High Voltage Low Power Consumption LDO MD7219 Series

CMOS Voltage Regulator 1A

MD7219 series is a high voltage (up to 18V) ultra-low quiescent current low dropout voltage regulator (LDO) manufactured in CMOS processes. It can deliver up to 1A of current while consuming 14uA 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 MD7219 series 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.

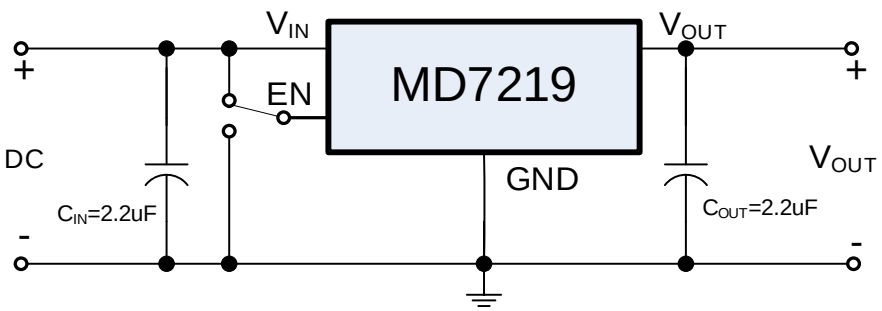
■ Features:

- Ultra-low Quiescent Current: 14uA
- Maximum Input Voltage: 18V
- Output Voltage Highly Accurate: ±2%
- Maximum Output Current: 1A
- Dropout Voltage: 900mV@V_{OUT}=3.3V/1A
- Temperature Stability: ±50ppm/℃
- ON/OFF Logic = Enable High
- Protections Circuits: Current Limiter, Foldback, Thermal shutdown
- Output Capacitor: Low ESR Ceramic Capacitor Compatible

■ Applications:

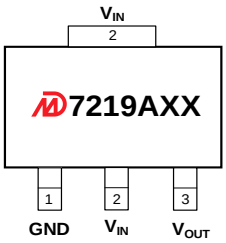
- Smart wearer
- Long-life battery-powered devices
- Portable mobile devices, such as mobile phones, cameras, and so on
- Wireless communication equipment

■ Typical Application:

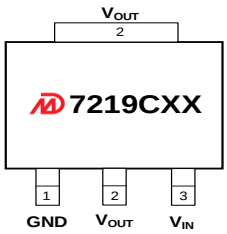


■ Pin Configuration (Top View):

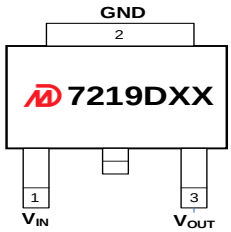
SOT89-3L(A_Type)
Top View



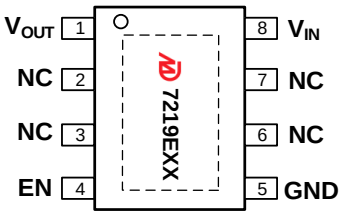
SOT223-3L
Top View



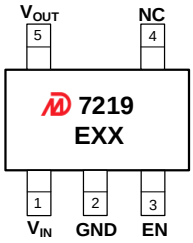
TO252-2L
Top View



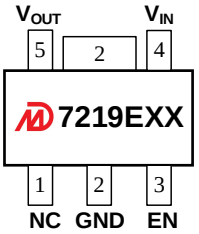
ESOP8
Top View



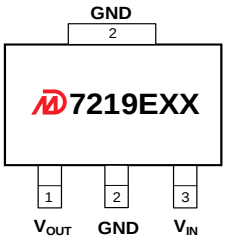
SOT23-5L
Top View



SOT89-5L
Top View



SOT89-3L(E_Type)
Top View



■ Product Selections

Product Name	V_{OUT} (V)	Package	Ordering Name	Marking	Package Information
MD7219A30	3.0	SOT89-3L	MD7219A30PA1	7219A30	Tape and Reel, 1000pcs
MD7219A33	3.3	SOT89-3L	MD7219A33PA1	7219A33	
MD7219A36	3.6	SOT89-3L	MD7219A36PA1	7219A36	
MD7219A40	4.0	SOT89-3L	MD7219A40PA1	7219A40	
MD7219A50	5.0	SOT89-3L	MD7219A50PA1	7219A50	
MD7219AC0	12.0	SOT89-3L	MD7219AC0PA1	7219AC0	
MD7219EC0	12.0	SOT89-3L	MD7219EC0PA1	7219EC0	
MD7219E33	3.3	SOT89-5L	MD7219E33PC1	7219E33	
MD7219E36	3.6	SOT89-5L	MD7219E36PC1	7219E36	
MD7219E50	5.0	SOT89-5L	MD7219E50PC1	7219E50	
MD7219C30	3.0	SOT223-3L	MD7219C30YA2	7219C30	Tape and Reel, 2500pcs
MD7219C33	3.3	SOT223-3L	MD7219C33YA2	7219C33	
MD7219C36	3.6	SOT223-3L	MD7219C36YA2	7219C36	
MD7219C40	4.0	SOT223-3L	MD7219C40YA2	7219C40	
MD7219C50	5.0	SOT223-3L	MD7219C50YA2	7219C50	
MD7219CC0	12.0	SOT223-3L	MD7219CC0YA2	7219CC0	
MD7219D30	3.0	TO252-2L	MD7219D30UA2	7219D30	Tape and Reel, 2500pcs
MD7219D33	3.3	TO252-2L	MD7219D33UA2	7219D33	
MD7219D36	3.6	TO252-2L	MD7219D36UA2	7219D36	

MD7219D40	4.0	TO252-2L	MD7219D40UA2	7219D40	
MD7219D50	5.0	TO252-2L	MD7219D50UA2	7219D50	
MD7219DC0	12.0	TO252-2L	MD7219DC0UA2	7219DC0	
MD7219E30	3.0	ESOP8	MD7219E30SF4	7219E30	Tape and Reel, 4000pcs
MD7219E33	3.3	ESOP8	MD7219E33SF4	7219E33	
MD7219E36	3.6	ESOP8	MD7219E36SF4	7219E36	
MD7219E40	4.0	ESOP8	MD7219E40SF4	7219E40	
MD7219E50	5.0	ESOP8	MD7219E50SF4	7219E50	
MD7219EC0	12.0	ESOP8	MD7219EC0SF4	7219EC0	
MD7219E18	1.8	SOT23-5L	MD7219E18QC3	7219E18	Tape and Reel, 3000pcs
MD7219E25	2.5	SOT23-5L	MD7219E25QC3	7219E25	
MD7219E30	3.0	SOT23-5L	MD7219E30QC3	7219E30	
MD7219E33	3.3	SOT23-5L	MD7219E33QC3	7219E33	
MD7219E36	3.6	SOT23-5L	MD7219E36QC3	7219E36	
MD7219E40	4.0	SOT23-5L	MD7219E40QC3	7219E40	
MD7219E44	4.4	SOT23-5L	MD7219E44QC3	7219E44	
MD7219E50	5.0	SOT23-5L	MD7219E50QC3	7219E50	

Notes:

1* Customer can request to customize the output voltage ranged from 1.8V to 12V, 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 ~ 20		V
Output Voltage	V_{OUT}	Vss-0.3 ~ VIN+0.3V		
Power Dissipation	P_D	SOT89-3L	1000	mW
		SOT89-5L	1000	
		SOT223-3L	1500	
		TO252-2L	1800	
		ESOP8	800	
		SOT23-5L	250	
Thermal Resistance	$R_{\theta JA}$	SOT89-3L	100	℃/W
		SOT89-5L	100	
		SOT223-3L	66	
		TO252-2L	55	
		ESOP8	80	
		SOT23-5L	180	
Operating Ambient Temperature	T_{opr}	-40 ~ +85		℃
Storage Temperature	T_{stg}	-40 ~ +125		
ESD Protection	ESD HBM	4000		V

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

■ Electrical Characteristics:

MD7219 Series (Unless otherwise indicated：T_a=25℃)

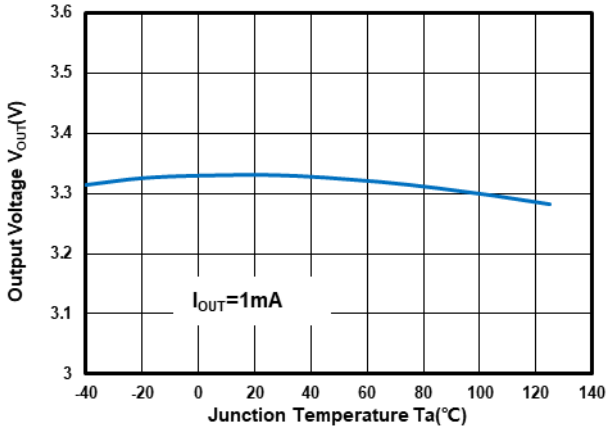
PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNIT
Output Voltage*1	$V_{OUT(S)}$	V_{IN}= $V_{OUT(S)}$+2V，I_{OUT}=1mA		$V_{OUT(S)}$× 0.98	$V_{OUT(S)}$	$V_{OUT(S)}$× 1.02	V
Dropout Voltage*2	V_{DROP}	$V_{OUT(S)}$=3.3V	I_{OUT}=1mA		3	8	mV
			I_{OUT}=1A		900	1300	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \bullet V_{OUT(s)}}$	$V_{OUT(S)}$+2V≤V_{IN}≤18V I_{OUT} =1mA			0.01	0.02	%/V
Load Regulation	ΔV_{OUT2}	V_{IN}=$V_{OUT(S)}$+2V 1mA≤I_{OUT}≤1A	$V_{OUT(S)}$≤5.0V		80		mV
			$V_{OUT(S)}$>5.0V		90		
Temperature Stability	$\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT(s)}}$	V_{IN} = $V_{OUT(S)}$+2V，I_{OUT}=1mA -40℃≤T_a≤125℃			±50		ppm/℃
GND Current	I_{GND}	no load	$V_{OUT(S)}$≤5.0V		14	30	μA
			$V_{OUT(S)}$>5.0V		20	40	
		I_{OUT}=100mA			420		
Shutdown Current	I_{SHUT}	V_{IN}=18V, V_{EN}=0			0.1	1	
Input Voltage	V_{IN}	---		2.2		18	V
Maximum Output Current	I_{OUTMAX}			1			A
Current Limit*3	I_{LIM}	V_{IN}= $V_{OUT(S)}$+2V, V_{OUT} = 0.95 ×$V_{OUT(S)}$			1.35		
Power Supply Rejection Ratio*4	PSRR	f=10Hz, I_{OUT}=10mA			72		dB
		f=100Hz, I_{OUT}=10mA			80		
		f=1kHz, I_{OUT}=10mA			75		
Short Circuit Current*5	I_{SHORT}	V_{IN}=V_{EN}=$V_{OUT(S)}$+2.0V V_{OUT}=0V			40		mA
EN 'H' Level Voltage	V_{ENH}			1.6		18	V
EN 'L' Level Voltage	V_{ENL}			0		0.5	
EN 'H' Level Current	I_{ENH}	VIN=18V, VEN=VIN		-0.1		0.1	μA
EN 'L' Level Voltage	I_{ENL}	VIN=18V, VEN=0		-0.1		0.1	
Over Temperature Protection	OTP	I_{OUT}=1mA			150		℃

Notes:

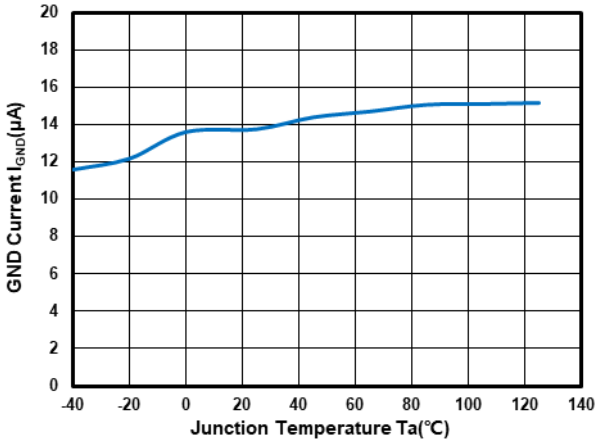
1. $V_{OUT(S)}$: Output voltage when V_{IN}=V_{OUT}+2V, I_{OUT}=1 mA.
2. V_{DROP}=V_{IN1} -（$V_{OUT(S)}$× 0.98）where V_{IN1} is the input voltage when V_{OUT} = $V_{OUT(S)}$× 0.98.
3. I_{LIM}: Output current when V_{IN}=$V_{OUT(S)}$+2V and V_{OUT} = 0.95*$V_{OUT(S)}$.
4. PSRR was measured for $V_{OUT(S)}$ = 3.3V and V_{IN}= 5.3V.
5. VOUT pin should be shorted to GND pin, and the impedance between them is less than 0.1 ohm.

■ Typical Performance Characteristics:

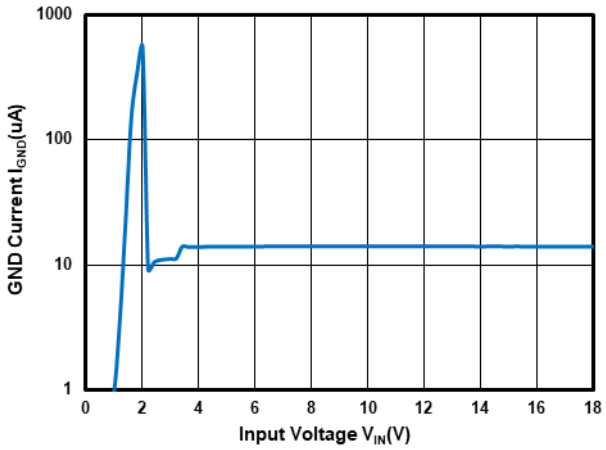
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, unless otherwise indicated.



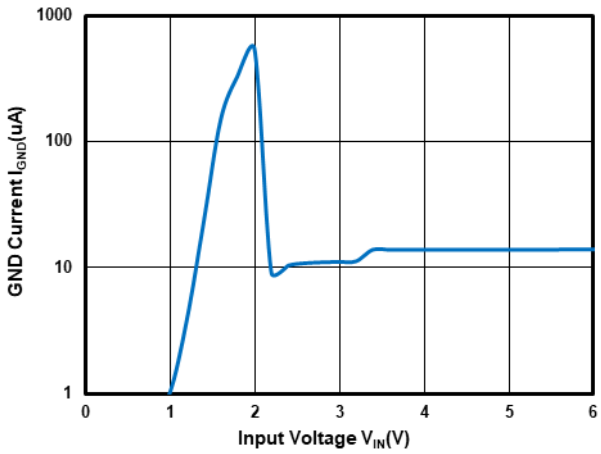
Output Voltage vs Temperature at V_{OUT}=3.3V



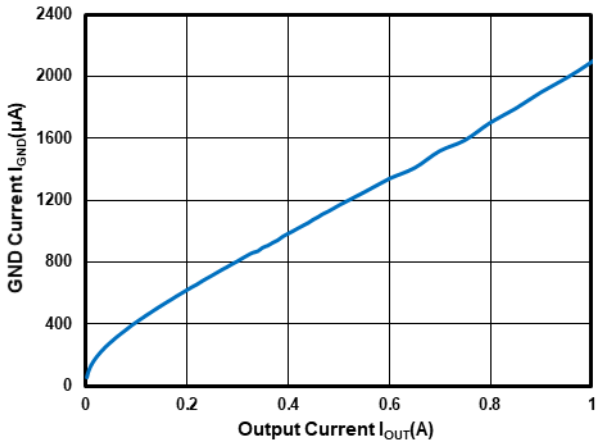
GND Current vs Temperature at V_{OUT}=3.3V



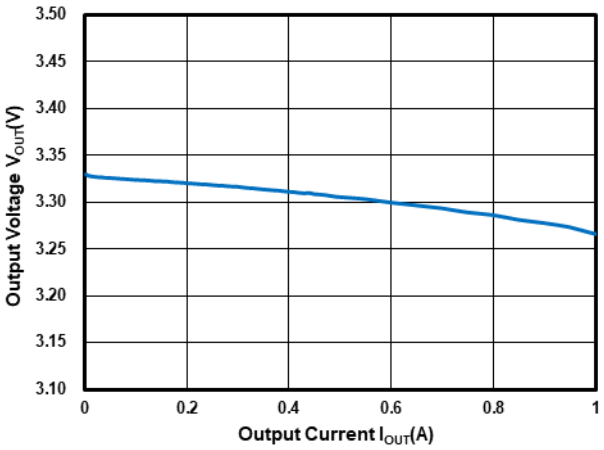
GND Current vs Input Voltage at V_{OUT}=3.3V



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



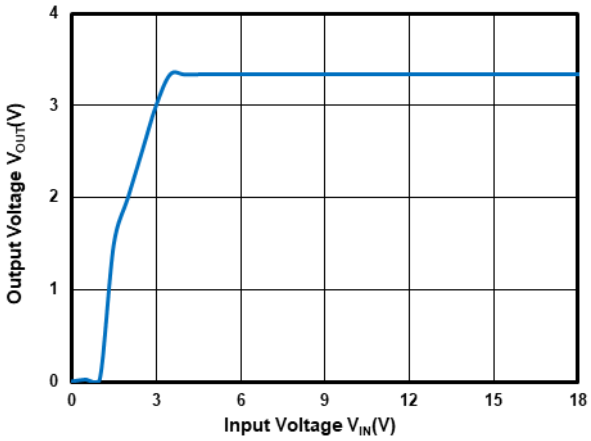
GND Current vs Output Current at V_{OUT}=3.3V



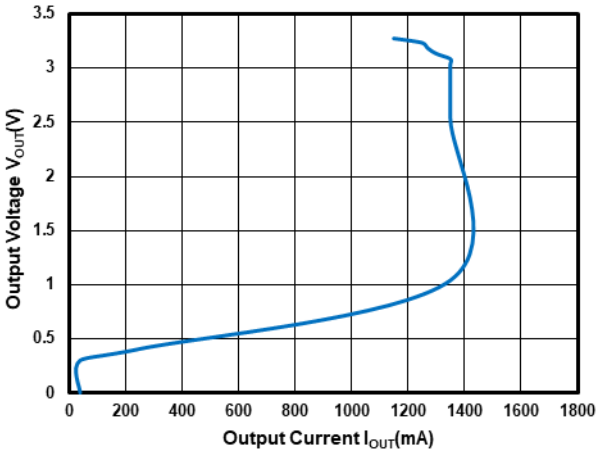
Output Voltage vs Output Current at V_{OUT}=3.3V

■ Typical Performance Characteristics (Continued):

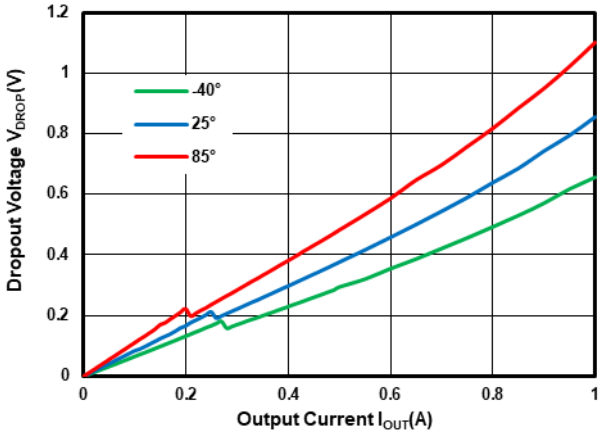
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, unless otherwise indicated.



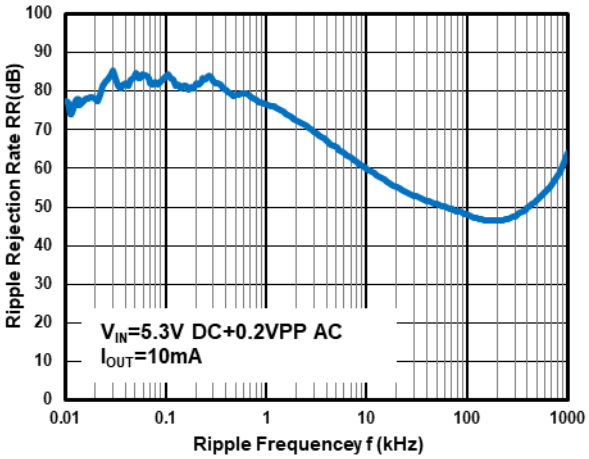
Output Voltage vs Input Voltage at V_{OUT}=3.3V



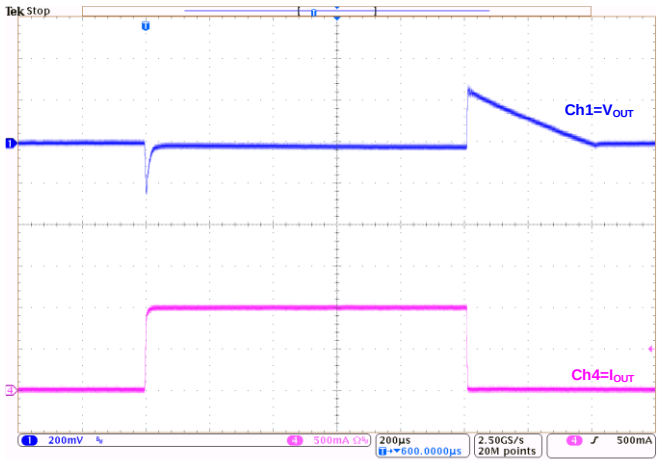
Output Current Fold-back at V_{OUT}=3.3V



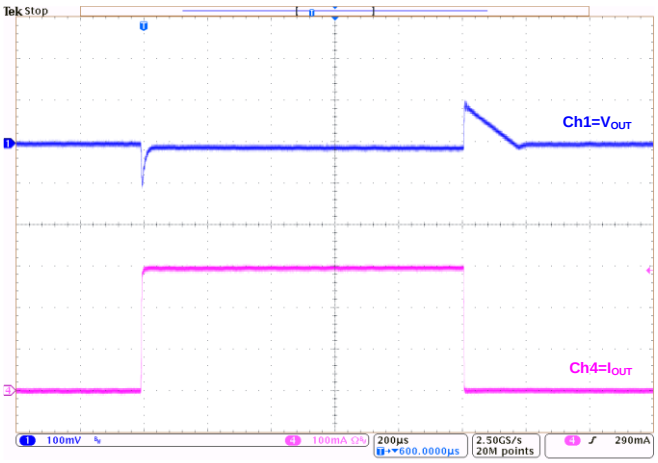
Dropout Voltage vs Temperature at V_{OUT}=3.3V



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



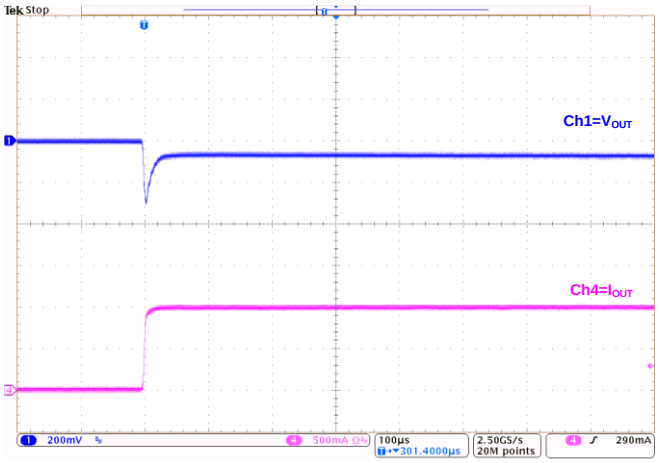
Load Transient at V_{OUT}=3.3V
(I_{OUT}=1mA~1A~1mA)



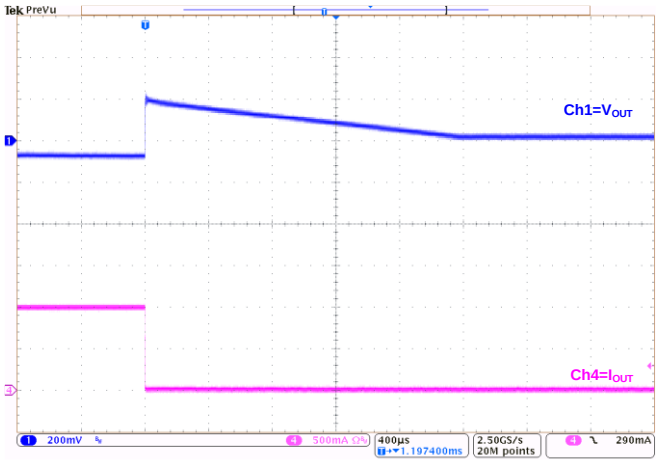
Load Transient at V_{OUT}=3.3V
(I_{OUT}=1mA~300mA~1mA)

■ Typical Performance Characteristics (Continued):

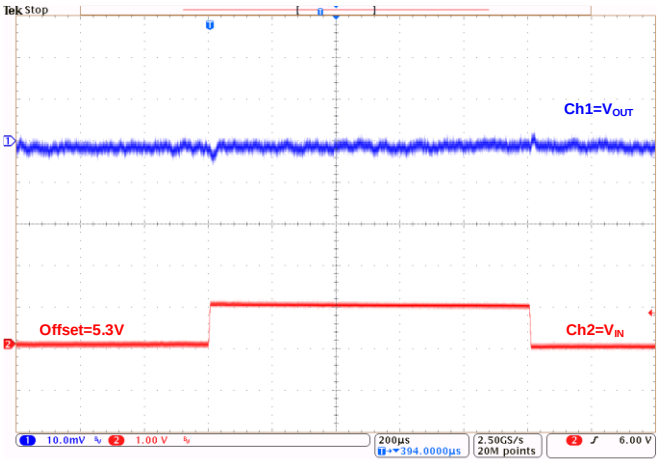
Test Conditions: V_{IN}=V_{OUT}+2.0V, C_{IN}=2.2μF, C_{OUT}=2.2μF, unless otherwise indicated.



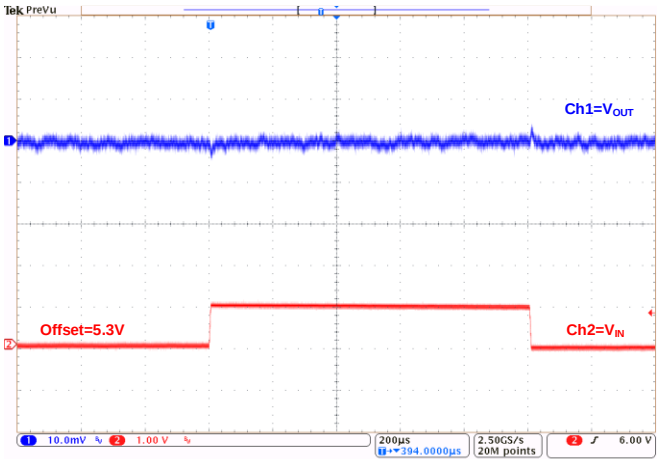
Load Transient at V_{OUT}=3.3V
(I_{OUT}=0mA~1A)



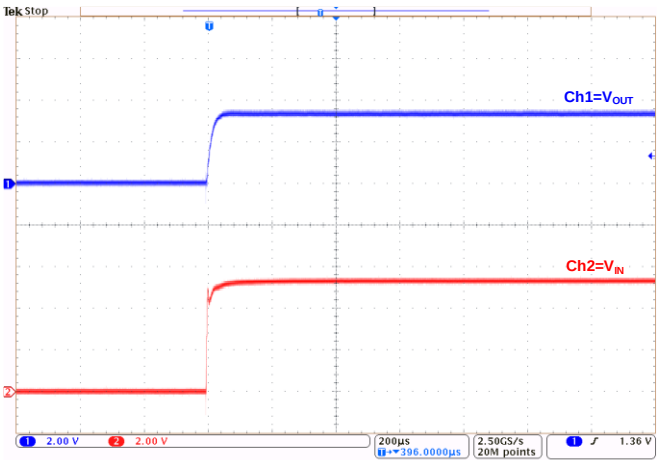
Load Transient at V_{OUT}=3.3V
(I_{OUT}=1A~0mA)



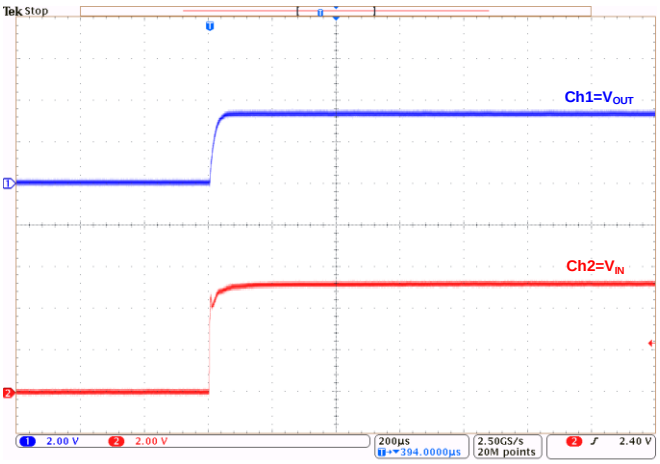
Line Transient at V_{OUT}=3.3V
(I_{OUT}=1mA)



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



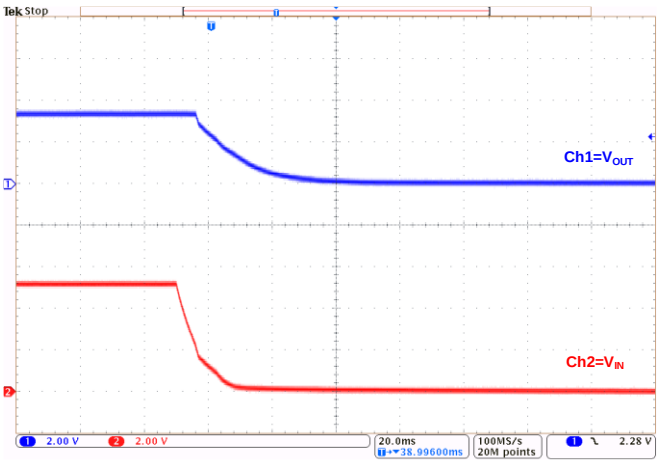
Power-Up at V_{OUT}=3.3V:
(I_{OUT}=1mA)



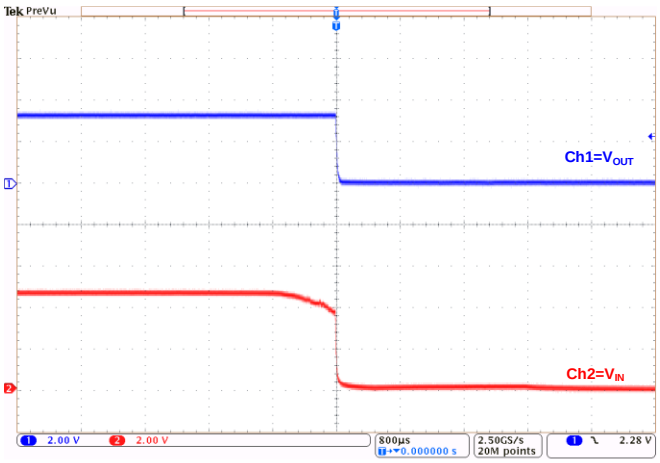
Power-Up at V_{OUT}=3.3V:
(I_{OUT}=1A)

■ Typical Performance Characteristics (Continued):

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



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

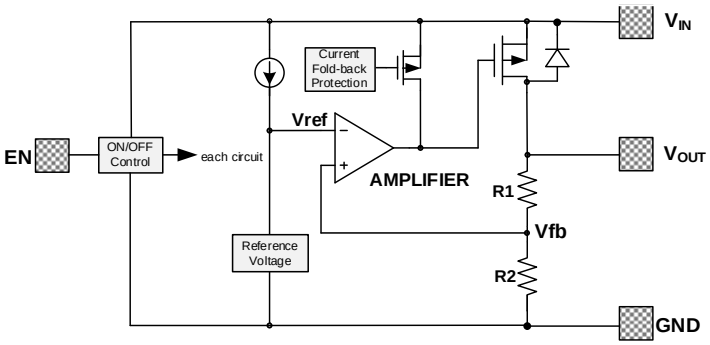


Power-Down at V_{OUT}=3.3V:
(I_{OUT}=1A)

■ Operational Explanation

■ 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.



■ Pass transistor

The pass transistor with low turn-on resistance used in MD7219 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.

■ Current limit, over temperature protection

The MD7219 series includes a combination of a fixed current limiter 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.

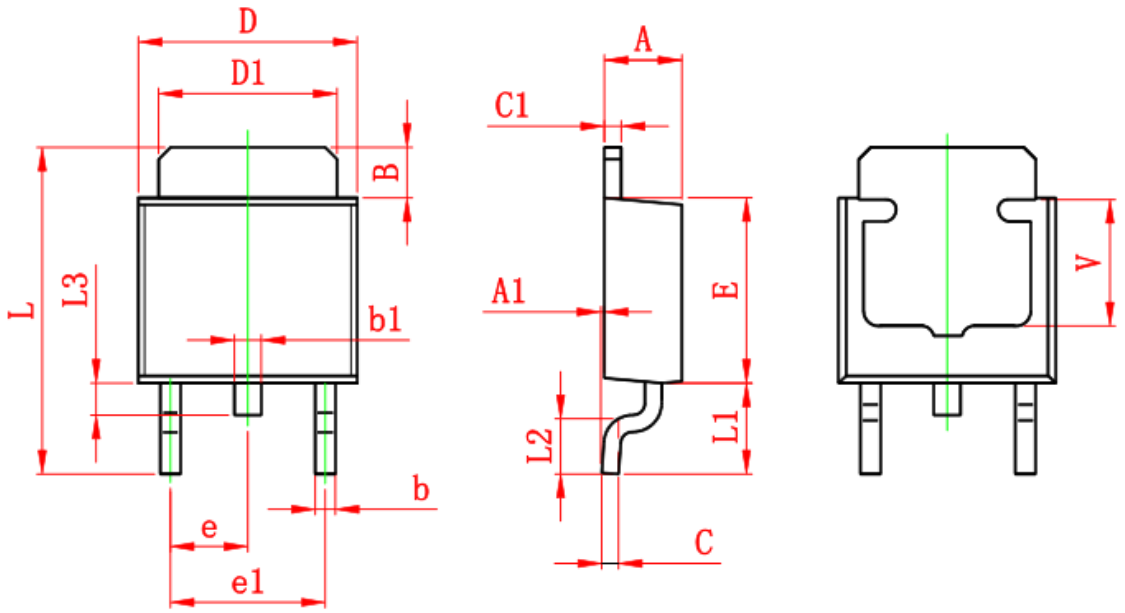
Special attention should be paid to that the product of the dropout voltage on the chip and the output current must be smaller than the heat dissipation. If power consumption on the chip is more than the heat dissipation, OTP will protect the chip from damaging due to over temperature.

■ 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

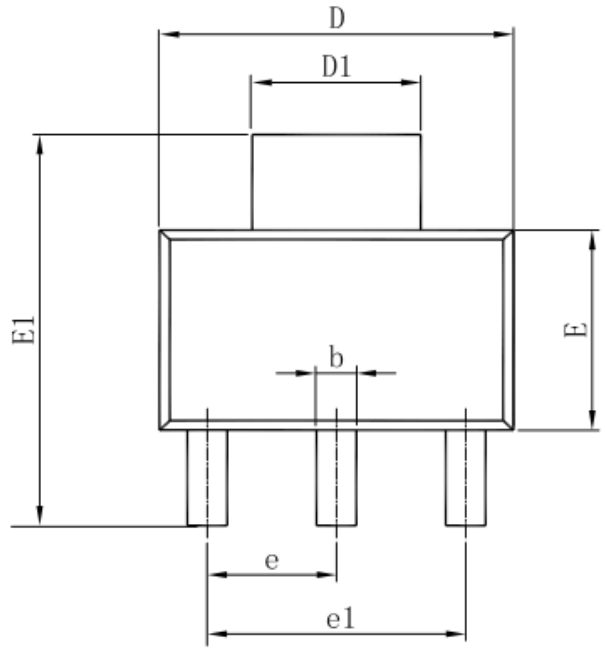
TO-252-2L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP.		0.091 TYP.	
e1	4.500	4.700	0.177	0.185
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.600	0.900	0.024	0.035
V	3.800 REF.		0.150 REF.	

■ Packaging Information (Continued)

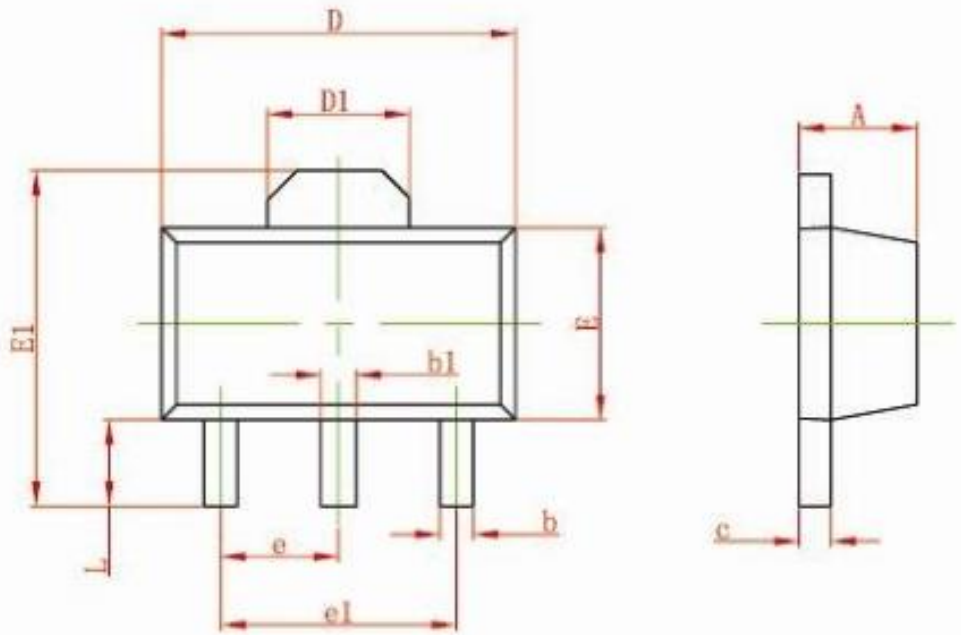
SOT-223 PACKAGE OUTLINE DIMENSIONS



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)

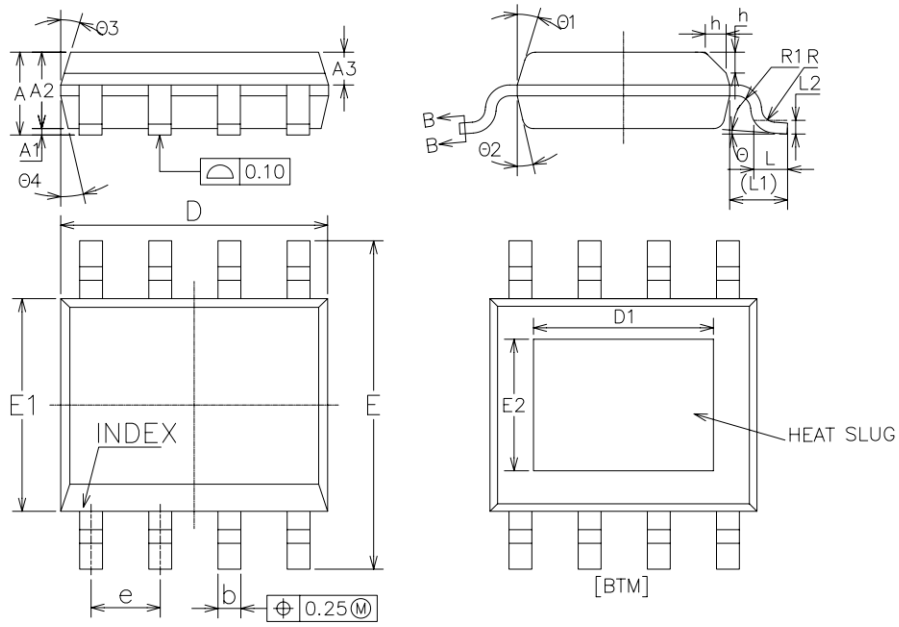
SOT-89-3L PACKAGE OUTLINE DIMENSIONS

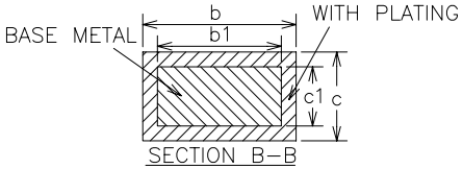


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.197
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060TYP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

■ Packaging Information (Continued)

ESOP8 PACKAGE OUTLINE DIMENSIONS



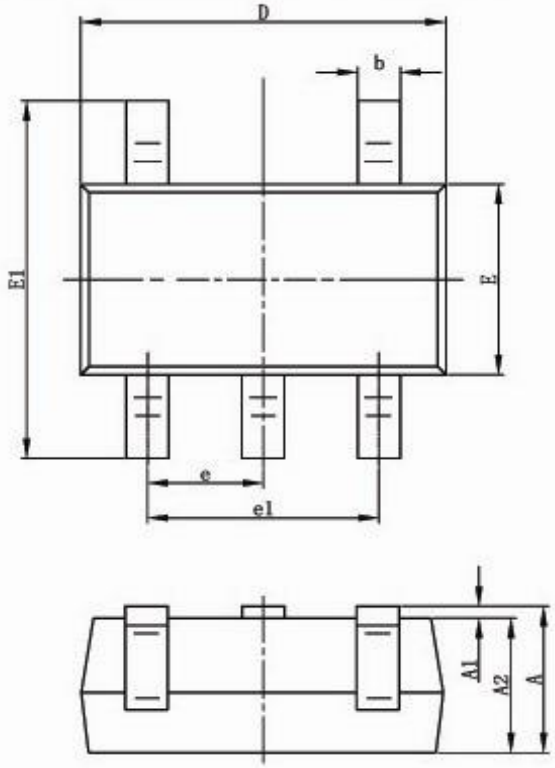


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

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)

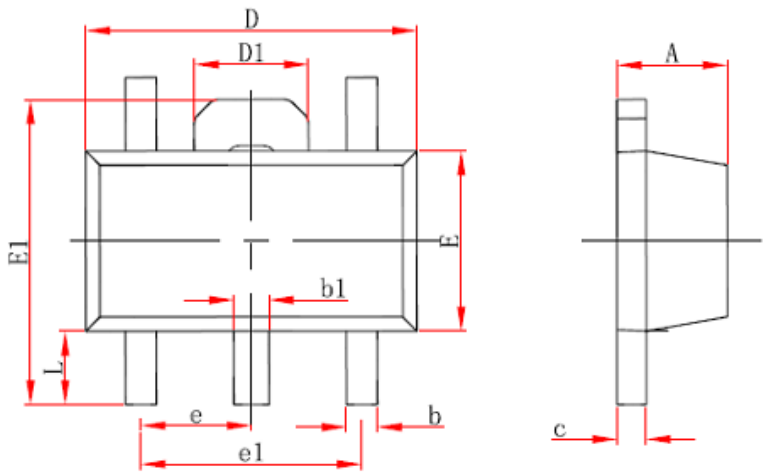
SOT-23-5L PACKAGE OUTLINE DIMENSIONS



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-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

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