

## General Description

**Specifically design to reside in battery packs**, the device AQ265 is used to stop the charge or discharge of a battery when the battery temperature is outside of the safe temperature range.

The AQ265 is an accurate low-power solid-state thermostat that provides shut down alarm at both cold and hot temperatures. It features very low standby current, which **prolongs battery shelf life**. The hot temperature trip point is 40°C and can be adjusted with one external resistor from 40°C to 90°C. The cold trip point is -20°C and can be adjusted with one external resistor from -20°C to 15°C. Thermal hysteresis is internally programmed to guarantee stability at the transition points.

At temperatures between its hot and cold trip points, the AQ265 lies quietly with open drain while drawing ICC of only 20µA. When either the hot or cold threshold temperature is reached the OUT pin will sink >200µA providing a low power signal to disconnect the battery from its load and/or charger.

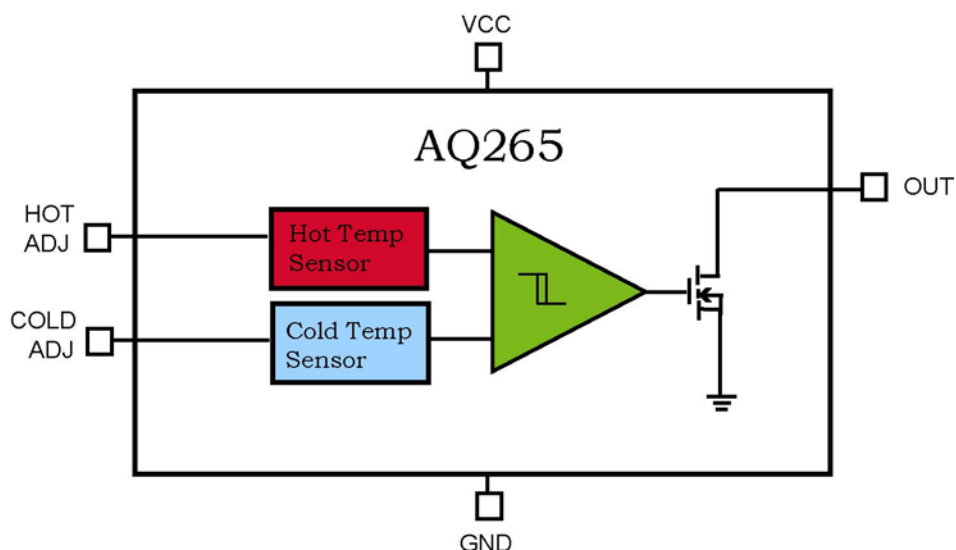
## Applications

- Battery Packs and Chargers
- Electronic System protection

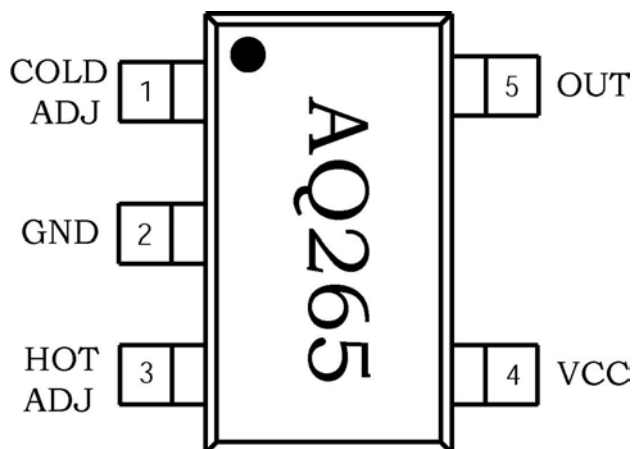
## Features

- 20µA off state current, prolongs battery shelf life
- +/-3 degrees Celsius accuracy
- Adjustable Hot and cold temperature trip points
- Internally programmed thermal hysteresis
- Excellent power supply noise rejection
- Offered in very small SOT23-5 package.
- RoHS Compliant

## Block Diagram



## Pin Configuration



## Pin Descriptions

Pin num	Pin Name	Function
1	COLD ADJ	Adjust pin, connects to lower temperature adjust resistor
2	GND	Ground
3	HOT ADJ	Adjust pin, connects to high temperature adjust resistor
4	VCC	V supply. Must be greater than 2.4V for normal operation.
5	OUT	Normally Open Drain, $V_{DSS}$ when thermal threshold is reached.

## Ordering Information

Device	Operating Tj	Hot TTHRESH RANGE	Cold TTHRESH RANGE	Tol.	PKG Type	Wrap	Ordering Number
AQ265	$-55^{\circ}\text{C} \leq 150^{\circ}\text{C}$	$40 < 90^{\circ}\text{C}$	$-20 < 15^{\circ}\text{C}$	$\pm 3^{\circ}\text{C}$	SOT-23-5	T&R	AQ265GY-M5-AJ-TRL

Note: The TRL parts are Lead Free and RoHS compliant.

## Absolute Maximum Ratings

Stress greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These stress ratings only, and functional operation of the device at these or any conditions beyond those indicated under recommended Operating Conditions is not implied. Exposure to “Absolute Maximum Rating” for extended periods may affect device reliability. Use of standard ESD handling precautions is required.

Parameter	Value	Units
VCC Voltage	18	V
VOUT Voltage	18	V
IOUT Current	10	mA
Cold ADJ Current	10	mA
Hot ADJ Current	10	mA
Operating Junction Temperature	155	°C
Lead Temperature (soldering 10 seconds)	260	°C
Storage Temperature Range	-65 to +150	°C

## Electrical Specifications

Electrical characteristics are guaranteed over the full temperature range  $-55^{\circ}\text{C} < T_j < 150^{\circ}\text{C}$  unless otherwise stated. Ambient temperature must be de-rated based upon power dissipation and package thermal characteristics. Unless otherwise specified: VCC = 5V COLD ADJ = HOTADJ = no connect,  $T_j = 25^{\circ}\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
IVCC	Input Current			20	30	$\mu\text{A}$
IVCC	Input Current	$T_j$ outside trip temperatures		20	30	$\mu\text{A}$
VCC	Input Voltage		2.4		16	V
VOUT	Output on V <sub>OUT</sub>	$I_{\text{OUT}} = 100\mu\text{A}$ , $T_j$ outside the trip temperatures		0.15	0.25	V
IOUT	Output on I <sub>OUT</sub>	$V_{\text{OUT}} = 2.2\text{V}$ , $T_j$ outside the trip temperatures	100	350	600	$\mu\text{A}$
IOUT	Output leakage current	VCC = 16V, $T_j$ inside the trip temperatures		0.2	0.4	$\mu\text{A}$
OTT	Hot temp Threshold	Unadjusted $T_j =$	37	40	43	°C
OTR	Hot temp range	Adjusted by resistor <sup>(1)</sup> $T_j =$	40		90	°C
HOT	Hysteresis			-5		°C
UTT	Cold temp Threshold	$T_j =$	-23	-20	-17	°C
UTR	Cold temp range	Adjusted by resistor <sup>(2)</sup> $T_j =$	-20		15	°C
HUT	Hysteresis			+3		°C

### Notes:

- 1) The over temperature trip point is adjusted with a resistor from HOT ADJ to GND (see graph 1)
- 2) The under temperature trip point is adjusted with a resistor from COLD ADJ to GND (see graph 2)
- 3) For an accurate RSET to adjust temperature email required temperature to [info@acutechnology.com](mailto:info@acutechnology.com)

## Typical Application

The device AQ265 is very simple to use. It is recommended to place the AQ265 in close proximity of the device whose temperature is to be sensed. The device AQ265 has an open drain output, which is capable of sinking greater than 200 $\mu$ A when the sensed temperature exceeds the Hot temp trip point or goes below the Cold temp trip point. The Hot and Cold temperature trip points can be set by the addition of external resistors RSET as depicted in FIG.1 below. 1nF capacitors must be placed from the adjust pins to ground close to the AQ265 for noise immunity.

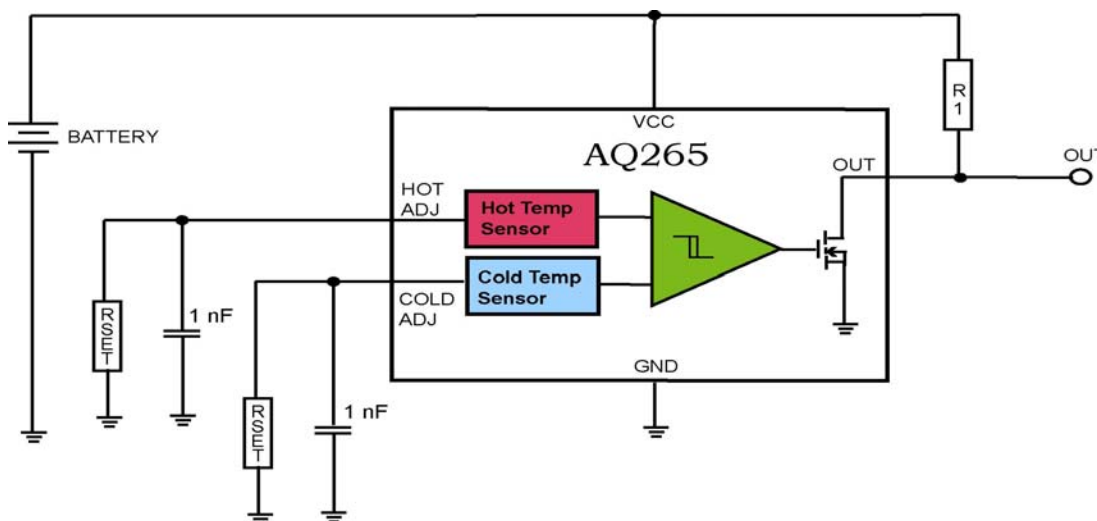
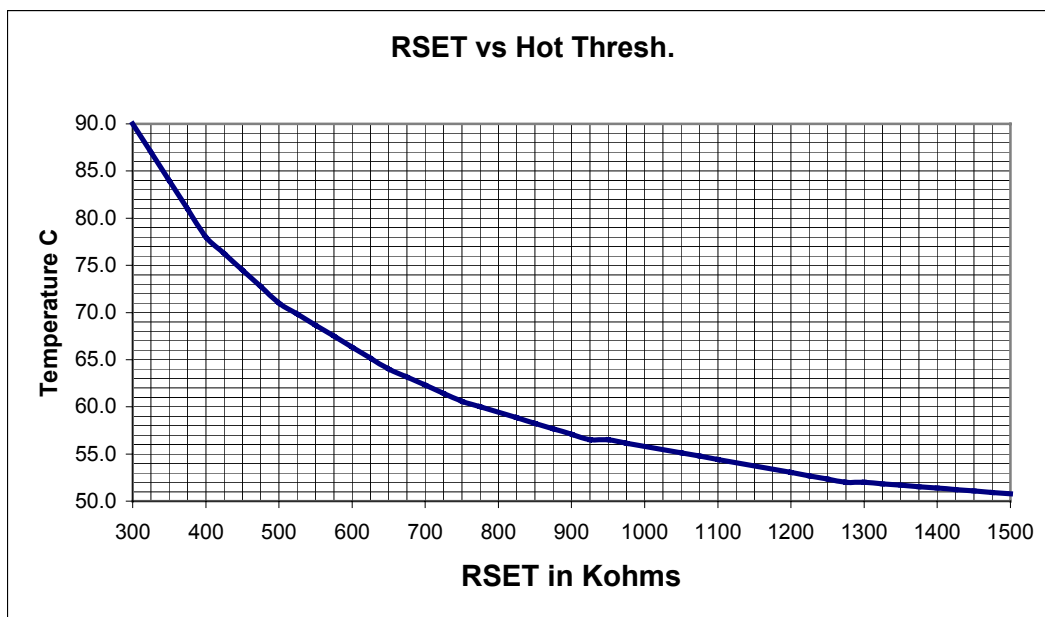


FIG.1

### SETTING THE HOT TEMPERATURE TRIP POINT

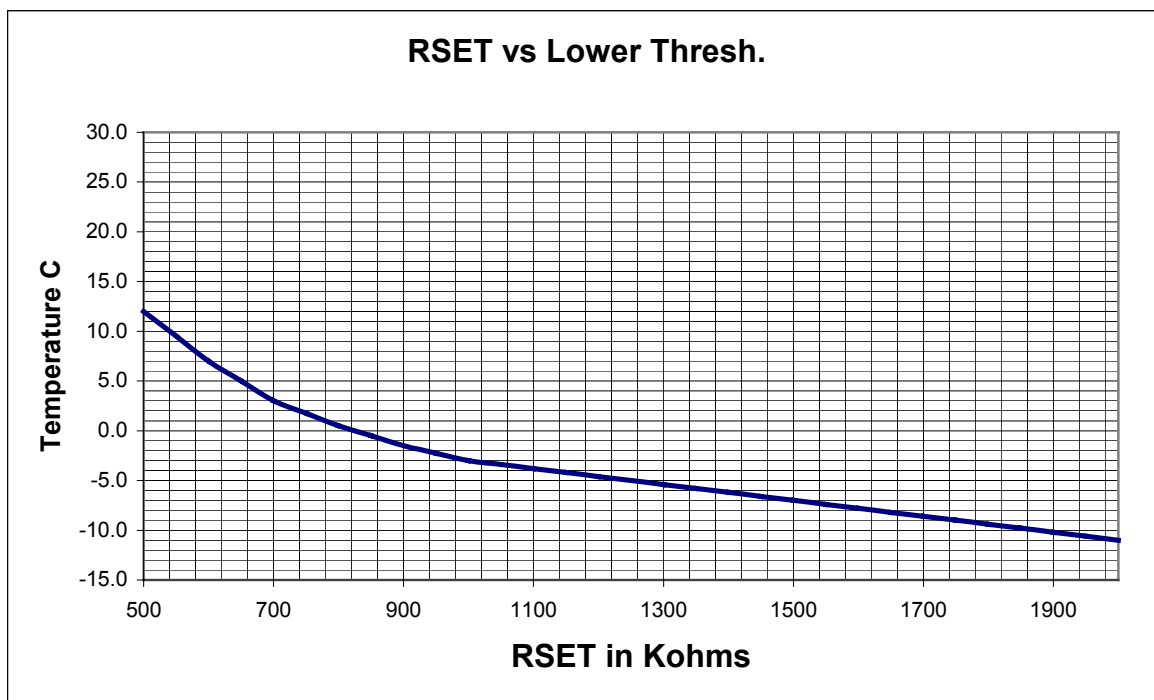
It is assumed that the temperature coefficient of the external resistor be close to zero as it commonly is. Higher accuracy resistors guarantee higher accuracy temperature trip point. To determine the desired Hot temperature trip point, the resistor RSET value should be selected according to the graph below. The graph shows the desired resistor value for the temperature range between 50°C and 85°C. If no external resistor is selected, the Hot temperature trip point will be 40°C. For an accurate RSET email [info@acutechnology.com](mailto:info@acutechnology.com)



GRAPH.1

**SETTING THE COLD TEMPERATURE TRIP POINT**

It is assumed that the temperature coefficient of the external resistor be close to zero as it commonly is. Higher accuracy resistors guarantee higher accuracy temperature trip point. To determine the desired Cold temperature trip point, the resistor RSET value should be selected according to the graph below. The graph shows the desired resistor value for the temperature range between -10°C and 10°C. If no external resistor is selected the Cold temperature trip point will be -20°C. For an accurate RSET email [info@acutecchnology.com](mailto:info@acutecchnology.com).



GRAPH.2

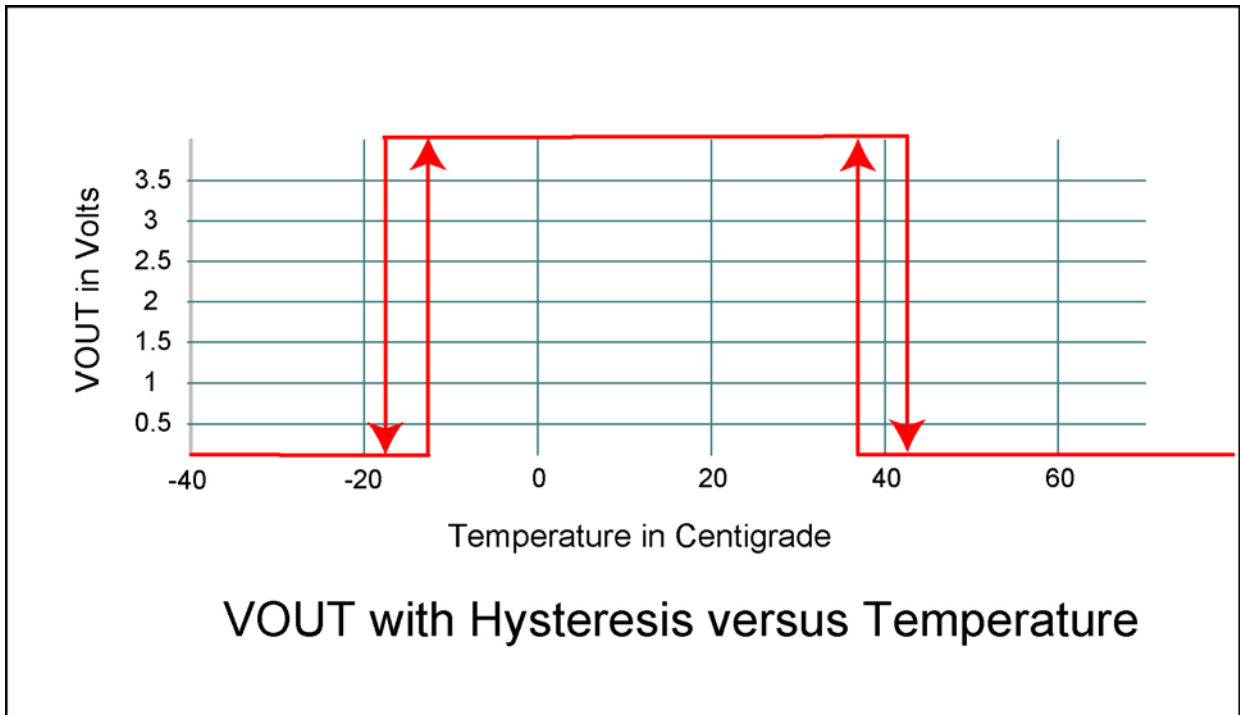
The AQ265 is designed to present the lowest possible current drain to the battery. ICC is less than 30µA under all conditions. OUT pin is designed to pull down with a minimum of 200µA. To insure the desired low state output voltage, the current required to pull down the element used to disconnect the Battery must be determined and is referred to as I load.

Selection of the R1 pull up resistor must allow for I load when the OUT engages into the alarm state, meaning the device is sensing temperatures outside of its set temperature window. The OT pin is guaranteed to sink a minimum of 100µA to keep the current drain as low as possible. Therefore, I load plus I R1 must not exceed 100µA or a true logic low may not be achieved when the AQ265 alarms an out of window temperature has been sensed.

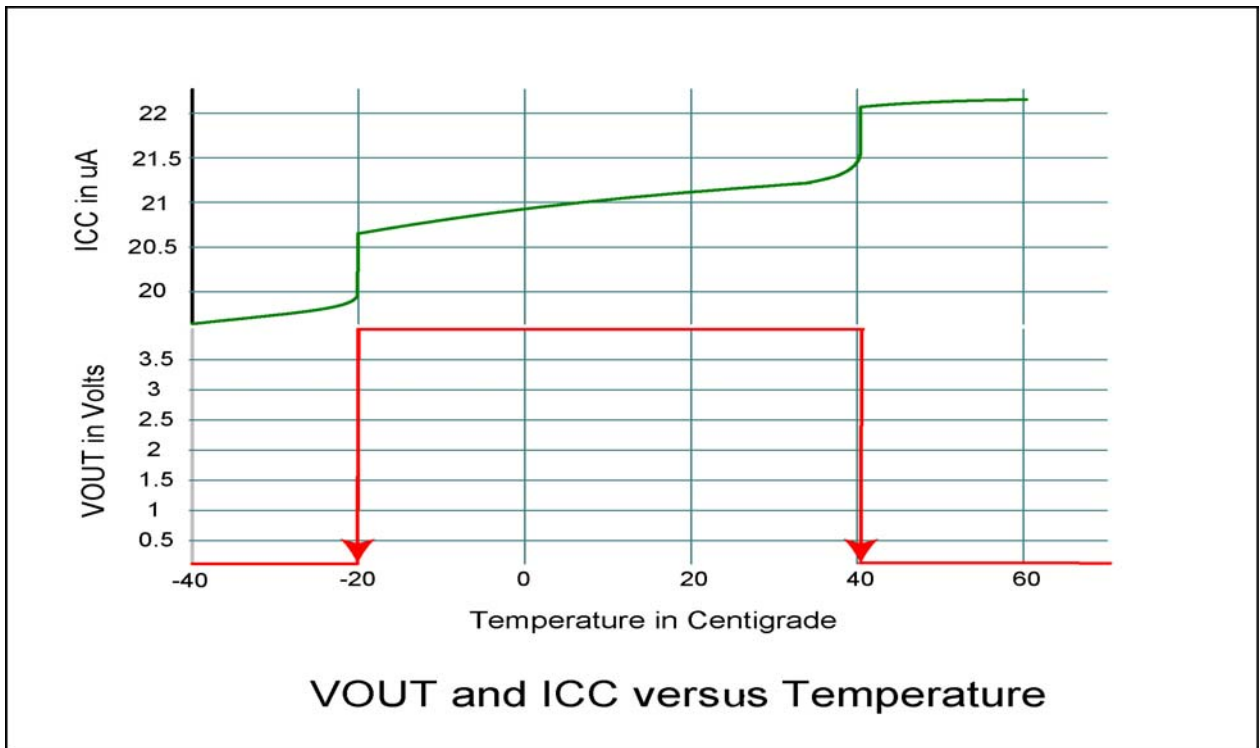
$$R1 = (V_{batt. \min} - \text{Max. } V_{OUTon}) / (\text{Min. } I_{OUTon} - (1.5 * I \text{ load})) = (V_{batt. \min} - 0.25V) / (100\mu A - (1.5 * I \text{ load}))$$

**Graph 3** below shows the hysteretic response of the OUT pin to temperature. In the normal range between the Cold and Hot trip points, the AQ265 presents an open Drain high state at the OUT pin. At the cold temperature trip point, VOUT will drop to its low state. The OUT pin will return to a high state when the AQ265 senses the temperature has risen above the Cold trip point by + 3 degrees of hysteresis. Likewise, the AQ265 will cause the OUT pin to go low state when the Hot temperature trip point is exceeded. OUT will return to high state when the AQ265 senses that the temperature is below the high trip point by - 5 degrees of hysteresis.

**Graph 4** shows the input current into the AQ265 and output state over the temperature range.



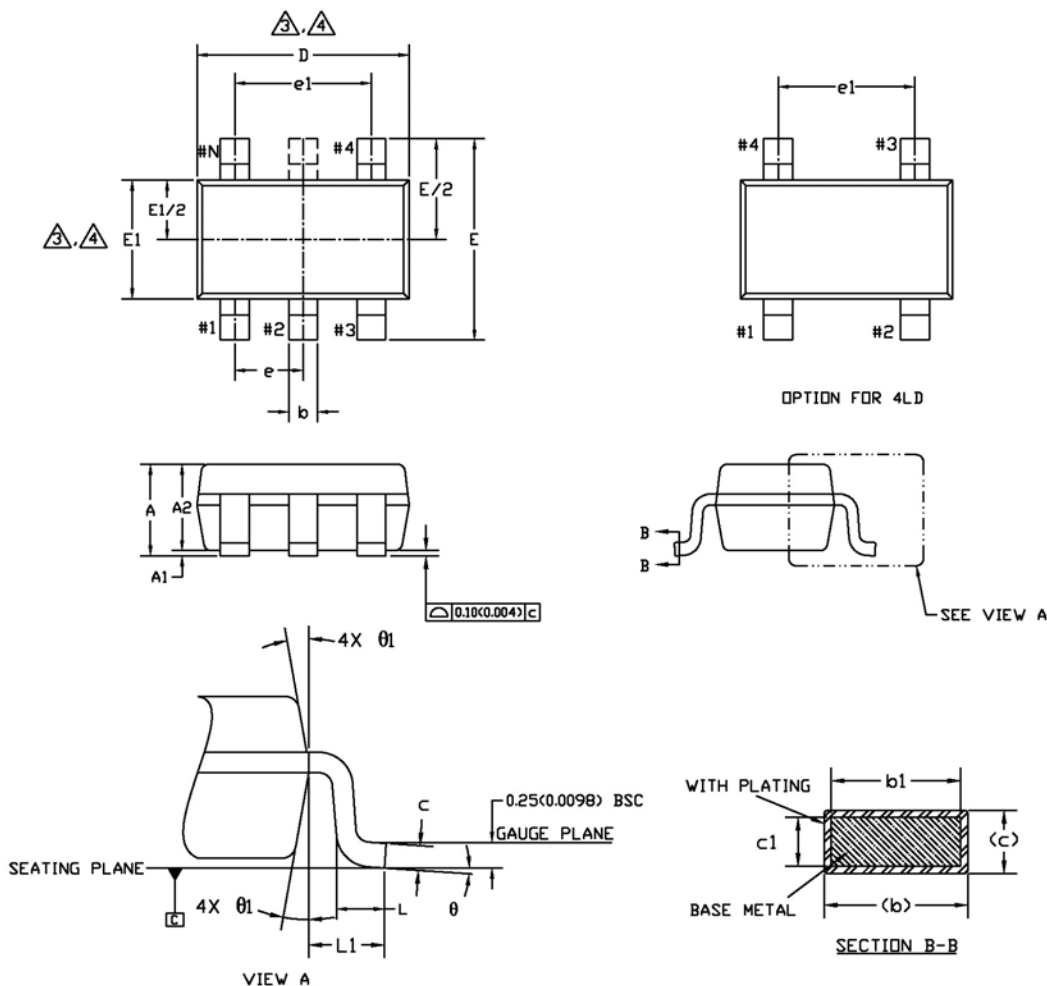
GRAPH.3



GRAPH.4

Package Dimensions

SOT23-3, SOT23-4, SOT23-5, SOT23-6



SYMBOL	COMMON					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NDM.	MAX.	MIN.	NDM.	MAX.
A	1.20	1.30	1.40	0.047	0.051	0.055
A1	0.05	-	0.15	0.002	-	0.006
A2	0.90	1.15	1.30	0.035	0.045	0.051
b	0.35	-	0.50	0.013	-	0.020
b1	0.35	0.40	0.45	0.013	0.015	0.017
c	0.08	-	0.22	0.003	-	0.008
c1	0.08	0.13	0.20	0.003	0.005	0.007
D	2.90 BSC			0.114 BSC		
E	2.80 BSC			0.110 BSC		
E1	1.60 BSC			0.062 BSC		
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.074 BSC		
L	0.35	0.45	0.55	0.013	0.017	0.021
L1	0.60 REF.			0.023 REF.		
theta	0°	4°	8°	0°	4°	8°
theta1	10° TYP			10° TYP		

NOTE :

1. Dimensioning and tolerancing per ASME Y 14.5 M - 1994.
2. Dimensions are in millimeters. Converted inch dimension are not necessarily exact.
3. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 0.15 mm per side. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.15 mm per side.
4. Top package may be smaller than the bottom package. Dimension D and E1 are determined at the outermost extremes of the plastic body exclusive of mold flash gate burrs and interlead flash.
5. Terminal numbers are shown for reference only. Die is facing up for molding. Die is facing down for trim/form.

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## Contact Information

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