

## ACT6700/6701/6702 ACT6710/6711/6712

## MobileLDO™ HIGH PERFORMANCE LOW DROPOUT REGULATORS

### FEATURES

- 110mV typical dropout with 150mA Load
- Very Low 23µA Supply Current
- 1.5% Voltage Accuracy
- 450mA (ACT670\_) or 700mA (ACT671\_) Typical Current Limit
- Thermal Shutdown Protection
- Fold-back Current Limit Protection
- 1.8V to 3.3V Fixed Output Voltage
- Power-Good Indicator
- Low Noise Bypass Pin
- Stability with Wide Range of Capacitors
- Compact SOT23-3 and SOT23-5 Packages

### APPLICATIONS

- Cellular Handsets
- Battery-Powered Equipment
- Personal Communication Devices
- Portable Information Devices
- Peripherals, Consumer Electronics

### GENERAL DESCRIPTION

The ACT670\_ and ACT671\_ MobileLDO™ series products are high performance low dropout voltage regulators designed for portable applications with very low quiescent current (23uA) and dropout voltage (110mV at 150mA).

The ACT6710/6711/6712 LDOs have typical current limit of 700mA. The ACT6700/6701/6702 LDOs have typical current limit of 450mA. Both series are available in high accuracy (1.5%) output voltages from 1.8V to 3.3V in 50mV increments. All of these products feature thermal shutdown protection and current limit with fold-back in short circuit.

The ACT6700 and ACT6710 are available in SOT23-3 package. The ACT6701 and ACT6711 are available in SOT23-5 package and include a power-good indicator output. The ACT6702 and ACT6712 are available in SOT23-5 package and include a low noise bypass pin for low noise applications. These products are ideal for portable information devices, cellular phones, and other battery powered applications.

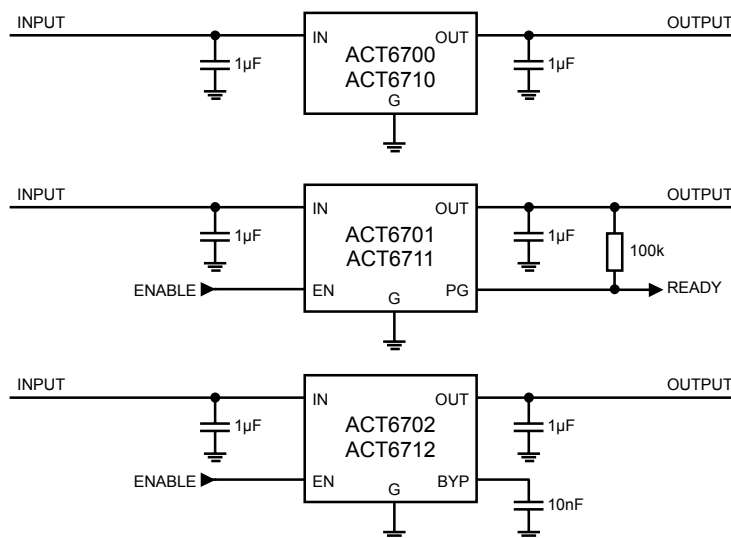


Figure 1. Typical MobileLDO™ Application Circuits

## ORDERING INFORMATION<sup>(1)</sup>

PART NUMBER <sup>(2)</sup>	ADDITIONAL FUNCTION	OUTPUT VOLTAGE (V)	CURRENT LIMIT	TEMPERATURE RANGE	PACKAGE	PINS	TOP MARK <sup>(3)</sup>
ACT6700UTxyz-T		x.yz	450mA	-40°C to 85°C	SOT23-3	3	SHC_
ACT6701UCxyz-T	Power Good	x.yz	450mA	-40°C to 85°C	SOT23-5	5	SHA_
ACT6702UCxyz-T	Noise Bypass	x.yz	450mA	-40°C to 85°C	SOT23-5	5	SHB_
ACT6710UTxyz-T		x.yz	700mA	-40°C to 85°C	SOT23-3	3	SHG_
ACT6711UCxyz-T	Power Good	x.yz	700mA	-40°C to 85°C	SOT23-5	5	SHE_
ACT6712UCxyz-T	Noise Bypass	x.yz	700mA	-40°C to 85°C	SOT23-5	5	SHF_

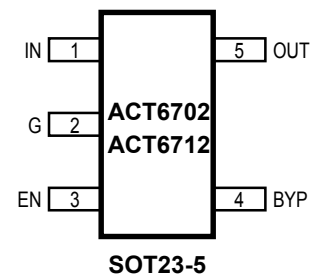
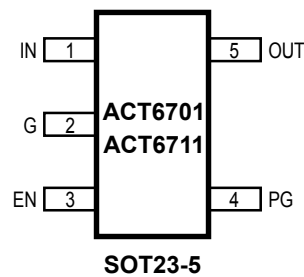
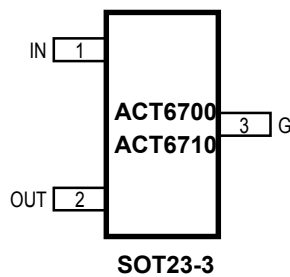
<sup>(1)</sup> Contact factory for parts availability and other package options.

<sup>(2)</sup> xyz indicates output voltage. For example, xyz=285 for 2.85V.

<sup>(3)</sup> The 4th letter of the package top mark indicates voltage:

PART NUMBER	TOP MARK						
	180 (1.8V)	250 (2.5V)	260 (2.6V)	270 (2.7V)	285 (2.85V)	300 (3.0V)	330 (3.3V)
ACT6700UT__-T	SHCA	SHCB	SHCC	SHCD	SHCE	SHCF	SHCG
ACT6701UC__-T	SHAA	SHAB	SHAC	SHAD	SHAE	SHAF	SHAG
ACT6702UC__-T	SHBA	SHBB	SHBC	SHBD	SHBE	SHBF	SHBG
ACT6710UT__-T	SHGA	SHGB	SHGC	SHGD	SHGE	SHGF	SHGG
ACT6711UC__-T	SHEA	SHEB	SHEC	SHED	SHEE	SHEF	SHEG
ACT6712UC__-T	SHFA	SHFB	SHFC	SHFD	SHFE	SHFF	SHFG

## PIN CONFIGURATION



## PIN DESCRIPTION

PIN NUMBER			PIN NAME	PIN DESCRIPTION
ACT67_0 SOT23-3	ACT67_1 SOT23-5	ACT67_2 SOT23-5		
1	1	1	IN	Input Voltage
3	2	2	G	Ground
	3	3	EN	(ACT6701/6702/6711/6712 only) Enable Input. High level enables the LDO. Connect this pin to IN if not used; do not leave EN unconnected.
	4		PG	(ACT6701/6711 only) Power-Good Open Drain Indicator. Connect to an external pull-up resistor. Low level indicates that the output voltage is out of regulation. This output has high impedance when EN = 0.
		4	BYP	(ACT6702/6712 only) Low Noise Bypass Pin. Connect a 10nF capacitor from BYP to G.
2	5	5	OUT	Output

## ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
IN Supply Voltage	-0.3 to 6	V
OUT Voltage	-0.3 to $V_{IN} + 0.3$	V
EN, PG, BYP Voltage	-0.3 to 6	V
Continuous OUT Current	Internally limited	A
Maximum Power Dissipation	SOT23-3	0.4
	SOT23-5	0.41
Junction to Ambient Thermal Resistance ( $\theta_{JA}$ )	SOT23-3	200
	SOT23-5	190
Operating Junction Temperature	-40 to 150	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = V_{OUT} + 0.5V$ ,  $V_{EN} = V_{IN}$ ,  $C_{OUT} = 1\mu F$ ,  $T_J = 25^\circ C$  unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Output Voltage Accuracy	$\Delta V_{OUT}$	$T_J = 25^\circ C$	-1.5	0	1.5	%	
		$T_J = -40^\circ C$ to $125^\circ C$	-2.5	0	2.5		
Line Regulation Error		$V_{IN} = V_{OUT} + 0.5V$ to $V_{IN} = 5.5V$		0		mV	
Load Regulation Error		$I_{OUT} = 1mA$ to $150mA$		-0.004		%/mA	
Power Supply Rejection Ratio	PSRR	$f = 1kHz$ , $I_{OUT} = 150mA$ , $C_{OUT} = 1\mu F$		56		dB	
		$f = 10kHz$ , $I_{OUT} = 150mA$ , $C_{OUT} = 1\mu F$		46			
Supply Current	$I_Q$	$EN = 1.4V$		23	45	$\mu A$	
		$EN = 0.4V$		0	1		
Dropout Voltage	$V_{DO}$	ACT6700/6701/ 6702, $I_{OUT} = 150mA$	$V_{OUT} \geq 3.0V$			mV	
			$2.8 \leq V_{OUT}$		110		150
			$2.5 \leq V_{OUT} < 2.8V$		140		220
		ACT6710/6711/ 6712 $I_{OUT} = 300mA$	$V_{OUT} \geq 3.0V$				
			$2.8 \leq V_{OUT} < 3.0V$				300
			$2.5 \leq V_{OUT} < 2.8V$				400
Current Limit	$I_{LIM}$	ACT6700/6701/6702	300	450		mA	
		ACT6710/6711/6712	450	700			
Current Limit Short Circuit Foldback	$I_{LIMSC}$	ACT6700/6701/6702, $V_{OUT} < 1V$		160		mA	
		ACT6710/6711/6712, $V_{OUT} < 1V$		230			
Output Noise		ACT6702/6712 with $C_{OUT} = 10\mu F$ , $C_{BYP} = 10nF$ , $f = 10Hz$ to $100kHz$		40		$\mu V_{RMS}$	
		ACT6700/6701/6710/6711 with $C_{OUT} = 10\mu F$ , $f = 10Hz$ to $100kHz$		120			
Stable $C_{OUT}$			1		20	$\mu F$	
Thermal Shutdown Temperature				160		$^\circ C$	
Thermal Shutdown Hysteresis				23		$^\circ C$	
<b>ACT6701/6702/6711/6712 ENABLE (EN) INPUT</b>							
EN Input Logic Low Threshold	$V_{IL}$	$T_J = -40^\circ C$ to $125^\circ C$			0.4	V	
EN Input Logic High Threshold	$V_{IH}$	$T_J = -40^\circ C$ to $125^\circ C$	1.5			V	
EN Input Current		$V_{EN} = 5.5V$		0	0.1	$\mu A$	
<b>ACT6701/6711 POWER-GOOD (PG) OUTPUT</b>							
PG High Threshold		$V_{OUT}$ rising, hysteresis = -1%		94.5		%	
PG Output Low Voltage		100 $\mu A$ pull-up			0.05	V	
PG Leakage Current		Fault condition, $V_{PG} = 5.5V$		0	0.1	$\mu A$	

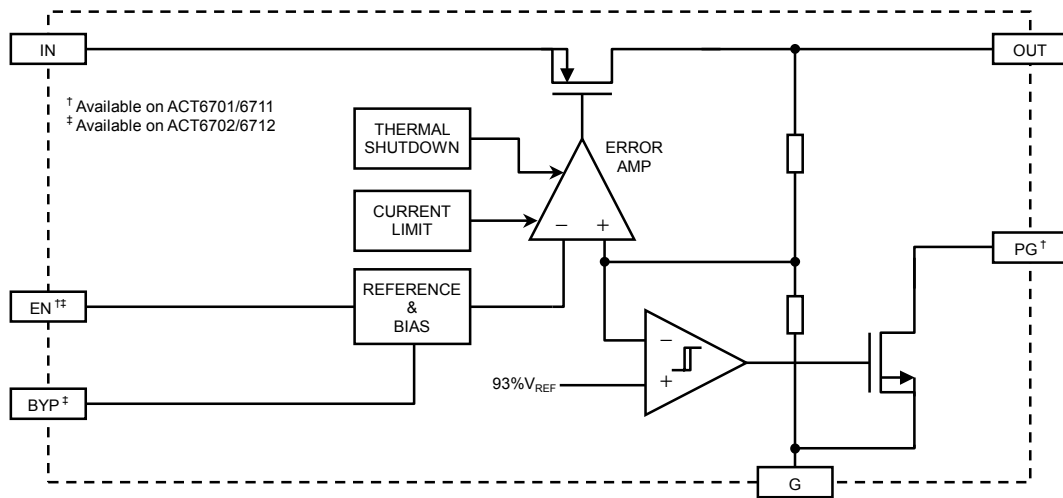


Figure 2. Functional Block Diagram

## FUNCTIONAL DESCRIPTION

The ACT670\_ and ACT671\_ series are high performance LDOs with very low quiescent current consumption.

As illustrated in Figure 2, *Functional Block Diagram*, the ACT670\_ and ACT671\_ LDO architecture consists of a low noise reference and bias circuitry, an error amplifier, feedback voltage resistor divider, 0.74Ω P-channel power MOSFET pass transistor, current limiter, and thermal shutdown circuitry. In addition, the ACT6701/6711 also contain a power-good comparator with indicator output and shutdown control. The ACT6702/6712 also contain low noise reference bypass and shutdown control.

## VOLTAGE REGULATION

Normally, the LDO's error amplifier compares the output feedback voltage (via the resistor divider) with the reference voltage and generates an error signal that is used to drive the P-channel power MOSFET. When the output voltage is higher than the needed value, the P-channel is driven off so that there is no output current. When the output voltage is lower than the needed value, the P-channel conducts to increase the output to its desired value.

## CURRENT LIMIT

When the output current is at the current limit value, the current limiter circuitry pulls back the power MOSFET gate to prevent its current from

increasing further. This current limit value is typically 700mA for the ACT671\_ and 450mA for the ACT670\_. However, for output voltage lower than 1V, the current limit folds back to 1/3 of its original value.

## THERMAL SHUTDOWN

If the die temperature exceeds the thermal protection threshold of 160°C, the IC turns off to allow for the die to cool down. When the die temperature decreases to about 137°C, the IC turns on again, resulting in a thermal cycling mode.

## SHUTDOWN CONTROL

The ACT6701/6702/6711/6712 have an enable input EN for turning the IC on or off. When EN is less than 0.4V, the IC is in low leakage current shutdown mode. When EN is higher than 1.5V, the IC is in normal mode.

## POWER-GOOD INDICATOR (ACT6701/6711)

The power-good comparator in the ACT6701/6711 detect when the output voltage falls below regulation point (93% of normal  $V_{OUT}$ ) and pull the PG open drain output low to indicate a fault condition. When the output voltage is higher than 94.5% of normal  $V_{OUT}$ , the PG output becomes high impedance. When IC is in shutdown, the PG output is also high impedance.

## LOW NOISE BYPASS (ACT6702/6712)

The ACT6702/6712 include a low noise

reference bypass pin BYP to filter high frequency noise to the error amplifier and a startup circuitry to fast charge BYP when the IC is turned on. Connect a 10nF capacitor from BYP pin to

ground to reduce output noise to  $40\mu\text{V}_{\text{RMS}}$ . The startup time with 10nF bypass capacitor is 250 $\mu\text{s}$ .

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## APPLICATION INFORMATION

### INPUT CAPACITOR

Any good quality capacitor with 1 $\mu\text{F}$  or greater value can be used as input capacitor for this family of LDOs. Connect this input capacitor as close to IN and G pins as possible to best absorb current pulses as the load varies. Ceramic capacitors have better performance and lower ESR (Equivalent Series Resistance) than other types of capacitors, and are recommended for use as input capacitor.

### OUTPUT CAPACITOR

The ACT670\_ and ACT671\_ LDOs need an output capacitor for stability. This capacitor should be connected as close to the OUT and G pins as possible to maximize device's performance. The output capacitance and ESR ranges for stability are shown in *Typical Performance Characteristics*. However, to ensure best performance for the device, the output capacitor should have a minimum

capacitance of 1 $\mu\text{F}$ , and ESR value between 10m $\Omega$  and 500m $\Omega$ . High quality ceramic capacitors such as X7R and X5R dielectric types are strongly recommended.

### POWER-GOOD OUTPUT

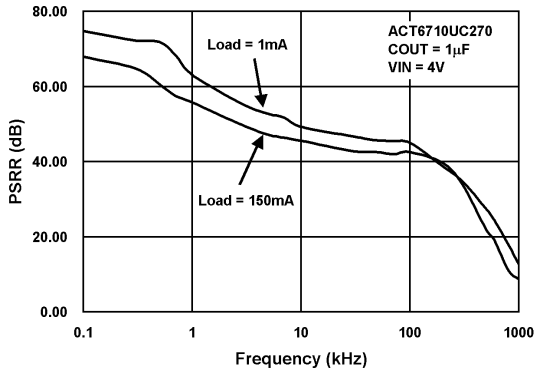
When using the ACT6701/6711's power-good indicator output, connect an external 100k $\Omega$  pull-up resistor from PG pin to  $V_{\text{OUT}}$  or to another supply rail. A low level indicates that the output voltage is out of regulation and can be used to reset the load. A capacitor can be added between PG and ground to add rising edge delay to the reset signal.

### BYPASS PIN CAPACITOR

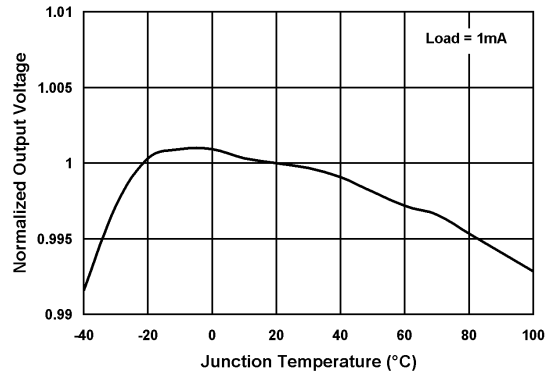
For ACT6702/6712 low noise bypass pin, the capacitor type and capacitor material is not as critical as input and output capacitors. Any good quality 10nF capacitor can be used in this application.

## TYPICAL PERFORMANCE CHARACTERISTICS

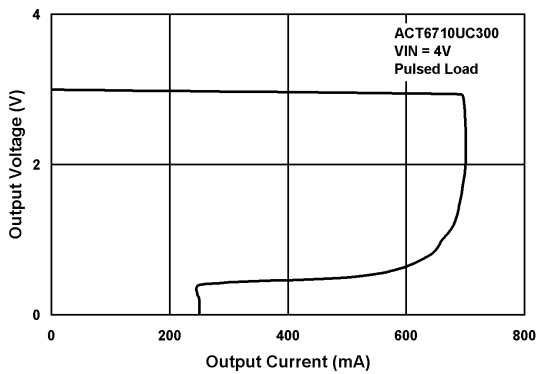
Power Supply Rejection Ratio



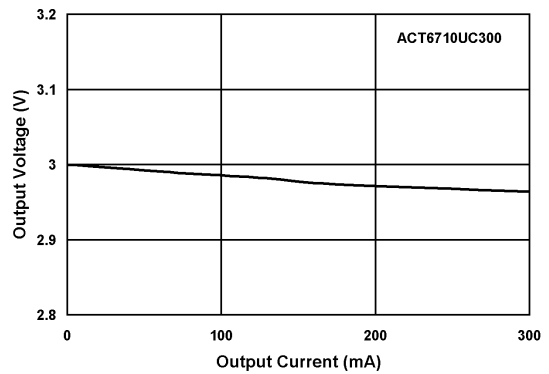
Output Voltage Temperature Coefficient



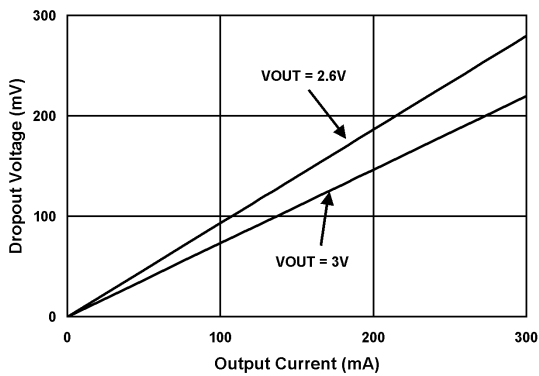
Current Limit Foldback



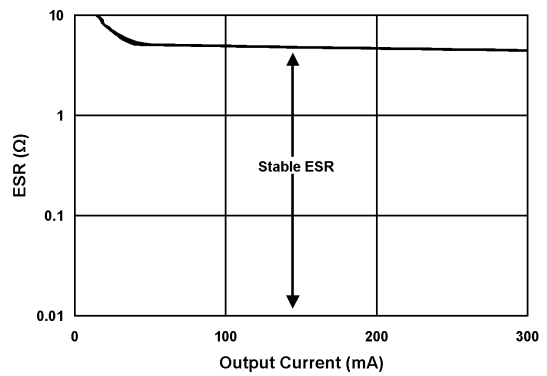
Load Regulation



Dropout Voltage vs. Output Current

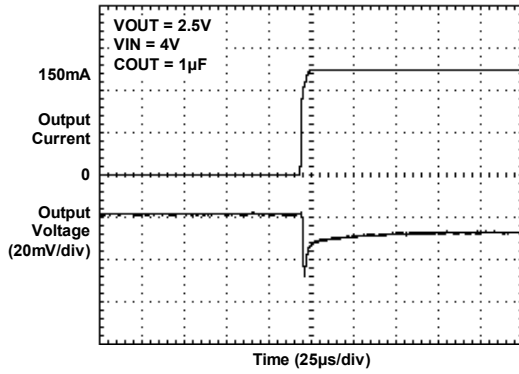


Region of Stable COUT ESR vs. Output Current

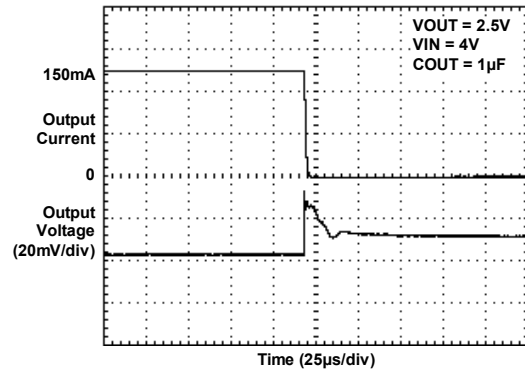


## TYPICAL PERFORMANCE CHARACTERISTICS (CONT'D)

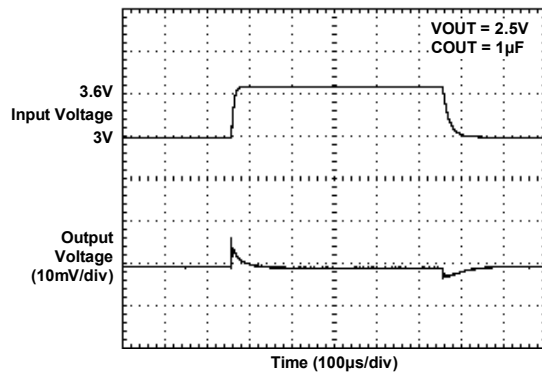
Load Step Response



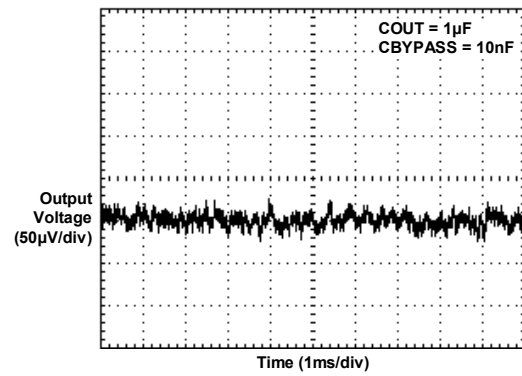
Load Step Response



Line Step Response



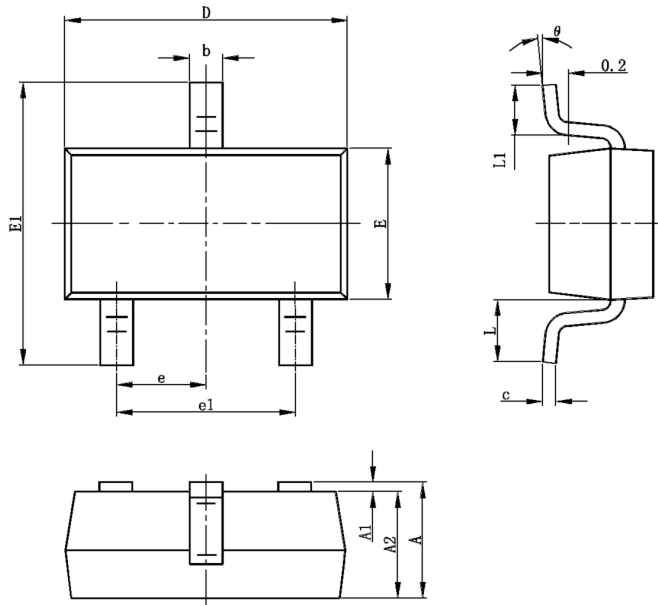
ACT6702/6712 Output Voltage Noise





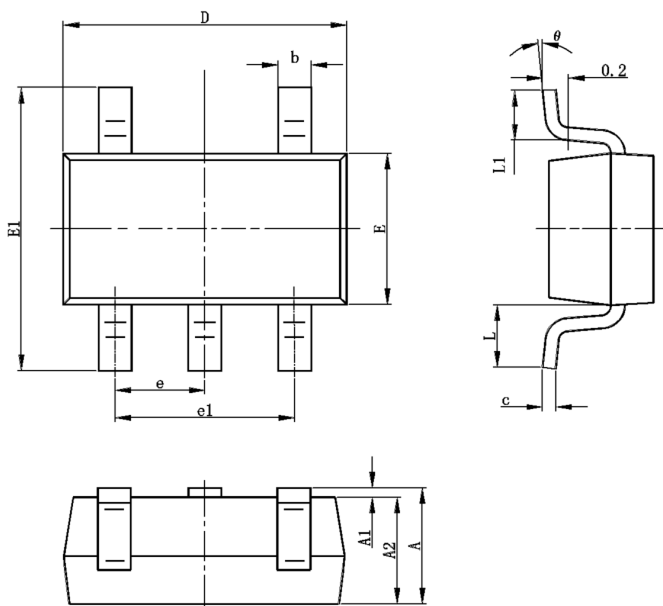
## PACKAGE OUTLINE

### SOT23-3 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.700 REF		0.028 REF	
L1	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

### SOT23-5 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.700 REF		0.028 REF	
L1	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°



## NOTES

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44081 Old Warm Springs Blvd, Fremont, California 94538, USA