

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, highspeed 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 525 μ A 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.

3. Applications

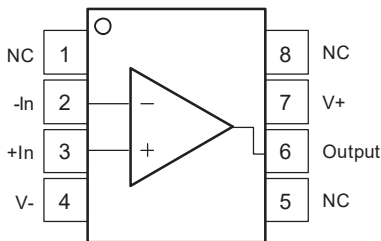
- Battery-powered Instruments
- Photodiode Pre-amps
- Medical Instruments
- Test Equipment

2. Features

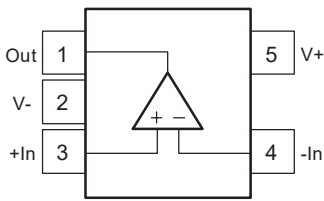
- Single-supply Operation
- Rail-to-rail Output Swing
- FET-input: $I_b=10\text{pA}$ max
- High Speed:
 - OPA337: 3MHz, 1.2V/ μ s ($G = 1$)
 - OPA338: 12.5MHz, 4.6V/ μ s ($G = 5$)
- Operation From 2.5V to 5.5V
- High Open-loop Gain: 120dB
- Low Quiescent Current: 525 μ A/amp
- Single And Dual Versions



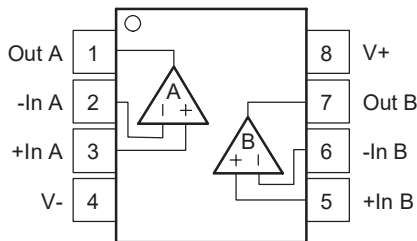
4.Pinning Information



OPA338
SOP-8



OPA338
SOT23-5



OPA2338
SOP-8

5.Absolute Maximum Ratings ⁽¹⁾

Description	Rating
Supply Voltage	7.5V
Input Voltage ⁽²⁾	(V-) – 0.5V to (V+) + 0.5V
Input Current ⁽²⁾	10mA
Output Short Circuit ⁽³⁾	Continuous
Operating Temperature	-55°C to +125°C
Storage Temperature	-55°C to +125°C
Junction Temperature	150°C
Lead Temperature (soldering, 10s)	300°C

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not supported.

(2) Input signal voltage is limited by internal diodes connected to power supplies. See text.

(3) Short-circuit to ground, one amplifier per package.



6. Electrical Characteristics: $V_S=2.7V$ to $5.5V$

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

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

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



Parameter	Symbol	Conditions	Min	Typ	Max	Units
Open-loop Gain						
Open-Loop Voltage Gain	A _{OL}	R _L =25kΩ, 125mV<V _O < (V+)-125mV	100	120		dB
T _A =-40°C to +85°C		R _L =25kΩ, 125mV<V _O < (V+)-125mV	100			dB
		R _L =5kΩ, 500mV<V _O < (V+)-500mV	100	114		dB
T _A =-40°C to +85°C		R _L =5kΩ, 500mV<V _O < (V+)-500mV	100			dB
OPA338 Frequency Response						
Gain-Bandwidth Product	GBW	V _S =5V, G=5		12.5		MHz
Slew Rate	SR	V _S =5V, G=5		4.6		V/μs
Settling Tlme: 0.1%		V _S =5V, 2V Step, C _L =100pF, G=5		1.4		μs
0.01%		V _S =5V, 2V Step, C _L =100pF, G=5		1.9		μs
Overload Recovery Time		V _{IN} × G=V _S		0.5		μs
Total Harmonic Distortion + Noise	THD+N	V _S =5V, V _O =3V _{PP} , G=5, f=1kHz		0.0035		%
Output						
Voltage Output Swing from Rail ⁽²⁾		R _L =25kΩ, A _{OL} ≥100dB		40	125	mV
T _A =-40°C to +85°C		R _L =25kΩ, A _{OL} ≥100dB			125	mV
		R _L =5kΩ, A _{OL} ≥100dB		150	500	mV
T _A =-40°C to +85°C		R _L =5kΩ, A _{OL} ≥100dB			500	mV
Short-Circuit Current				±9		mA
Capacitive Load Drive			See Typical Curve			
Power Supply						
Specified Voltage Range	V _S	T _A =-40°C to +85°C	2.7		5.5	V
Minimum Operating Voltage				2.5		V
Quiescent Curent (per amplifier)	I _Q	I _O =0		0.525	1	mA
T _A =-40°C to +85°C		I _O =0			1.2	mA



Parameter	Symbol	Conditions	Min	Typ	Max	Units
Temperature Range						
Specified Range					+85	°C
Operating Range			-40		+125	°C
Storage Range			-55		+125	°C
Thermal Resistance	θ_{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.



7.1 Typical Characteristic

Figure 1: Open-loop Gain/phase vs Frequency	Figure 2: Power-supply Rejection Ratio And Common-mode Rejection Ratio Vs Frequency
Figure 3: Input Voltage And Current Noise Spectral Density vs Frequency	Figure 4: Channel Separation vs Frequency
Figure 5: Input Bias Current vs Temperature	Figure 6: Input Bias Current vs Input Common-mode Voltage



7.2 Typical Characteristic

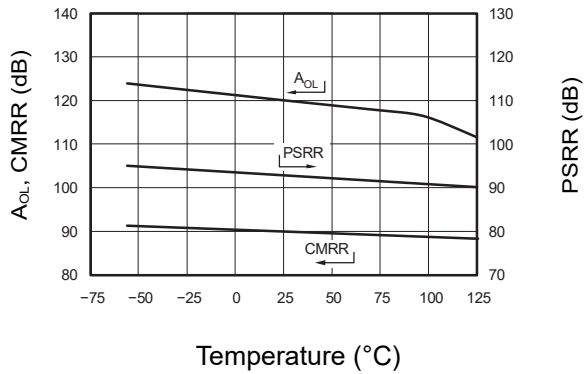
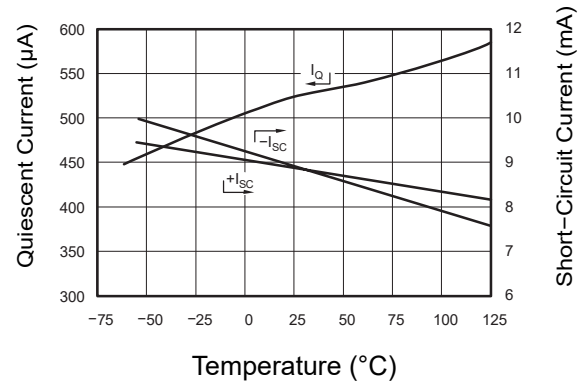
Figure 7: A_{OL} , CMRR, PSRR vs Temperature

Figure 8: Quiescent Current And Short-circuit Current vs Temperature

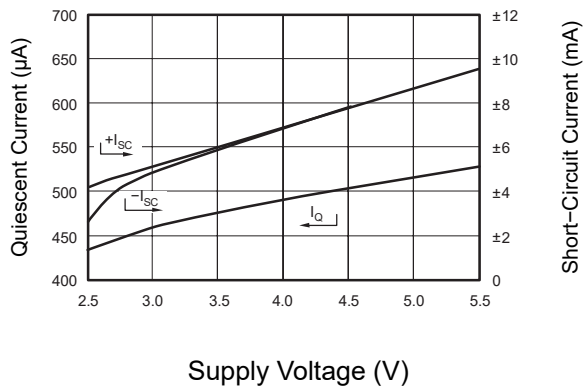


Figure 9: Quiescent And Short-circuit Current vs Supply Voltage

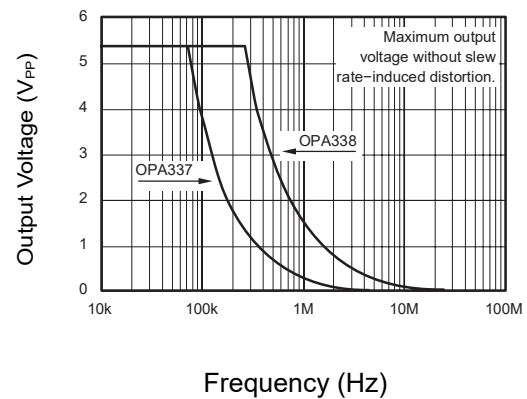


Figure 10: Maximum Output Voltage vs Frequency

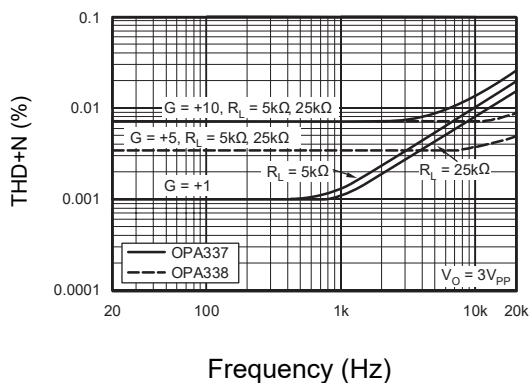


Figure 11: Total Harmonic Distortion + Noise vs Frequency

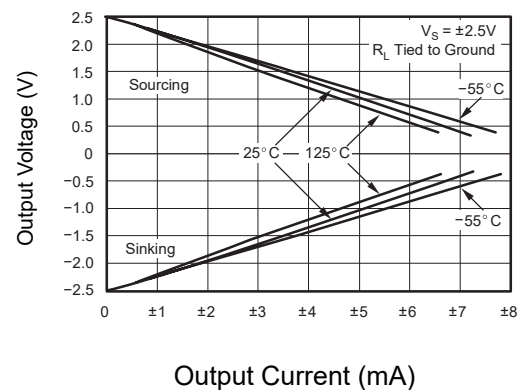


Figure 12: Output Voltage Swing vs Output Current



7.3 Typical Characteristic

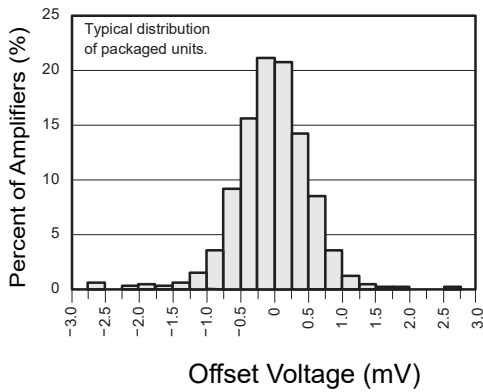


Figure 13: Offset Voltage Production Distribution

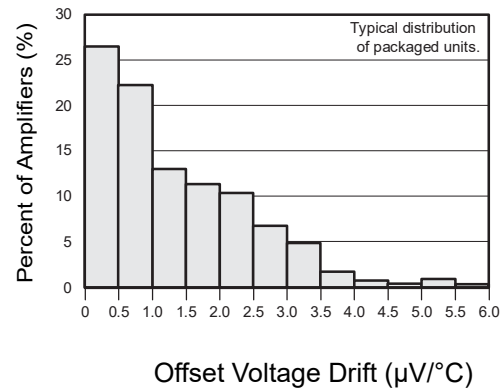


Figure 14: Offset Voltage Drift Production Distribution

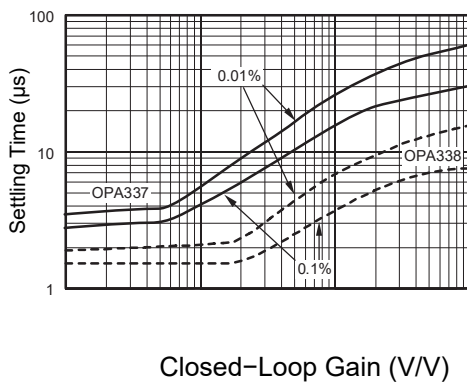


Figure 15: Settling Time vs Closed-loop Gain

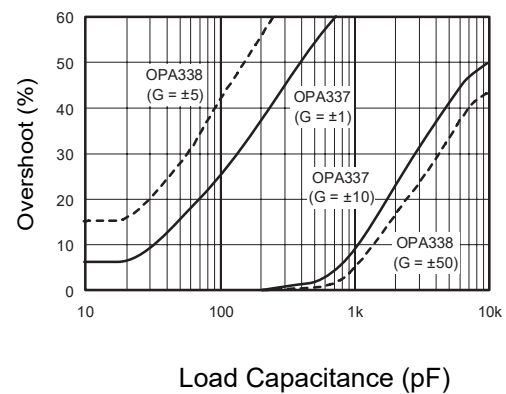


Figure 16: Small-signal Overshoot vs Load Capacitance

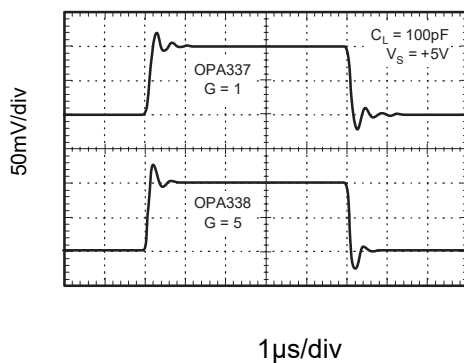


Figure 17: Small-signal Step Response

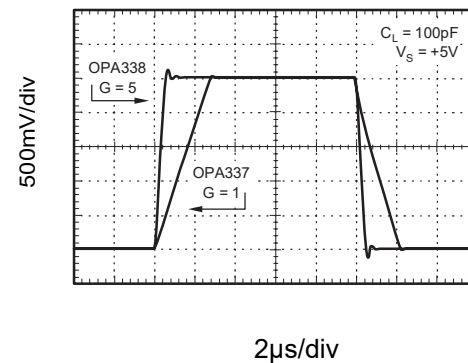
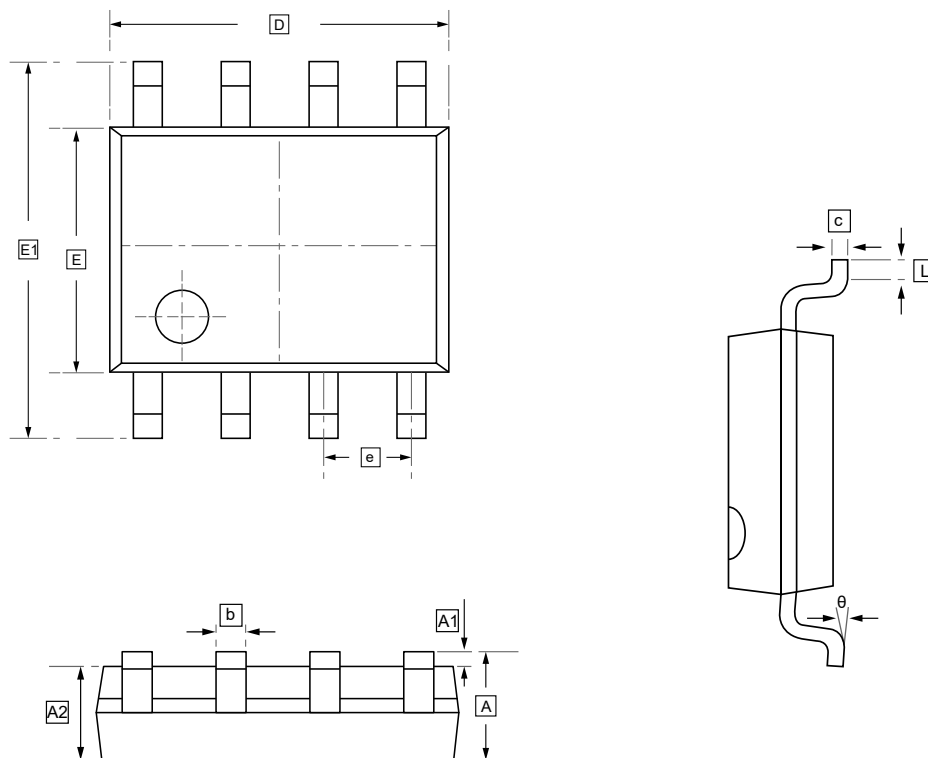


Figure 18: Large-signal Step Response



8.1 SOP-8 Package Outline Dimensions

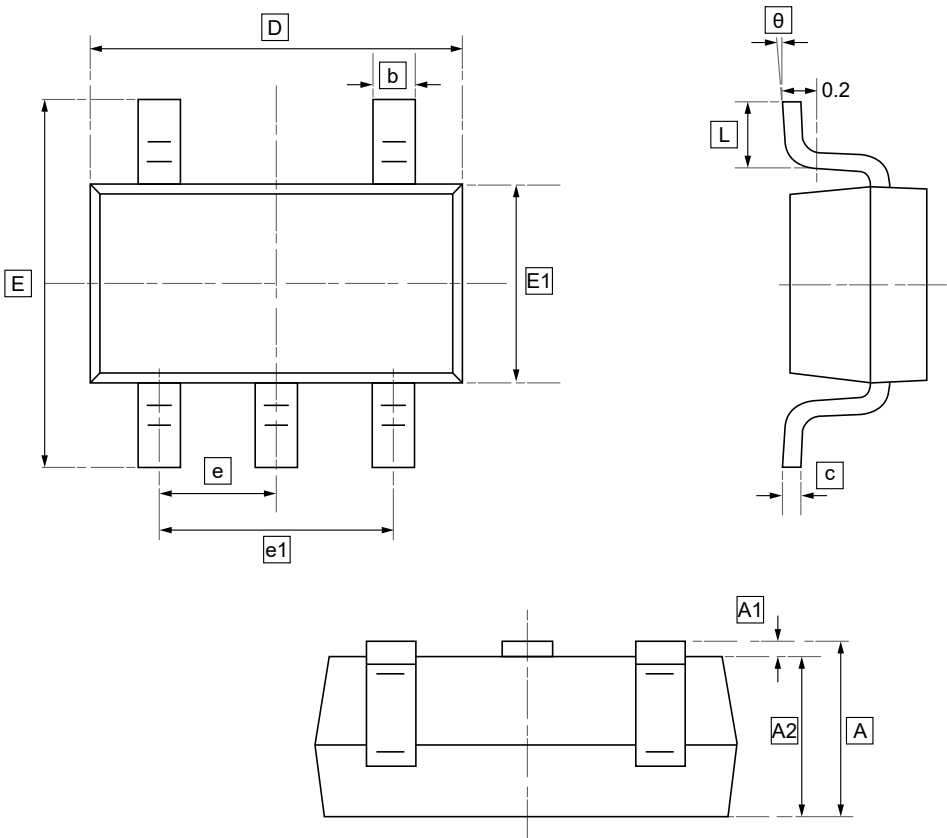


DIMENSIONS (mm are the original dimensions)

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



8.2 SOT-23-5 Package Outline Dimensions

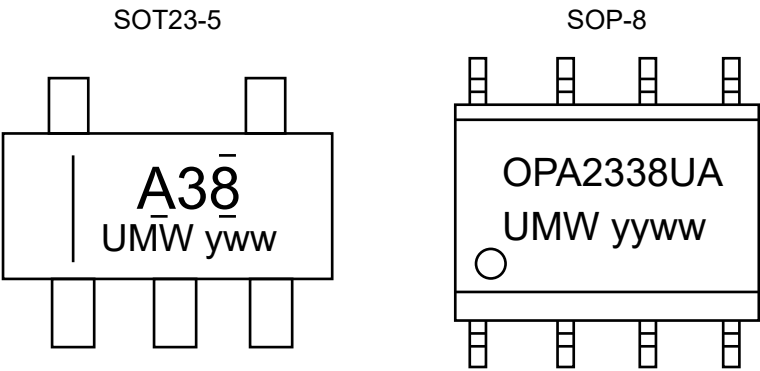


DIMENSIONS (mm are the original dimensions)

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°



9.Ordering Information



y: Year Code
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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