150mA Low-Noise, Low-Dropout Linear Regulator

FEATURES

- Output tolerance of ±2%.
- Output voltage of 1.8V to 3.3V with 0.1V increments.
- Active-low shutdown control.
- Very low quiescent current.
- Very low dropout voltage.
- Miniature package (SOT-23-5 & SOT-23-6W)
- Short-circuit and thermal protection.
- Very low noise.

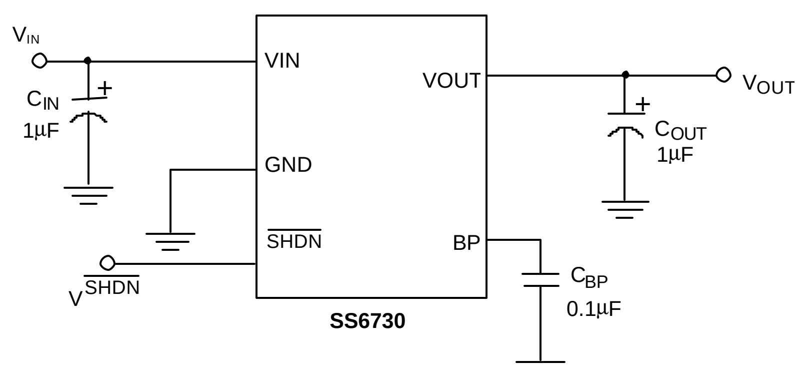
APPLICATIONS

- Cellular Telephones.
- Pagers.
- Personal Communication Equipment.
- Cordless Telephones.
- Portable Instrumentation.
- Portable Consumer Equipment.
- Radio Control Systems.
- Low Voltage Systems.
- Battery Powered Systems.

DESCRIPTION

The SS6730 is a low noise, low dropout linear regulator, housed in a small SOT-23-5 or SOT-23-6W package. The device is in the "ON" state when the $\overline{SHDN}$ pin is set to a logic-high level. An internal P-MOSFET pass transistor is used to achieve a low dropout voltage of 90mV at 50mA load current. It offers a high precision output voltage of ±2%. The very low quiescent current and low dropout voltage make this device ideal for battery powered applications. The internal reverse bias protection eliminates the requirement for a reverse voltage protection diode. The high ripple rejection and low noise provide enhanced performance for critical applications. An external capacitor can be connected to the noise bypass pin to reduce the output noise level.

TYPICAL APPLICATION CIRCUIT



Low Noise Low Dropout Linear Regulator

ORDERING INFORMATION

SS6730-XX CXXX

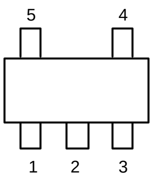
- Packing type
  TR: Tape and reel
- Package type
  V: SOT-23-5
  Q: SOT-23-6W
- Output voltage
  18: 1.8V
  .
  .
  .
  285: 2.85V
  .
  .
  33: 3.3V

The output voltage is available in 0.1V increments.

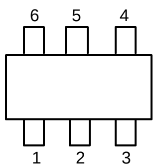
Example: SS6730-18CVTR
1.8V version, in SOT-23-5 package shipped on tape and reel.

PIN CONFIGURATION

SOT-23-5 (CV)
TOP VIEW
1: VIN
2: GND
3: SHDN
4: BP
5: VOUT



SOT-23-6W (CQ)
TOP VIEW
1: SHDN
2: GND
3: BP
4: VOUT
5: GND
6: VIN



ABSOLUTE MAXIMUM RATINGS

Supply Voltage 12V
Operating Temperature Range ....-40°C~85°C
Storage Temperature Range ....-65°C~150°C
Shutdown Terminal Voltage 12V
Noise Bypass Terminal Voltage 5V
Thermal Resistance (Junction to Case) SOT-23-5 ....130°C /W
Thermal Resistance Junction to Ambient SOT-23-5 ....220°C /W
(Assume no ambient airflow, no heatsink)

ELECTRICAL CHARACTERISTICS (C_{IN}=1mF , C_{OUT} =10mF, T_J=25° C, unless otherwise specified)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_{OUT} = 0mA, V_{IN} = 3.6~12V	I_Q		55	80	µA
Standby Current	V_{IN} = 3.6~8V , output OFF	I_{STBY}			0.1	µA
GND Pin Current	I_{OUT} = 0.1~150mA	I_{GND}		55	80	µA
Continuous Output Current	V_{IN} = V_{OUT} + 1V	I_{OUT}			150	mA
Output Current Limit	V_{IN} = V_{OUT} + 1V , V_{OUT} = 0V	I_{IL}	150	220		mA
Output Voltage Tolerance	V_{IN} = V_{OUT} + 1V , no load	V_{OUT}	-2		2	%
Temperature Coefficient		TC		50	150	ppm/ºC
Line Regulation	V_{IN} = $V_{OUT(TYP)}$ + 1V to $V_{OUT(TYP)}$ + 6V	ΔV_{LIR}		2	7	mV
Load Regulation	V_{IN} = 5V , I_{OUT} = 0.1~150mA	ΔV_{LOR}		7	25	mV
Dropout Voltage (1)	I_{OUT} = 50 mA, V_{OUT}≥2.5V	V_{DROP1}		90	160	mV
	I_{OUT} = 100 mA, V_{OUT}≥2.5V			140	230	mV
	I_{OUT} = 150 mA, V_{OUT}≥2.5V			200	350	mV
Dropout Voltage (2)	I_{OUT}=150 mA, V_{OUT} <2.5V	V_{DROP2}			700	mV
Noise Bypass Terminal Voltage		V_{REF}		1.23		V
Output Noise	C_{BP} = 0.1µF , f = 1KHz, V_{IN} = 5V	Δn		0.46		$\frac{mV}{\sqrt{Hz}}$
SHUTDOWN TERMINAL SPECIFICATIONS						
Shutdown Pin Current		$I_{\overline{SHDN}}$			0.1	µA
Shutdown Pin Voltage (ON)	Output ON	$V_{\overline{SHDN}}$ (ON)	1.6			V
Shutdown Pin Voltage (OFF)	Output OFF	$V_{\overline{SHDN}}$ (OFF)			0.6	V
Shutdown Exit Delay Time	C_{BP} = 0.1µF , C_{OUT} = 1µF, I_{OUT}=30mA	Δt		300		µS
THERMAL PROTECTION						
Thermal Shutdown Temperature		T_{SD}		155		ºC

TYPICAL PERFORMANCE CHARACTERISTICS

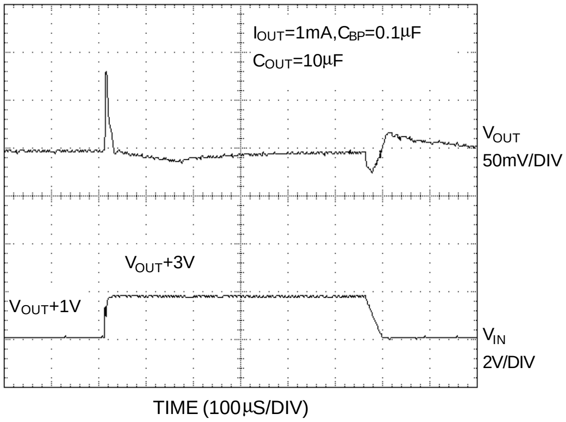


Fig. 1 Line Transient Response

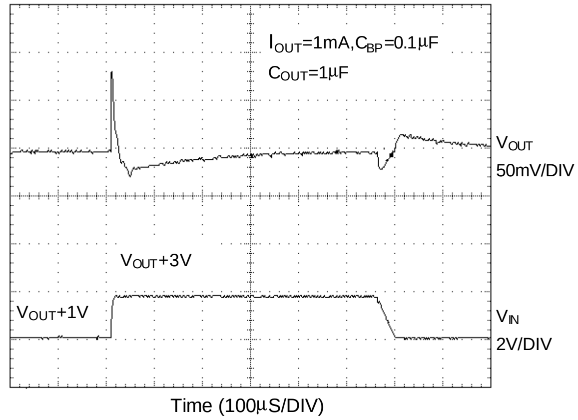


Fig. 2 Line Transient Response

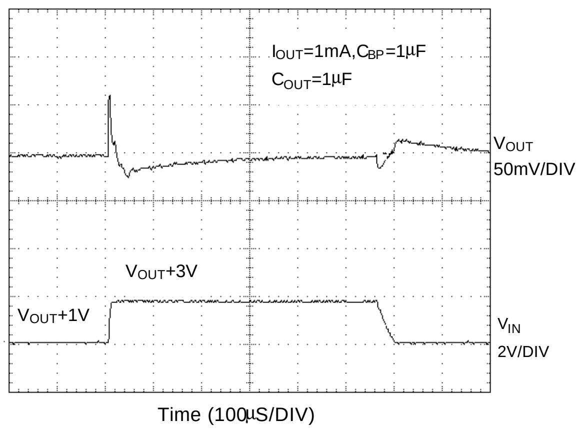


Fig. 3 Line Transient Response

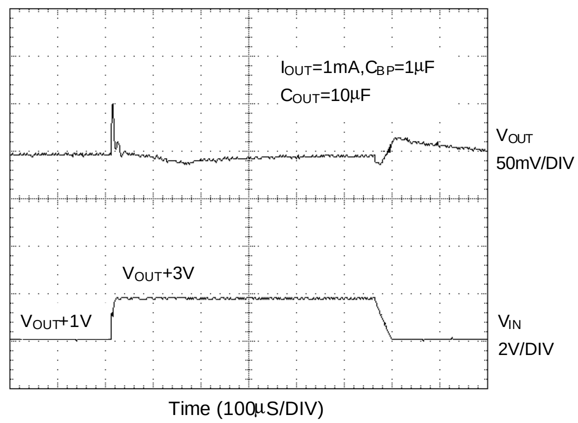


Fig. 4 Line Transient Response

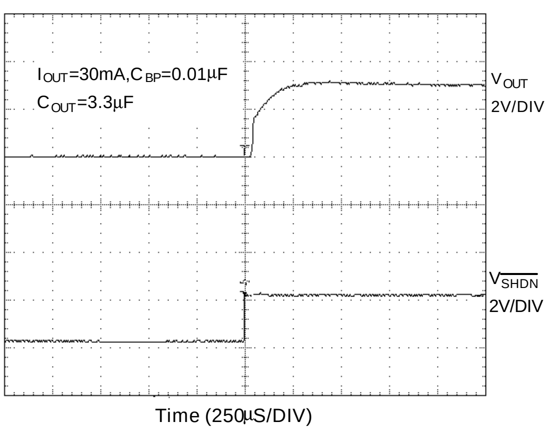


Fig. 5 Shutdown Exit Delay

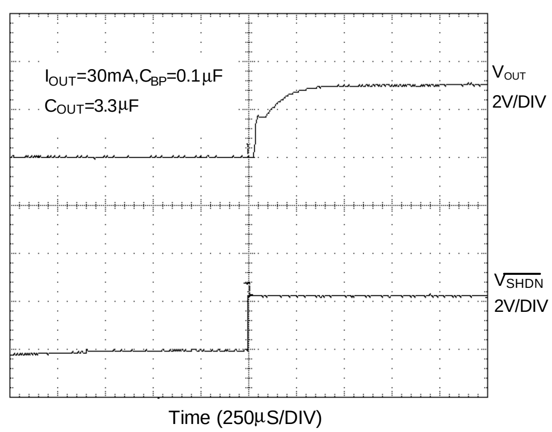


Fig. 6 Shutdown Exit Delay

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

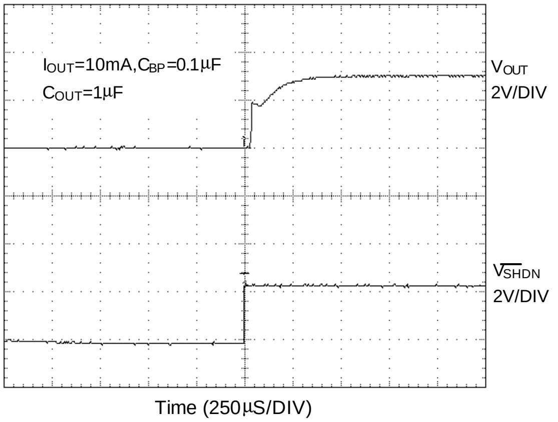


Fig. 7 Shutdown Exit Delay

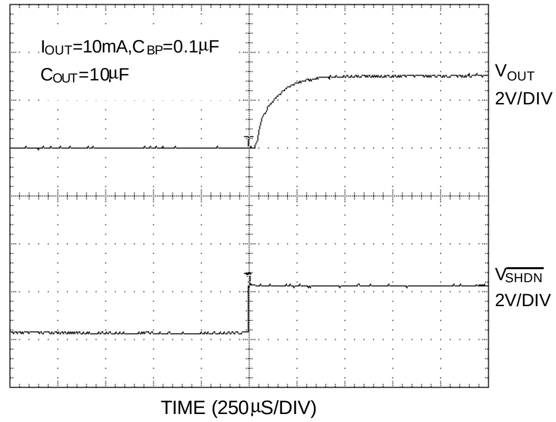


Fig. 8 Shutdown Exit Delay

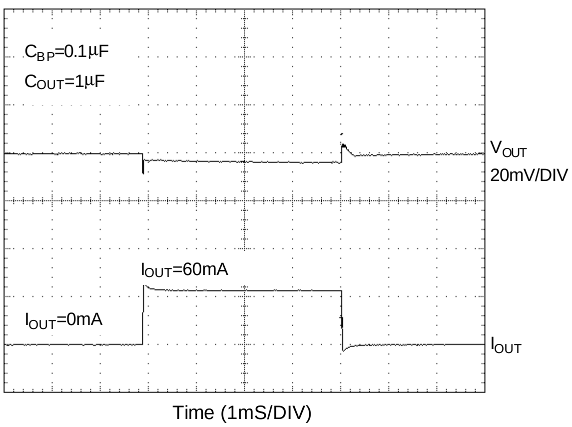


Fig. 9 Load Transient Response

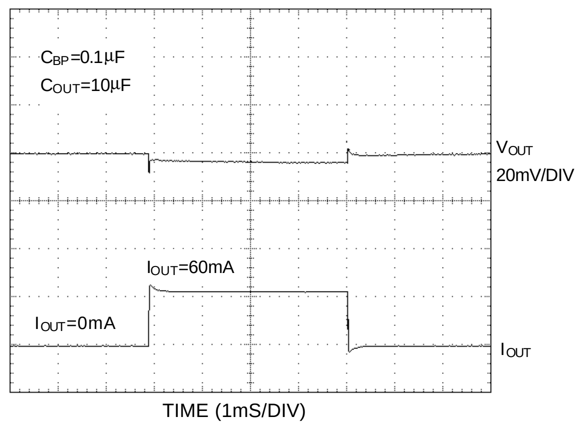


Fig. 10 Load Transient Response

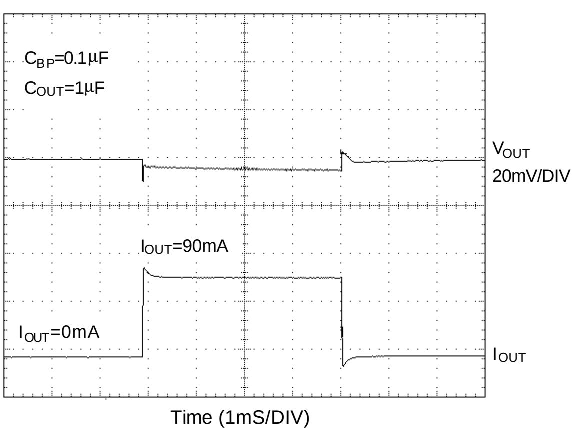


Fig. 11 Load Transient Response

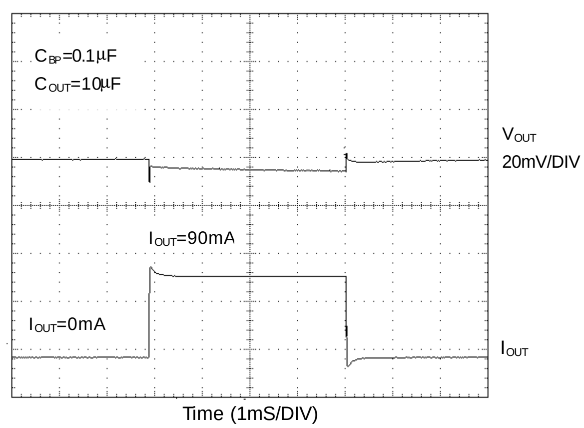


Fig. 12 Load Transient Response

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

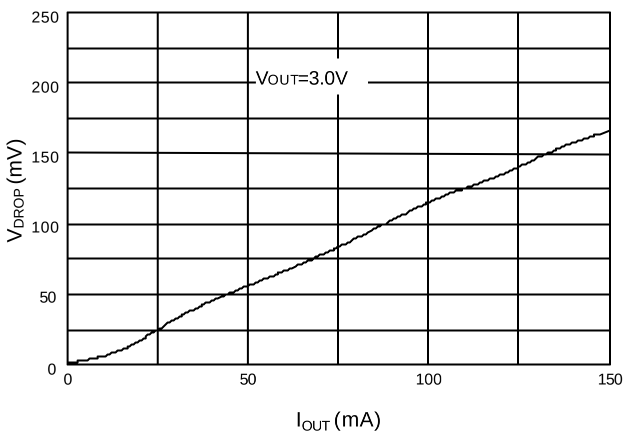


Fig. 13 Dropout Voltage vs. Output Current

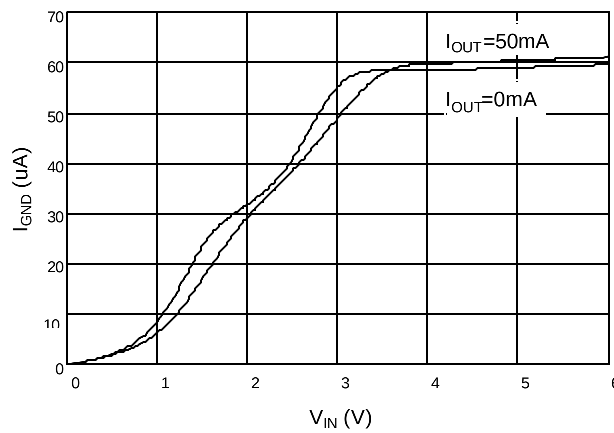


Fig. 14 Ground Current vs. Input Voltage (V_{OUT}=3.0V)

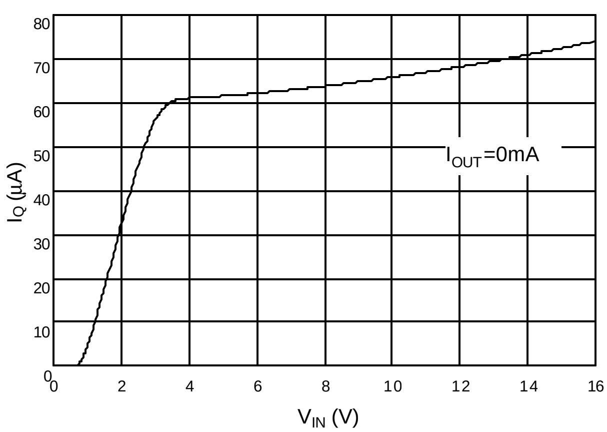


Fig. 15 Quiescent Current (ON Mode) vs. Input Voltage

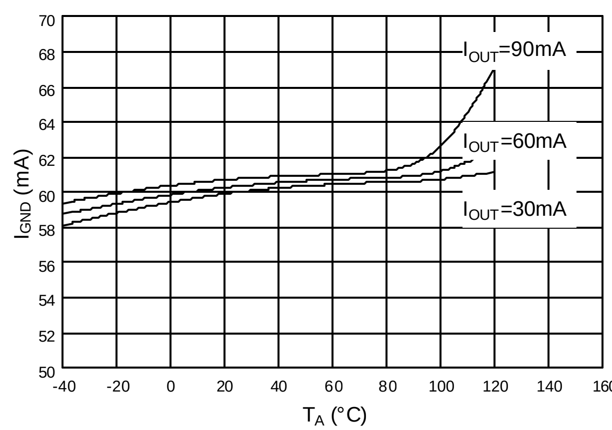


Fig. 16 Ground Current vs. Temperature

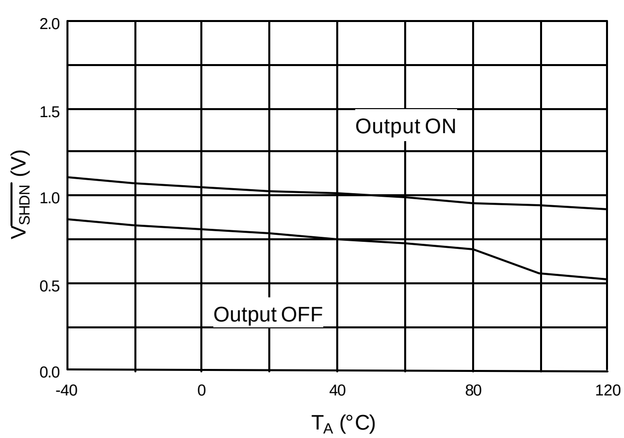


Fig. 17 Shutdown Voltage vs. Temperature

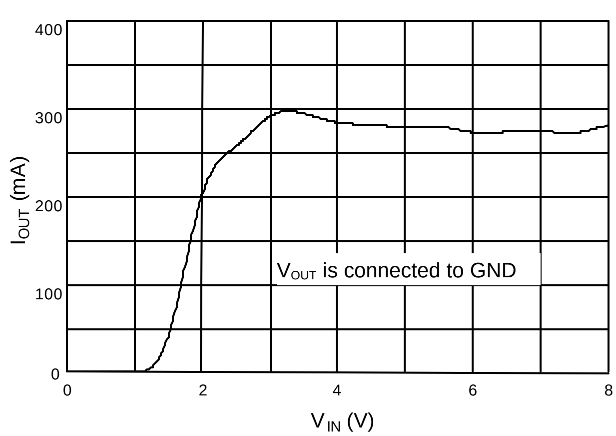


Fig. 18 Short Circuit Current vs. Input Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

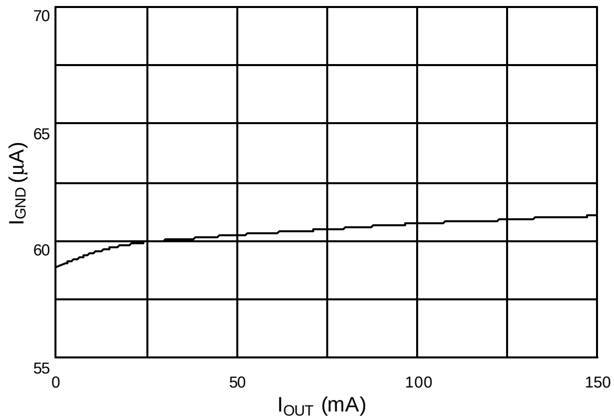
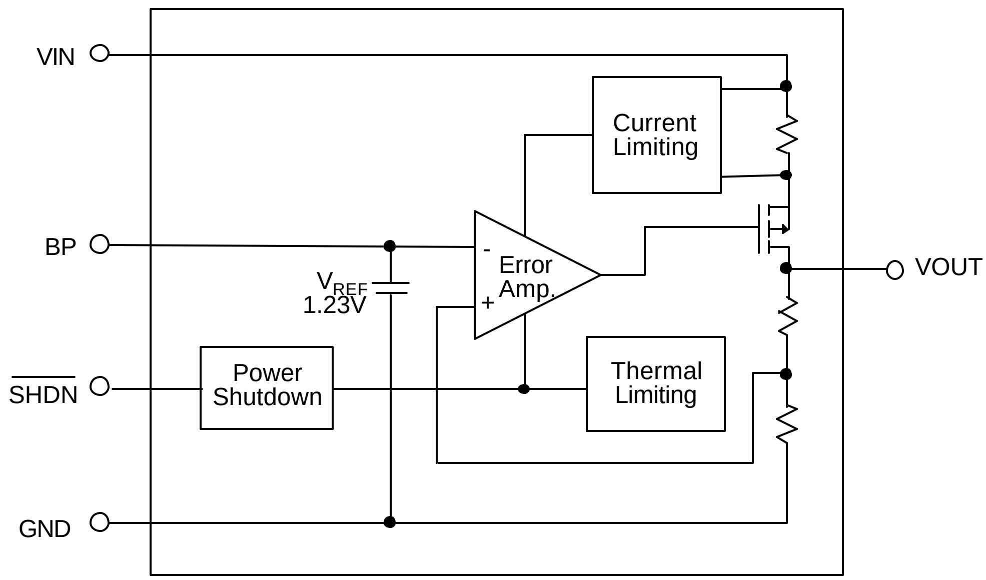


Fig. 19 Ground Current vs. Output Current

BLOCK DIAGRAM



PIN DESCRIPTIONS

SOT-23-5

PIN 1 : VIN - Power supply input pin. Bypass with a 1µF capacitor to GND

PIN 2 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 3 : $\overline{SHDN}$ - Active-low shutdown input pin.

PIN 4 : BP - Noise bypass pin. An external bypass capacitor connected to the BP pin reduces noise at the output.

PIN 5 : VOUT - Output pin. Sources up to 150 mA.

SOT-23-6W

PIN 1 : $\overline{SHDN}$ - Active-low shutdown input pin.

PIN 2 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 3 : BP - Noise bypass pin. An external bypass capacitor connected to the BP pin reduces noise at the output.

PIN 4 : VOUT - Output pin. Sources up to 150 mA.

PIN 5 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 6 : VIN - Power supply input pin. Bypass with a 1µF capacitor to GND.

DETAILED DESCRIPTION OF TECHNICAL TERMS

OUTPUT VOLTAGE (V_{OUT})

The SS6730 provides factory-set output voltages from 1.8V to 3.3V, in 100mV increments. The output voltage is specified with $V_{IN} = V_{OUT}$ (TYP) + 1V and I_{OUT} = 0mA

DROPOUT VOLTAGE (V_{DROP})

The dropout voltage is defined as the difference between the input voltage and output voltage at which point the regulator starts to fall out of regulation. Below this value, the output voltage will fall as the input voltage is reduced. It depends on the load current and junction temperature. The dropout voltage is specified at which the output voltage drops 100mV below the value measured with a 1V difference.

CONTINUOUS OUTPUT CURRENT (I_{OUT})

Normal rated output current. This is limited by package power dissipation.

LINE REGULATION

Line regulation is the ability of the regulator to maintain a constant output voltage as the input voltage changes. The line regulation is specified as the input voltage is changed from $V_{IN} = V_{OUT}$ + 1 V to $V_{IN} = V_{OUT}$ + 6 V and IOUT = 1mA.

LOAD REGULATION

Load regulation is the ability of the regulator to maintain a constant output voltage as the load current changes. To minimize temperature effects, it is a pulsed measurement with the input voltage set to V_{IN} = V_{OUT} + 1 V. The load regulation is specified under the output current step of 0.1mA to 150mA.

QUIESCENT CURRENT (I_Q)

The quiescent current is the current flowing through the ground pin under no load.

GROUND CURRENT (I_{GND})

Ground current is the current flowing through the ground pin under loading.

STANDBY CURRENT (I_{STBY})

Standby current is the current flowing into the regulator when the output is shutdown by setting $V_{\overline{SHDN}}$ = 0V, V_{IN} = 8 V.

CURRENT LIMIT (I_{IL})

The SS6730 includes a current limiter, to monitor and control the maximum output current to be 300mA typically if the output is shorted to ground. This can protect the device from being damaged.

THERMAL PROTECTION

The thermal sensor protects the device when the junction temperature exceeds T_J= +155°C. It signals the shutdown logic, turning off the pass transistor and allowing the IC to cool. After the IC's junction temperature cools by 15°C, the thermal sensor will turn on the pass transistor again. Thermal protection is designed to protect the device in the event of fault conditions. For continuous operation do not exceed the absolute maximum junction-temperature rating of T_J= 150°C, or damage may occur to the device.

APPLICATION INFORMATION

INPUT-OUTPUT CAPACITORS

Linear regulators require input and output capacitors to maintain stability. The recommended minimum value of input capacitor is 0.22µF. The output capacitor should be selected within the Equivalent Series Resistance (ESR) range shown in the graphs below for stability. Because a ceramic capacitor's ESR is lower and its electrical characteristics (capacitance and ESR) vary widely over temperature, a tantalum output capacitor is recommended, especially for heavier loads. In general, the capacitor should be at least 1µF(tantalum) and be rated for the actual ambient operating temperature range.

Note: It is very important to check the selected manufacturers' electrical characteristics (capacitance and ESR) over temperature.

NOISE BYPASS CAPACITOR

Use a 0.1µF bypass capacitor at BP pin for low output voltage noise. Increasing the capacitance up to 1µF will decrease the output noise. However, values above 1µF provide no performance advantage and are not recommended.

POWER DISSIPATION

The maximum dissipation of the SS6730 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of air flow. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting with good thermal conductivity is used, the junction will be low even if the power dissipation is great.

The power dissipation across the device is

$P = I_{OUT} (V_{IN}-V_{OUT})$.

The maximum power dissipation is:

$$P_{MAX} = \frac{(T_J - T_A)}{(R\theta_{JB} + R\theta_{BA})}$$

where T_J-T_A is the temperature difference between the die junction and the surrounding air, $R\theta_{JB}$ is the thermal resistance of the package, and $R\theta_{BA}$ is the thermal resistance through the PCB, copper traces, and other materials to the surrounding air.

As a general rule, the lower the temperature, the better the reliability of the device, so the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

The GND pin performs the dual function of providing an electrical connection to ground and channeling heat away. Therefore, connecting the GND pin to ground with a large pad or ground plane would increase the power dissipation and reduce the device temperature.

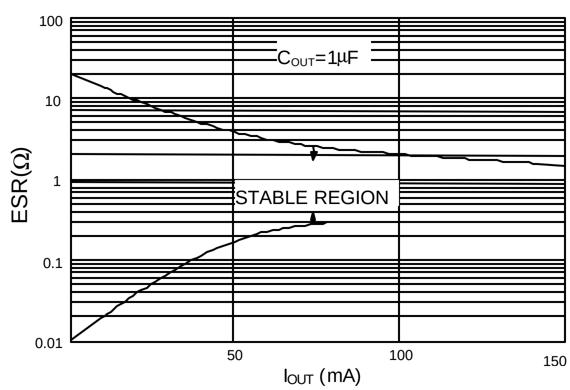


Fig. 20 Max Power Dissipation, C_{OUT}=1µF

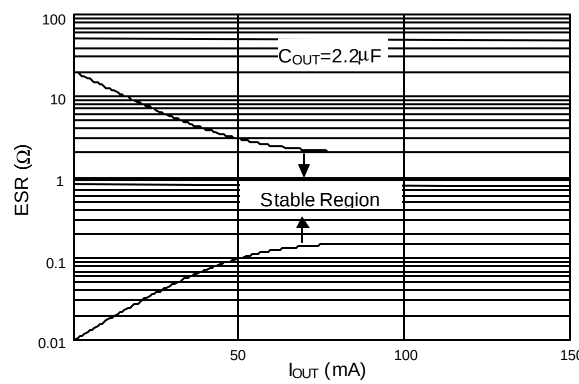


Fig. 21 Max Power Dissipation, C_{OUT}=2.2µF

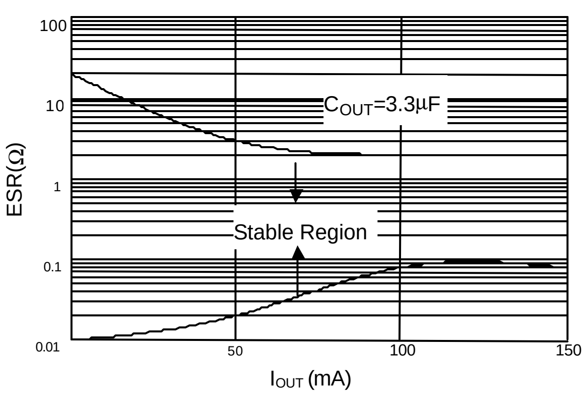


Fig. 22 Max Power Dissipation, C_{OUT}=3.3µF

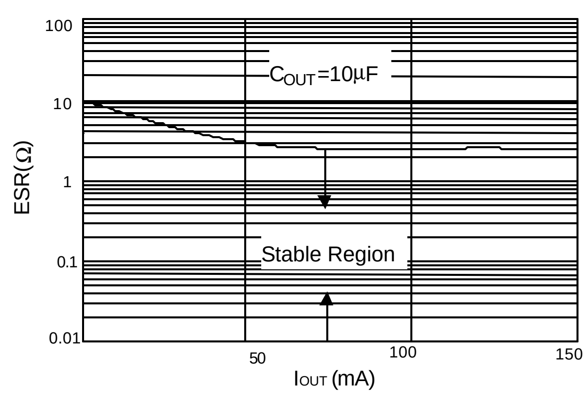
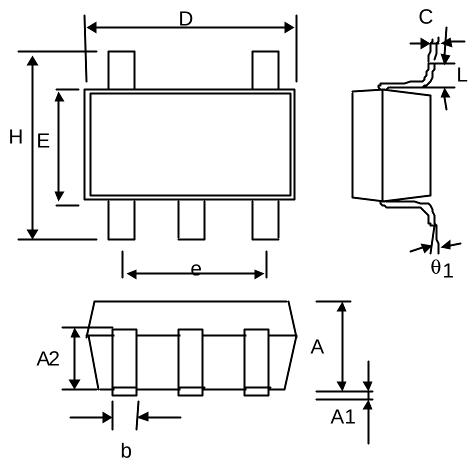


Fig. 23 Max Power Dissipation, C_{OUT}=10µF

PHYSICAL DIMENSIONS

SOT-23-5 (unit: mm)



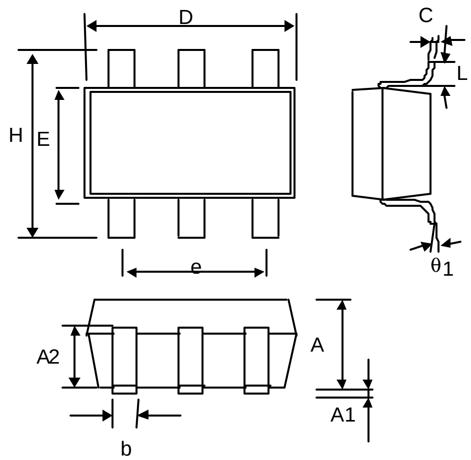
SYMBOL	MIN	MAX
A	1.00	1.30
A1	—	0.10
A2	0.70	0.90
b	0.35	0.50
C	0.10	0.25
D	2.70	3.10
E	1.40	1.80
e	1.90 (TYP)	
H	2.60	3.00
L	0.37	—
θ1	1°	9°

SOT-23-5 Marking

Part No.	Marking
SS6730-18CV	EC18
SS6730-19CV	EC19
SS6730-20CV	EC20
SS6730-21CV	EC21
SS6730-22CV	EC22
SS6730-23CV	EC23
SS6730-24CV	EC24
SS6730-25CV	EC25
SS6730-26CV	EC26

Part No.	Marking
SS6730-27CV	EC27
SS6730-28CV	EC28
SS6730-285CV	EC2J
SS6730-29CV	EC29
SS6730-30CV	EC30
SS6730-31CV	EC31
SS6730-32CV	EC32
SS6730-33CV	EC33

SOT-23-6W (unit: mm)



SYMBOL	MIN	MAX
A	1.00	1.30
A1	—	0.10
A2	0.70	0.90
b	0.35	0.50
C	0.10	0.25
D	2.70	3.10
E	1.60	2.00
e	1.90 (TYP)	
H	2.60	3.00
L	0.37	—
θ1	1°	9°

SOT-23-6W Marking

Part No.	Marking
SS6730-18CQ	EB18
SS6730-19CQ	EB19
SS6730-20CQ	EB20
SS6730-21CQ	EB21
SS6730-22CQ	EB22
SS6730-23CQ	EB23
SS6730-24CQ	EB24
SS6730-25CQ	EB25
SS6730-26CQ	EB26

Part No.	Marking
SS6730-27CQ	EB27
SS6730-28CQ	EB28
SS6730-285CQ	EB2J
SS6730-29CQ	EB29
SS6730-30CQ	EB30
SS6730-31CQ	EB31
SS6730-32CQ	EB32
SS6730-33CQ	EB33