



SGM8249-4

8MHz, High Voltage, High Precision, Low Noise, Rail-to-Rail Output Operational Amplifier

GENERAL DESCRIPTION

The SGM8249-4 is a quad, high voltage, low noise and high precision operational amplifier which can operate from 4.5V to 36V single supply or from $\pm 2.25\text{V}$ to $\pm 18\text{V}$ dual supplies. The device provides rail-to-rail output operation.

The SGM8249-4 offers a low offset voltage less than $12\mu\text{V}$ and a low bias current. The combination of characteristics makes the SGM8249-4 a good choice for temperature measurements, pressure and position sensors, strain gauge amplifiers and medical instrumentation, or any other 4.5V to 36V applications requiring precision and long-term stability.

The SGM8249-4 is available in Green SOIC-14 and TSSOP-14 packages. It is specified over the extended -40°C to $+125^{\circ}\text{C}$ temperature range.

FEATURES

- **Low Offset Voltage:** $2\mu\text{V}$ (TYP), $12\mu\text{V}$ (MAX)
- **Open-Loop Voltage Gain:** 150dB (TYP)
- **PSRR:** 150dB (TYP)
- **CMRR:** 140dB (TYP)
- **Input Voltage Noise Density:** $12\text{nV}/\sqrt{\text{Hz}}$ at 1kHz
- **Gain-Bandwidth Product:** 8MHz
- **Overload Recovery Time:** $0.7\mu\text{s}$
- **Rail-to-Rail Output Swing**
- **Support Single or Dual Power Supplies:**
4.5V to 36V or $\pm 2.25\text{V}$ to $\pm 18\text{V}$
- **Low Supply Current:** 3.2mA (TYP)
- **-40°C to $+125^{\circ}\text{C}$ Operating Temperature Range**
- **Available in Green SOIC-14 and TSSOP-14 Packages**

APPLICATIONS

Pressure Sensors
Temperature Measurements
Precision Current Sensing
Electronic Scales
Strain Gauge Amplifiers
Handheld Test Equipment
Thermocouple Amplifiers
Medical Instrumentation

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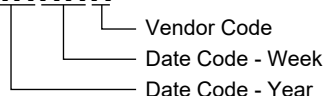
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8249-4	SOIC-14	-40°C to +125°C	SGM8249-4XS14G/TR	SGM82494XS14 XXXXX	Tape and Reel, 2500
	TSSOP-14	-40°C to +125°C	SGM8249-4XTS14G/TR	SGM82494 XTS14 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

XXXXX



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage.....	40V
Input Voltage Range	$-V_S$ to $(+V_S) + 0.1V$
Differential Input Voltage Range	-1V to 1V
Junction Temperature	+150°C
Storage Temperature Range.....	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility	
HBM.....	6000V
CDM	1000V

RECOMMENDED OPERATING CONDITIONS

Operating Voltage Range.....	4.5V to 36V
Operating Temperature Range	-40°C to +125°C

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

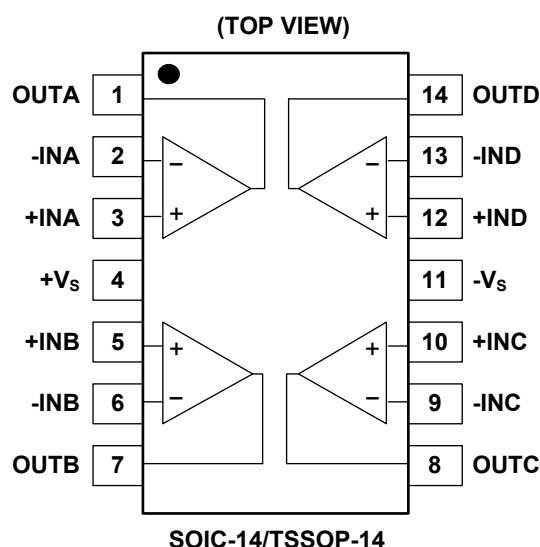
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision

integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS



SGM8249-4

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ELECTRICAL CHARACTERISTICS

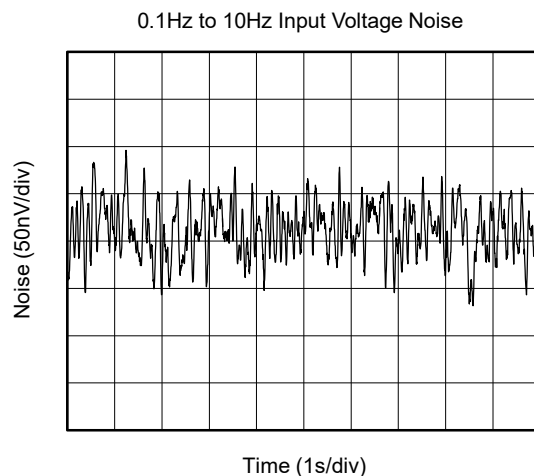
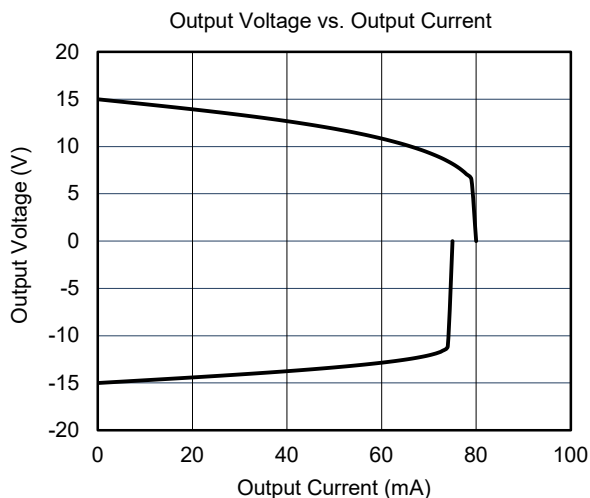
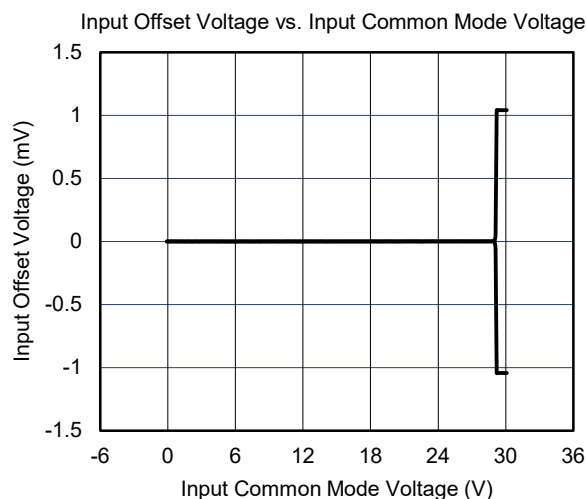
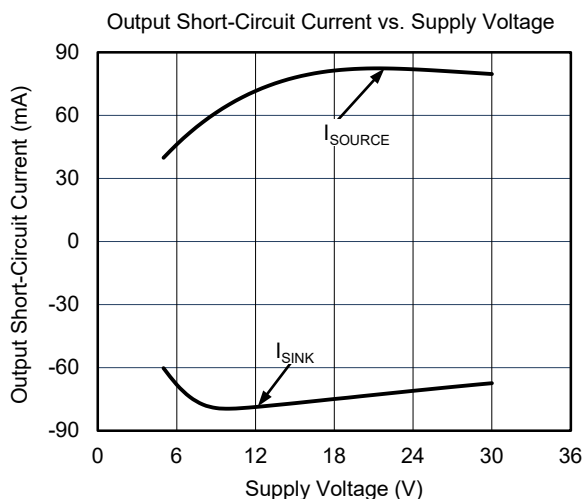
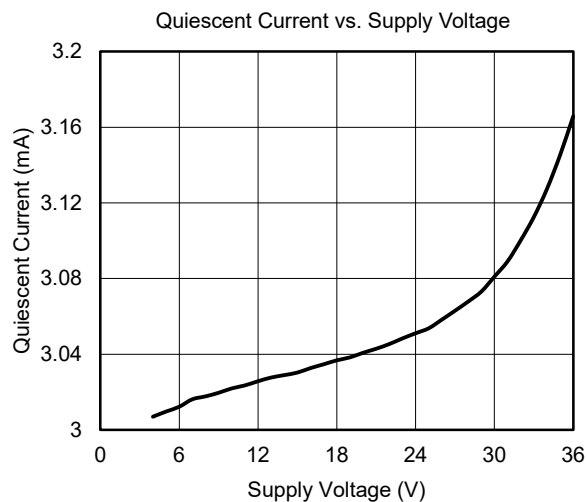
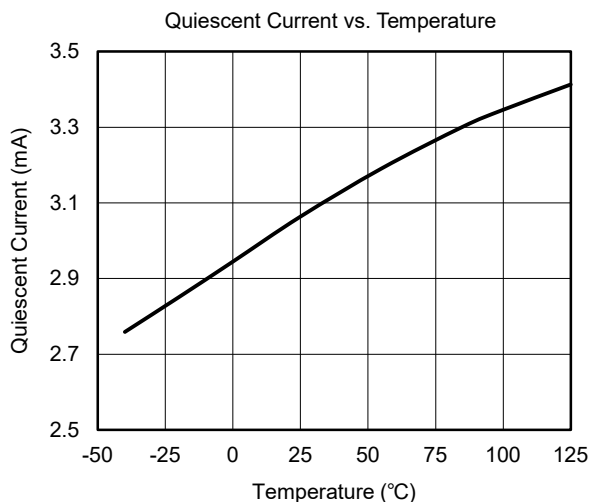
(At $T_A = +25^\circ\text{C}$, $V_S = \pm 2.25\text{V}$ to $\pm 18\text{V}$, $V_{CM} = 0\text{V}$ and R_L connected to 0V , Full = -40°C to $+125^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics							
Input Offset Voltage	V _{OS}		+25°C		2	12	μV
			Full			18	
Input Offset Voltage Drift	ΔV _{OS} /ΔT		Full		14		nV/°C
Input Bias Current	I _B		+25°C		±100	±450	pA
Input Offset Current	I _{OS}		+25°C		±200	±650	
Input Common Mode Voltage Range	V _{CM}		Full	(-V _S)		(+V _S) - 1.5	V
Common Mode Rejection Ratio	CMRR	V _{CM} = (-V _S) to (+V _S) - 1.5V	+25°C	117	140		dB
			Full	114			
Open-Loop Voltage Gain	A _{OL}	V _S = ±2.25V, V _{OUT} = ±2.0V, R _L = 10kΩ	+25°C	119	150		dB
			Full	116			
		V _S = ±18V, V _{OUT} = ±17.5V, R _L = 10kΩ	+25°C	128	160		
			Full	125			
Output Characteristics							
Output Voltage Swing from Rail		V _S = ±2.25V, R _L = 10kΩ	+25°C		22	33	mV
			Full			45	
		V _S = ±18V, R _L = 10kΩ	+25°C		185	250	
			Full			350	
Output Short-Circuit Current	I _{SC}	V _S = ±2.25V	+25°C	±24	±34		mA
			Full	±13			
		V _S = ±18V	+25°C	±52	±70		
			Full	±38			
Power Supply							
Operating Voltage Range	V _S		Full	4.5		36	V
Quiescent Current	I _Q	I _{OUT} = 0A	+25°C		3.2	4.2	mA
			Full			4.5	
Power Supply Rejection Ratio	PSRR	V _S = 4.5V to 36V	+25°C	128	150		dB
			Full	124			
Dynamic Performance							
Gain-Bandwidth Product	GBP	V _{OUT} = 100mV _{P-P} , R _L = 10kΩ, C _L = 10pF	+25°C		8		MHz
Slew Rate	SR	R _L = 10kΩ	+25°C		5		V/μs
Settling Time to 0.1%	t _s	V _{IN} = 1V step, R _L = 10kΩ, A _V = +1	+25°C		0.8		μs
Overload Recovery Time		R _L = 10kΩ, V _{IN} × A _V > V _S	+25°C		0.7		μs
Total Harmonic Distortion + Noise	THD+N	V _{IN} = 2V _{P-P} , A _V = +1, R _L = 10kΩ, f = 1kHz	+25°C		0.0003		%
Noise							
Input Voltage Noise		f = 0.1Hz to 10Hz	+25°C		0.2		μV _{P-P}
Input Voltage Noise Density	e _n	f = 0.1kHz, V _{CM} = V _S /2	+25°C		12		nV/√Hz
		f = 1kHz, V _{CM} = V _S /2			12		
		f = 10kHz, V _{CM} = V _S /2			13		

8MHz, High Voltage, High Precision, Low Noise, SGM8249-4 Rail-to-Rail Output Operational Amplifier

TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $C_L = 10\text{pF}$ and $R_L = 5\text{k}\Omega$, unless otherwise noted.

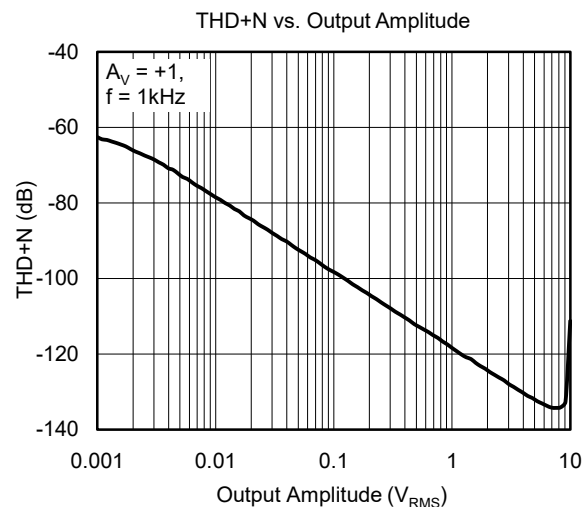
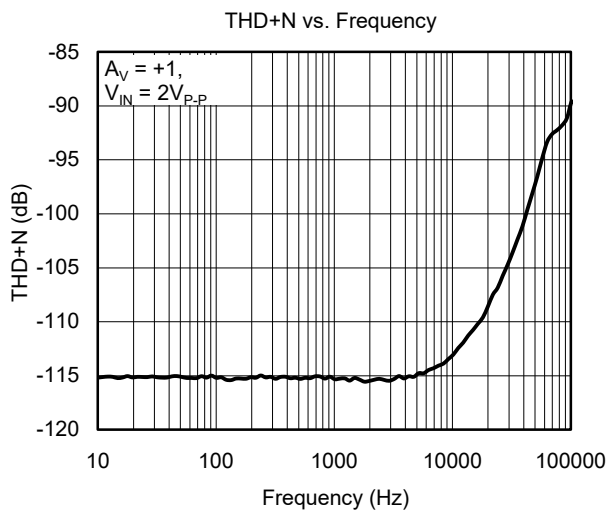
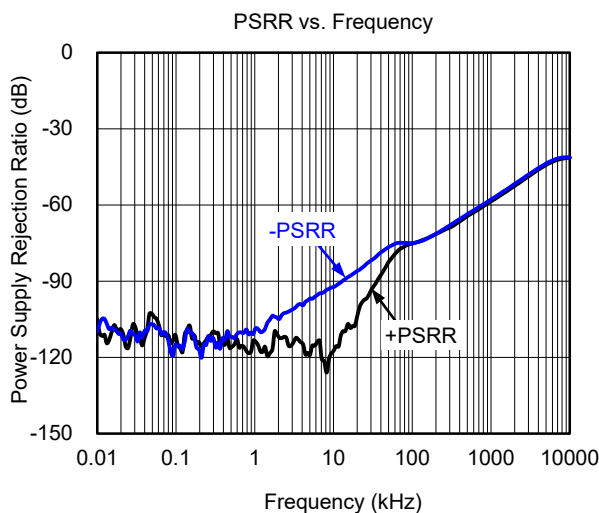
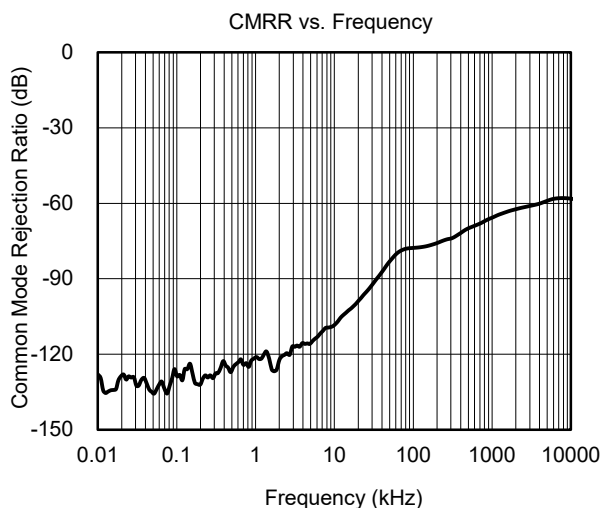
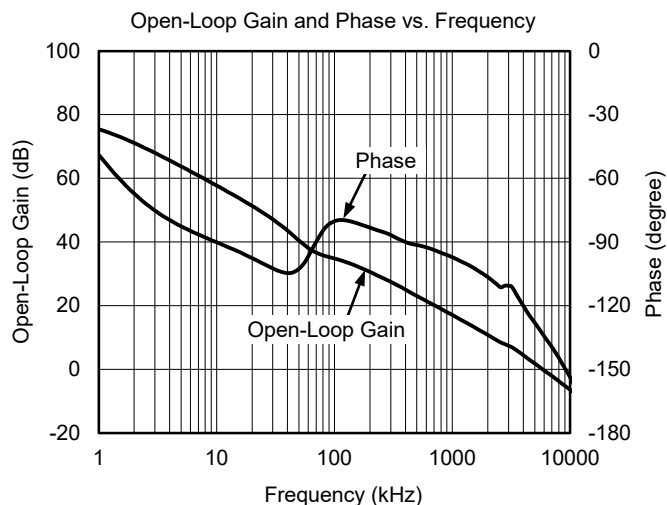
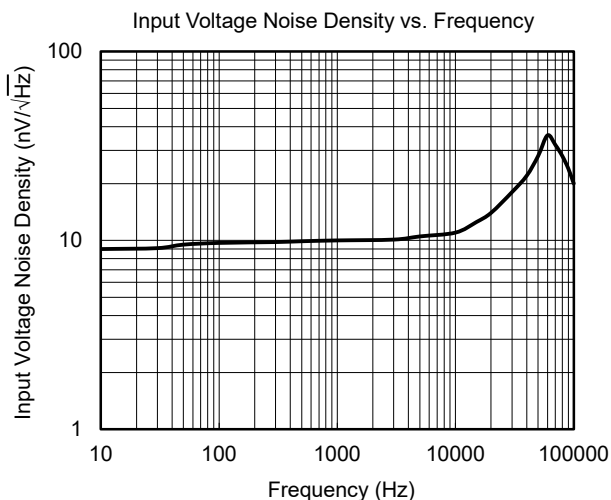


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TYPICAL PERFORMANCE CHARACTERISTICS (continued)

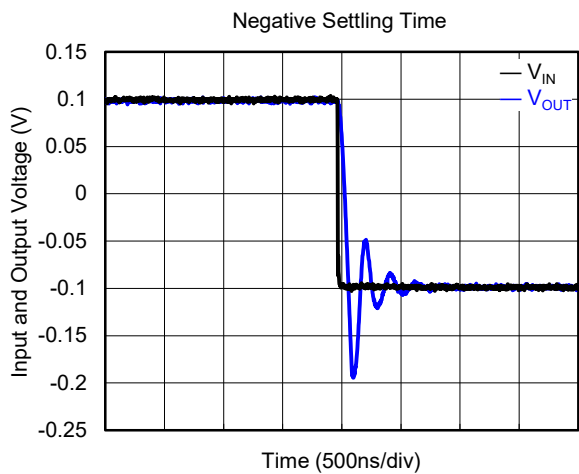
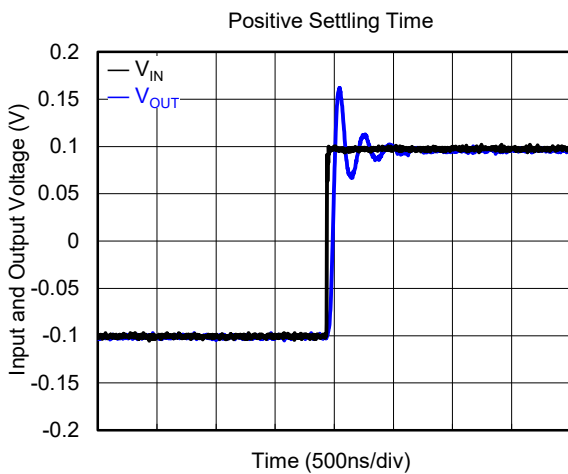
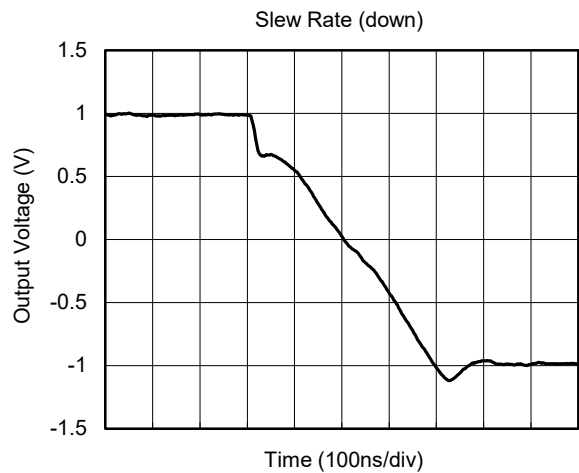
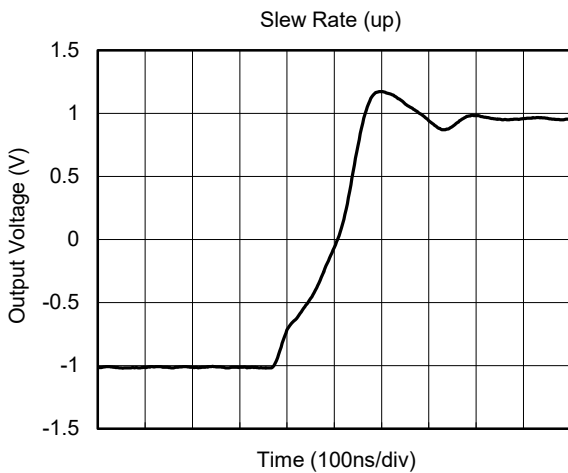
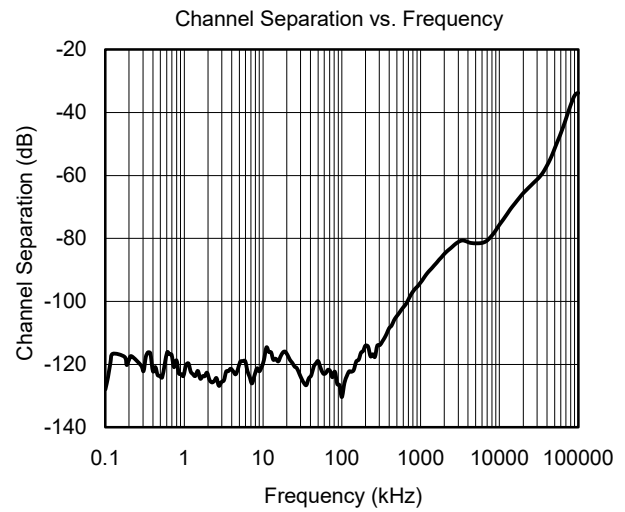
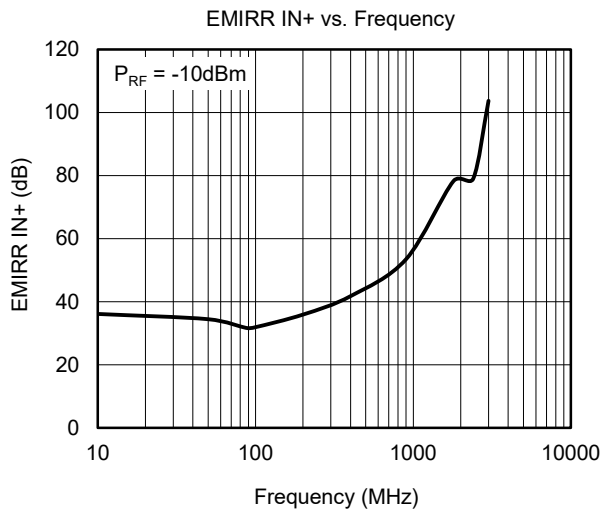
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8MHz, High Voltage, High Precision, Low Noise, SGM8249-4 Rail-to-Rail Output Operational Amplifier

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

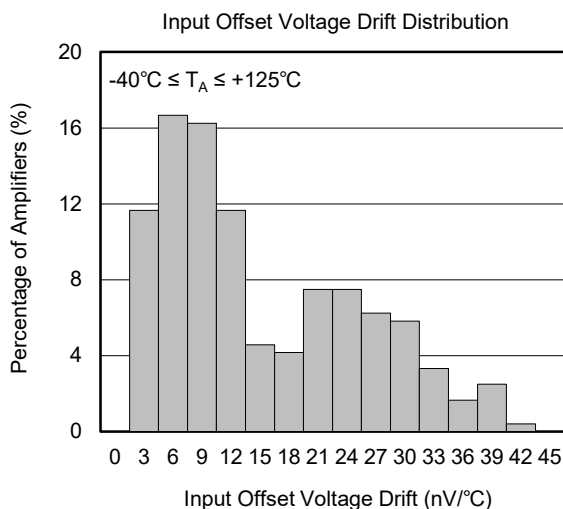
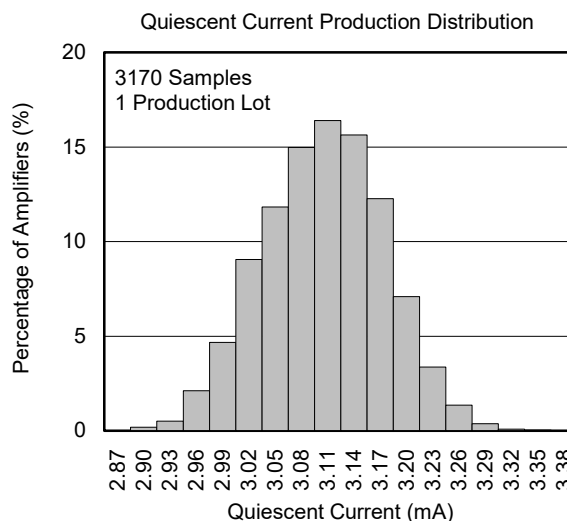
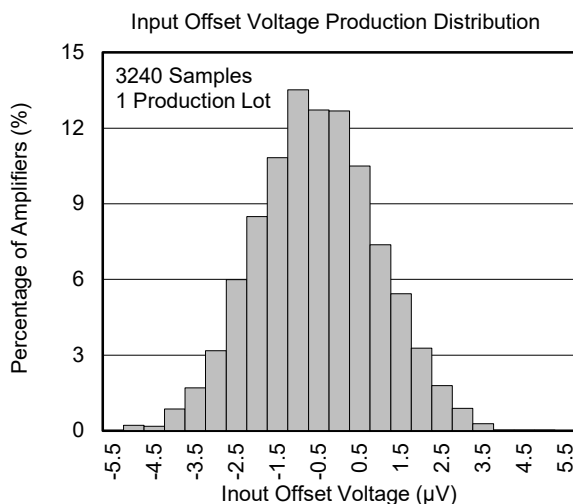
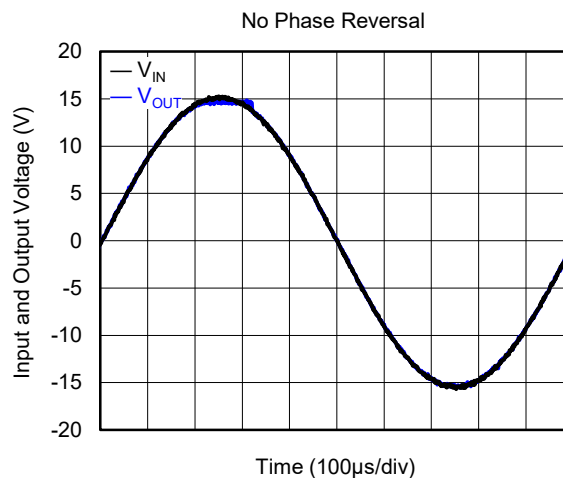
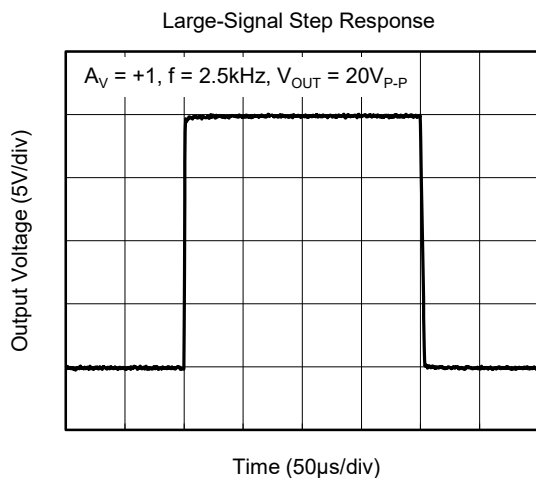
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SGM8249-4 8MHz, High Voltage, High Precision, Low Noise, Rail-to-Rail Output Operational Amplifier

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $C_L = 10\text{pF}$ and $R_L = 5\text{k}\Omega$, unless otherwise noted.



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APPLICATION INFORMATION

Rail-to-Rail Output

The SGM8249-4 supports rail-to-rail output operation. In single power supply application, for example, when $+V_S = 36V$, $-V_S = GND$, $10k\Omega$ load resistor is tied from OUT pin to ground, the typical output swing range is from 0.185V to 35.815V.

Driving Capacitive Loads

The SGM8249-4 is unity-gain stable with heavy capacitive load. If greater capacitive load must be driven in application, the circuit in Figure 1 can be used. In this circuit, the IR drop voltage generated by R_{ISO} is compensated by feedback loop.

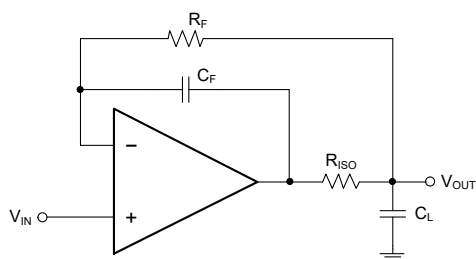


Figure 1. Circuit to Drive Heavy Capacitive Load

Power Supply Decoupling and Layout

A clean and low noise power supply is very important in amplifier circuit design, besides of input signal noise, the power supply is one of important source of noise to the amplifier through $+V_S$ and $-V_S$ pins. Power supply bypassing is an effective method to clear up the noise at power supply, and the low impedance path to ground of decoupling capacitor will bypass the noise to GND. In application, $10\mu F$ ceramic capacitor paralleled with $0.1\mu F$ or $0.01\mu F$ ceramic capacitor is used in Figure 2. The ceramic capacitors should be placed as close as possible to $+V_S$ and $-V_S$ power supply pins.

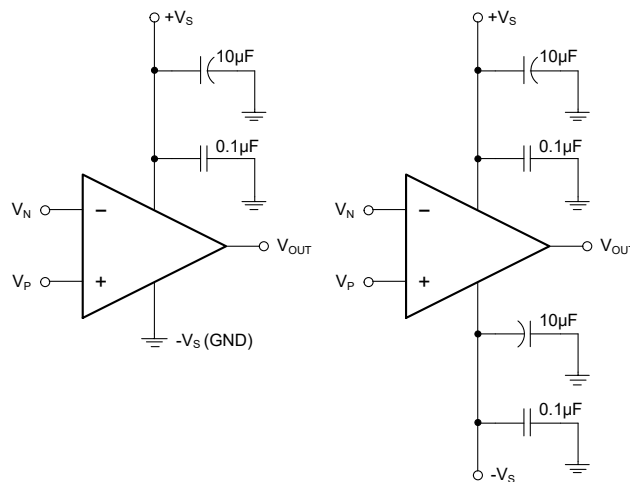


Figure 2. Amplifier Power Supply Bypassing

Grounding

In low speed application, one node grounding technique is the simplest and most effective method to eliminate the noise generated by grounding. In high speed application, the general method to eliminate noise is to use a complete ground plane technique, and the whole ground plane will help distribute heat and reduce EMI noise pickup.

Reduce Input-to-Output Coupling

To reduce the input-to-output coupling, the input traces must be placed as far away from the power supply or output traces as possible. The sensitive trace must not be placed in parallel with the noisy trace in same layer. They must be placed perpendicularly in different layers to reduce the crosstalk. These PCB layout techniques will help to reduce unwanted positive feedback and noise.

APPLICATION INFORMATION (continued)

Typical Application Circuits

Difference Amplifier

The circuit in Figure 3 is a design example of classical difference amplifier. If $R_4/R_3 = R_2/R_1$, then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

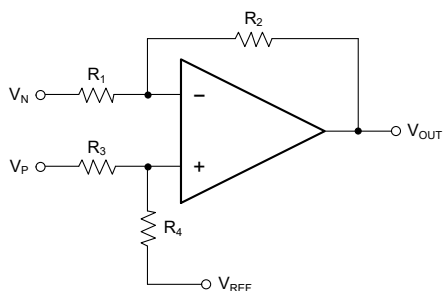


Figure 3. Difference Amplifier

High Input Impedance Difference Amplifier

The circuit in Figure 4 is a design example of high input impedance difference amplifier, the added amplifiers at the input are used to increase the input impedance and eliminate drawback of low input impedance in Figure 3.

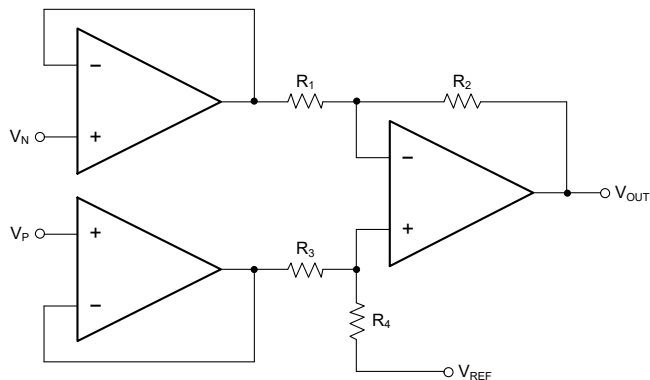


Figure 4. High Input Impedance Difference Amplifier

Active Low-Pass Filter

The circuit in Figure 5 is a design example of active low-pass filter, the DC gain is equal to $-R_2/R_1$ and the -3dB corner frequency is equal to $1/2\pi R_2 C$. In this design, the filter bandwidth must be less than the bandwidth of the amplifier, the resistor values must be selected as low as possible to reduce ringing or oscillation generated by the parasitic parameters in PCB layout.

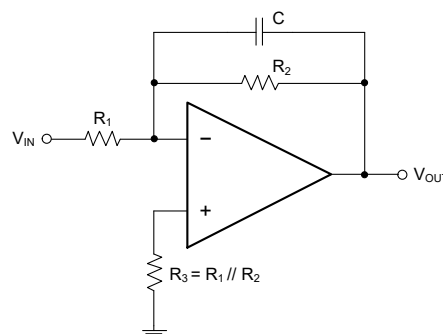


Figure 5. Active Low-Pass Filter

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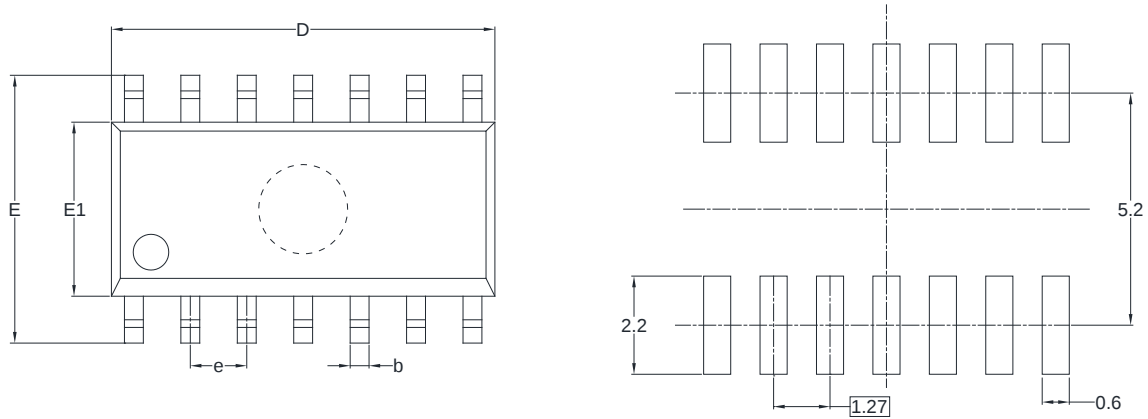
REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

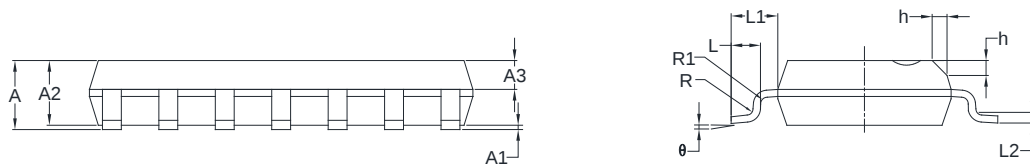
OCTOBER 2022 – REV.A to REV.A.1	Page
Updated Typical Performance Characteristics section	5
Changes from Original (DECEMBER 2018) to REV.A	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

SOIC-14



RECOMMENDED LAND PATTERN (Unit: mm)



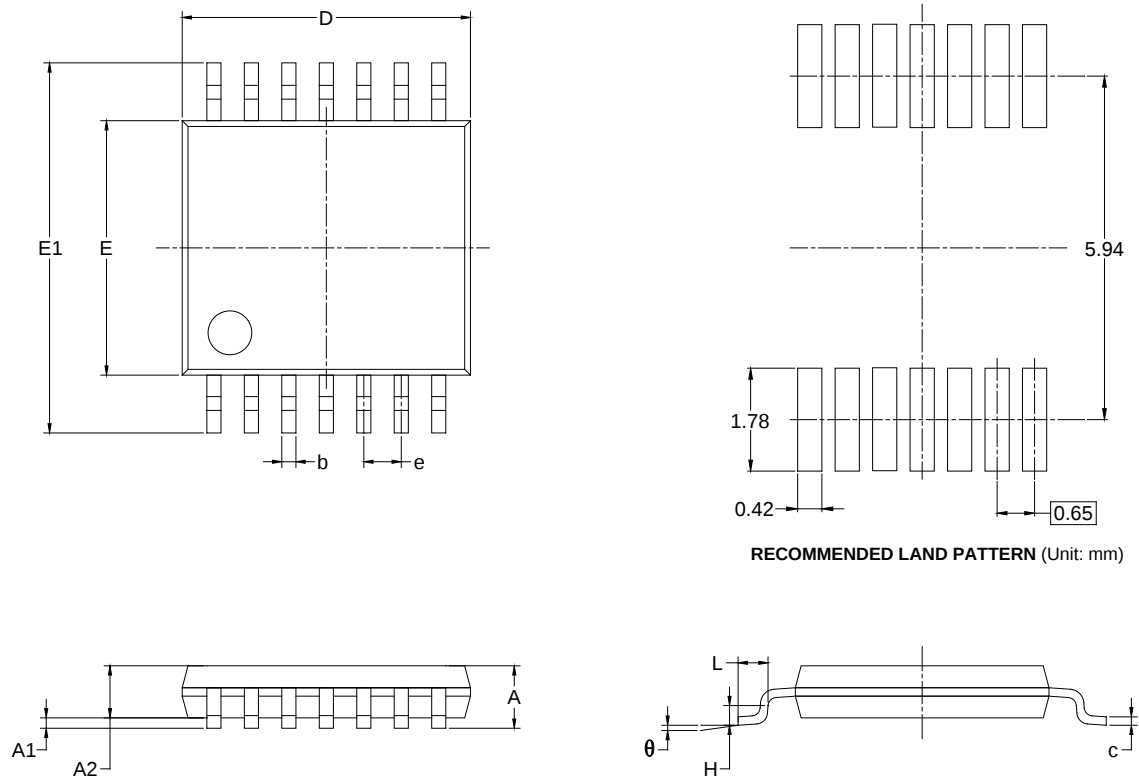
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	0.018	0.032
L1	1.04 REF		0.040 REF	
L2	0.25 BSC		0.01 BSC	
R	0.07		0.003	
R1	0.07		0.003	
h	0.30	0.50	0.012	0.020
θ	0°	8°	0°	8°

NOTES:

1. Body dimensions do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

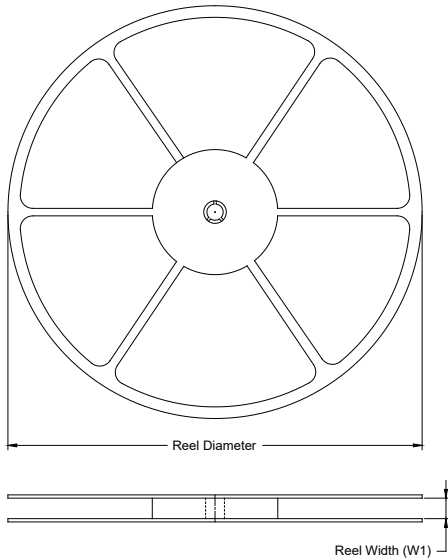
NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

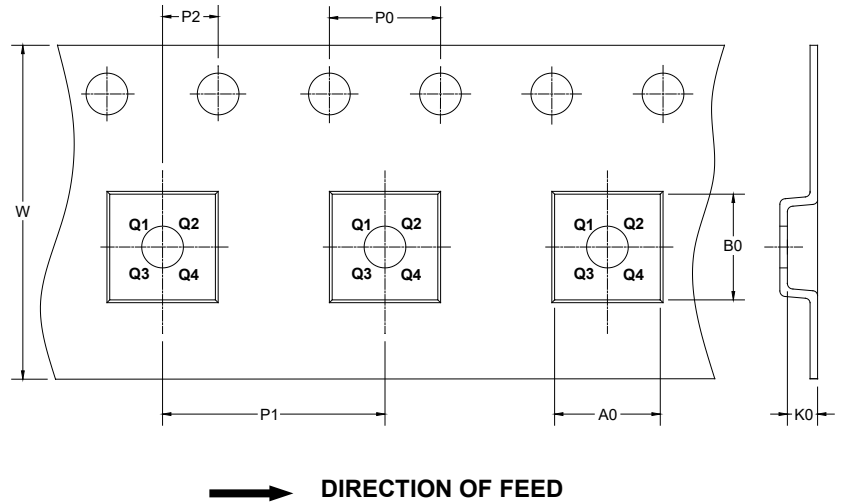
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

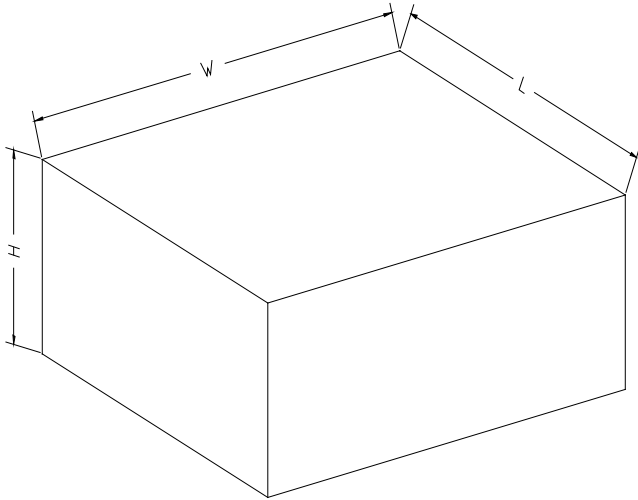
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-14	13"	16.4	6.60	9.30	2.10	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13"	12.4	6.95	5.60	1.50	4.0	8.0	2.0	12.0	Q1

DD0001

PACKAGE INFORMATION

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)	Width (mm)	Height (mm)	Pizza/Carton
13"	386	280	370	5

DD0002