



## ULV6004

CMOS IC

### MICRO-POWER QUAD OPERATIONAL AMPLIFIERS

#### DESCRIPTION

The UTC **ULV6004** of operational amplifiers (op amps) with operational voltage (2.1V, min.) is specifically designed for general-purpose applications.. This amplifier will draw 110 $\mu$ A (typ.) quiescent current when the single supply voltage is as low as 2.1V. It also has a power supply range of 2.1V to 5.5V. Additionally, the UTC **ULV6004** supports rail-to-rail input and output swing, with a common mode input voltage range of  $V^+ + 300\text{mV}$  to  $V^- - 300\text{mV}$ .

#### FEATURES

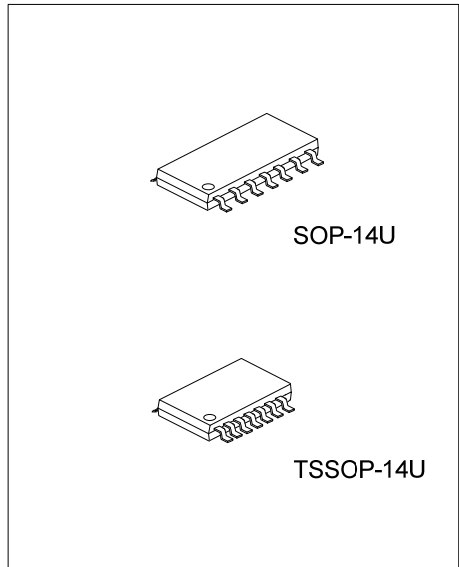
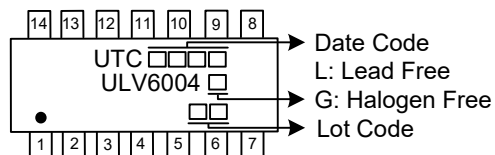
- \* Supply Voltage: 2.1~5.5V
- \* Supply Current/Amplifier: 170 $\mu$ A (Max.)
- \* Input Offset Voltage: 4.5mV (Max.)
- \* Rail-to-Rail Input and Output
- \* Slew Rate: 1.1V/ $\mu$ s (Typ.)

#### ORDERING INFORMATION

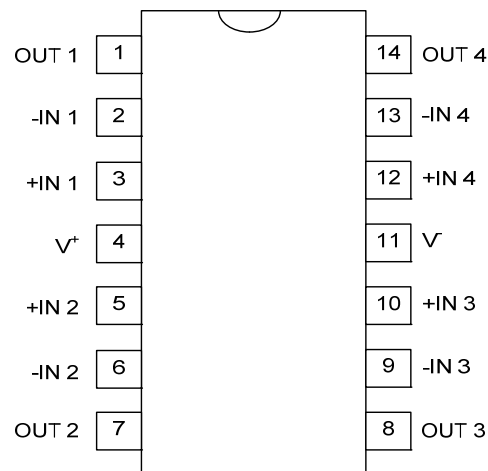
Ordering Number		Package	Packing
Lead Free	Halogen Free		
ULV6004L-UEA-R	ULV6004G-UEA-R	SOP-14U	Tape Reel
ULV6004L-UEB-R	ULV6004G-UEB-R	TSSOP-14U	Tape Reel

<p>ULV6004G-UEA-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) UEA: SOP-14U, UEB: TSSOP-14U</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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#### MARKING



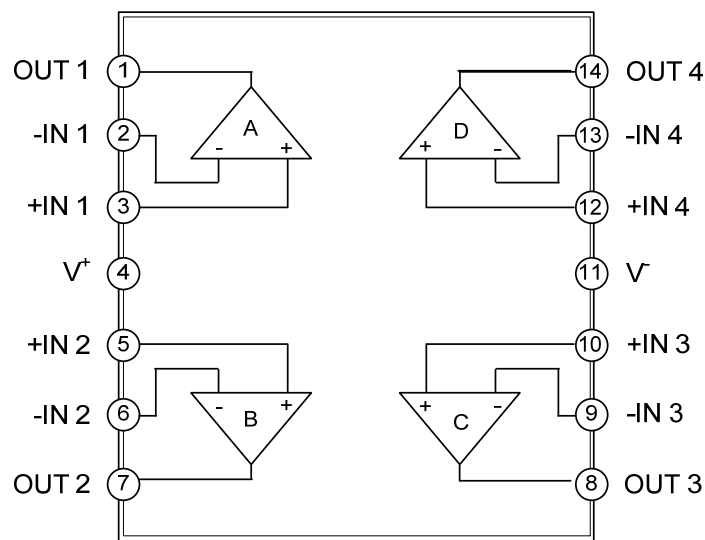
PIN CONFIGURATION



PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUT 1	Output of 1 AMP
2	-IN 1	Inverting input of 1 AMP
3	+IN 1	Non-inverting input of 1 AMP
4	V <sup>+</sup>	Positive power supply
5	+IN 2	Non-inverting input of 2 AMP
6	-IN 2	Inverting input of 2 AMP
7	OUT 2	Output of 2 AMP
8	OUT 3	Output of 3 AMP
9	-IN 3	Inverting input of 3 AMP
10	+IN 3	Non-inverting input of 3 AMP
11	V <sup>-</sup>	Negative power supply
12	+IN 4	Non-inverting input of 4 AMP
13	-IN 4	Inverting input of 4 AMP
14	OUT 4	Output of 4 AMP

BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ( $T_A=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Power Supply	$V^+ - V^-$	7.0	V
All Inputs and Outputs		$V^+ - 0.3 \sim V^- 0.3$	V
Differential Input Voltage	$V_{ID}$	Supply Voltage	V
Power Dissipation ( $T_A=25^{\circ}\text{C}$ )	SOP-14U	1000	mW
	TSSOP-14U	700	mW
Current at Input Pins	$I_{IN}$	$\pm 2$	mA
Current at Output and Supply Pins		$\pm 30$	mA
Junction Temperature	$T_J$	+150	$^{\circ}\text{C}$
Storage Temperature	$T_{STG}$	-65 ~ +150	$^{\circ}\text{C}$

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

( $V^+=2.1\text{V} \sim 5.5\text{V}$ , and  $V^-=0\text{V}$ ,  $T_A=25^{\circ}\text{C}$ , unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V^+ - V^-$	2.1 ~ 5.5	V
Operating Free-Air Temperature	$T_{OPR}$	-40 ~ +125	$^{\circ}\text{C}$

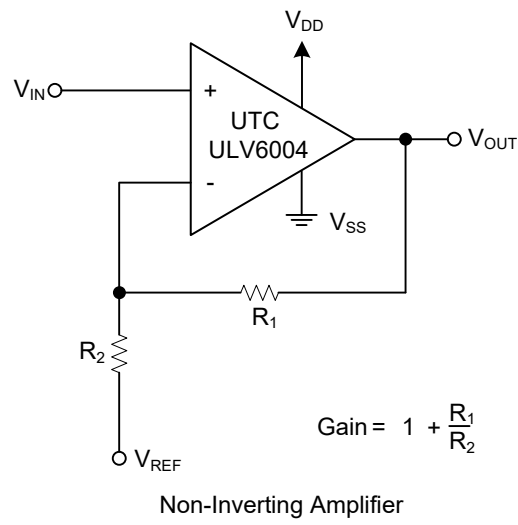
Note: The industrial temperature devices operate over this extended temperature range, but with reduced performance. In any case, the internal Junction Temperature ( $T_J$ ) must not exceed the Absolute Maximum specification of +150 $^{\circ}\text{C}$ .

■ DC ELECTRICAL CHARACTERISTICS

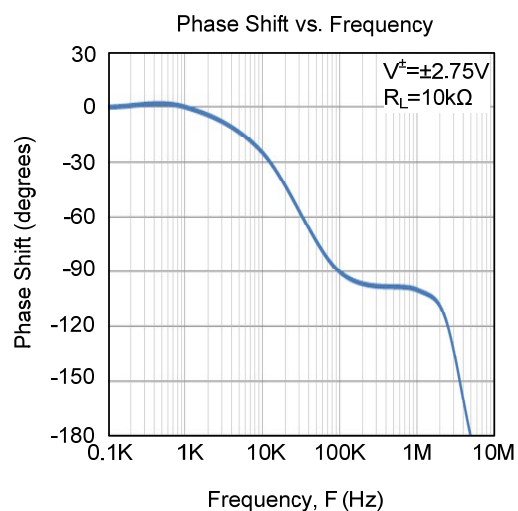
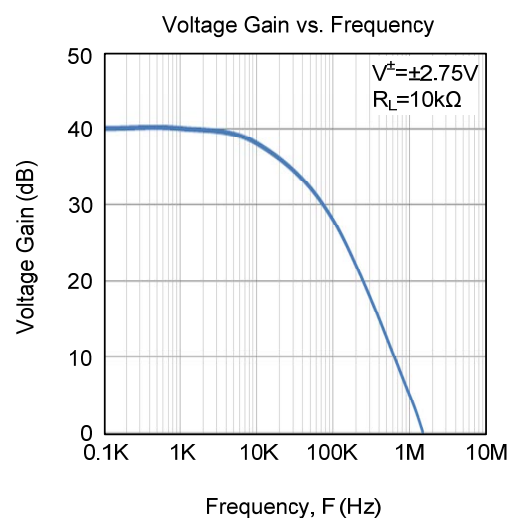
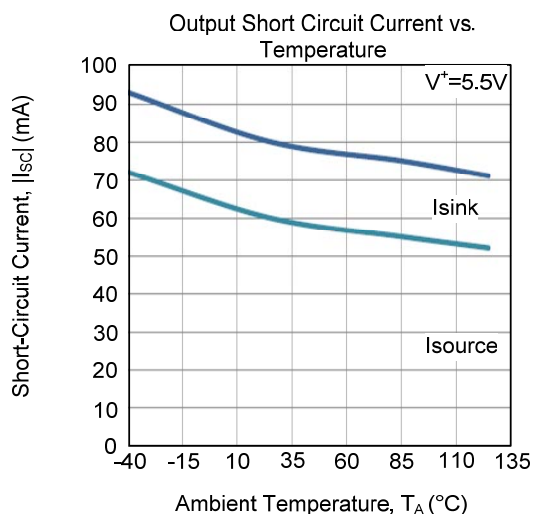
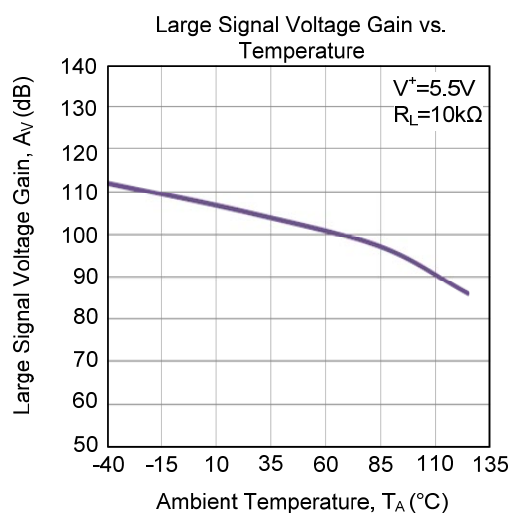
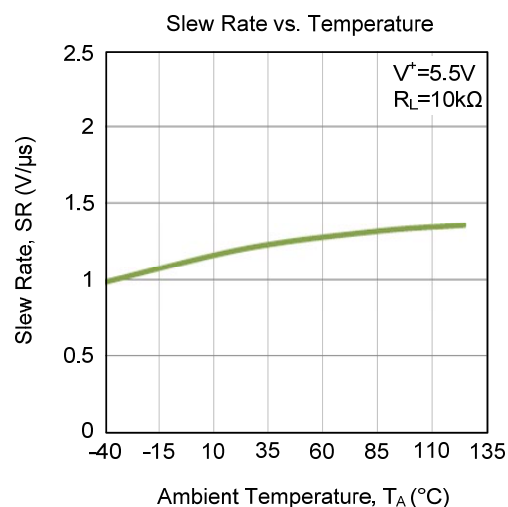
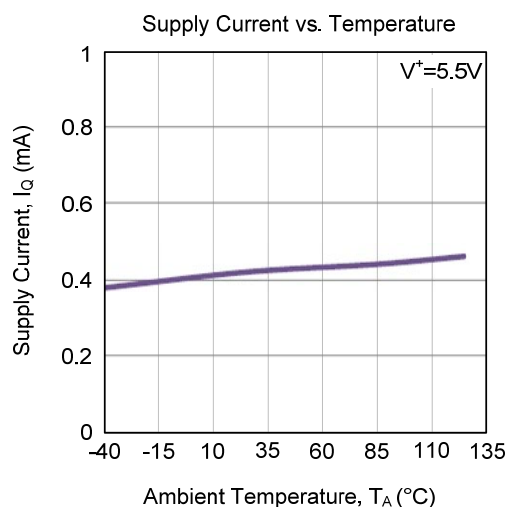
( $T_A=25^{\circ}\text{C}$ ,  $V^+=2.1\text{V} \sim 5.5\text{V}$ ,  $V^-=0\text{V}$ ,  $V_{CM}=V^+/2$ ,  $R_L=10\text{k}\Omega$ , unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Current/Amplifier	$I_Q$	$I_O=0$ , $V_{DD}=5.5\text{V}$ , $V_{CM}=5\text{V}$		110	170	$\mu\text{A}$
Power Supply Rejection Ratio	PSRR	$V_{CM}=0\text{V}$		85		dB
Input Offset Voltage	$V_{OS}$	$V_O=0\text{V}$		1	4.5	mV
Input Bias Current	$I_B$	$V_O=0\text{V}$		2		pA
Input Offset Current	$I_{OS}$	$V_O=0\text{V}$		2		pA
Common-Mode Voltage Range	$V_{CM}$		$V^- - 0.3$		$V^+ + 0.3$	V
Common-Mode Rejection Ratio	CMRR	$V^- - 0.3 < V_{CM} < V^+ + 0.3\text{V}$	60	107		dB
Large Signal Voltage Gain	$A_V$	$R_L=10\text{k}\Omega$ , $V_O=0.3 \sim V^+ - 0.3\text{V}$	88	105		dB
Output Voltage	$V_O$	$R_L=10\text{k}\Omega$	$V_{OH}$	$V^+ - 0.09$	$V^+ - 0.03$	V
			$V_{OL}$	0.005	0.09	V
Short-Circuit Current	$I_{SC}$	Sourcing		80		mA
		Sinking		60		mA
Slew Rate	SR			1.1		V/ $\mu\text{s}$
Gain-Bandwidth Product	GBW			1.5		MHz
Input-Referred Voltage Noise	$e_n$	$f=1\text{kHz}$		30		nV/ $\sqrt{\text{Hz}}$
Input-Referred Current Noise	$i_n$	$f=1\text{kHz}$		1		fA/ $\sqrt{\text{Hz}}$

## ■ TYPICAL APPLICATION CIRCUIT



## TYPICAL CHARACTERISTICS



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