

36V, Low-Power Quad-Operational Amplifier

FEATURES

- Voltage Gain: 100dB (Typ)
- Input Bias Current: 20nA (Typ)
- Input Offset Voltage: 2mV (Typ)
- Low Supply Current: 0.6mA (Typ)
- Wide Power Supply Voltage: 3V to 36V or $\pm 1.5V$ to $\pm 18V$
- Large Output Voltage Swing: (V-) to (V+) -1.5V
- Input Common Mode Voltage Range include GND/(V-)

PRODUCT DESCRIPTION

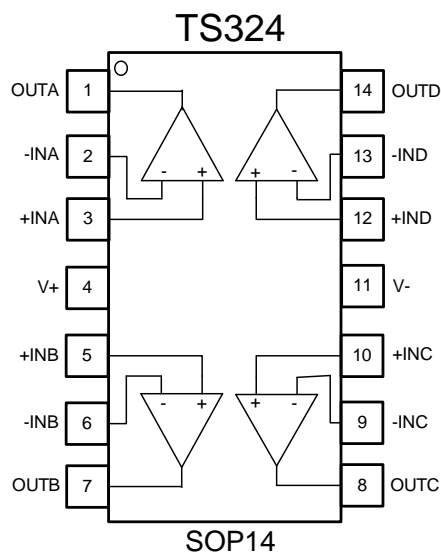
The TS324 consists of four independent, high gain and internally frequency compensated operational amplifiers. These quad operational amplifiers feature low power consumption, a common mode input voltage range extending to ground/(V-), and single supply or split supply operation. They can operate at supply voltages as low as 3.0V or as high as 36V. The common mode input range includes the negative supply which eliminates the necessity for external biasing. The output voltage range also includes the negative power supply voltage.

APPLICATIONS

- Signal Conditioning
- Sensor Interface
- Medical/Industrial Instrumentation
- Power Converter/Inverter

The TS324 is specified at the full temperature range of -40°C to $+125^{\circ}\text{C}$ and available in Green SOP14 packages.

PIN ASSIGNMENTS



ORDERING INFORMATION

Model	Part Number	Eco Plan	Package	Container, Pack Qty
TS324	TS324SOP14R	RoHS	SOP14	Reel, 2500

ABSOLUTE MAXIMUM RATINGS

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

Parameter	Min	Max	Unit
Supply Voltage		40	V
Signal Input Terminal Voltage	(V-) - 0.5	(V+) + 0.5	V
Operating Temperature	-40	150	°C
Junction Temperature		150	°C
Storage Temperature Range	-65	150	°C
Lead Temperature (Soldering, 10s)		260	°C
ESD MM		100	V
ESC CDM		1500	V

- (1) Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION



ESD (electrostatic discharge) sensitive device

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjects to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

ELECTRICAL CHARACTERISTICS

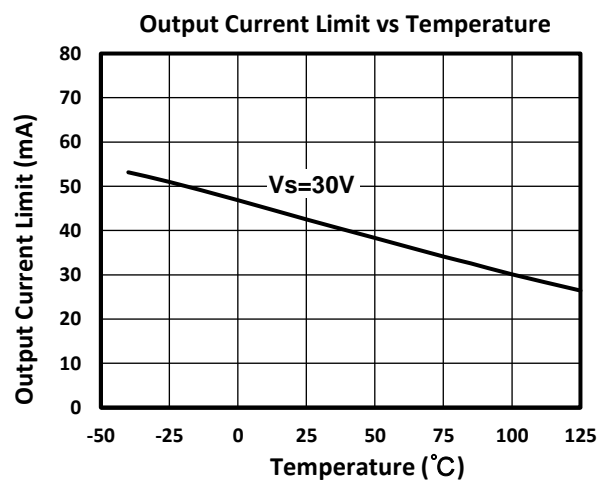
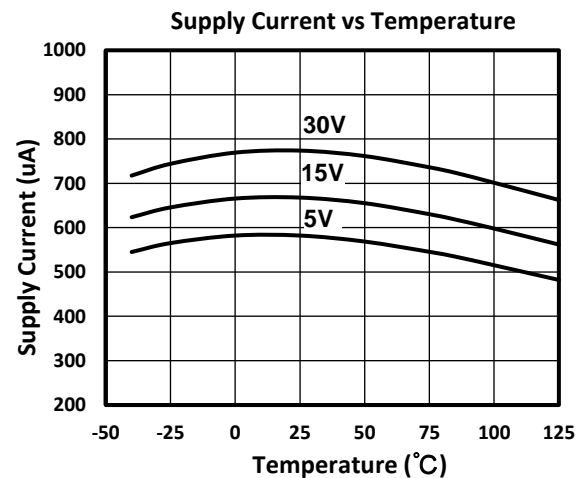
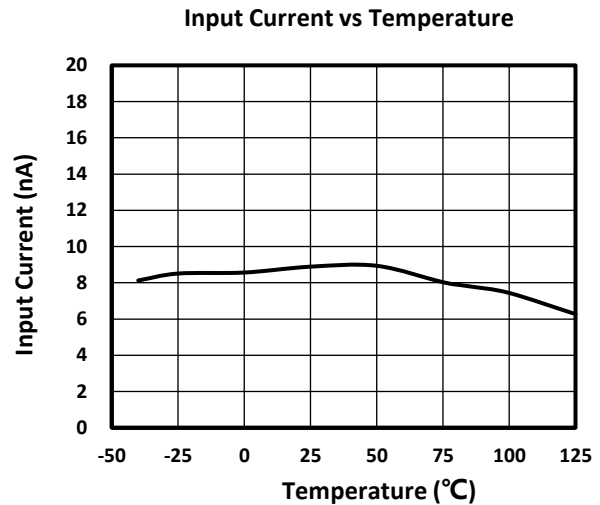
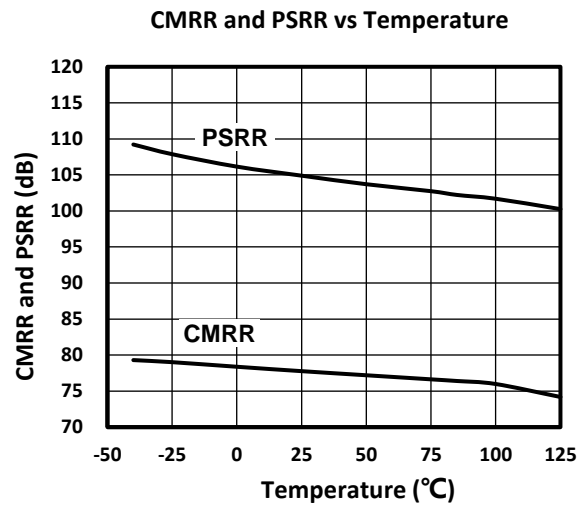
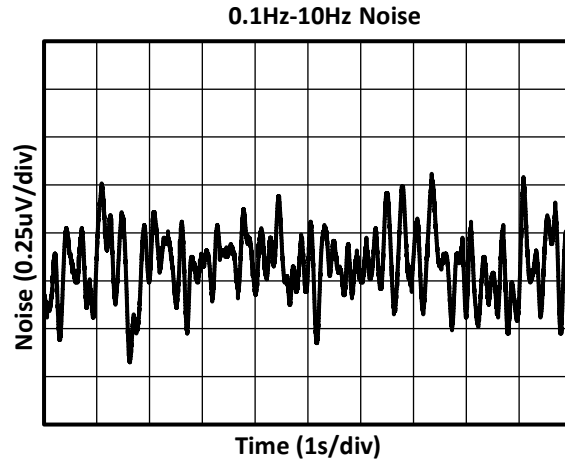
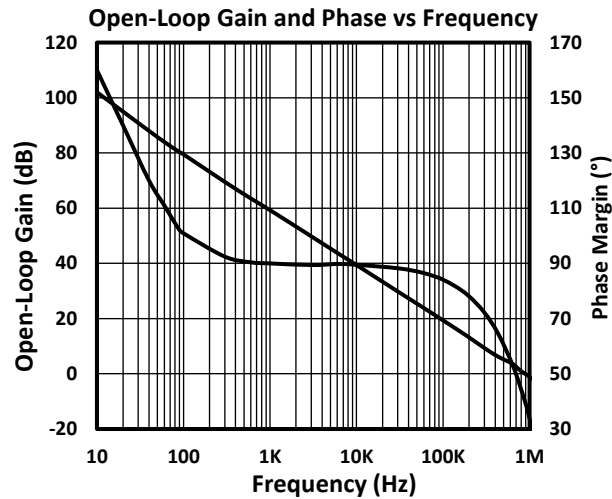
Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$.

At $T_A = +25^{\circ}\text{C}$, $V_S = 5\text{V}$ (unless otherwise noted)

Parameter			Operating Conditions		Min	Typ	Max	Unit
V _S	Power Supply Voltage				3		36	V
I _S	Supply Current		I _O = 0mA	V _S = 30V		0.8	3	mA
				V _S = 5V		0.6	1.2	mA
PSRR	Power Supply Rejection Ratio		V _S = 5V to 30V, V _{CM} = V _O = 1.4V		70	100		dB
			T _A = -40°C to +125°C		60			dB
Input Characteristics								
V _{OS}	Input Offset Voltage		V _S = 5V to 30V, V _O = 1.4V, R _S = 0Ω			2	5	mV
			T _A = -40°C to +125°C				7	mV
dV _{OS} /dT	Average Drift		V _S = 5V to 30V, V _O = 1.4V, R _S = 0Ω			7		μV/°C
I _B	Input Bias Current		I _{IN+} or I _{IN-} , V _{CM} = 0V			20	100	nA
			T _A = -40°C to +125°C				200	nA
I _{OS}	Input Offset Current		I _{IN+} - I _{IN-} , V _{CM} = 0V			5	30	nA
			T _A = -40°C to +125°C				100	nA
V _{IN +/-}	Input Voltage Range				(V-)		(V+) -1.5	V
CMRR	Common Mode Rejection Ratio		(V-) < V _{CM} < (V+) -1.5V		60	70		dB
			T _A = -40°C to +125°C		60			dB
AOL	Open-Loop Voltage Gain		Vs = 15V, R _L ≥ 2kΩ, 1V < V _{out} < 11V		85	100		dB
			T _A = -40°C to +125°C		80			dB
Output Characteristics								
V _{OH}	Output Voltage Swing from Rail		Vs = 30V, R _L = 2kΩ		26			V
			T _A = -40°C to +125°C		26			V
			Vs = 30V, R _L = 10kΩ		27	28		V
			T _A = -40°C to +125°C		27			V
V _{OL}	Output Voltage		Vs = 5V, R _L = 10kΩ			5	20	mV
			T _A = -40°C to +125°C				30	mV
I _{OUT}	Output Current	Source	V _{IN+} = 1V, V _{IN-} = 0V, V _S = 15V, V _O = 2V		20	40		mA
		Sink	V _{IN+} = 0V, V _{IN-} = 1V, V _S = 15V, V _O = 2V		10	15		mA
			V _{IN+} = 0V, V _{IN-} = 1V, V _S = 15V, V _O = 0.2V		12	50		uA
I _{SC}	Short Circuit Current		V _S = 15V, V _{out} = 0V			40	60	mA
Dynamic Performance								
GBW	Gain Bandwidth Product					1		MHz
SR	Slew Rate		G = +1			0.25		V/μs
V _{noise}	Input Voltage Noise		f = 0.1Hz to 10Hz			1.5		μVpp
Temperature Range								
θ _{JA}	Specified Range				-40		+125	°C
	Operating Range				-55		+150	°C
	Storage Range				-65		+150	°C
	SOP14					91		°C/W

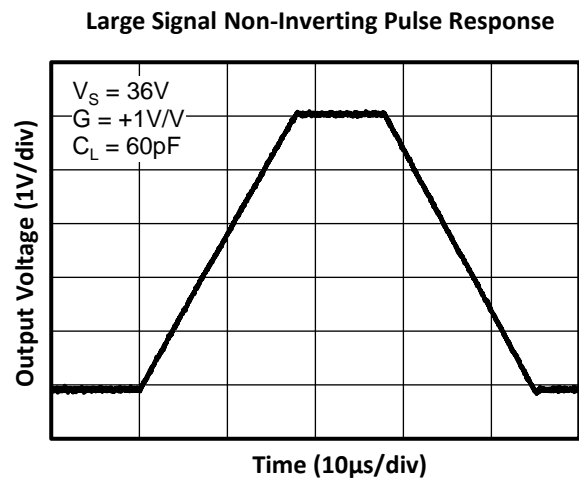
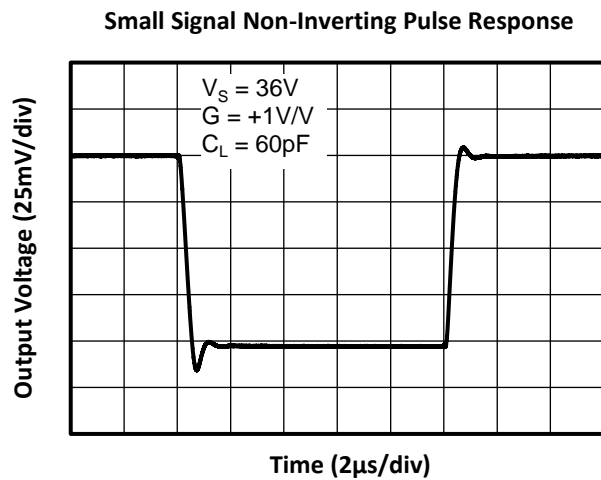
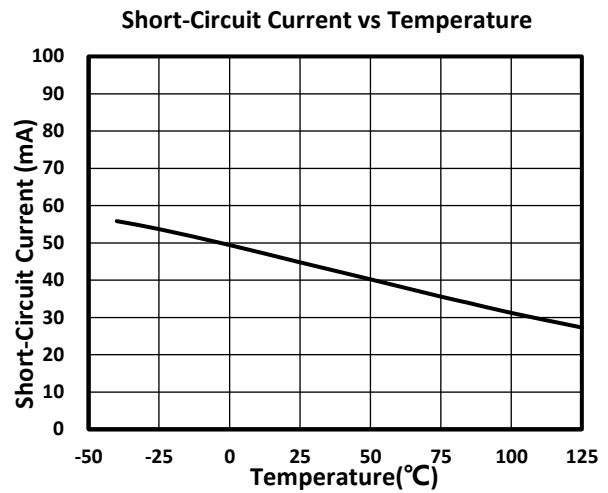
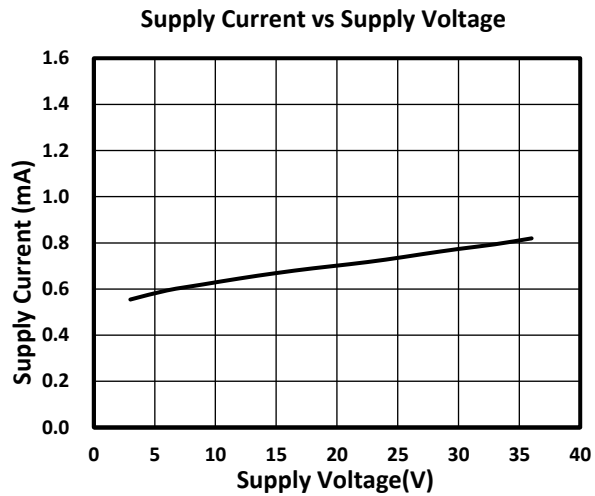
TYPICAL CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{k}\Omega$ connected to GND, and $V_{OUT} = 1.4\text{V}$ (unless otherwise noted)



TYPICAL CHARACTERISTICS (CONTINUE)

At $T_A = +25^\circ\text{C}$, $R_L = 10\text{k}\Omega$ connected to GND, and $V_{OUT} = 1.4\text{V}$ (unless otherwise noted)



TYPICAL APPLICATION

Two-Pole Micro-Power Sallen-Key Low-Pass Filter

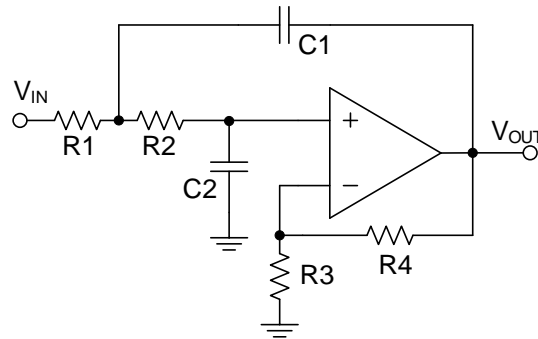


Figure 1

Figure 1 shows a micro-power two-pole Sallen-Key Low-Pass Filter. For best results, the filter's cut-off frequency should be 8 to 10 times lower than the OPA's crossover frequency. Additional OPA's phase margin shift can be avoided if the OPA's bandwidth-to-signal ratio is greater than 8.

Inverting Amplifier

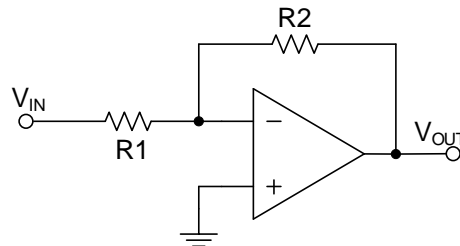
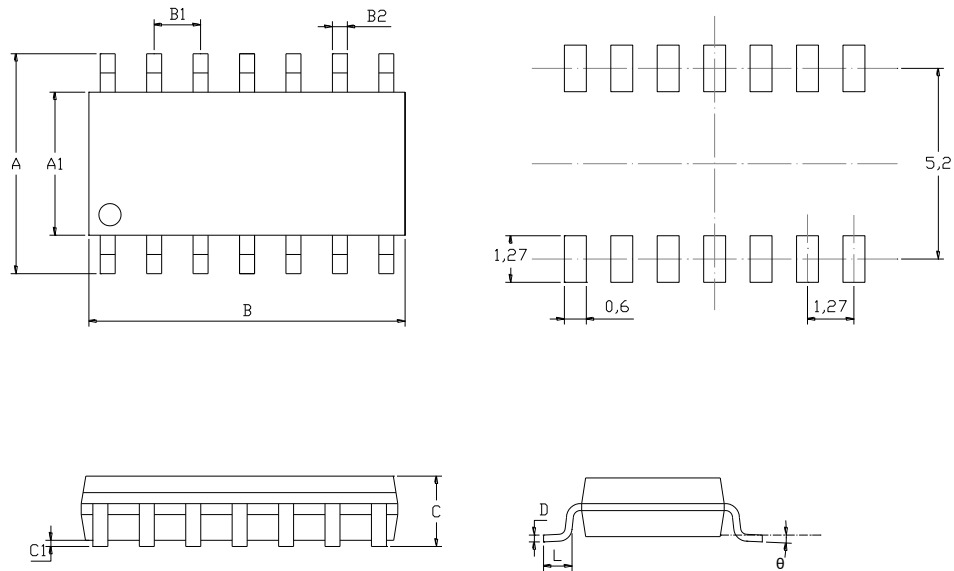


Figure 2

A typical application for an operational amplifier is an inverting amplifier. This amplifier takes a positive voltage on the input, and makes it a negative voltage of the same magnitude. In the same manner, it also makes negative voltages positive.

MECHANICAL DIMENSIONS

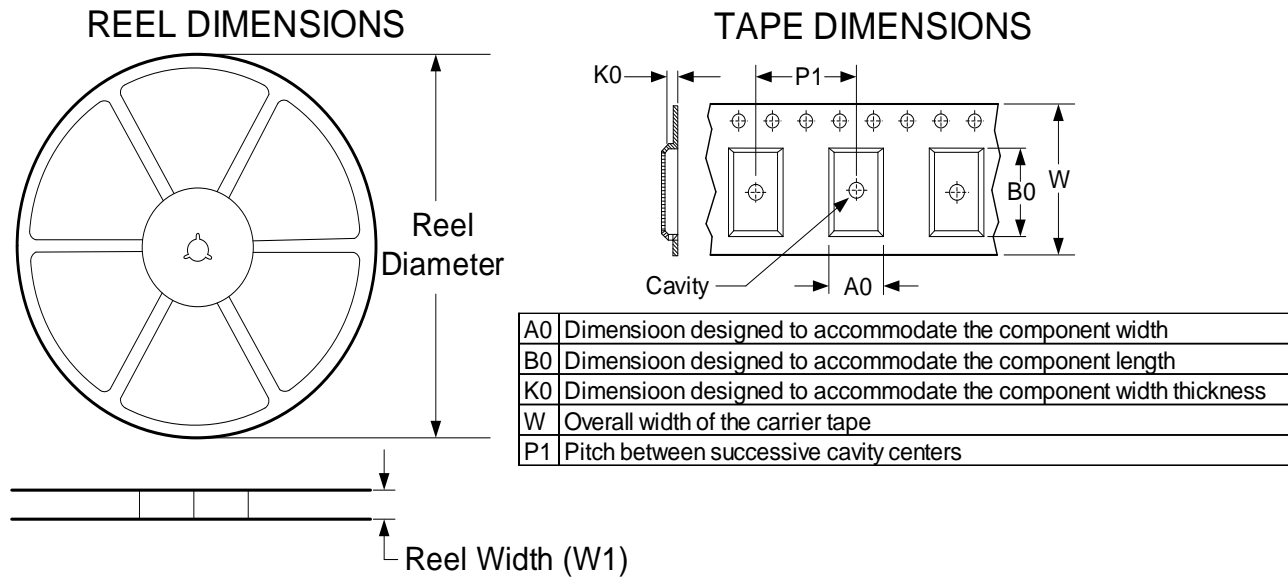
SOP14 PACKAGE MECHANICAL DRAWING



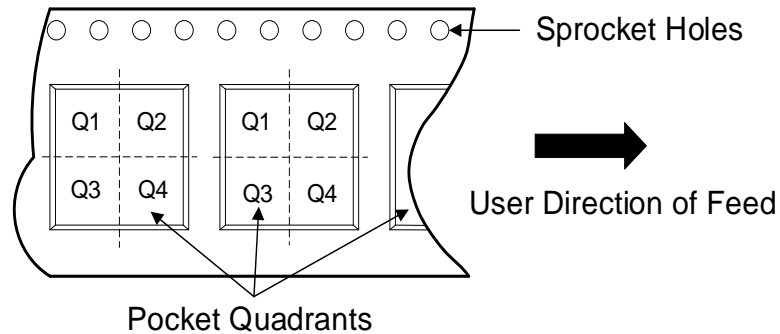
SOP14 PACKAGE MECHANICAL DATA

symbol	dimensions			
	millimeters		inches	
	min	max	min	max
A	5.800	6.200	0.228	0.244
A1	3.800	4.000	0.150	0.157
B	8.450	8.850	0.333	0.348
B1	1.270		0.050	
B2	0.310	0.510	0.012	0.020
C		1.750		0.069
C1	0.100	0.250	0.004	0.010
L	0.400	1.270	0.016	0.050
D	0.100	0.250	0.004	0.010
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS324SOP14R	SOP14	14	2500	330.0	21.6	6.5	9	2.1	8	16	Q1

REVISION HISTORY

NOTE: Page numbers for previous revisions may be different from that of the current version.

CONTACT INFORMATION

Trusignal Microelectronics

Phone: +86 512-65923982

Fax: +86 512-65923995

Email: support@kunyuanic.com; sales@kuyuanic.com