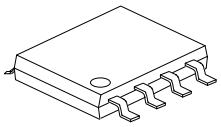
OPA2336 **Preliminary** ***CMOS IC***

SINGLE-SUPPLY, MICROPOWER CMOS OPERATIONAL AMPLIFIERS



SOP-8

■ DESCRIPTION

The UTC **OPA2336** is a CMOS operational amplifier. It is operated on a 2.1V (Min.) single supply. A100kΩ load is driven by the rail-to-rail output and the accuracy of the output voltage is ensured at ± 3mV.

The UTC **OPA2336** is characterized by its low quiescent current (20μA/amplifier), low offset voltage (125μV max), low input bias current (1pA), and high open-loop gain (115dB).

The UTC **OPA2336** features completely independent circuitry for lowest crosstalk and freedom from interaction.

The UTC **OPA2336** is particularly designed for battery-powered applications and the common-mode range extending to the negative supply makes it ideal for single-supply applications.

In addition to the applications mentioned above, the UTC **OPA2336** is suitable for portable devices, high-Impedance applications, photodiode, pre-amps, precision integrators, medical instruments, and test equipment.

■ FEATURES

* Operating on a Single-Supply
* Rail-to-Rail Output (Accuracy: ± 3mv)
* Low Power Dissipation: I_Q=20μA/Amplifier
* Low Offset Voltage up to 125μV (MAX.)
* Power Supply Specified from 2.3V to 5.5V
* Halogen Free

■ ORDERING INFORMATION

Ordering Number	Package	Packing
OPA2336G-S08-R	SOP-8	Tape Reel

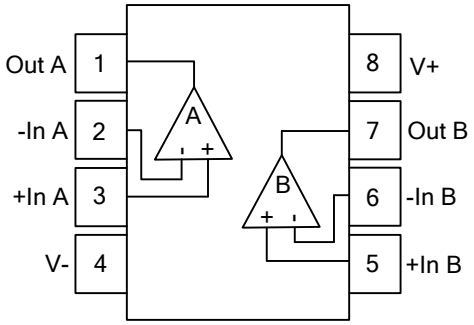
OPA2336G-S08-R

(1)Packing Type
(2)Package Type
(3)Halogen Free

(1) R: Tape Reel
(2) S08: SOP-8
(3) G: Halogen Free

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■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUTA	Output of channel A
2	-In A	Negative Input of channel A
3	+In A	Positive Input of channel A
4	V-	Ground
5	+In B	Positive Input of channel B
6	-in B	Negative Input of channel B
7	Out B	Output of channel B
8	V+	Power supply

■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_S	7.5	V
Signal Input Terminals Voltage (Note 2)	V_{IT}	(V-)-0.3~(V+)+0.3	V
Signal Input Terminals Current (Note 2)	I_{IT}	10	mA
Output Short-Circuit (Note 3)	I_{OS}	Continuous	A
Operating Junction Temperature	T_{OPR}	-40~ +125	°C
Storage Temperature	T_{STG}	-55~ +125	°C

Note: 1. 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.
2. Input terminals are diode-clamped to the power supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.
3. Short-circuit to ground, one amplifier per package.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	θ_{JA}	150	°C/W

■ ELECTRICAL CHARACTERISTICS

(At T_A=+25°C, V_S=+5V,R_L=25kΩ connected to V_S/2, unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFFSET VOLTAGE						
Input Offset Voltage	$V_{I(OFF)}$			±60	±125	μV
Input Offset Voltage vs. Temperature	dV_{OS}/dT			±1.5		μV/°C
Input Offset Voltage vs. Power Supply	PSRR	V_S = 2.3V ~ 5.5V		25	100	μV/V
Over Temperature		V_S = 2.3V ~ 5.5V			130	μV/V
Channel Separation, DC				0.1		μV/V
INPUT BIAS CURRENT						
Input Bias Current	I_{BIAS}			±1	±10	pA
Over Temperature					±60	pA
Input Offset Current	$I_{O(OFF)}$			±1	±10	pA
NOISE						
Input Voltage Noise, f = 0.1 ~ 10Hz				3		μV_{P-P}
Input Voltage Noise Density, f = 1kHz	e_N			40		nV/√Hz
Current Noise Density, f = 1kHz	i_N			30		fA/√Hz
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		-0.2		(V+)-1	V
Common-Mode Rejection Ratio	CMRR	-0.2V<V_{CM}<(V+)-1V	80	90		dB
Over Temperature		-0.2V<V_{CM}<(V+)-1V	76			dB
INPUT IMPEDANCE						
Differential				10^{13}||2		Ω||pF
Common-Mode	CM			10^{13}||4		Ω||pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	A_{OL}	R_L=25kΩ, 100mV<V_{OUT}<(V+)-100mV	100	115		dB
Over Temperature		R_L=25kΩ, 100mV<V_{OUT}<(V+)-100mV	100			dB
Open-Loop Voltage Gain	A_{OL}	R_L=5kΩ, 500mV<V_{OUT} <(V+)-500mV	90	106		dB
Over Temperature		R_L=5kΩ, 500mV<V_{OUT} <(V+)-500mV	90			dB

■ ELECTRICAL CHARACTERISTICS(Cont.)

FREQUENCY RESPONSE						
Gain-Bandwidth Product	GBW	V_S=5V, G=1		100		kHZ
Slew Rate	SR	V_S=5V, G=1		0.03		V/μs
Overload Recovery Time		V_{IN} · G = V_S		100		μs
OUTPUT						
Voltage Output Swing from Rail (Note 2)	V_{OS}	R_L=100kΩ, A_{OL}≥70dB		3		mV
Voltage Output Swing from Rail (Note 2)		R_L=25kΩ, A_{OL}≥90dB		20	100	mV
Over Temperature		R_L=25kΩ, A_{OL}≥90dB			100	mV
Voltage Output Swing from Rail (Note 2)		R_L=5kΩ, A_{OL}≥90dB		70	500	mV
Over Temperature		R_L=5kΩ, A_{OL}≥90dB			500	mV
Short-Circuit Current	I_{SC}			±5		mA
Capacitive Load Drive	C_{LOAD}					pF
POWER SUPPLY						
Specified Voltage Range	V_S		2.3		5.5	V
Minimum Operating Voltage				2.1		V
Quiescent Current (Per Amplifier)	I_Q	I_{OUT}=0		20	32	μA
Over Temperature		I_{OUT}=0			36	μA
TEMPERATURE RANGE						
Specified Range			-40		+85	°C
Operating Range			-55		+125	°C
Storage Range			-55		+125	°C

Note: 1. V_S= +5V.
2. Output voltage swings are measured between the output and positive and negative power-supply rails.

■ APPLICATION INFORMATION

The UTC **OPA2336** is a CMOS operational amplifier, its outstanding features and functions make it suitable for several applications. The UTC **OPA2336** is unity-gain stable and can be protected under the reverse battery voltages conditions. 0.01μF ceramic capacitors are required to bypass the power supply.

OPERATING VOLTAGE

The UTC **OPA2336** is operating on a single supply ranging from 2.1V to +5.5V, most behavior remains unchanged throughout the full operating voltage range. The UTC **OPA2336** is fully specified for operation from +2.3V to +5.5V; a single limit applies over the supply range. Moreover, this device performs well over a temperature range of -40°C to +85°C.

INPUT VOLTAGE

The UTC **OPA2336** allows input common-mode range varies from (V-)-0.2V to (V+)-1V, normal behaviors should operate within this range. In addition, the absolute maximum input voltage is 300mV beyond the supplies. Thus, inputs greater than the input common-mode range but less than maximum input voltage, while not valid, will not cause any damage to the op-amp.

Normally, input bias current is approximately 1pA. However, the input pin may be applied to an excess inrush current, which is encountered when input voltages are higher than the power supplies. This device is not damaged unless the current on the input pins is less than 10mA. This is easily accomplished with an input resistor, as shown in **Figure 1**.

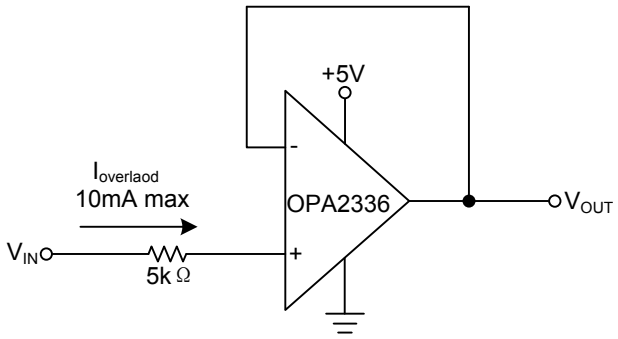


Figure 1. Input Current Protection for Voltages Exceeding the Supply Voltage

CAPACITIVE LOAD AND STABILITY

The UTC **OPA2336** under certain conditions may become unstable. For device's stability, there are many factors considered besides the amplifier gain, load value and so on.

The UTC **OPA2336** can drive a wide range of capacitive loads, it can drive approximately 10,000pF when properly configured. An op amp in unity-gain configuration is the most vulnerable to capacitive load. The capacitive load reacts with the op amp's output resistance, along with any additional load resistance, to create a pole in the response which degrades the phase margin. In unity gain, 300pF capacitive load is to be optimal for the UTC **OPA2336**. Increasing gain enhances the amplifier's ability to drive loads beyond this level.

In order to improve capability of driving capacitive load in the unity-gain configuration, a 50Ω to 100Ω resistor is expected to locate inside the feedback loop, as shown in **Figure 2**. This reduces ringing with large capacitive loads while maintaining DC accuracy.

■ APPLICATION INFORMATION (Cont.)

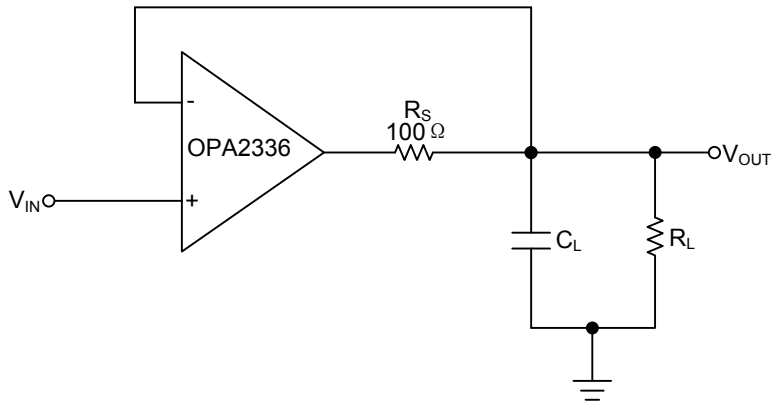


Figure 2. Series Resistor in Unity-Gain Configuration
Improves Capacitive Load Drive

The resistor can be also located in series with the output outside of the feedback loop, if paralleling a resistive load to the capacitive load, a voltage divider is generated with it. This introduces a Direct Current (DC) error at the output, however, this error may be insignificant. For instance, with R_L= 100kΩand R_S= 100Ω, there is only about a 0.1% error at the output.

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