Features

- **Single-Supply Operation from +2.1V ~ +5.5V**
- **Rail-to-Rail Input / Output**
- **Gain-Bandwidth Product: 1MHz (Typ)**
- **Low Input Bias Current: 1pA (Typ)**
- **Low Offset Voltage: 3.5mV (Max)**
- **Quiescent Current: 60μA per Amplifier (Typ)**
- **Operating Temperature: -40°C ~ +125°C**
- **Embedded RF Anti-EMI Filter**
- **Small Package:**

Available in Green TQFN-3×3-16L Package

General Description

The GS3130 have a high gain-bandwidth product of 1MHz, a slew rate of 0.6V/μs, and a quiescent current of 60μA/amplifier at 5V. The GS3130 is designed to provide optimal performance in low voltage and low noise systems. They provide rail-to-rail output swing into heavy loads. The input common mode voltage range includes ground, and has the positive offset voltage; the maximum input offset voltage is 3.5mV for GS3130. They are specified over the extended industrial temperature range (-40℃ to +125℃). The operating range is from 2.1V to 5.5V. The GS3130 Quad is available in Green TQFN-3×3-16L Package.

Applications

- ASIC Input or Output Amplifier
- Sensor Interface
- Medical Communication
- Smoke Detectors
- Audio Output
- Piezoelectric Transducer Amplifier
- Medical Instrumentation
- Portable Systems

Pin Configuration

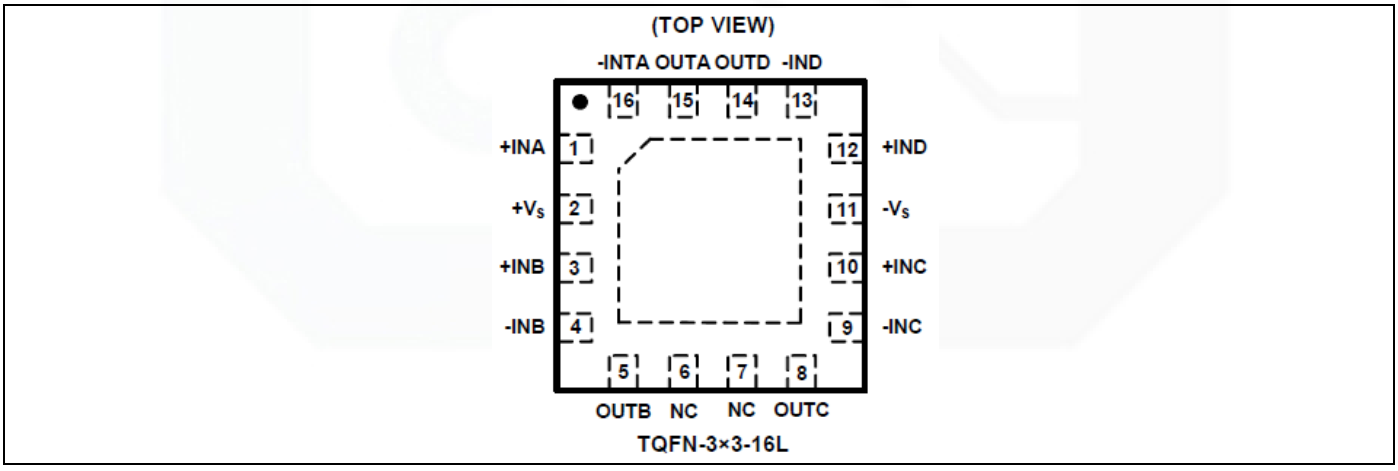


Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to Vss)	-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)	Vss-0.5V	V_{DD}+0.5V
PDB Input Voltage	Vss-0.5V	+7V
Operating Temperature Range	-40°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°C	
ESD Susceptibility		
HBM	6KV	
MM	300V	

Note: Stress greater than 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 outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Package/Ordering Information

MODEL	CHANNEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
GS3130	Quad	GS3130-FR	TQFN-3×3-16L	Tape and Reel,3000	GS3130

Electrical Characteristics

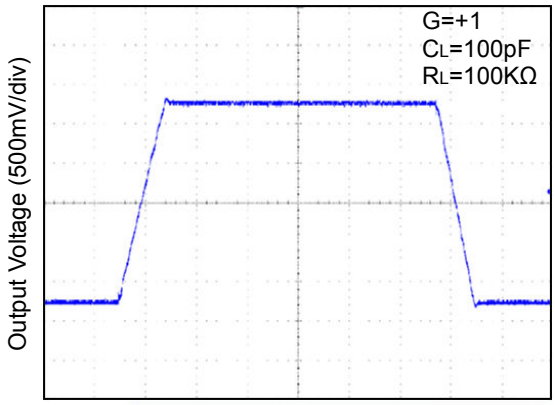
(At V_S = +5V, R_L = 100kΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	GS3130				
			TYP	MIN/MAX OVER TEMPERATURE			
			+25℃	+25℃	-40℃ to +85℃	UNITS	MIN/MAX
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	V_{CM} = V_S/2	1	3.5	5.6	mV	MAX
Input Bias Current	I_B		1			pA	TYP
Input Offset Current	I_{OS}		1			pA	TYP
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1 to +5.6			V	TYP
Common-Mode Rejection Ratio	CMRR	V_S = 5.5V, V_{CM} = -0.1V to 4V	70	62	62	dB	MIN
		V_S = 5.5V, V_{CM} = -0.1V to 5.6V	68	56	55		
Open-Loop Voltage Gain	A_{OL}	R_L = 5kΩ, V_O = +0.1V to +4.9V	80	70	70	dB	MIN
		R_L = 10kΩ, V_O = +0.1V to +4.9V	100	94	85		
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta_T$		2.7			μV/℃	TYP
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OH}	R_L = 100kΩ	4.997	4.990	4.980	V	MIN
	V_{OL}	R_L = 100kΩ	3	10	20	mV	MAX
	V_{OH}	R_L = 10kΩ	4.992	4.970	4.960	V	MIN
	V_{OL}	R_L = 10kΩ	8	30	40	mV	MAX
Output Current	I_{SOURCE}	R_L = 10Ω to V_S/2	84	60	45	mA	MIN
	I_{SINK}		75	60	45		
POWER SUPPLY							
Operating Voltage Range				2.1	2.5	V	MIN
				5.5	5.5	V	MAX
Power Supply Rejection Ratio	PSRR	V_S = +2.5V to +5.5V, V_{CM} = +0.5V	82	60	58	dB	MIN
Quiescent Current / Amplifier	I_Q		60	90	120	μA	MAX
DYNAMIC PERFORMANCE (CL = 100pF)							
Gain-Bandwidth Product	GBP		1			MHz	TYP
Slew Rate	SR	G = +1, 2V Output Step	0.6			V/μs	TYP
Settling Time to 0.1%	t_S	G = +1, 2V Output Step	5			μs	TYP
Overload Recovery Time		V_{IN} ·Gain = V_S	2.6			μs	TYP
NOISE PERFORMANCE							
Voltage Noise Density	e_n	f = 1kHz	27			$nV/\sqrt{Hz}$	TYP
		f = 10kHz	20			$nV/\sqrt{Hz}$	TYP

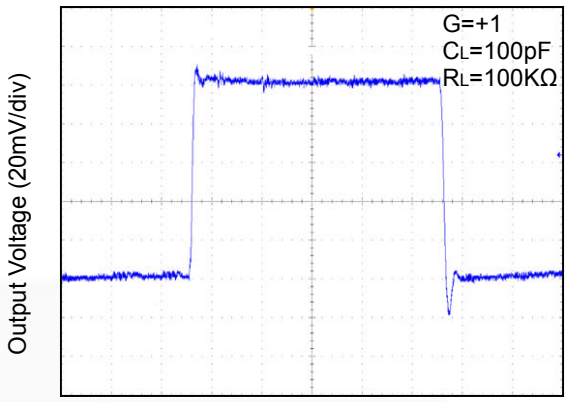
Typical Performance characteristics

At T_A=+25°C, V_S=+5V, and R_L=100KΩ connected to V_S/2, unless otherwise noted.

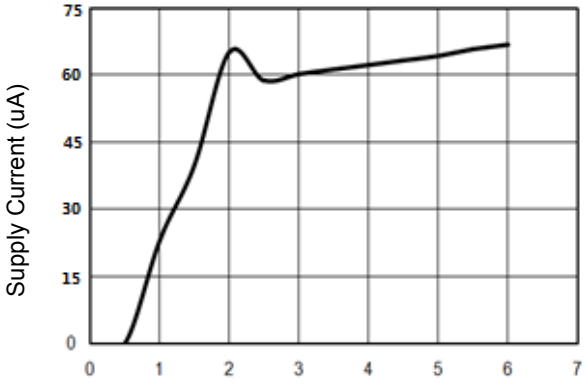
Large-Signal Step Response



Small-Signal Step Response

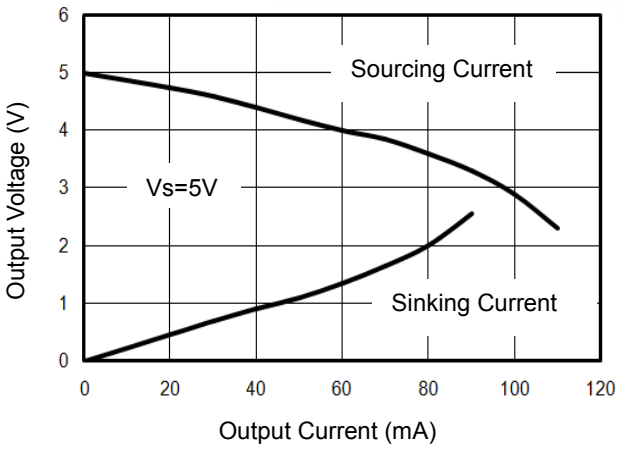


Supply Current vs. Supply Voltage

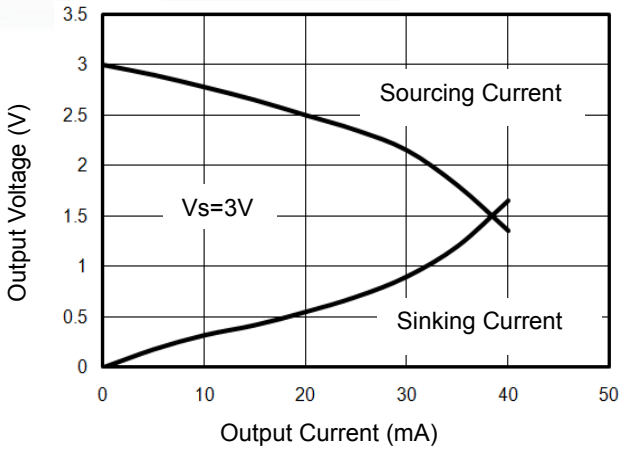


Short-Circuit Current vs. Supply Voltage

Output Voltage vs. Output Current



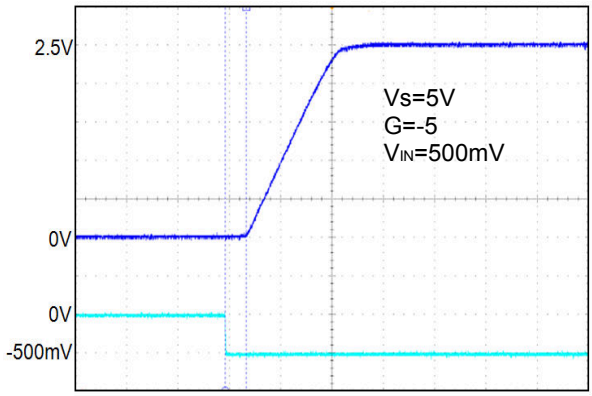
Output Voltage vs. Output Current



Typical Performance characteristics

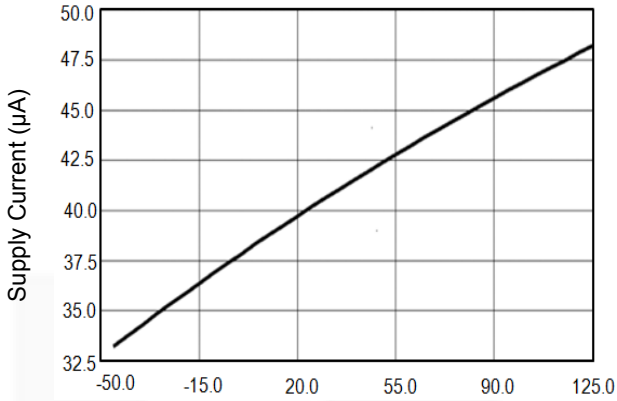
At T_A=+25°C, V_S=+5V, and R_L=100KΩ connected to V_S/2, unless otherwise noted.

Overload Recovery Time

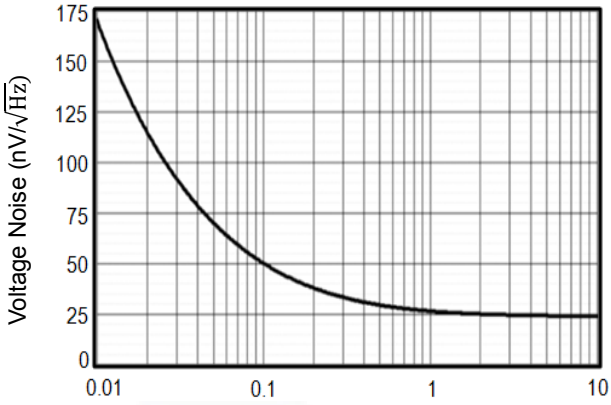


Time (2μs/div)

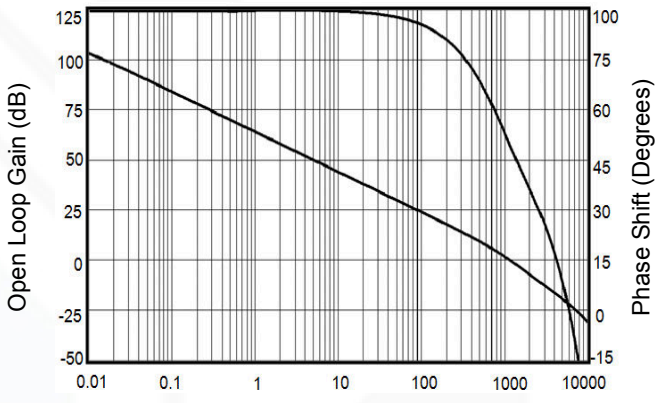
Supply Current vs. Temperature



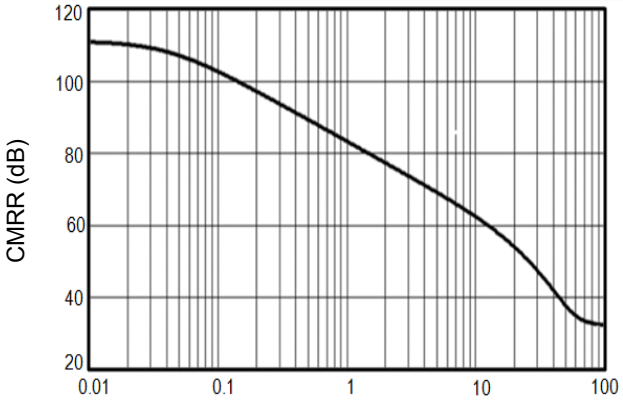
Input Voltage Noise Spectral Density vs. Frequency



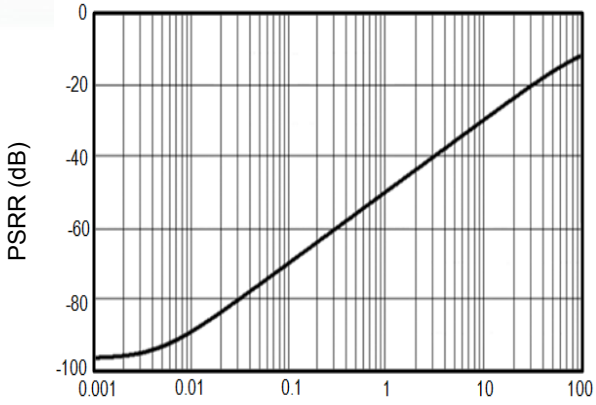
Open Loop Gain, Phase Shift vs. Frequency at +5V



CMRR vs. Frequency



PSRR vs. Frequency



Application Note

Size

GS3130 op amp is unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the GS3130 package save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

GS3130 operates from a single 2.1V to 5.5V supply or dual ±1.05V to ±2.75V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 60uA per channel) of GS3130 will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

GS3130 operates under wide input supply voltage (2.1V to 5.5V). In addition, all temperature specifications apply from -40°C to +125°C. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime.

Rail-to-Rail Input

The input common-mode range of GS3130 extend 100mV beyond the supply rails (V_{SS}-0.1V to V_{DD}+0.1V). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

Rail-to-Rail Output

Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important when operating in low supply voltages. The output voltage of GS3130 can typically swing to less than 5mV from supply rail in light resistive loads (>100kΩ), and 30mV of supply rail in moderate resistive loads (10kΩ).

Capacitive Load Tolerance

The GS3130 is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier's feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier's output and the load capacitance and (2) reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain. Figure 2. shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

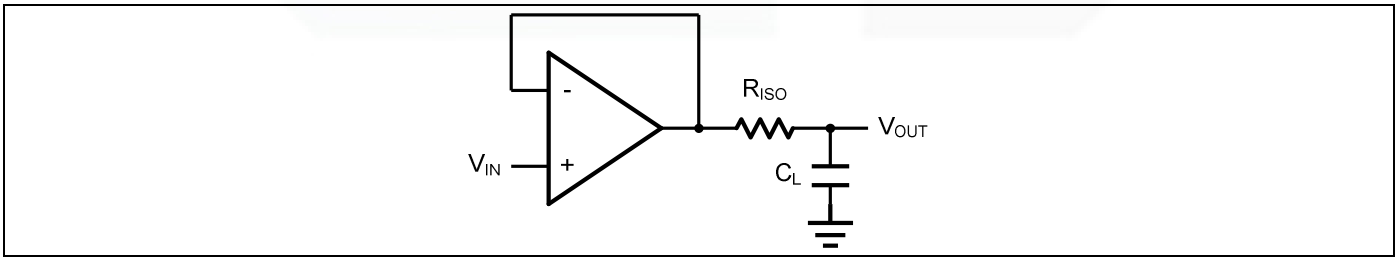


Figure 2. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. However, if there is a resistive load R_L in parallel with the capacitive load, a voltage divider (proportional to R_{ISO}/R_L) is formed, this will result in a gain error.

The circuit in Figure 3 is an improvement to the one in Figure 2. R_F provides the DC accuracy by feed-forward the V_{IN} to R_L. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of C_F. This in turn will slow down the pulse response.

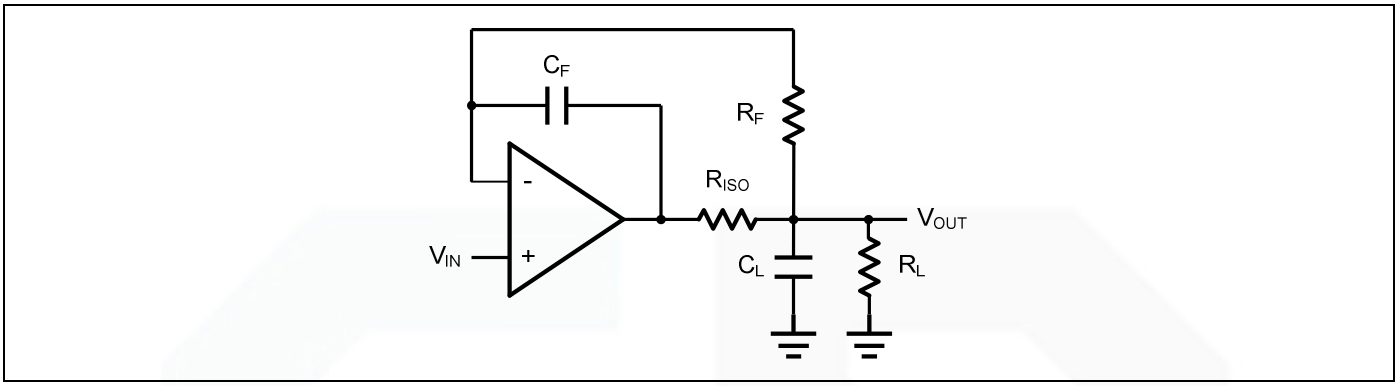


Figure 3. Indirectly Driving a Capacitive Load with DC Accuracy

Typical Application Circuits

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 4. shown the differential amplifier using GS3130.

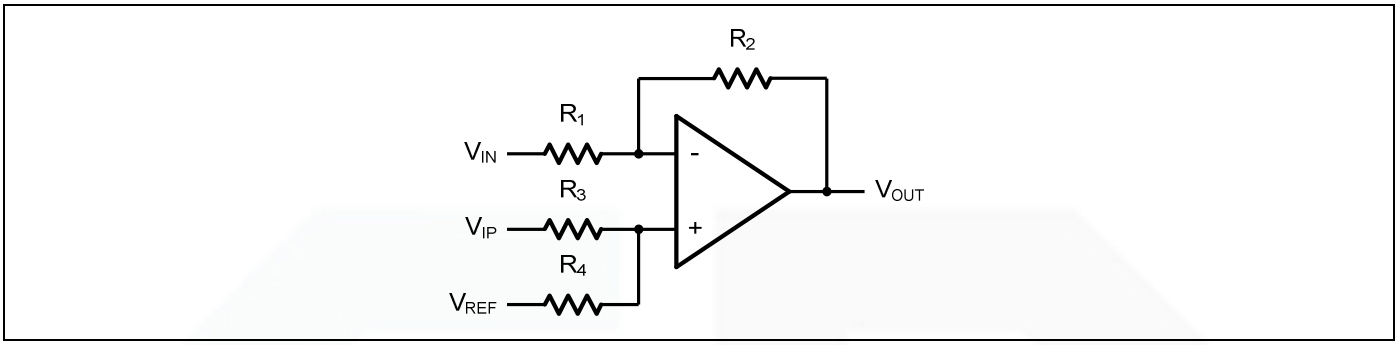


Figure 4. Differential Amplifier

$$V_{OUT}=(\frac{R1+R2}{R3+R4})\frac{R4}{R1}V_{IN}-\frac{R2}{R1}V_{IP}+(\frac{R1+R2}{R3+R4})\frac{R3}{R1}V_{REF}$$

If the resistor ratios are equal (i.e. R_1=R_3 and R_2=R_4), then

$$V_{OUT}=\frac{R_2}{R_1}(V_{IP}-V_{IN})+V_{REF}$$

Low Pass Active Filter

The low pass active filter is shown in Figure 5. The DC gain is defined by $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_C=1/(2\pi R_3C_1)$.

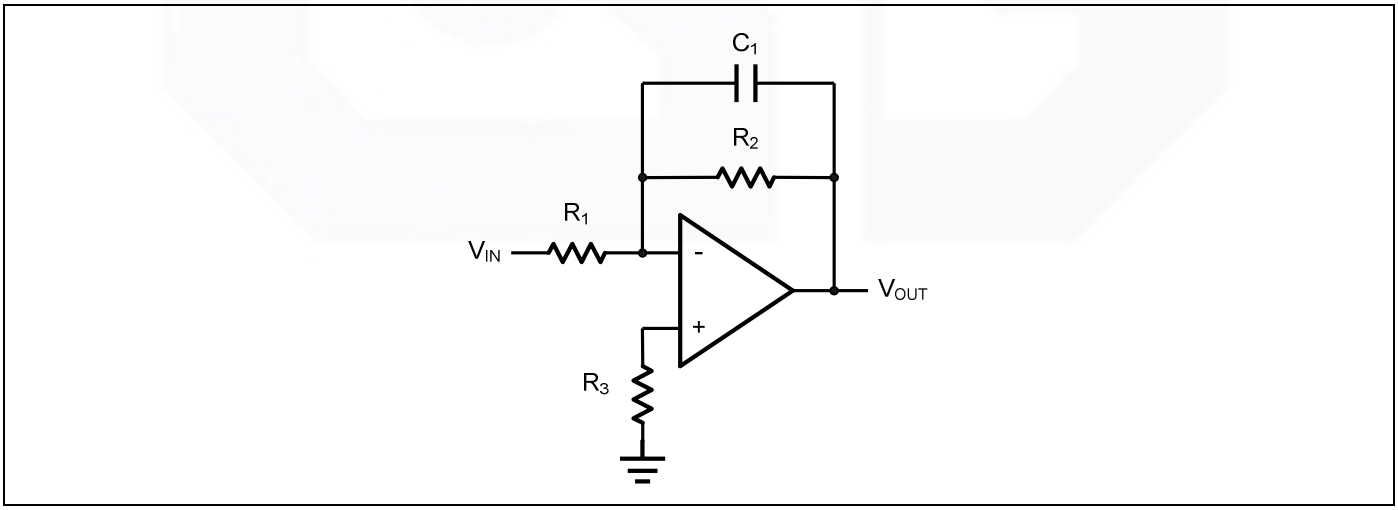


Figure 5. Low Pass Active Filter

Instrumentation Amplifier

The triple GS3130 can be used to build a three-op-amp instrumentation amplifier as shown in Figure 6. The amplifier in Figure 6 is a high input impedance differential amplifier with gain of R2/R1. The two differential voltage followers assure the high input impedance of the amplifier.

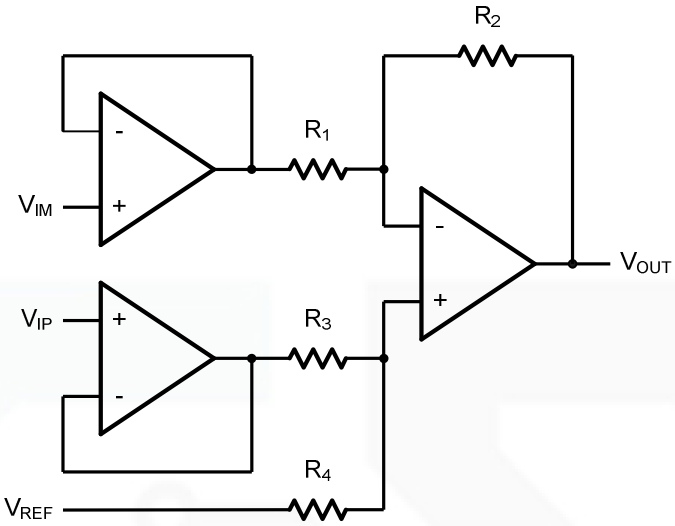


Figure 6. Instrument Amplifier

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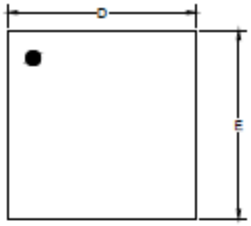
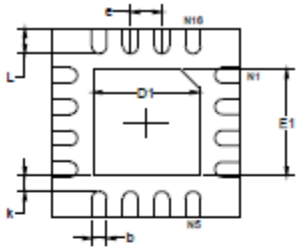
Package Information

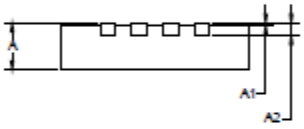
TQFN-3x3-16L



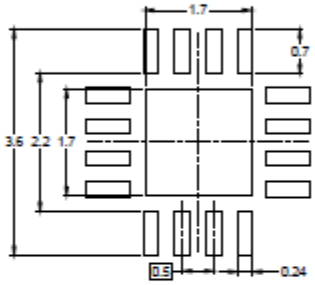
TOP VIEW



BOTTOM VIEW



SIDE VIEW



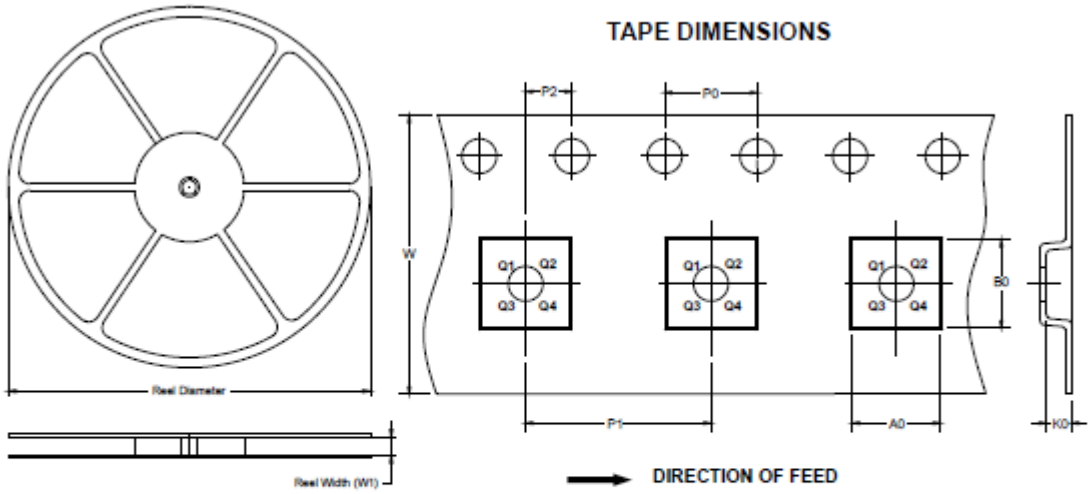
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

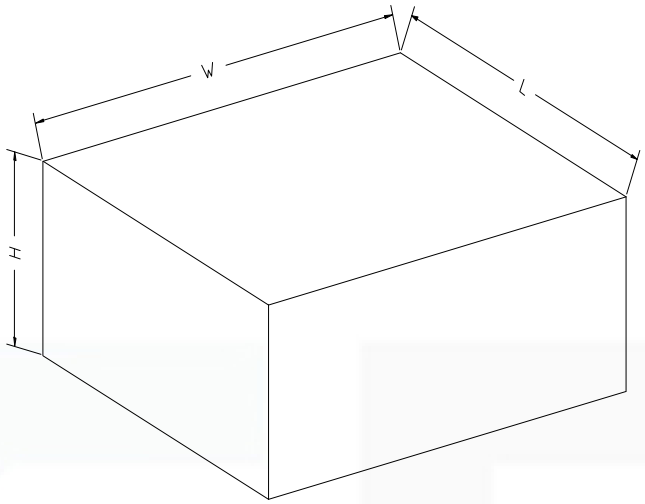


NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-3×3-16L	13"	12.40	3.35	3.35	1.13	4.00	4.00	2.00	12.00	Q1

CARTON BOX DIMENSIONS



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

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Widt h	Height (mm)	Pizza/Carton
13″	386	280	370	5