

## 1. Description

The UMW OPA338 series rail-to-rail output CMOS operational amplifiers are designed for low cost and miniature applications. UMW OPA338 op amps provide low bias current, high speed operation, high open-loop gain, and rail-to-rail output swing. They operate on a single supply with operation as low as 2.5V while drawing only 525µA quiescent current. In addition, the input common-mode voltage range includes ground—ideal for single-supply operation. The UMW OPA338 series is optimized for gains greater than or equal to 5. They are easy-to-use and free from phase inversion and overload problems found in some other op amps. Excellent performance is maintained as the amplifiers swing to their specified limits. The dual versions feature completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

## 2. Features

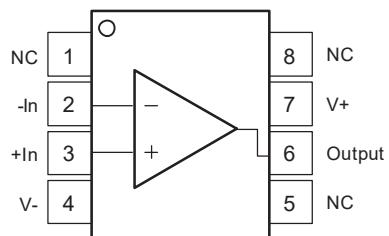
- Single-supply Operation
- Rail-to-rail Output Swing
- FET-input:  $I_B = 10\text{pA}$  max
- High Speed:
  - OPA337: 3MHz, 1.2V/µs ( $G = 1$ )
  - OPA338: 12.5MHz, 4.6V/µs ( $G = 5$ )
- Operation From 2.5V to 5.5V
- High Open-loop Gain: 120dB
- Low Quiescent Current: 525µA/amp
- Single And Dual Versions

## 3. Applications

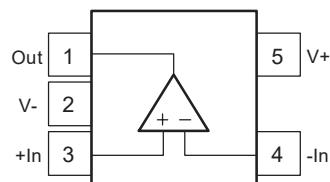
- Battery-powered Instruments
- Photodiode Pre-amps
- Medical Instruments
- Test Equipment
- Audio Systems
- DRIVING ADCs
- Consumer Products



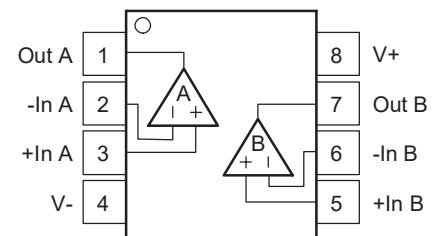
## 4.Pinning Information



**OPA338**  
**SOP-8**



**OPA338**  
**SOT23-5**



**OPA2338**  
**SOP-8**

**5.Electrical Characteristics: $V_s=2.7V$  to  $5.5V$** 

Boldface limits apply over the specified temperature range,  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_s=5\text{V}$ .

At  $T_A=+25^{\circ}\text{C}$  and  $R_L=25\text{k}\Omega$  connected to  $V_s/2$ , unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>Offset Voltage</b>						
Input Offset Voltage	$V_{os}$			$\pm 0.5$	$\pm 3$	mV
$T_A=-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$					$\pm 3.5$	mV
vs Temperature	$dV_{os}/dT$			$\pm 2$		$\mu\text{V}/^{\circ}\text{C}$
vs Power-Supply Rejection Ratio	PSRR	$V_s=2.7\text{V}$ to $5.5\text{V}$		25	125	$\mu\text{V/V}$
$T_A=-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$		$V_s=2.7\text{V}$ to $5.5\text{V}$			125	$\mu\text{V/V}$
Channel Separation (dual versions)		dc		0.3		$\mu\text{V/V}$
<b>Input Bias Current</b>						
Input Bias Current	$I_B$			$\pm 0.2$	$\pm 10$	pA
$T_A=-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$			See Typical Curve			
Input Offset Current	$I_{os}$			$\pm 0.2$	$\pm 10$	pA
<b>Noise</b>						
Input Voltage Noise, $f=0.1\text{Hz}$ to $10\text{Hz}$				6		$\mu\text{V}_{\text{PP}}$
Input Voltage Noise Density, $f=1\text{kHz}$	$e_n$			26		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density, $f= 1\text{kHz}$	$i_n$			0.6		$\text{fA}/\sqrt{\text{Hz}}$
<b>Input Voltage Range</b>						
Common-Mode Voltage Range	$V_{CM}$	$T_A=-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	-0.2		$(V+)-1.2$	V
Common-Mode Rejection Ratio	CMRR	$-0.2\text{V} < V_{CM} < (V+) - 1.2\text{V}$	74	90		dB
$T_A=-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$		$-0.2\text{V} < V_{CM} < (V+) - 1.2\text{V}$	74			dB
<b>Input Impedance</b>						
Differential				$10^{13}\text{II}2$		$\Omega\text{IIpF}$
Common-Mode				$10^{13}\text{II}4$		$\Omega\text{IIpF}$



Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>Open-loop Gain</b>						
Open-Loop Voltage Gain	$A_{OL}$	$R_L=25k\Omega, 125mV < V_o < (V+) - 125mV$	100	120		dB
$T_A=-40^\circ C$ to $+85^\circ C$		$R_L=25k\Omega, 125mV < V_o < (V+) - 125mV$	100			dB
		$R_L=5k\Omega, 500mV < V_o < (V+) - 500mV$	100	114		dB
$T_A=-40^\circ C$ to $+85^\circ C$		$R_L=5k\Omega, 500mV < V_o < (V+) - 500mV$	100			dB
<b>OPA338 Frequency Response</b>						
Gain-Bandwidth Product	GBW	$V_s=5V, G=5$		12.5		MHz
Slew Rate	SR	$V_s=5V, G=5$		4.6		V/ $\mu$ s
Settling Time: 0.1%		$V_s=5V, 2V Step, C_L=100pF, G=5$		1.4		$\mu$ s
0.01%		$V_s=5V, 2V Step, C_L=100pF, G=5$		1.9		$\mu$ s
Overload Recovery Time		$V_{IN} \times G = V_s$		0.5		$\mu$ s
Total Harmonic Distortion + Noise	THD+N	$V_s=5V, V_o=3V_{PP}, G=5, f=1kHz$		0.0035		%
<b>Output</b>						
Voltage Output Swing from Rail <sup>(2)</sup>		$R_L=25k\Omega, A_{OL} \geq 100dB$		40	125	mV
$T_A=-40^\circ C$ to $+85^\circ C$		$R_L=25k\Omega, A_{OL} \geq 100dB$			125	mV
		$R_L=5k\Omega, A_{OL} \geq 100dB$		150	500	mV
$T_A=-40^\circ C$ to $+85^\circ C$		$R_L=5k\Omega, A_{OL} \geq 100dB$			500	mV
Short-Circuit Current				$\pm 9$		mA
Capacitive Load Drive			See Typical Curve			
<b>Power Supply</b>						
Specified Voltage Range	$V_s$	$T_A=-40^\circ C$ to $+85^\circ C$	2.7		5.5	V
Minimum Operating Voltage				2.5		V
Quiescent Current (per amplifier)	$I_Q$	$I_o=0$		0.525	1	mA
$T_A=-40^\circ C$ to $+85^\circ C$		$I_o=0$			1.2	mA



Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>Temperature Range</b>						
Specified Range					+85	°C
Operating Range			-40		+125	°C
Storage Range			-55		+125	°C
Thermal Resistance	$\theta_{JA}$		-55			
SOP-8 Surface-Mount				150		°C/W

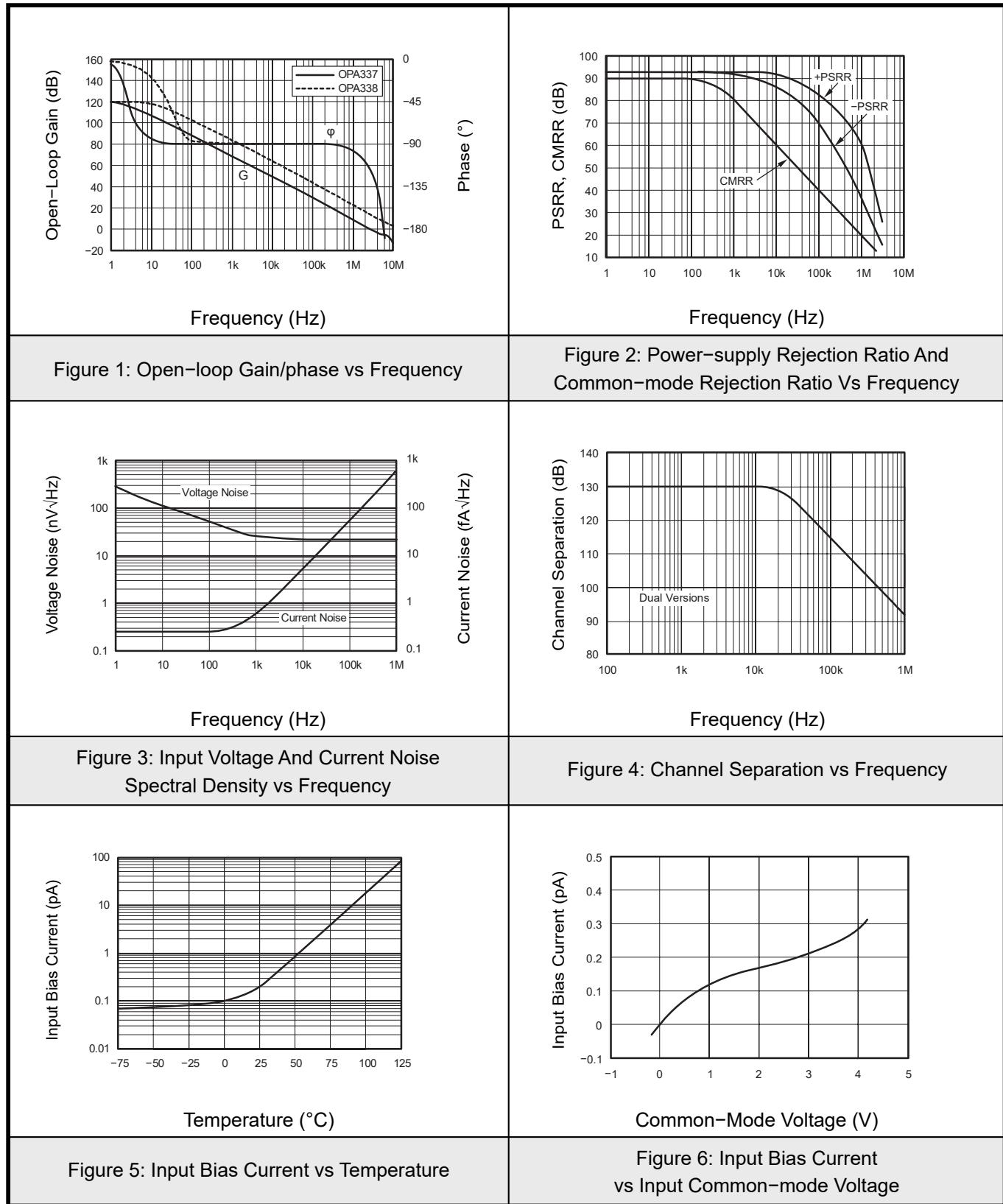
Notes:

(1)  $V_S=5V$ .

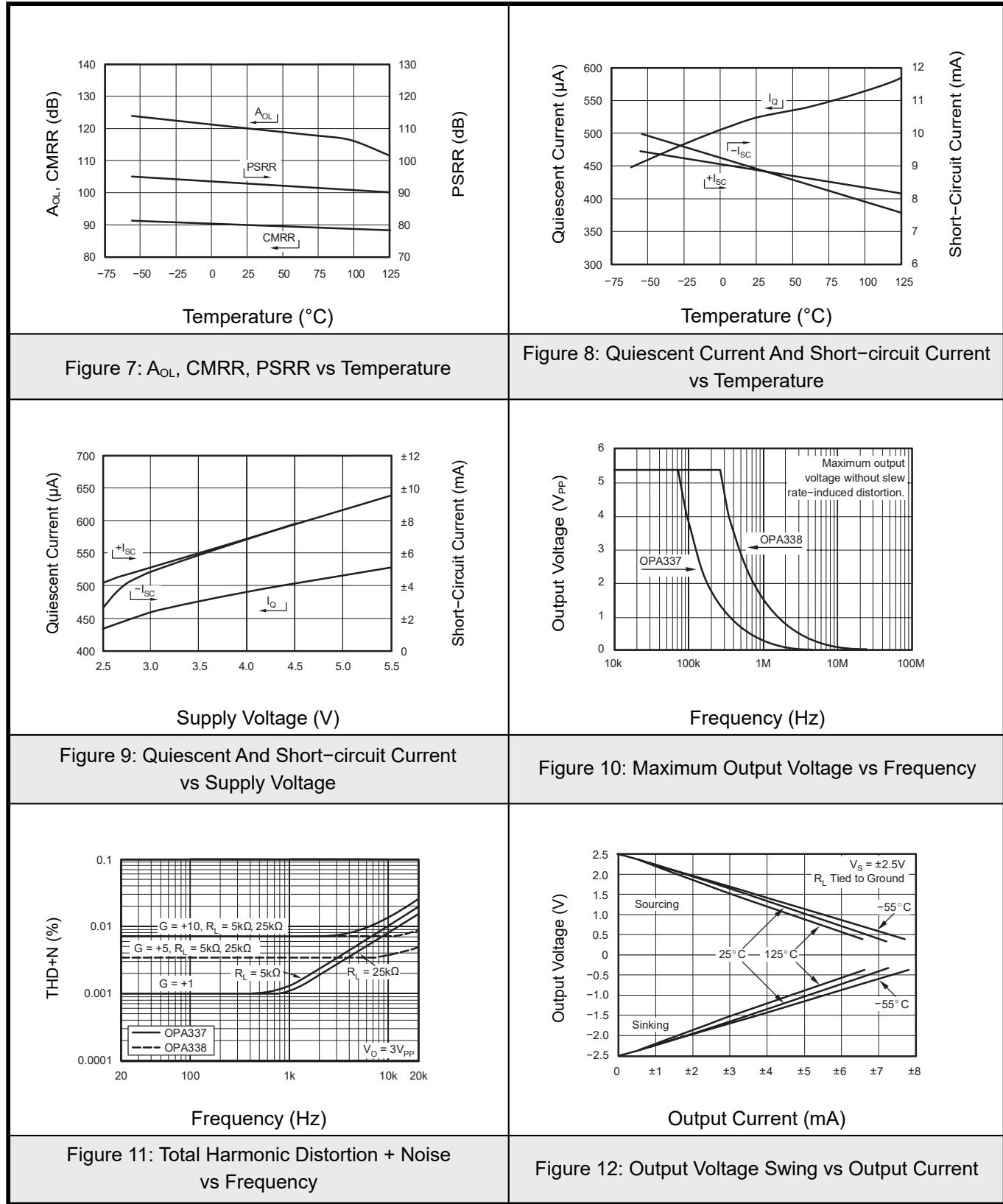
(2) Output voltage swings are measured between the output and negative and positive power-supply rails.



## 6.1 Typical characteristic



## 6.2 Typical characteristic





### 6.3 Typical characteristic

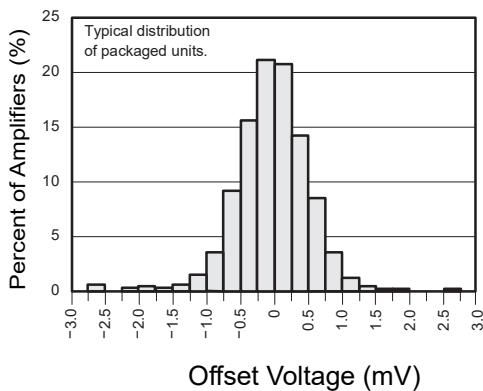


Figure 13: Offset Voltage Production Distribution

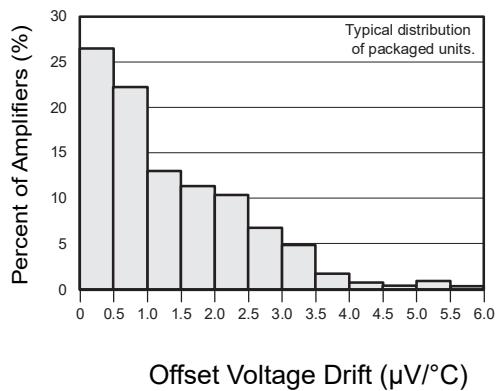


Figure 14: Offset Voltage Drift Production Distribution

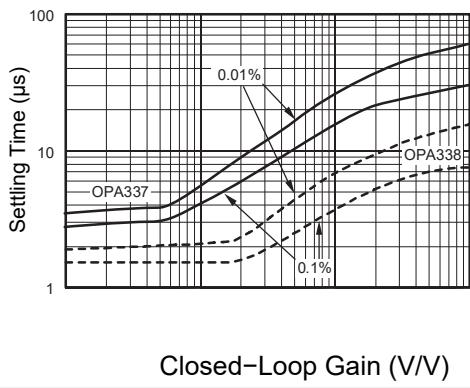


Figure 15: Settling Time vs Closed-loop Gain

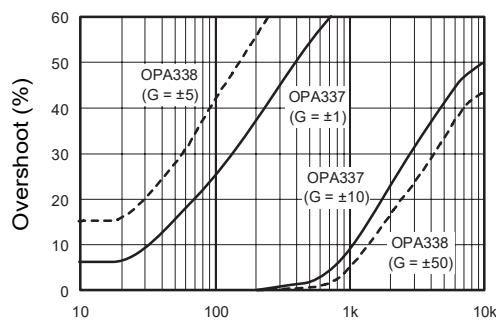


Figure 16: Small-signal Overshoot vs Load Capacitance

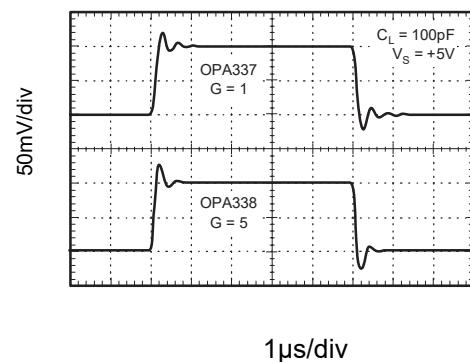


Figure 17: Small-signal Step Response

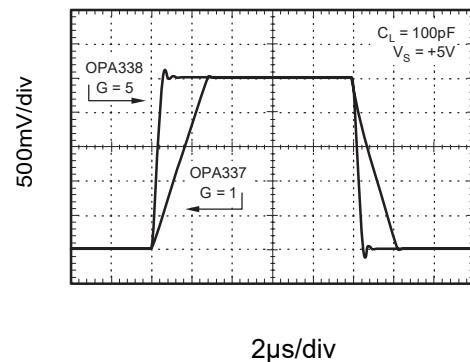
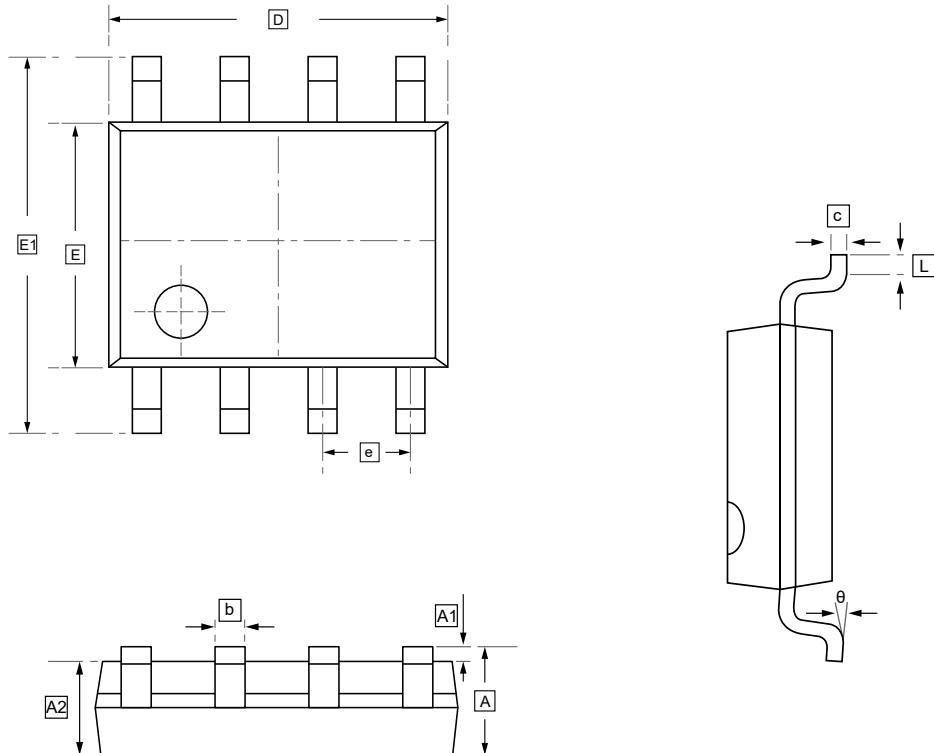


Figure 18: Large-signal Step Response



## 7.1 SOP-8 Package Outline Dimensions

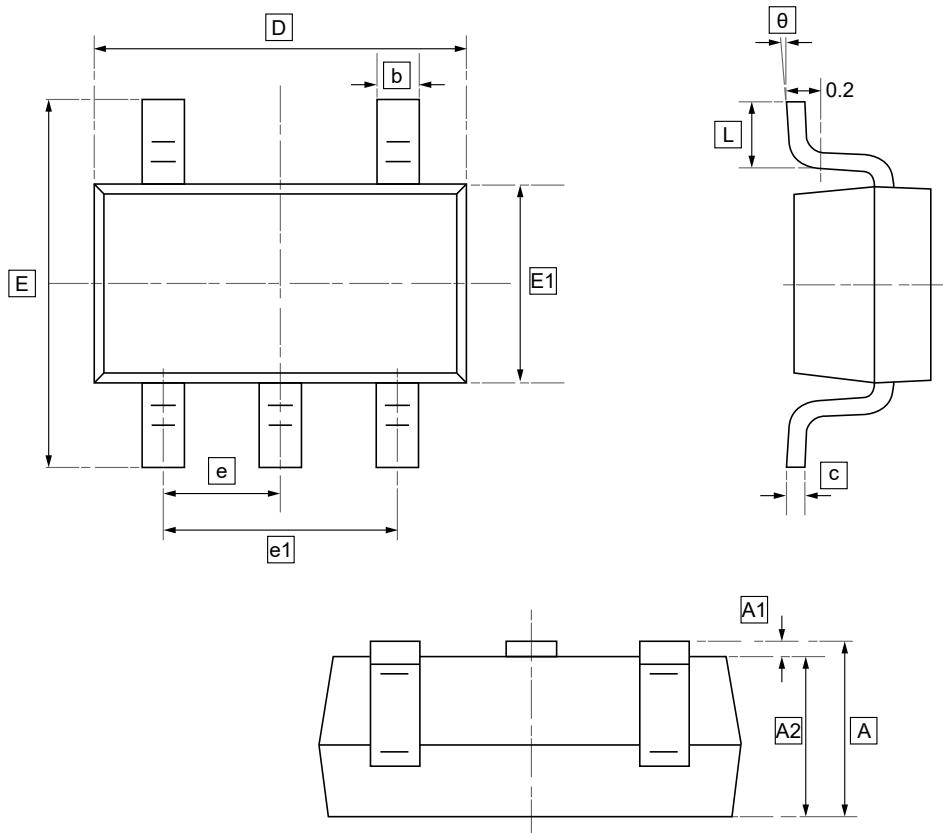


**DIMENSIONS (mm are the original dimensions)**

Symbol	A	A1	A2	b	c	D	E	E1	e	L	θ
<b>Min</b>	1.350	0.000	1.350	0.330	0.170	4.700	3.800	5.800	1.270	0.400	0°
<b>Max</b>	1.750	0.100	1.550	0.510	0.250	5.100	4.000	6.200	BSC	1.270	8°

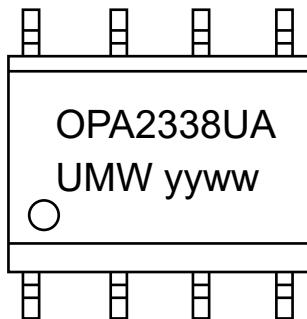


## 7.2 SOT-23-5 Package Outline Dimensions



### DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E1	E	e	e1	L	θ
Min	1.050	0.000	1.050	0.300	0.100	2.820	1.500	2.650	0.950	1.800	0.300	0°
Max	1.250	0.100	1.150	0.500	0.200	3.020	1.700	2.950	BSC	2.000	0.600	8°

**8.Ordering information**yy: Year Code  
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW OPA338NA	A38	SOT23-5	3000	Tape and reel
UMW OPA2338UA	OPA2338UA	SOP-8	2500	Tape and reel
UMW OPA338UA	OPA338UA	SOP-8	2500	Tape and reel



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