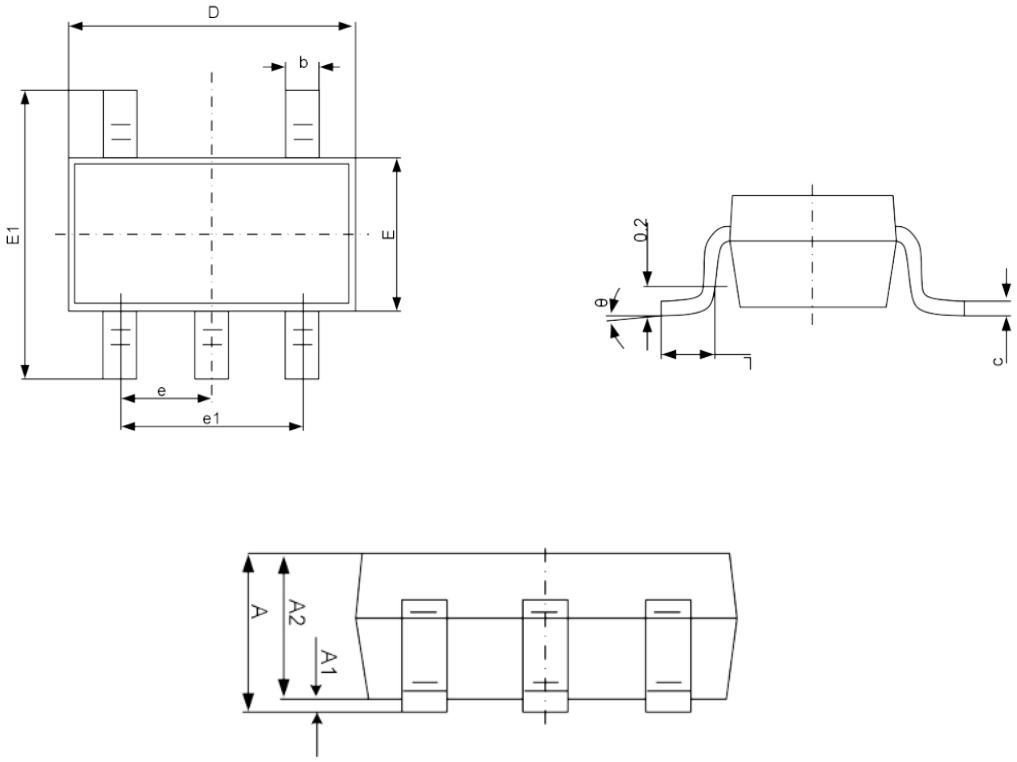
The output capacitor should be placed as close as possible to the OUT pin. 1μF or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SK601302 can remain stable is 1μF. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, so enough margin of C_{OUT} must be considered in design. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Enable Operation

The EN pin of the SK601302 is used to enable/disable its device and to deactivate/activate the output automatic discharge function. When the EN pin voltage is lower than 0.3V, the device is in shutdown state. There is no current flowing from IN to OUT pins. In this state, the automatic discharge transistor is active to discharge the output voltage through a 100Ω (TYP) resistor.

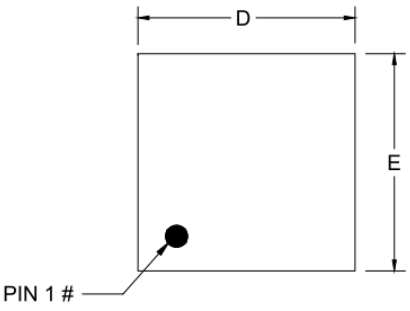
When the EN pin voltage is higher than 0.7V, the device is in active state. The output voltage is regulated to the expected value and the automatic discharge transistor is turned off.

PACKAGE DIMENSIONS: SOT23-5

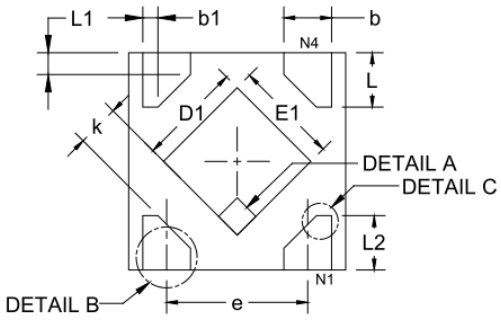


Symbol	Dimensions in Millimeters	
	Min.	Max.
A	-	1.350
A1	0.000	0.150
A2	1.000	1.200
b	0.300	0.500
c	0.100	0.220
D	2.820	3.020
E	1.500	1.700
E1	2.600	3.000
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

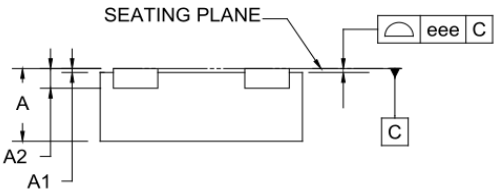
PACKAGE DIMENSIONS: TDFN1×1-4L



TOP VIEW



BOTTOM VIEW



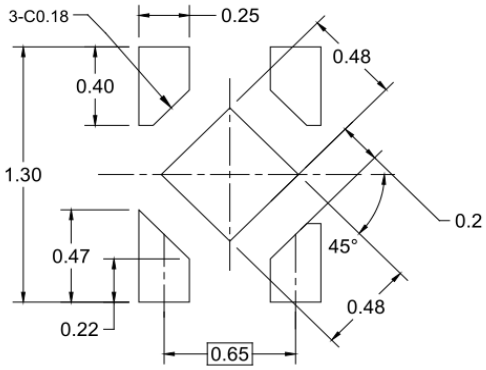
SIDE VIEW



DETAIL A
ALTERNATE PIN 1 CONSTRUCTION

DETAIL B
ALTERNATE TERMINAL CONSTRUCTION

DETAIL C
ALTERNATE TERMINAL CONSTRUCTION



RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions in Millimeters		
	Min.	Nom.	Max.
A	0.340	0.370	0.400
A1	0.000	0.020	0.050
A2	0.100REF		
b	0.170	-	0.300
b1	0.068REF		
D	0.950	1.000	1.050
E	0.950	1.000	1.050
D1	0.430	0.480	0.530
E1	0.430	0.480	0.530
e	0.650(BSC)		
L	0.200	0.250	0.300
L1	0.093REF		
L2	0.200	-	0.370
k	0.150	-	-
eee	-	0.050	-