HM85XX

High Voltage Low Power Consumption LDO — HM85XX Series

CMOS Voltage Regulator With ON/OFF Switch — 300mA

HM85XX is a high voltage (up to 40V) ultra-low quiescent current low dropout voltage regulator (LDO) manufactured in CMOS processes. It can deliver up to 300mA of current while consuming only 1.5uA of quiescent current. It consists of a reference voltage generator, an error amplifier, a current foldback circuit, and a phase compensation circuit plus a driver transistor. The HM85XX is designed specifically for applications where very-low I_Q is a critical parameter. This device maintains low quiescent current consumption even in dropout mode to further increase the battery life. When in shutdown or disabled mode, the device consumes less than 100-nA I_Q even with input voltage of 40V that helps increase the shelf life of the battery.

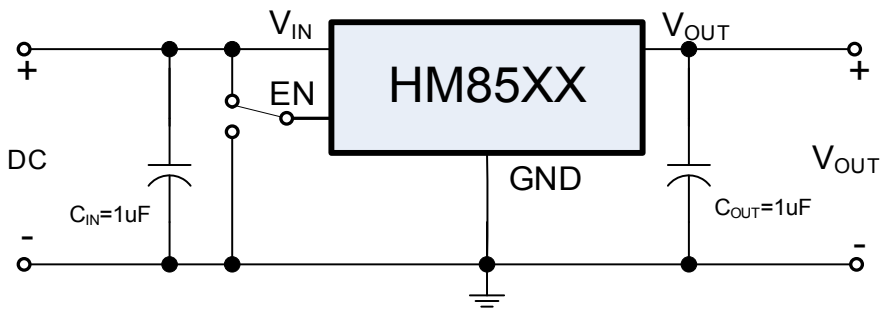
■ Features

- Ultra-low Quiescent Current: 1.5uA
- Maximum Input Voltage: 40V
- Output Voltage Highly Accurate: ±2%
- Maximum Output Current: 300mA
- Dropout Voltage: 4mV@I_{OUT}=1mA
- Temperature Stability: ±50ppm/℃
- ON/OFF Logic = Enable High
- Protections Circuits: Current Limiter, Foldback, Thermal shutdown
- Output Capacitor: Low ESR Ceramic Capacitor Compatible

■ Applications

- Smart wearer
- Long-life battery-powered devices
- Portable mobile devices, such as mobile phones, cameras, and so on
- Wireless communication equipment

■ Typical Applications



■ Notes on Use

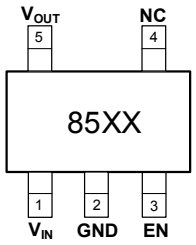
1.Input Capacitor (C_{IN}): 1μF above.

2.Output Capacitor (C_{OUT}): 1μF above.

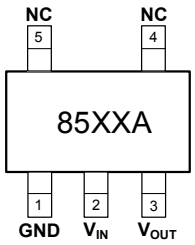
3.If the output capacitor is 1uF, it is recommended that the withstand voltage value is not less than 25V, and the capacitance value change rate at high temperature or low temperature does not exceed 20%.

■ Pin Configuration and Functions

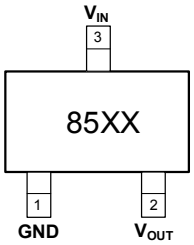
SOT23-5
Top View



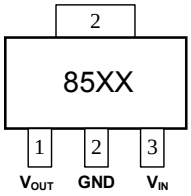
SOT23-5(A_Type)
Top View



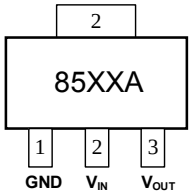
SOT23-3
Top View



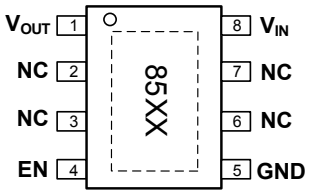
SOT89-3
Top View



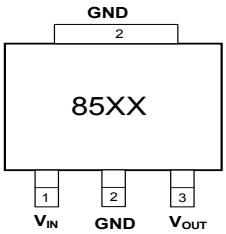
SOT89-3(A_Type)
Top View



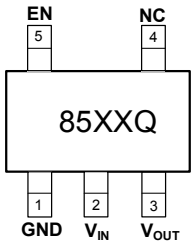
ESOP8
Top View



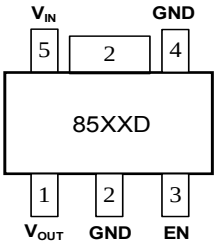
SOT223-3
Top View



SOT23-5(Q_Type)
Top View



SOT89-5(D_Type)
Top View



Pin Functions

NAME	DESCRIPTION
V_{IN}	Power Input Pin.
EN	Enable pin. Drive this pin high to enable the device. Drive this pin low to put the device into low current shutdown.
V_{OUT}	Regulated output voltage pin
GND	Ground
Thermal pad	The thermal pad is electrically connected to the GND node. Connect this pad to the GND plane for improved thermal performance.
NC	No internal connection

■ Product Selections

Product Name	V_{OUT} (V)	Package	Ordering Name	Marking	Package Information
HM85E18M5	1.8	SOT23-5L	HM85E18M5	8518	Tape and Reel, 3000pcs
HM85E25M5	2.5	SOT23-5L	HM85E25M5	8525	
HM85E28M5	2.8	SOT23-5L	HM85E28M5	8528	
HM85E30M5	3.0	SOT23-5L	HM85E30M5	8530	
HM85E33M5	3.3	SOT23-5L	HM85E33M5	8533	
HM85E36M5	3.6	SOT23-5L	HM85E36M5	8536	
HM85E50M5	5.0	SOT23-5L	HM85E50M5	8550	
HM85A30M5	3.0	SOT23-5L	HM85A30M5	8530A	
HM85A33M5	3.3	SOT23-5L	HM85A33M5	8533A	
HM85A36M5	3.6	SOT23-5L	HM85A36M5	8536A	
HM85A50M5	5.0	SOT23-5L	HM85A50M5	8550A	
HM85Q33M5	3.3	SOT23-5L	HM85Q33M5	8533Q	
HM85Q50M5	5.0	SOT23-5L	HM85Q50M5	8550Q	
HM85E30MR	3.0	SOT23-3L	HM85E30MR	8530	Tape and Reel, 3000pcs
HM85E33MR	3.3	SOT23-3L	HM85E33MR	8533	
HM85E36MR	3.6	SOT23-3L	HM85E36MR	8536	
HM85E50MR	5.0	SOT23-3L	HM85E50MR	8550	
HM85E55MR	5.5	SOT23-3L	HM85E55MR	8555	
HM85E30PR	3.0	SOT89-3L	HM85E30PR	8530	Tape and Reel, 1000pcs
HM85E33PR	3.3	SOT89-3L	HM85E33PR	8533	
HM85E36PR	3.6	SOT89-3L	HM85E36PR	8536	
HM85E40PR	4.0	SOT89-3L	HM85E40PR	8540	
HM85E50PR	5.0	SOT89-3L	HM85E50PR	8550	
HM85E53PR	5.3	SOT89-3L	HM85E53PR	8553	
HM85E55PR	5.5	SOT89-3L	HM85E55PR	8555	
HM85E57PR	5.7	SOT89-3L	HM85E57PR	8557	
HM85E80PR	8.0	SOT89-3L	HM85E80PR	8580	
HM85EC0PR	12.0	SOT89-3L	HM85EC0PR	85C0	
HM85EF0PR	15.0	SOT89-3L	HM85EF0PR	85F0	
HM85A18PR	1.8	SOT89-3L	HM85A18PR	8518A	Tape and Reel, 1000pcs
HM85A25PR	2.5	SOT89-3L	HM85A25PR	8525A	
HM85A28PR	2.8	SOT89-3L	HM85A28PR	8528A	
HM85A30PR	3.0	SOT89-3L	HM85A30PR	8530A	
HM85A33PR	3.3	SOT89-3L	HM85A33PR	8533A	
HM85A35PR	3.5	SOT89-3L	HM85A35PR	8535A	
HM85A36PR	3.6	SOT89-3L	HM85A36PR	8536A	
HM85A40PR	4.0	SOT89-3L	HM85A40PR	8540A	

HM85A44PR	4.4	SOT89-3L	HM85A44PR	8544A	
HM85A50PR	5.0	SOT89-3L	HM85A50PR	8550A	
HM85A80PR	8.0	SOT89-3L	HM85A80PR	8580A	
HM85A90PR	9.0	SOT89-3L	HM85A90PR	8590A	
HM85AC0PR	12.0	SOT89-3L	HM85AC0PR	85C0A	
HM85AF0PR	15.0	SOT89-3L	HM85AF0PR	85F0A	
HM85D33P5	3.3	SOT89-5L	HM85D33P5	8533D	
HM85D50P5	5.0	SOT89-5L	HM85D50P5	8550D	
HM85E33ES	3.3	ESOP8	HM85E33ES	8533	Tape and Reel, 4000pcs
HM85E50ES	5.0	ESOP8	HM85E50ES	8550	
HM85EC0ES	12.0	ESOP8	HM85EC0ES	85C0	
HM85EF0ES	15.0	ESOP8	HM85EF0ES	85F0	
HM85C33	3.3	SOT223-3L	HM85C33	8533	Tape and Reel 2500pcs
HM85C50	5.0	SOT223-3L	HM85C50	8550	

Notes:

1* Customer can request to customize the output voltage ranged from 1.2V to 15V if desired voltage is not found in the selections.

2* Customer can request customization of package choice.

3* Please pay attention to the MARKING of the product package type.

■ Absolute Maximum Ratings (Unless otherwise indicated: T_a=25℃)

PARAMETER	SYMBOL	RATINGS		UNITS
Input Voltage	V_{IN}	-0.3 ~ 45		V
Output Voltage	V_{OUT}	Vss-0.3 ~ VIN+0.3V		
Power Dissipation	P_D	SOT23-5	250	mW
		SOT23-3	250	
		ESOP8	1800	
		SOT89-3	1000	
		SOT89-5	1000	
		SOT223-3	1500	
Thermal Resistance	$R_{\theta JA}$	SOT23-5	180	℃/W
		SOT23-3	200	
		ESOP8	80	
		SOT89-3	100	
		SOT89-5	100	
		SOT223-3	66	
Operating Ambient Temperature	T_{opr}	-40 ~ +85		℃
Storage Temperature	T_{stg}	-40 ~ +125		
ESD Protection	ESD HBM	5000		V
Humidity sensitive level	MSL	3		

Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

■ Electrical Characteristics

HM85XX Series (Unless otherwise indicated：T_a=25℃)

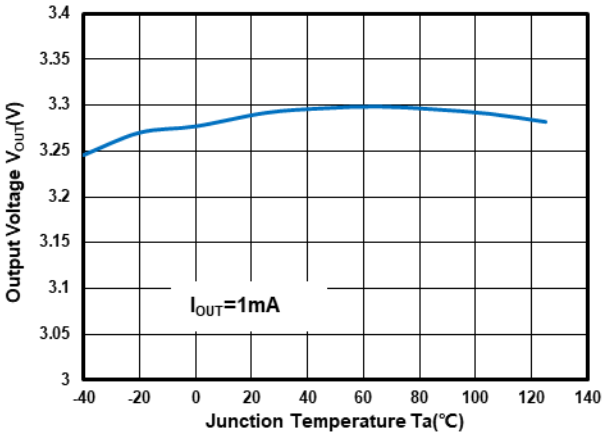
PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNIT
Output Voltage*1	$V_{OUT(S)}$	V_{IN}= $V_{OUT(S)}$+2V，I_{OUT}=1mA		$V_{OUT(S)}$× 0.98	$V_{OUT(S)}$	$V_{OUT(S)}$× 1.02	V
Dropout Voltage*2	V_{DROP}	V_{EN}=V_{IN}, $V_{OUT(S)}$=3.3V I_{OUT}=1mA			4	8	mV
		V_{EN}=V_{IN}, $V_{OUT(S)}$=3.3V I_{OUT}=300mA			1200	1800	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \bullet V_{OUT(S)}}$	$V_{OUT(S)}$+2V≤V_{IN}≤40V I_{OUT} =1mA			0.01	0.02	%/V
Load Regulation	ΔV_{OUT2}	V_{IN} = $V_{OUT(S)}$+2V 1mA≤I_{OUT}≤300mA	$V_{OUT(S)}$≤5.3V		25	50	mV
			$V_{OUT(S)}$>5.3V		50	80	
Temperature Stability	$\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT(S)}}$	V_{IN} = $V_{OUT(S)}$+2V，I_{OUT}=10mA -40℃≤T_a≤125℃			±50		ppm/℃
GND Current (V_{EN}=V_{IN})	I_{GND}	no load	$V_{OUT(S)}$<3.0V	0.8	1.2	2	uA
			3.0≤$V_{OUT(S)}$≤5.3V	1	1.5	2.5	
			$V_{OUT(S)}$>5.3V	1.5	2.3	3.5	
		I_{OUT}=100mA			420		
Shutdown Current (EN=0)	I_{SHUT}	V_{IN}=40.0V, V_{EN}=0			0.1	1	
Input Voltage	V_{IN}	---		2.2		40	V
Maximum Output Current	I_{OUTMAX}			300	350		mA
Current Limit*3	I_{LIM}	V_{IN}= $V_{OUT(S)}$+2V, V_{OUT} = 0.95 ×$V_{OUT(S)}$		350	550		
Short Circuit Current*4	I_{SHORT}	V_{IN}=V_{EN}=$V_{OUT(S)}$+2.0V V_{OUT}=0V			65		
Power Supply Rejection Ratio	PSRR	f=100Hz, I_{OUT} =10mA			79		dB
		f=1kHz, I_{OUT} =10mA			62		
		f=10kHz, I_{OUT} =10mA			48		
		f=100kHz, I_{OUT} =10mA			40		
EN 'H' Level Voltage	V_{ENH}			1.5		40.0	V
EN 'L' Level Voltage	V_{ENL}			0		0.6	
EN 'H' Level Current	I_{ENH}	V_{IN}=40V, V_{EN}=V_{IN}		-0.1		0.1	uA
EN 'L' Level Voltage	I_{ENL}	V_{IN}=40V, V_{EN}=0		-0.1		0.1	
Over Temperature Protection	OTP	I_{OUT}=1mA			170		℃

Notes:

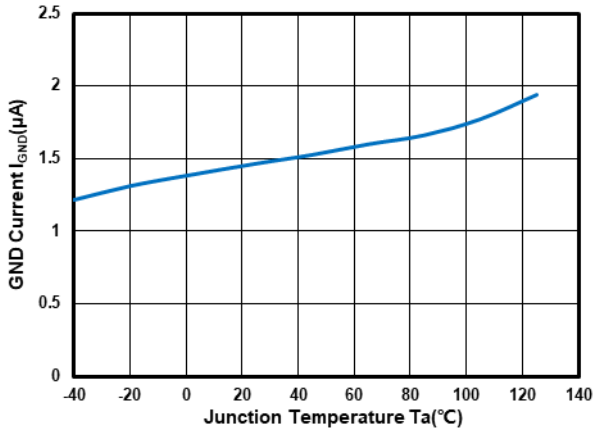
1. $V_{OUT(S)}$: Output voltage when V_{IN}=V_{OUT}+2V, I_{OUT}=1 mA.
2. V_{DROP}=V_{IN1} -（$V_{OUT(S)}$× 0.98）where V_{IN1} is the input voltage when V_{OUT} = $V_{OUT(S)}$× 0.98.
3. I_{LIM}: Output current when V_{IN}=$V_{OUT(S)}$+2V and V_{OUT} = 0.95*$V_{OUT(S)}$.
4. VOUT pin should be shorted to GND pin, and the impedance between them is less than 0.1 ohm.

■ Typical Performance Characteristics

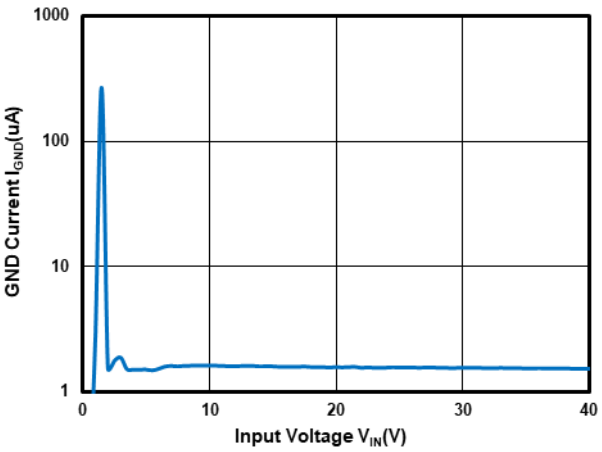
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, Ta=25℃, unless otherwise indicated.



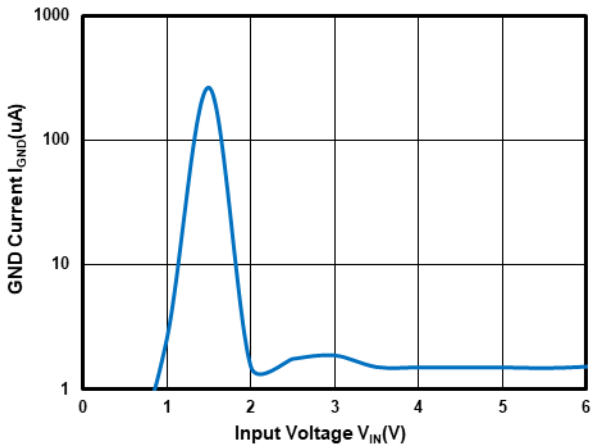
Output Voltage vs Temperature at V_{OUT}=3.3V



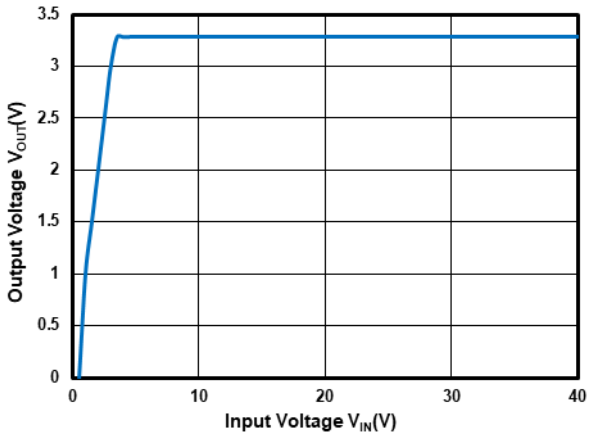
GND Current vs Temperature at V_{OUT}=3.3V



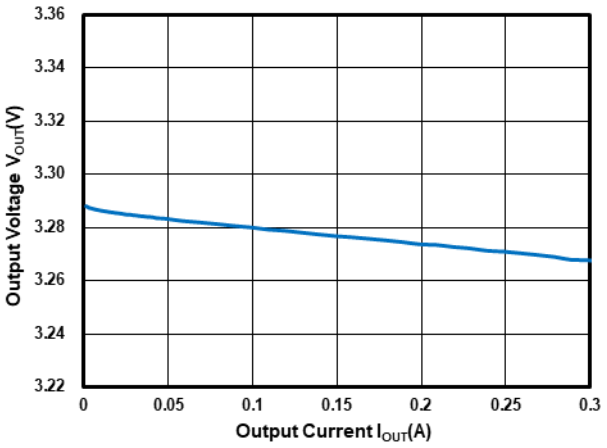
GND Current vs Input Voltage at V_{OUT}=3.3V



GND Current vs Input Voltage at V_{OUT}=3.3V



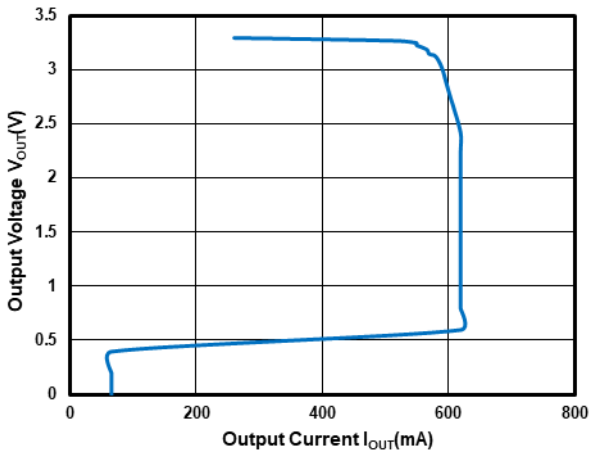
Output Voltage vs Input Voltage at V_{OUT}=3.3V



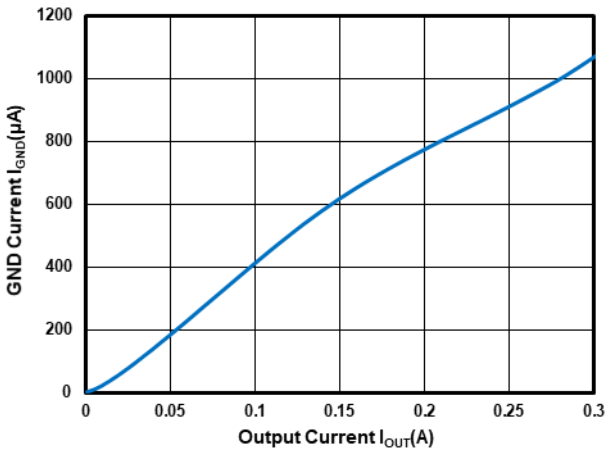
Output Voltage vs Output Current at V_{OUT}=3.3V

■ Typical Performance Characteristics (Continued)

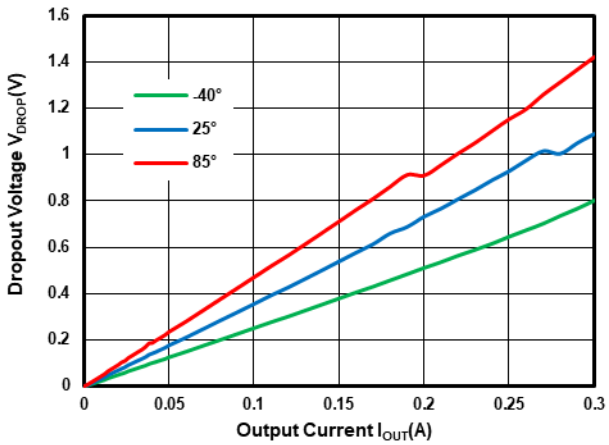
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, unless otherwise indicated.



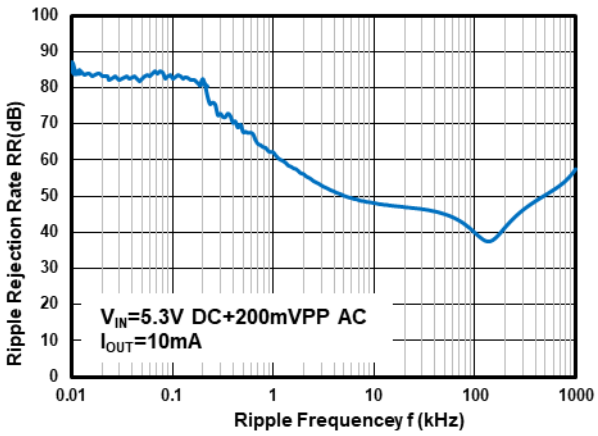
Output Current Fold-back at V_{OUT}=3.3V



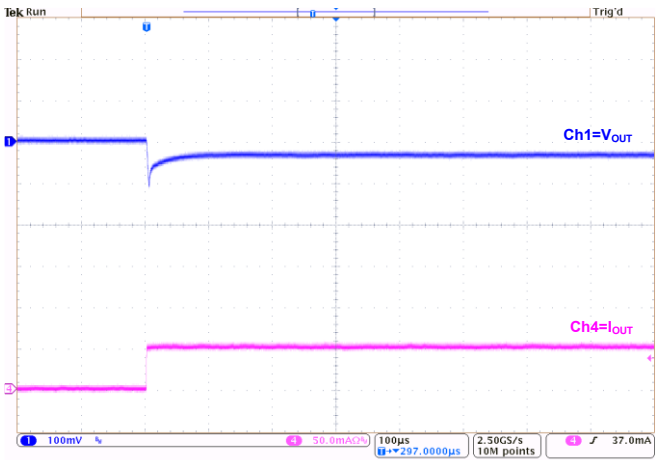
GND Current vs Output Current at V_{OUT}=3.3V



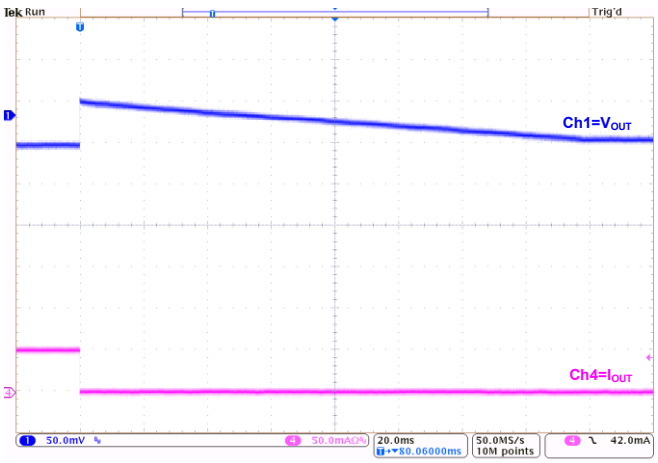
Dropout Voltage vs Temperature at V_{OUT}=3.3V



Power Supply Rejection Ratio at V_{OUT}=3.3V



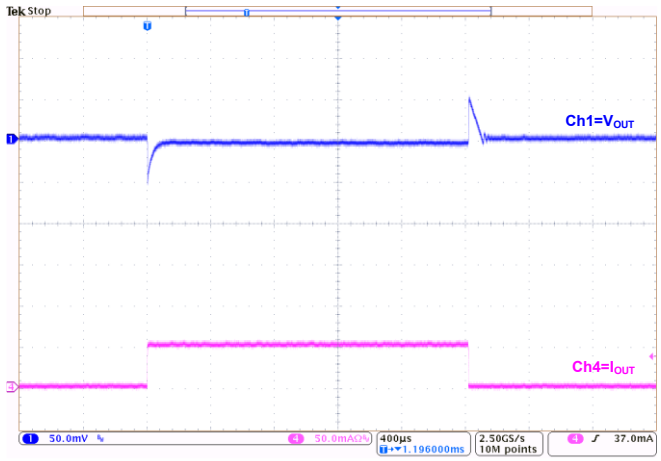
Load Transient at V_{OUT}=3.3V:
(I_{OUT}=0mA~50mA)



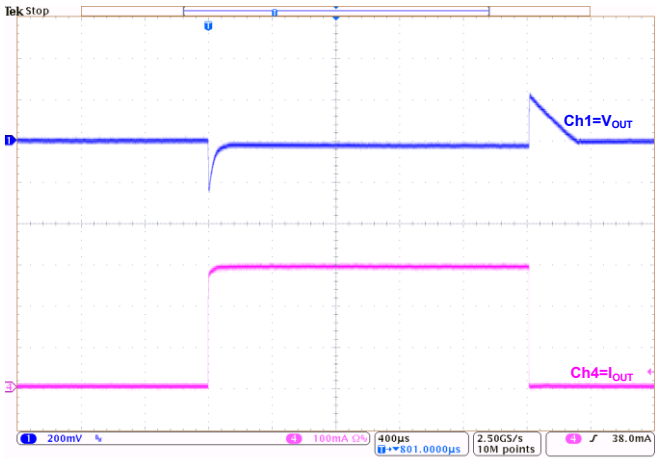
Load Transient at V_{OUT}=3.3V:
(I_{OUT}=50mA~0mA)

■ Typical Performance Characteristics (Continued)

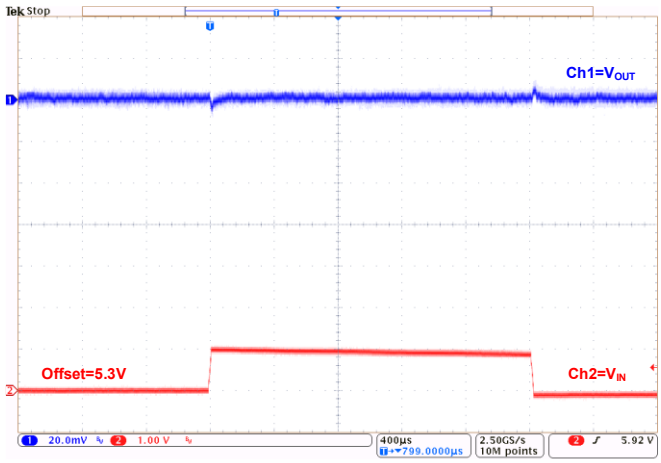
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, Ta=25℃, unless otherwise indicated.



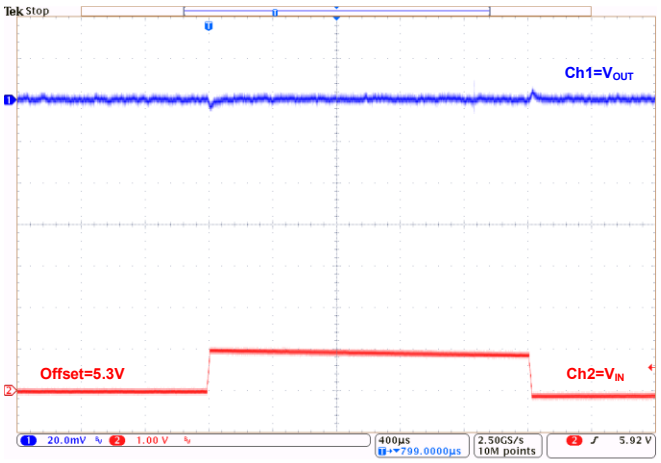
Load Transient at V_{OUT}=3.3V:
(I_{OUT}=1mA~50mA~1mA)



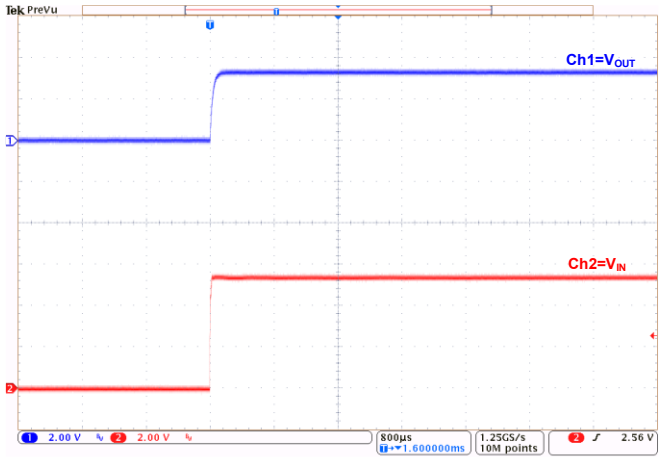
Load Transient at V_{OUT}=3.3V:
(I_{OUT}=1mA~300mA~1mA)



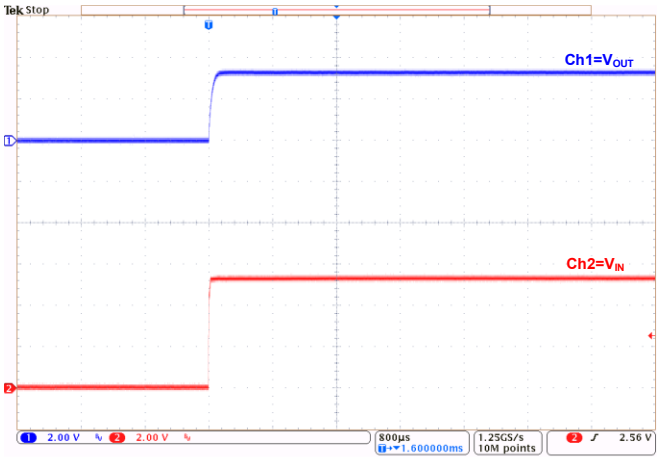
Line Transient at V_{OUT}=3.3V:
(I_{OUT}=1mA)



Line Transient at V_{OUT}=3.3V:
(I_{OUT}=10mA)



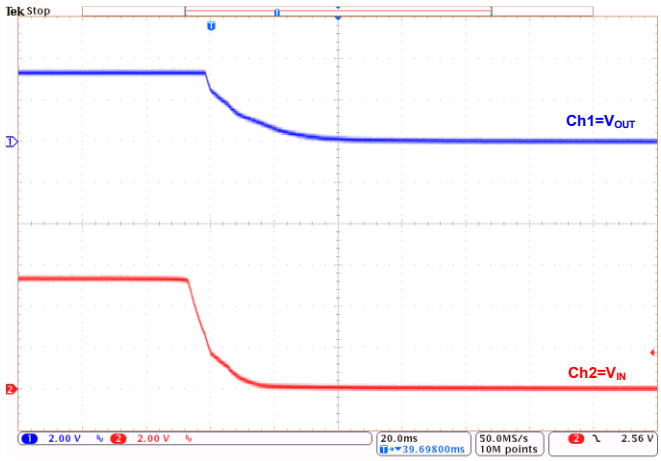
Power-Up at V_{OUT}=3.3V:
(I_{OUT}=1mA)



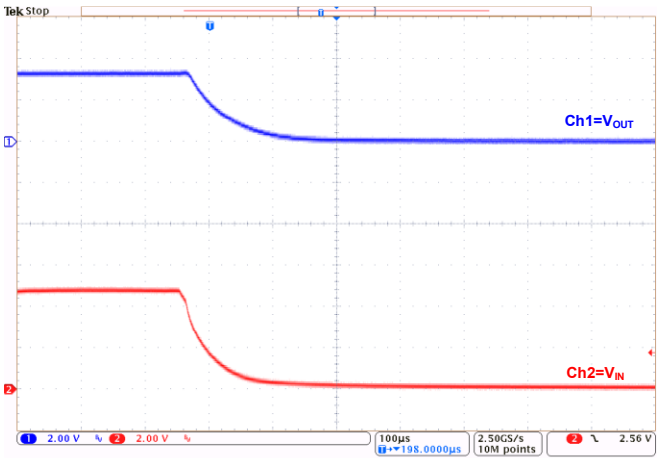
Power-Up at V_{OUT}=3.3V:
(I_{OUT}=300mA)

■ Typical Performance Characteristics (Continued)

Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, Ta=25℃, unless otherwise indicated.



Power-Down at V_{OUT}=3.3V:
(I_{OUT}=1mA)

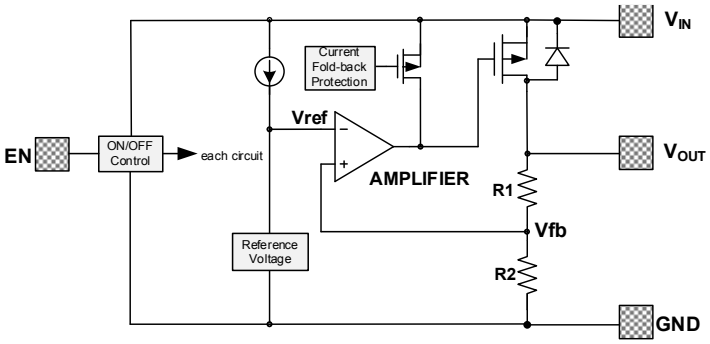


Power-Down at V_{OUT}=3.3V:
(I_{OUT}=300mA)

■ Operational Explanation

1. Output voltage control

The voltage divided by resistors R1 and R2 is compared with the internal reference voltage by the error amplifier. The amplifier output then drives the P-channel MOSFET connected to the V_{OUT} pin. The output voltage at the V_{OUT} pin is regulated by this negative feedback system. The current limit circuit and short protect circuit operate in relation to output current level. Further, the IC's internal circuitry can be in operation or shutdown modes controlled by the CE pin's signal.



2. Pass transistor

The pass transistor with low turn-on resistance used in HM85XX is a P-channel MOSFET. If the potential on V_{OUT} pin is higher than VIN, it is possible that IC will be destroyed due to reverse current which is caused by parasitic diodes between V_{IN} and V_{OUT}. Therefore, the V_{OUT} pin potential exceeds V_{IN}+0.3V is not allowed.

3. Current foldback and over temperature protection

The HM85XX series includes a combination of a fixed current limiter circuit and a foldback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. This design can prevent the chip be damaged due to over temperature, moreover, the heat dissipation is limited by the package type.

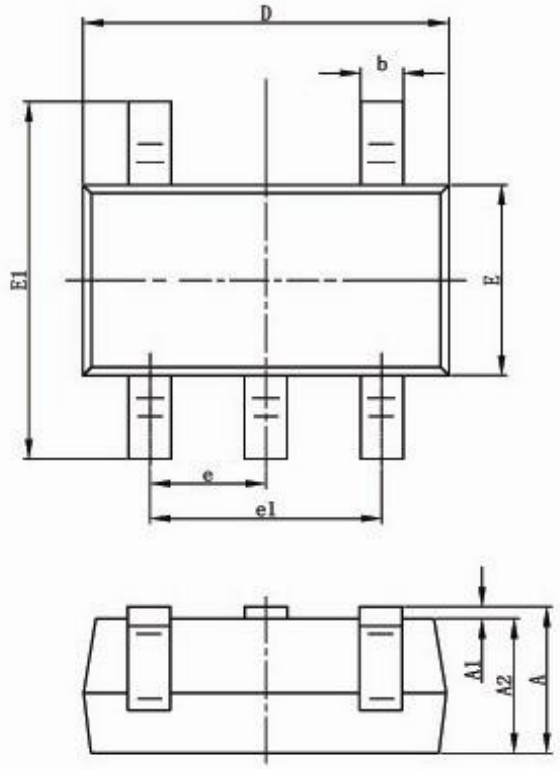
Special attention should be paid to that the product of the dropout voltage on the chip and the output current must be smaller than the heat dissipation. If power consumption on the chip is more than the heat dissipation, OTP will protect the chip from damaging due to over temperature.

■ Notes:

1. The input and output capacitors should be placed as close as possible to the IC.
2. If the impedance of the power supply is high, which is caused by forgetting installing input capacitor or installing too small value capacitor, the oscillation may occur.
3. Pay attention to the operation conditions of input and output voltage and load current, such that the power consumption in the IC should not exceed the allowable power consumption of the package even though the chip has short circuit protection.
4. IC has a built-in anti-static protection (ESD) circuit, but please do not add excessive stress to the IC.

■ Packaging Information

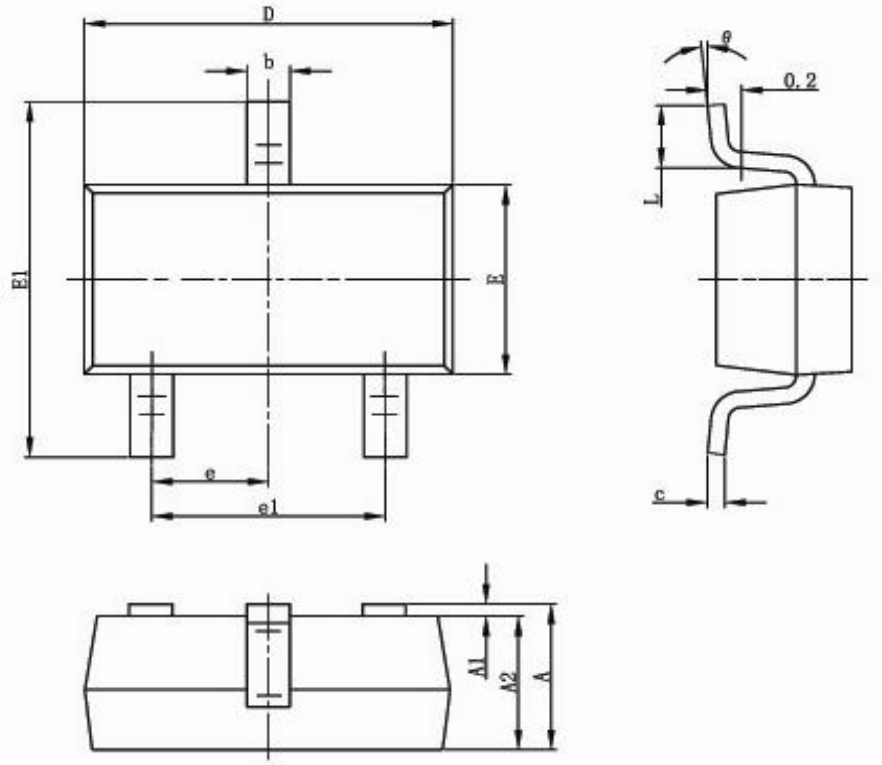
SOT-23-5L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions 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	0.500	0.012	0.020
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(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

■ Packaging Information (Continued)

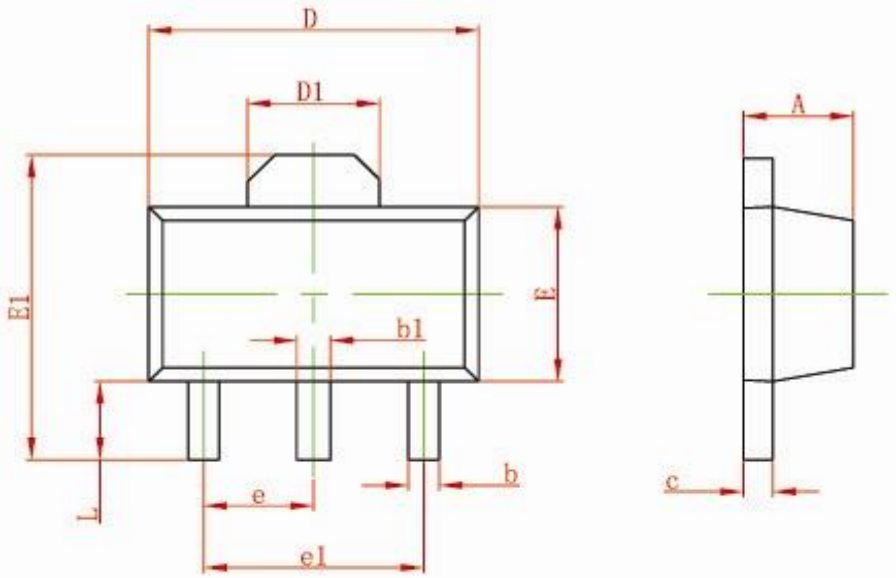
SOT-23-3L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions 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	0.500	0.012	0.020
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(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

■ Packaging Information (Continued)

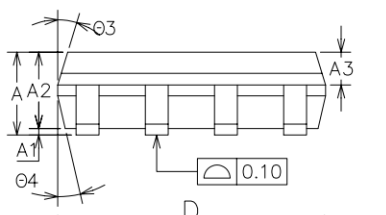
SOT-89-3L PACKAGE OUTLINE DIMENSIONS

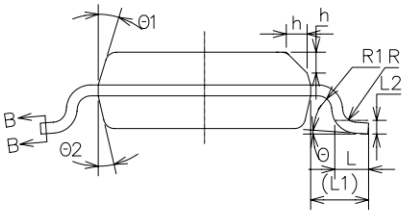


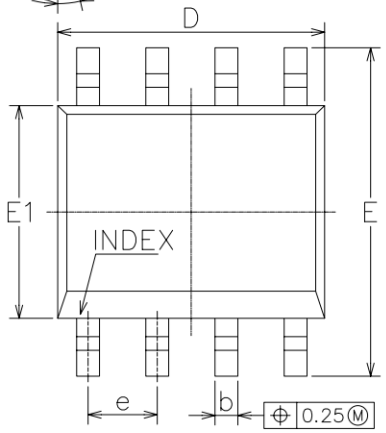
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.197
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060TYP	
e1	3.000 TYP		0.118TYP	
L	0.900	1.200	0.035	0.047

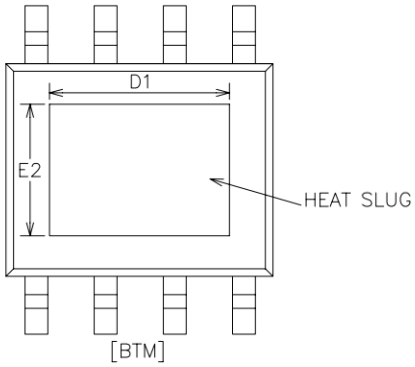
■ Packaging Information (Continued)

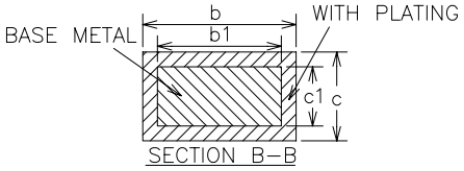
ESOP8 PACKAGE OUTLINE DIMENSIONS









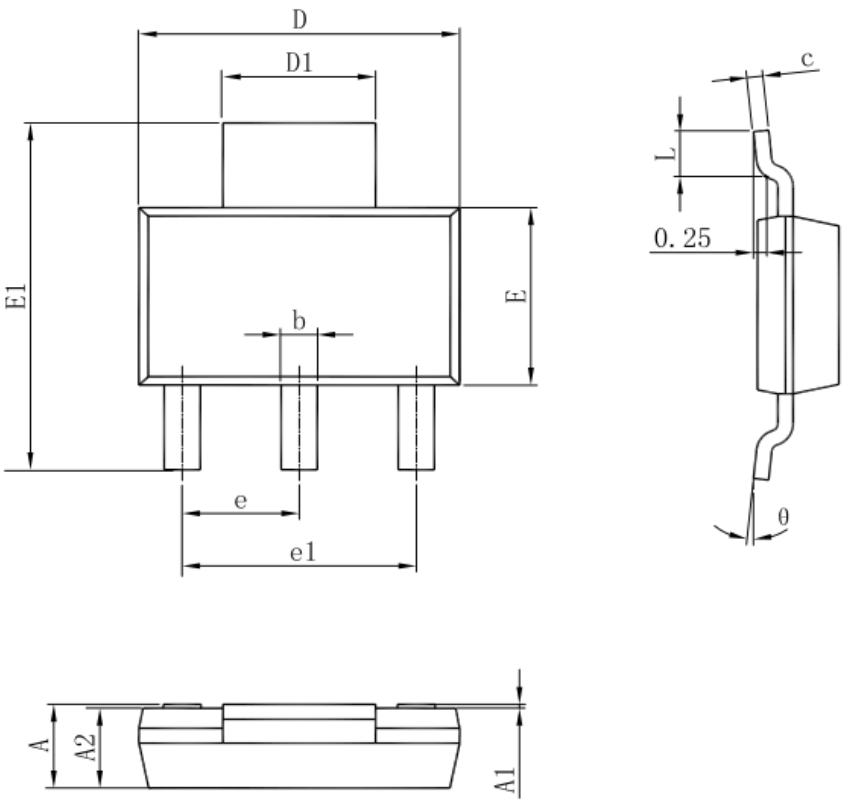


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.70
A1	0	0.10	0.15
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	–	0.51
b1	0.37	0.42	0.47
c	0.17	–	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
D1 Option 1	3.10	3.30	3.50
D1 Option 2	2.09	2.29	2.49
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
E2 Option 1	2.20	2.40	2.60
E2 Option 2	2.09	2.29	2.49
e	1.17	1.27	1.37
L	0.45	0.60	0.80
L1		1.04REF	
L2		0.25BSC	
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
θ	0°	–	8°
θ1	15°	17°	19°
θ2	11°	13°	15°
θ3	15°	17°	19°
θ4	11°	13°	15°

■ Packaging Information (Continued)

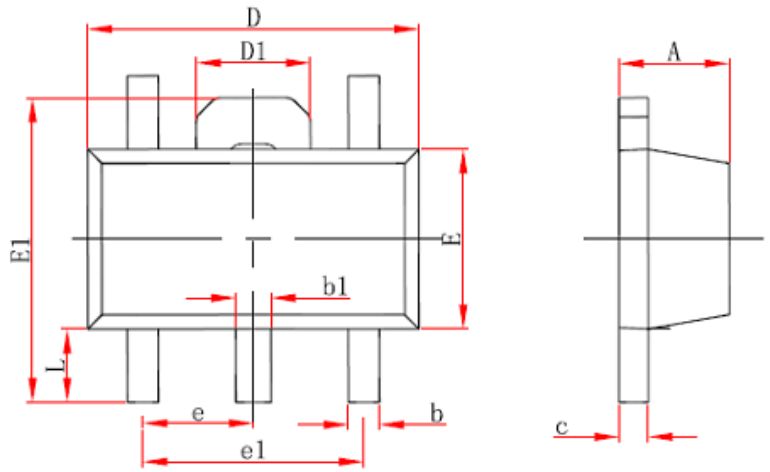
SOT-223 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.520	1.800	0.060	0.071
A1	0.000	0.100	0.000	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.820	0.026	0.032
c	0.250	0.350	0.010	0.014
D	6.200	6.400	0.244	0.252
D1	2.900	3.100	0.114	0.122
E	3.300	3.700	0.130	0.146
E1	6.830	7.070	0.269	0.278
e	2.300(BSC)		0.091(BSC)	
e1	4.500	4.700	0.177	0.185
L	0.900	1.150	0.035	0.045
θ	0°	10°	0°	10°

■ Packaging Information (Continued)

SOT-89-5L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.380	0.580	0.015	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047