

## General Description

The HBT3220 PowerLinear™ NanoPower Low Dropout Linear Regulator is ideal for portable applications where extended battery life is critical. This device features extremely low quiescent current which is typically 1.1µA. Dropout voltage is also very low, typically less than 225mV at the maximum output current of 150mA. The HBT3220 has output short circuit and over current protection. In addition, the device also has an over temperature protection circuit, which will shutdown the LDO regulator during extended over current events.

The HBT3220 is available in a space saving SOT-23 package or a SOT-89 for applications requiring increased power dissipation. The device is rated over a -40°C to 85°C temperature range. Since only a small, 1µF ceramic output capacitor is required, often the only space used is that occupied by the HBT3220 itself. The HBT3220 is truly a compact and cost effective voltage conversion solution.

The HBT3221/2 is a similar product for this application, especially when a shutdown mode is required for further power savings.

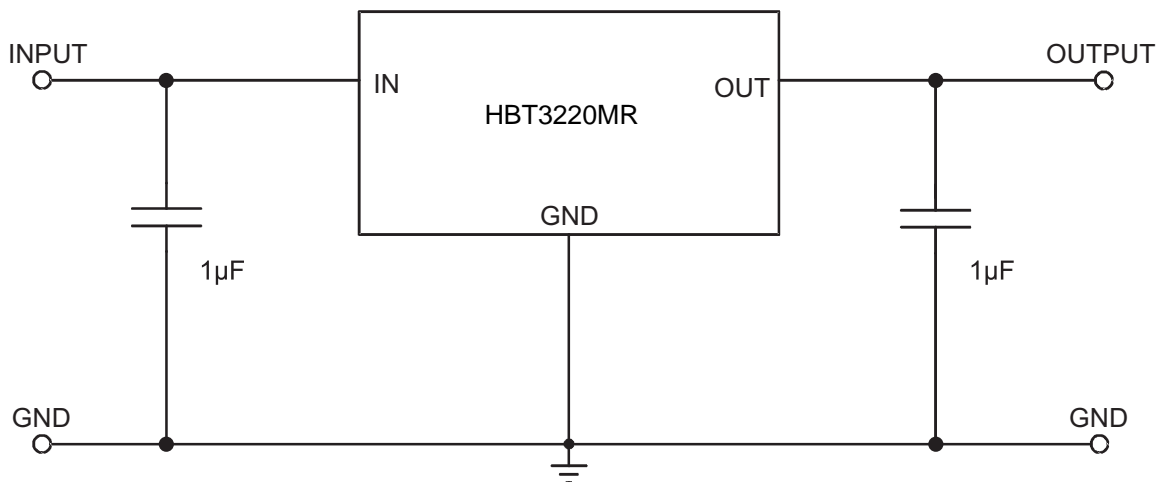
## Features

- 1.1 µA Quiescent Current
- Low Dropout: 200 mV (typ)
- Guaranteed 150mA Output
- High accuracy: ±2.0%
- Current limit protection
- Over-Temperature protection
- Low Temperature Coefficient
- Factory programmed output voltages: 1.8V to 3.5V
- Stable operation with virtually any output capacitor type
- 3-pin SOT-89 and SOT-23 packages
- 4kV ESD Rating

## Applications

- Cellular Phones
- Notebook Computers
- Portable Communication Devices
- Handheld Electronics
- Remote Controls
- Digital Cameras
- PDAs

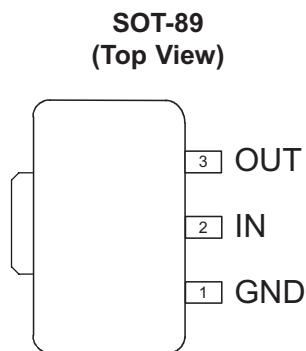
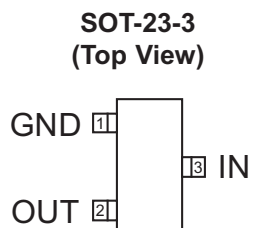
## Typical Application



### Pin Descriptions

Pin #		Symbol	Function
SOT23-3	SOT-89		
1	1	GND	Ground connection
3	2	$V_{IN}$	Input - should be decoupled with 1 $\mu$ F or greater capacitor
2	3	OUT	Output - should be decoupled with 1 $\mu$ F or greater output capacitor
N/A	N/A	NC	Not connected

### Pin Configuration



**Absolute Maximum Ratings** ( $T_A=25^\circ\text{C}$  unless otherwise noted)

Symbol	Description	Value	Units
$V_{IN}$	Input Voltage	-0.3 to 6	V
$I_{OUT}$	DC Output Current	$P_D/(V_{IN}-V_O)$	mA
$T_J$	Operating Junction Temperature Range	-40 to 150	$^\circ\text{C}$
$T_{LEAD}$	Maximum Soldering Temperature (at leads, 10 sec)	300	$^\circ\text{C}$
$V_{ESD}$	ESD Rating <sup>1</sup> — HBM	4000	V

Note: Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one Absolute Maximum rating should be applied at any one time.

Note 1: Human body model is a 100pF capacitor discharged through a 1.5k $\Omega$  resistor into each pin.

**Thermal Information**

Symbol	Description	Rating	Units
$\Theta_{JA}$	Maximum Thermal Resistance (SOT-23-3) <sup>2</sup>	200	$^\circ\text{C}/\text{W}$
	Maximum Thermal Resistance (SOT-89) <sup>2</sup>	50	$^\circ\text{C}/\text{W}$
$P_D$	Maximum Power Dissipation (SOT-23-3) <sup>2</sup>	500	mW
	Maximum Power Dissipation (SOT-89) <sup>2</sup>	2	W

Note 2: Mounted on a demo board.

**Recommended Operating Conditions**

Symbol	Description	Rating	Units
$V_{IN}$	Input Voltage	$(V_{OUT}+0.34)$ to 5.5	V
T	Ambient Temperature Range	-40 to +85	$^\circ\text{C}$

**Electrical Characteristics** ( $V_{IN}=V_{OUT(NOM)}+1V$ ,  $I_{OUT}=1mA$ ,  $C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$  unless otherwise noted)

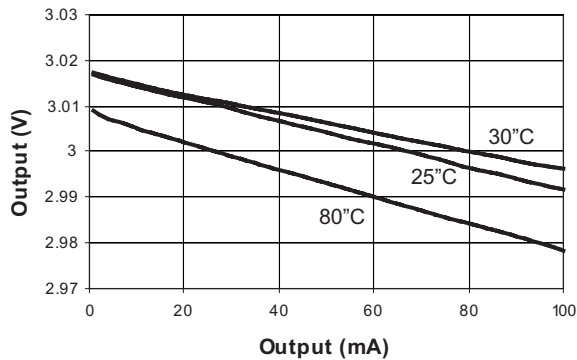
Symbol	Description	Conditions	Min	Typ	Max	Units
$V_{OUT}$	DC Output Voltage Tolerance		-2.0		2.0	%
$I_{OUT}$	Output Current	$V_{OUT} > 1.2V$	150			mA
$I_{SC}$	Short Circuit Current	$V_{OUT} < 0.4V$		350		mA
$I_Q$	Ground Current	$V_{IN} = 5V$ , no load		1.1	2.5	$\mu A$
$\Delta V_{OUT}/V_{OUT}$	Line Regulation	$V_{IN} = 4.0-5.5V$		0.15	0.4	%/V
$\Delta V_{OUT}/V_{OUT}$	Load Regulation	$I_L=1$ to 100mA	$V_{OUT} = 1.8$	1.0	1.65	%
			$V_{OUT} = 2.0$	0.9	1.60	
			$V_{OUT} = 2.3$	0.8	1.45	
			$V_{OUT} = 2.4$	0.8	1.40	
			$V_{OUT} = 2.5$	0.8	1.35	
			$V_{OUT} = 2.7$	0.7	1.25	
			$V_{OUT} = 2.8$	0.7	1.20	
			$V_{OUT} = 2.85$	0.7	1.20	
			$V_{OUT} = 3.0$	0.6	1.15	
			$V_{OUT} = 3.3$	0.5	1.00	
			$V_{OUT} = 3.5$	0.5	1.00	
$V_{DO}$	Dropout Voltage <sup>1</sup>	$I_{OUT} = 100mA$	$V_{OUT} = 1.8$	290	340	mV
			$V_{OUT} = 2.0$	265	315	
			$V_{OUT} = 2.3$	230	275	
			$V_{OUT} = 2.4$	220	265	
			$V_{OUT} = 2.5$	210	255	
			$V_{OUT} = 2.7$	200	240	
			$V_{OUT} = 2.8$	190	235	
			$V_{OUT} = 2.85$	190	230	
			$V_{OUT} = 3.0$	190	225	
			$V_{OUT} = 3.3$	180	220	
$V_{OUT} = 3.5$	180	220				
PSRR	Power Supply Rejection Ratio	100 Hz		50		dB
$T_{SD}$	Over Temp Shutdown Threshold			140		$^\circ C$
$T_{HYS}$	Over Temp Shutdown Hysteresis			20		$^\circ C$
$e_N$	Output Noise	10 Hz through 10 kHz		350		$\mu V$
$T_C$	Output Voltage Temp. Coeff.			80		ppm/ $^\circ C$

Note 1:  $V_{DO}$  is defined as  $V_{IN} - V_{OUT}$  when  $V_{OUT}$  is 98% of nominal.

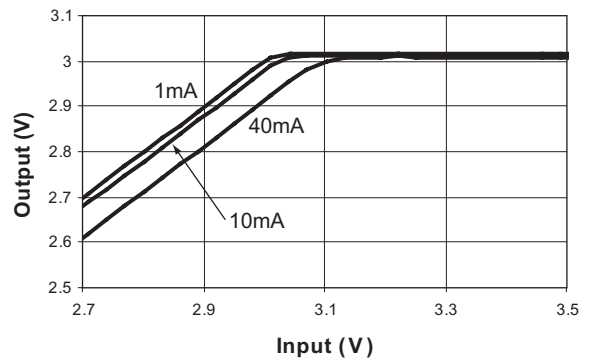
## Typical Characteristics

(Unless otherwise noted:  $V_{IN} = V_{OUT} + 1V$ ,  $T_A = 25^\circ C$ , Output capacitor is 1  $\mu F$  ceramic,  $I_{OUT} = 40\text{ mA}$ )

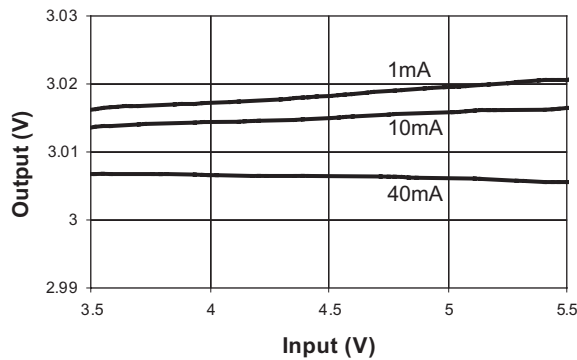
**Output Voltage v. Output Current**



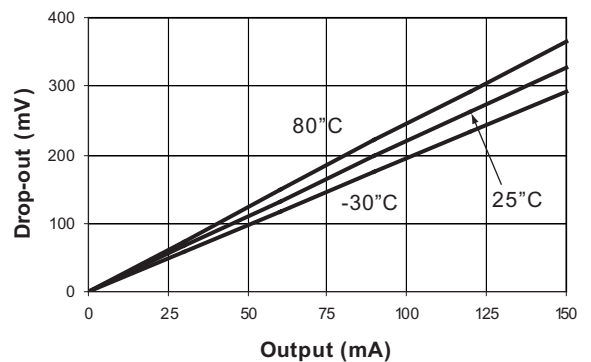
**Output Voltage v. Input Voltage**



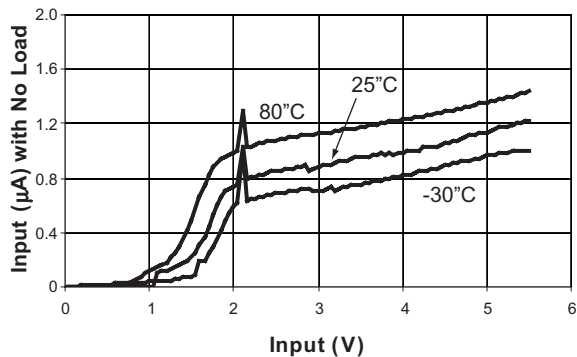
**Output Voltage v. Input Voltage**



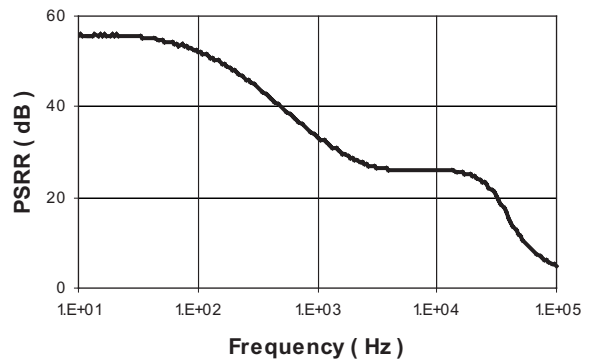
**Drop-out Voltage v. Output Current**



**Supply Current v. Input Voltage**



**PSRR with 10mA Load**

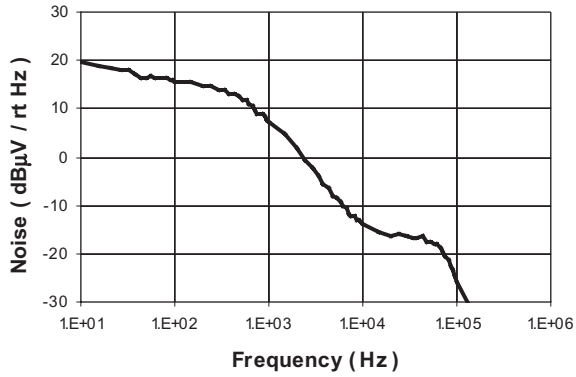


# HBT3220MR

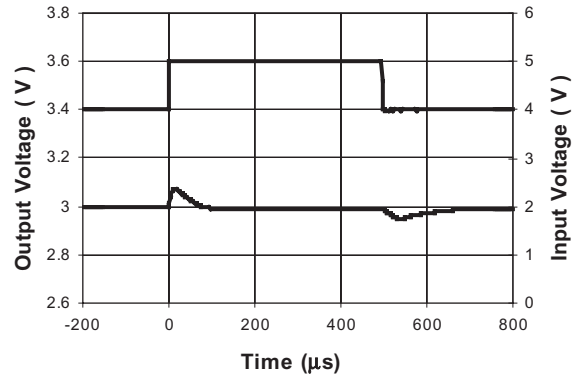
## 150mA NanoPower™ LDO Linear Regulator

(Unless otherwise noted:  $V_{IN} = V_{OUT} + 1V$ ,  $T_A = 25^\circ C$ , Output capacitor is 1  $\mu F$  ceramic,  $I_{OUT} = 40 mA$ )

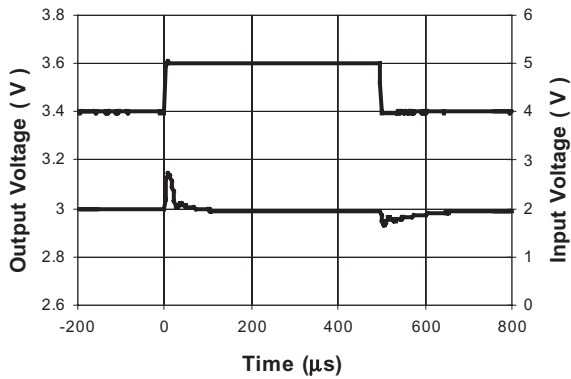
### HBT3220NoiseSpectrum



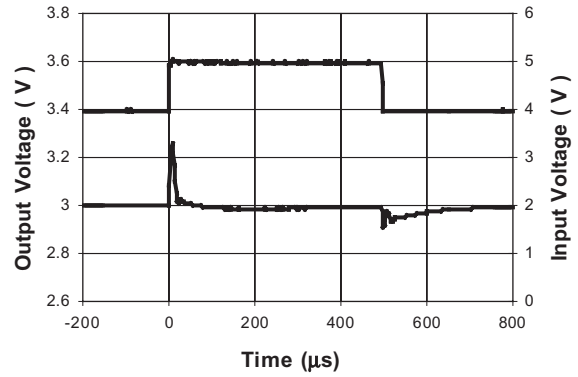
### Line Response with 1mA Load



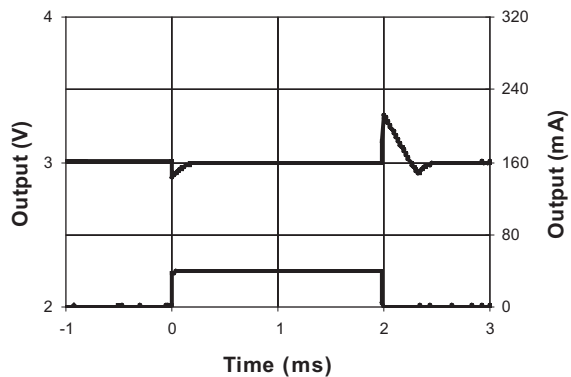
### Line Response with 10mA Load



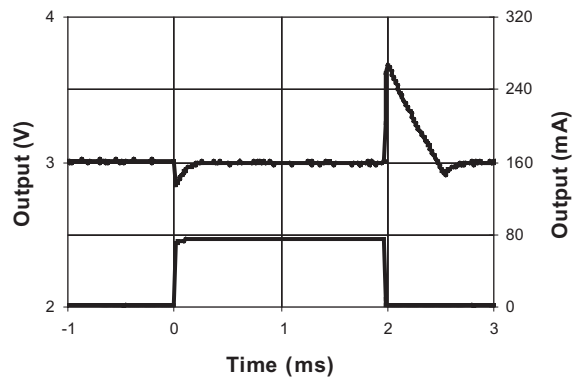
### Line Response with 100mA Load



### Load Transient - 1 mA / 40 mA

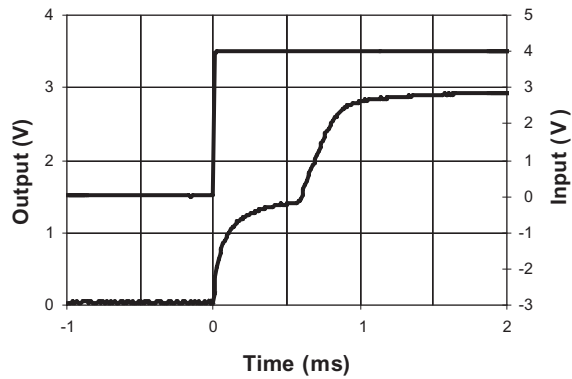


### Load Transient - 1 mA / 80 mA

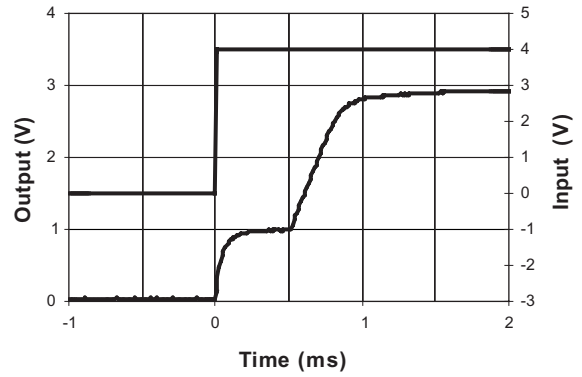


(Unless otherwise noted:  $V_{IN} = V_{OUT} + 1V$ ,  $T_A = 25^\circ C$ , Output capacitor is 1  $\mu F$  ceramic,  $I_{OUT} = 40\text{ mA}$ )

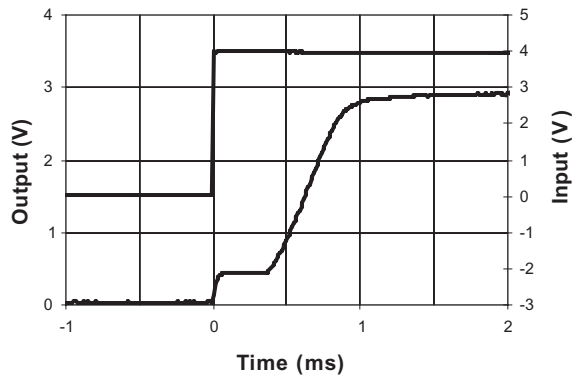
### Power Up with 1mA Load



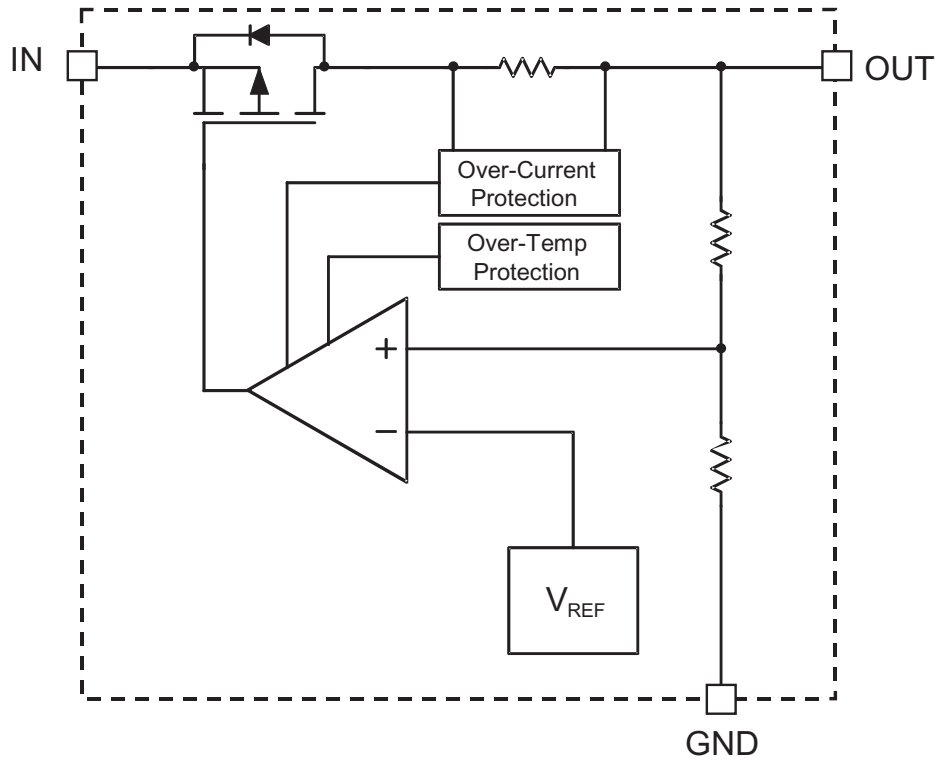
### Power Up with 10mA Load



### Power Up with 100mA Load



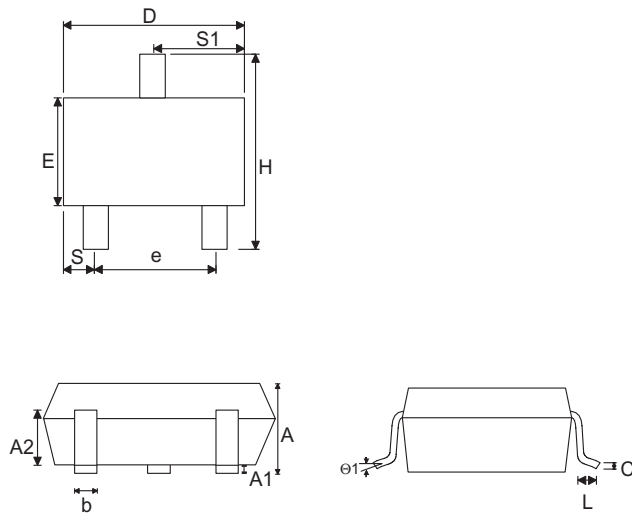
### Functional Block Diagram





### Package Information

SOT-23-3



Dim	Millimeters		Inches	
	Min	Max	Min	Max
A	1.00	1.70	0.040	0.067
A1	0.00	0.10	0.000	0.003
A2	0.70	3.15	0.027	0.124
b	0.35	0.85	0.013	0.033
C	0.10	0.35	0.003	0.013
D	2.70	3.10	0.106	0.122
E	1.40	1.80	0.055	0.070
e	0.00	0.00	0.000	0.000
H	2.60	3.00	0.094	0.118
L	0.37	0.00	0.014	0.000
S	0.45	0.55	0.017	0.021
S1	0.85	1.05	0.033	0.041
θ1	1°	9°	1°	9°

Note:

1. PACKAGE BODY SIZE EXCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.
2. TOLERANCE  $\pm 0.1000$  mm (4mi) UNLESS OTHERWISE SPECIFIED
3. COPLANARITY: 0.1000
4. DIMENSION L IS MEASURED IN GAGE PLANE