

10MHz, Rail-to-Rail I/O CMOS Operational Amplifier

1 FEATURES

- **High Gain Bandwidth: 10MHz**
- **Rail-to-Rail Input and Output**
1mV Typical Vos
- **Input Voltage Range: -0.1V to +5.6V**
with Vs = 5.5V
- **Supply Range: +2.5V to +5.5V**
- **Specified Up to +125°C**
- **Micro Size Packages: SOT23-5**

2 APPLICATIONS

- **Sensors**
- **Photodiode Amplification**
- **Active Filters**
- **Test Equipment**
- **Driving A/D Converters**

3 DESCRIPTIONS

The RES6012IUR offer low voltage operation and rail-to-rail input and output, as well as excellent speed/power consumption ratio, providing an excellent bandwidth (10MHz) and slew rate of 7V/ μ s. The op-amps are unity gain stable and feature an ultra-low input bias current.

The devices are ideal for sensor interfaces, active filters and portable applications. The RES6012IUR is specified at the full temperature range of -40°C to $+125^{\circ}\text{C}$ under single supplies of 2.5V to 5.5V or dual power supplies of $\pm 1.25\text{V}$ to $\pm 2.75\text{V}$.

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RES6012IUR	SOT23-5	2.10mm×1.25mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

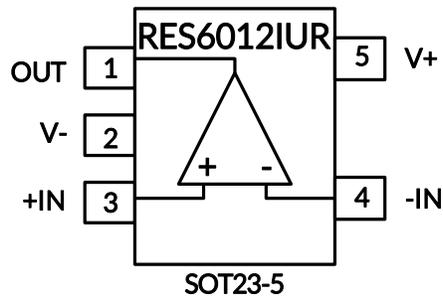
5 PACKAGE/ORDERING INFORMATION ⁽¹⁾

Orderable Device	Temperature Range	Package Lead	Package Marking ⁽²⁾	MSL ⁽³⁾	Package Qty
RES6012IUR	-40°C ~125°C	SOT23-5	RES6012IUR	MSL3	Tape and Reel, 3000

NOTE:

- (1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.
- (2) There may be additional marking, which relates to the lot trace code information(data code and vendor code), the logo or the environmental category on the device.

6 PIN CONFIGURATION AND FUNCTIONS



Pin Description

NAME	PIN	I/O ⁽¹⁾	DESCRIPTION
	SOT23-5		
-IN	4	I	Negative (inverting) input
+IN	3	I	Positive (noninverting) input
OUT	1	O	Output
V-	2	-	Negative (lowest) power supply
V+	5	-	Positive (highest) power supply

(1) I = Input, O = Output.

7 SPECIFICATIONS

7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

		MIN	MAX	UNIT
Voltage	Supply Voltage, V+ to V-		7	V
	Input Terminals ⁽²⁾	-0.5	(V+) +0.5	
Current	Input Terminals ⁽²⁾	-10	10	mA
θ_{JA}	Package thermal impedance ⁽³⁾	SC70-5	380	°C/W
Temperature	Operating, T _A	-40	125	°C
	Junction, T _J ⁽⁴⁾		150	
	Storage, T _{stg}	-65	150	
	Lead Temperature (Soldering, 10s)		260	

(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 implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

(3) The package thermal impedance is calculated in accordance with JESD-51.

(4) The maximum power dissipation is a function of T_{J(MAX)}, R_{θJA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

7.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-Body Model (HBM)	±3000
		Machine Model (MM)	±200



ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

7.3 Electrical Characteristics

(At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, and $V_{OUT} = V_S/2$, Full ⁽⁹⁾ = -40°C to $+125^\circ\text{C}$, unless otherwise noted.) ⁽¹⁾

PARAMETER		CONDITIONS	T_J	RES6012IUR			UNIT
				MIN ⁽²⁾	TYP ⁽³⁾	MAX ⁽²⁾	
POWER SUPPLY							
V_S	Operating Voltage Range		25°C	2.5		5.5	V
I_Q	Quiescent Current Per Amplifier		25°C		1.15	1.55	mA
PSRR	Power-Supply Rejection Ratio	$V_S = 2.5\text{V to } 5.5\text{V}$, $V_{CM} = (V_-) + 0.5\text{V}$	25°C	77	90		dB
			Full	68			
INPUT							
V_{OS}	Input Offset Voltage	$V_{CM} = 2.5\text{V}$	25°C		± 1	± 3	mV
$V_{OS\ TC}$	Input Offset Voltage Average Drift		Full		2.6		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current ^{(4) (5)}		25°C		1	10	pA
I_{OS}	Input Offset Current ⁽⁵⁾		25°C		1	10	pA
V_{CM}	Common-Mode Voltage Range	$V_S = 5.5\text{V}$	25°C	-0.1		5.6	V
CMRR	Common-Mode Rejection Ratio	$V_S = 5.5\text{V}$, $V_{CM} = -0.1\text{V to } 4\text{V}$	25°C	77	90		dB
			Full	70			
			25°C	63	80		
			Full	60			
OUTPUT							
A_{OL}	Open-Loop Voltage Gain	$R_L = 2\text{k}\Omega$, $V_O = 0.15\text{V to } 4.85\text{V}$	25°C	96	105		dB
			Full	75			
			25°C	100	110		
			Full	77			
	Output Swing from Rail	$R_L = 2\text{k}\Omega$ $R_L = 10\text{k}\Omega$	25°C		52		mV
					7		
I_{OUT}	Output Short-Circuit Current ^{(6) (7)}		25°C		150		mA
FREQUENCY RESPONSE							
SR	Slew Rate ⁽⁸⁾		25°C		7		$\text{V}/\mu\text{s}$
GBP	Gain-Bandwidth Product		25°C		10		MHz
PM	Phase Margin ⁽⁵⁾		25°C		62		$^\circ$
t_s	Settling Time, 0.1%				0.2		μs
	Overload Recovery Time	$V_{IN} \cdot \text{Gain} \geq V_S$			0.35		μs
NOISE							
e_n	Input-Referred Voltage Noise	$f = 1\text{KHz}$	25°C		9.5		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 10\text{KHz}$	25°C		6.5		$\text{nV}/\sqrt{\text{Hz}}$

NOTE:

- (1) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device.
- (2) Limits are 100% production tested at 25°C . Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- (3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.
- (4) Positive current corresponds to current flowing into the device.
- (5) This parameter is ensured by design and/or characterization and is not tested in production.
- (6) The maximum power dissipation is a function of $T_{J(\text{MAX})}$, $R_{\theta JA}$, and T_A . The maximum allowable power dissipation at any ambient temperature is $PD = (T_{J(\text{MAX})} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.
- (7) Short circuit test is a momentary test.
- (8) Number specified is the slower of positive and negative slew rates.
- (9) Specified by characterization only.

7.4 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.

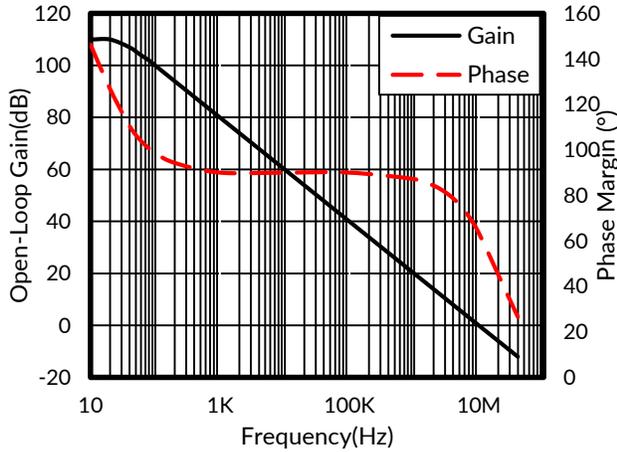


Figure 1. Open-Loop Gain And Phase vs Frequency

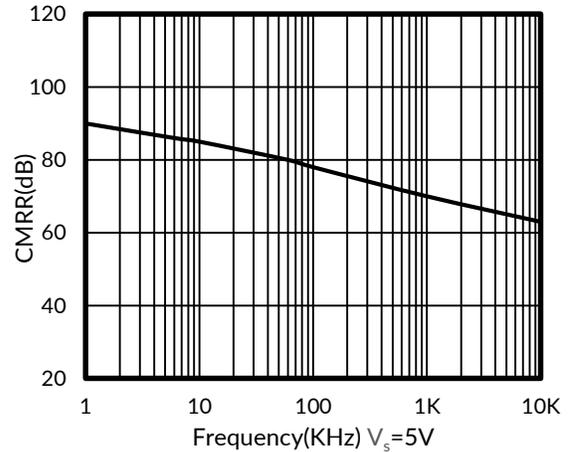


Figure 2. Common-Mode Rejection Ratio vs Frequency

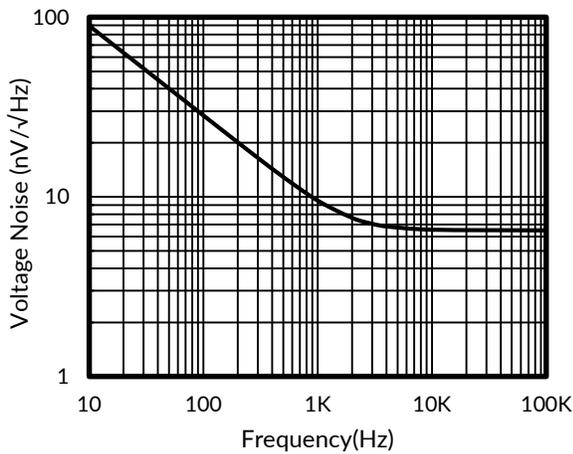


Figure 3. Input Voltage Noise Spectral Density vs Frequency

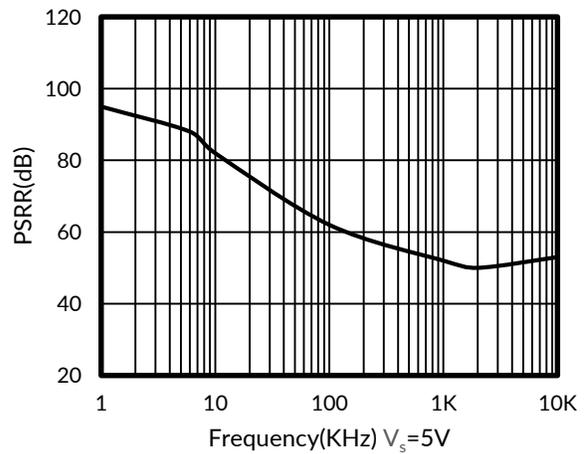


Figure 4. Power-Supply Rejection Ratio vs Frequency

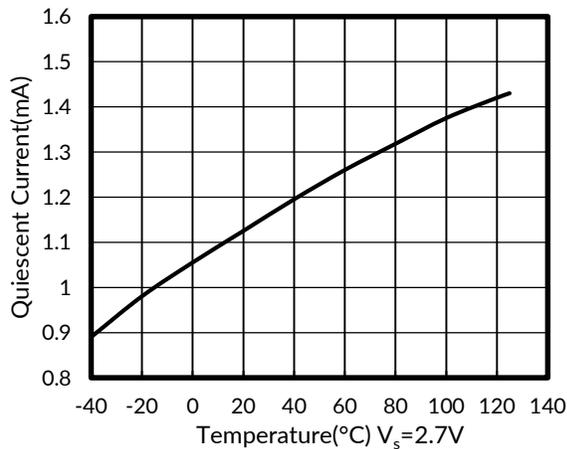


Figure 5. Quiescent Current Vs Temperature

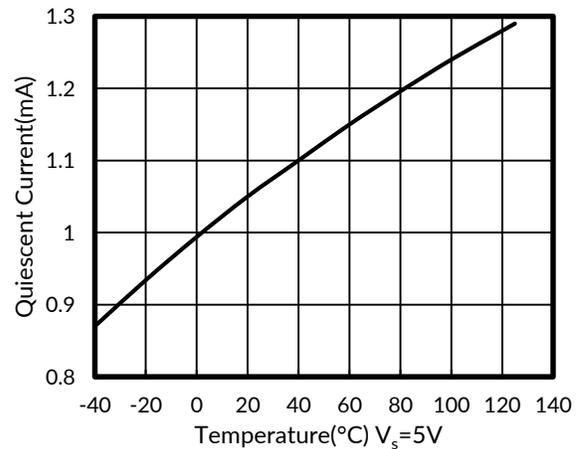


Figure 6. Quiescent Current Vs Temperature

Typical Characteristics

NOTE: The graphs and tables following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $R_L = 10\text{k}\Omega$ connected to $V_S/2$, $V_{OUT} = V_S/2$, unless otherwise noted.

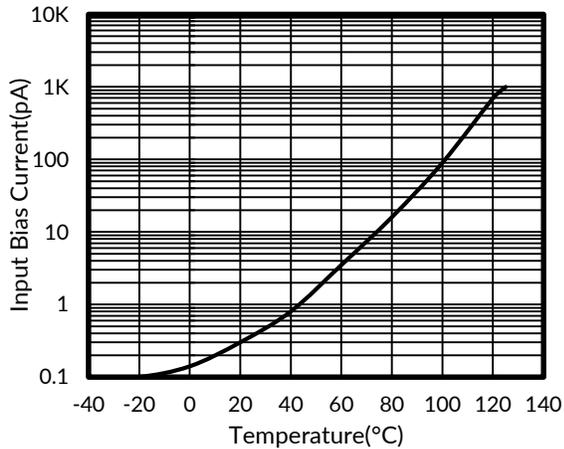


Figure 7. Input Bias Current vs Temperature

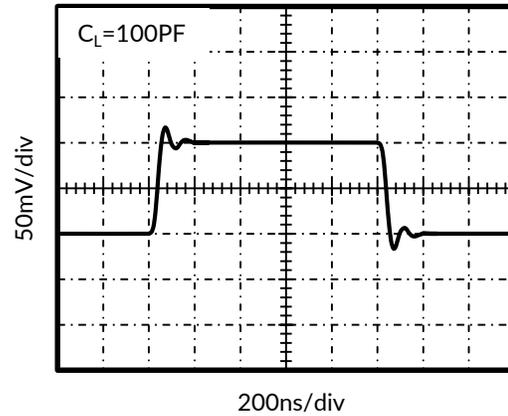


Figure 8. Small-Signal Step Response

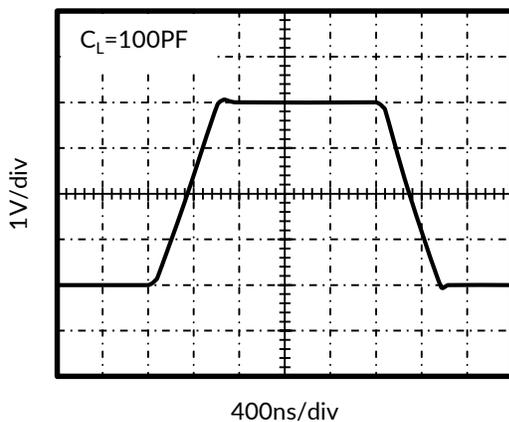


Figure 9. Large-Signal Step Response

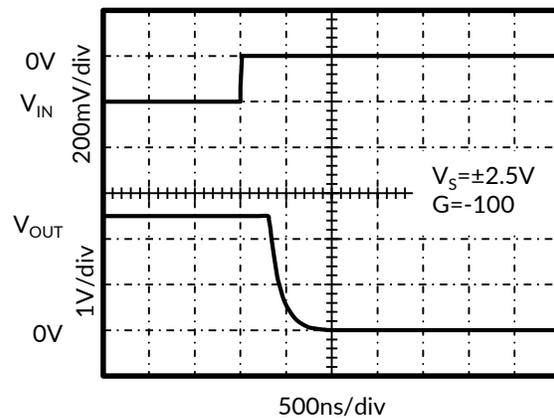


Figure 10. Positive Overload Recovery

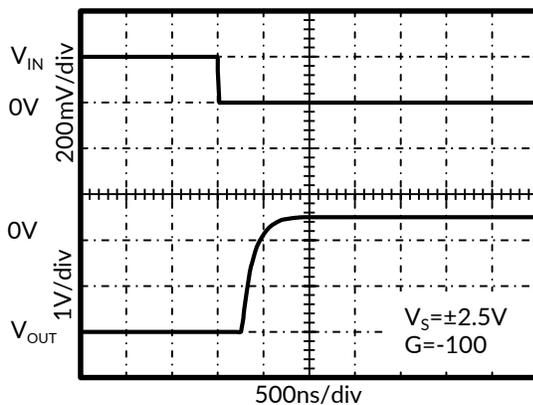
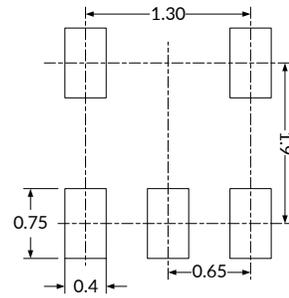
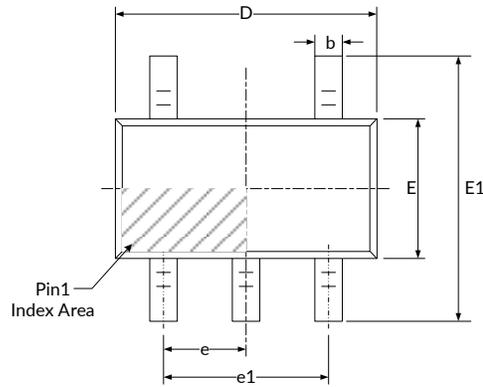


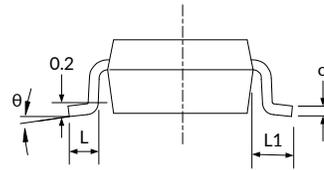
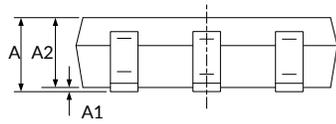
Figure 11. Negative Overload Recovery

8 PACKAGE OUTLINE DIMENSIONS

SOT23-5⁽³⁾



RECOMMENDED LAND PATTERN (Unit: mm)



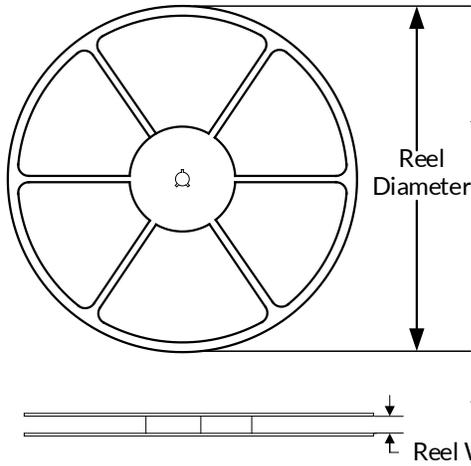
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A ⁽¹⁾	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D ⁽¹⁾	2.000	2.200	0.079	0.087
E ⁽¹⁾	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650(BSC) ⁽²⁾		0.026(BSC) ⁽²⁾	
e1	1.300(BSC) ⁽²⁾		0.051(BSC) ⁽²⁾	
L	0.260	0.460	0.010	0.018
L1	0.525		0.021	
θ	0°	8°	0°	8°

NOTE:

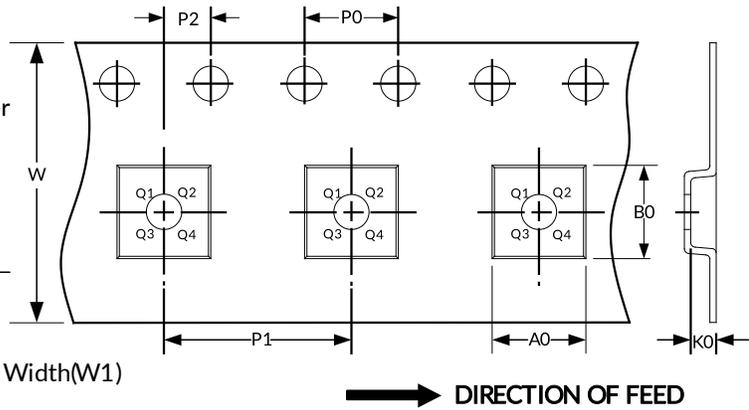
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

9 TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT23-5	7"	9.5	2.25	2.55	1.20	4.0	4.0	2.0	8.0	Q3

NOTE:

1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.