



## ULV2333

Preliminary

CMOS IC

### 1.8V, MICRO-POWER CMOS ZERO-DRIFT OPERATIONAL AMPLIFIERS

#### DESCRIPTION

The dual UTC **ULV2333** CMOS operational amplifiers provide very low offset voltage and zero-drift over time and temperature.

The miniature, high precision, low quiescent current amplifiers offer high-impedance inputs that have a wide input common mode range of 100mV beyond the rails and rail-to-rail output that swings within 35mV of the rails. Single or dual supplies as low as 1.8V ( $\pm 0.9V$ ) and up to 5.5V ( $\pm 2.75V$ ) may be used. They are optimized for low voltage, single or dual supply operation.

The UTC **ULV2333** offers excellent CMRR without the crossover associated with traditional complementary input stages. This design results in superior performance for driving analog-to-digital converters (ADCs) without degradation of differential linearity.

#### FEATURES

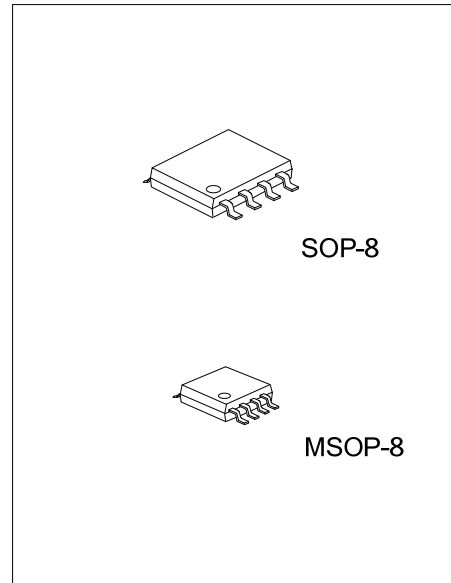
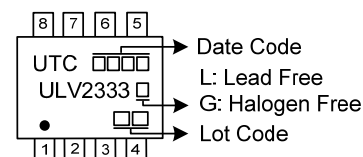
- \* Supply Voltage Range: 1.8V~5.5V
- \* Rail-to-Rail Input and Output
- \* Low Offset Voltage: 25 $\mu$ V (Max.)
- \* Low 0.1Hz to 10Hz Noise: 2 $\mu$ V<sub>P-P</sub>
- \* Quiescent Current: 80 $\mu$ A/Amplifier (Typ.)
- \* Single or Dual Supply Operation
- \* Integrated RFI Filter

#### ORDERING INFORMATION

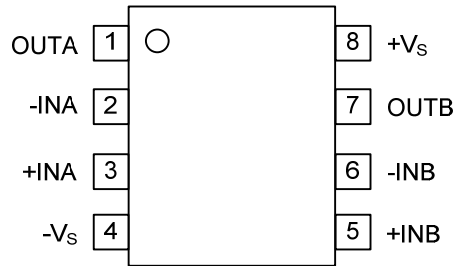
Ordering Number		Package	Packing
Lead Free	Halogen Free		
ULV2333L-S08-R	ULV2333G-S08-R	SOP-8	Tape Reel
ULV2333L-SM1-R	ULV2333G-SM1-R	MSOP-8	Tape Reel

<p>ULV2333G-S08-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) R: Tape Reel (2) S08: SOP-8, SM1: MSOP-8 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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#### MARKING



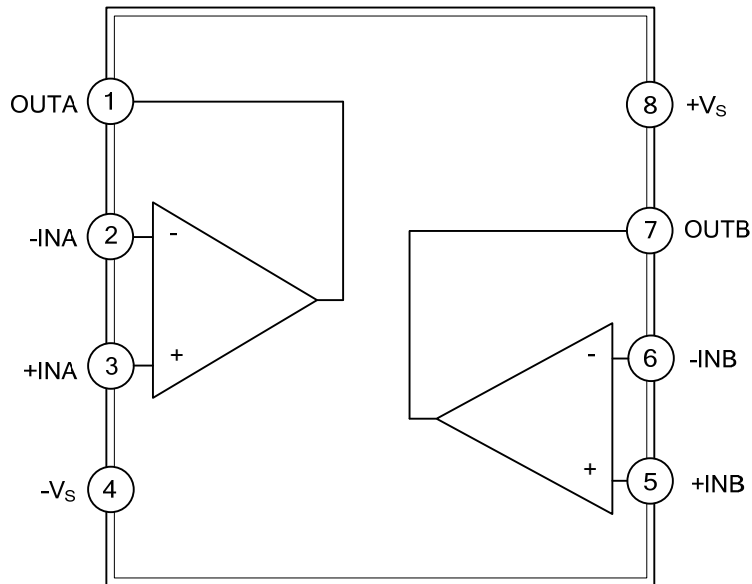
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUTA	Output (op amp A)
2	-INA	Inverting Input (op amp A)
3	+INA	Non-inverting Input (op amp A)
4	-Vs	Negative Power Supply
5	+INB	Non-inverting Input (op amp B)
6	-INB	Inverting Input (op amp B)
7	OUTB	Output (op amp B)
8	+Vs	Positive Power Supply

■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V_{CC}$	6	V
Input Common Mode Voltage Range	$V_I$	$(-V_S) - 0.3 \sim (+V_S) + 0.3$	V
Junction Temperature	$T_J$	+150	°C
Storage Temperature Range	$T_{STG}$	-65 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Specified Voltage Range	$V_{CC}$	1.8 ~ 5.5	V
Operating Temperature Range	$T_A$	-40 ~ +125	°C

### ■ ELECTRICAL CHARACTERISTICS

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 1.8\text{V} \sim 5.5\text{V}$ ,  $V_{CM} = V_S/2$ ,  $V_{OUT} = V_S/2$  and  $R_L = 10\text{k}\Omega$  to  $V_S/2$ , Full =  $-40^\circ\text{C} \sim +125^\circ\text{C}$ , unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>INPUT CHARACTERISTICS</b>							
Input Offset Voltage	$V_{OS}$	$V_S = 5\text{V}$ $T_A = 25^\circ\text{C}$		14	25	$\mu\text{V}$	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T_A$	$T_A = -40^\circ\text{C} \sim +125^\circ\text{C}$		0.08		$\mu\text{V}/^\circ\text{C}$	
Input Bias Current	$I_B$			130		pA	
Input Common Mode Voltage Range	$V_{CM}$		$(-V_S) - 0.1$		$(+V_S) + 0.1$	V	
Common-Mode Rejection Ratio	CMRR	$(-V_S) - 0.1\text{V} < V_{CM} < (+V_S) + 0.1\text{V}$	$T_A = 25^\circ\text{C}$	89	100		dB
			Full Range	85			dB
Open-Loop Voltage Gain	$A_{OL}$	$(-V_S) + 0.1\text{V} < V_{OUT} < (+V_S) - 0.1\text{V}$ , $R_L = 10\text{k}\Omega$	$T_A = 25^\circ\text{C}$	95	121		dB
			Full Range	94			dB
<b>INPUT IMPEDANCE</b>							
Differential		$T_A = +25^\circ\text{C}$		$10^9$		$\Omega$	
Common Mode		$T_A = +25^\circ\text{C}$		$10^9$		$\Omega$	
<b>OUTPUT CHARACTERISTICS</b>							
Output Voltage Swing from Rail		$R_L = 10\text{k}\Omega$	$T_A = 25^\circ\text{C}$		24	35	mV
			Full Range			37	mV
Output Short-Circuit Current	$I_{SC}$	$V_S = 1.8\text{V}$		4		mA	
		$V_S = 5\text{V}$		40		mA	
Open-Loop Output Impedance		$f = 350\text{kHz}$ , $I_{OUT} = 0$		1		k $\Omega$	
<b>POWER SUPPLY</b>							
Specified Voltage Range	$V_S$	$T_A = -40^\circ\text{C} \sim +125^\circ\text{C}$	1.8		5.5	V	
Power Supply Rejection Ratio	PSRR	$V_S = 1.8\text{V} \sim 5.5\text{V}$	$T_A = 25^\circ\text{C}$		4	20	$\mu\text{V}/\text{V}$
			Full Range			25	$\mu\text{V}/\text{V}$
Quiescent Current/Amplifier	$I_Q$	$I_{OUT} = 0$	$T_A = 25^\circ\text{C}$		80	148	$\mu\text{A}$
			Full Range			192	$\mu\text{A}$
Turn-On Time		$V_S = 5\text{V}$		200		$\mu\text{s}$	
<b>DYNAMIC PERFORMANCE</b>							
Gain-Bandwidth Product	GBP	$C_L = 100\text{pF}$		350		kHz	
Slew Rate	SR	$G = +1$		0.25		V/ $\mu\text{s}$	
<b>NOISE</b>							
Input Voltage Noise		$f = 0.1\text{Hz} \sim 10\text{Hz}$		2		$\mu\text{V}_{P-P}$	

■ TYPICAL APPLICATION CIRCUIT

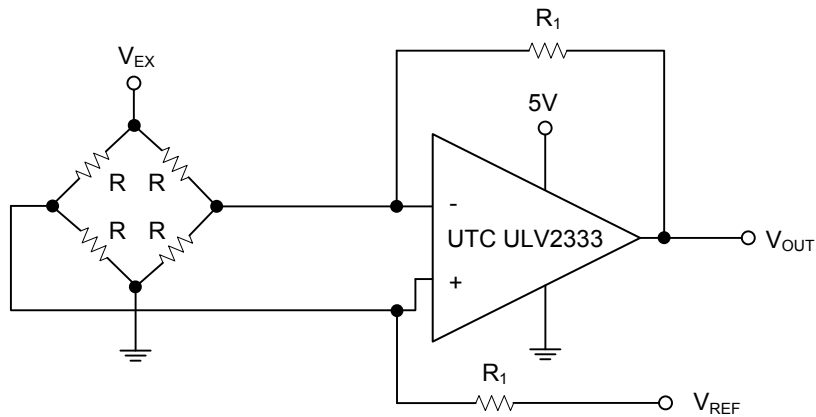


Figure 1. Bridge Amplifier Configuration

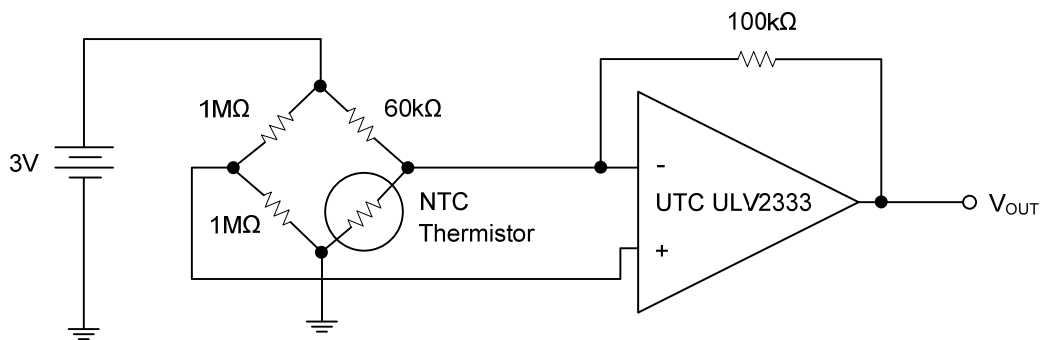


Figure 2. Thermistor Measurement

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