



# SGM8965A-2Q

## 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

### GENERAL DESCRIPTION

The SGM8965A-2Q is a dual, high speed CMOS operational amplifier with high input impedance, zero-crossover and low distortion. This device can operate from 2.2V to 5.5V single supply.

The SGM8965A-2Q features high speed and low noise. It supports rail-to-rail input and output operation. The input common mode voltage range is from  $(-V_S) - 0.1V$  to  $(+V_S) + 0.1V$ , and the output range is from  $(-V_S) + 0.006V$  to  $(+V_S) - 0.006V$ . Furthermore, the SGM8965A-2Q provides high CMRR with zero-crossover and low distortion, which is designed to drive ADCs with high linearity. The device can be used in a variety of applications, such as audio, mobile phone and signal conditioning.

The device is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM8965A-2Q is available in Green SOIC-8 and MSOP-8 packages. It is specified over the extended  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range.

### FEATURES

- **AEC-Q100 Qualified for Automotive Applications**  
**Device Temperature Grade 1**  
 $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- **Unity-Gain Stable**
- **Gain-Bandwidth Product: 50MHz**
- **Slew Rate: 28V/ $\mu\text{s}$**
- **High CMRR: 94dB (TYP)**
- **Low Offset Voltage:  $\pm 280\mu\text{V}$  (MAX)**
- **Low Bias Current:  $\pm 1\text{pA}$  (TYP)**
- **Low Input Voltage Noise:  $5.5\text{nV}/\sqrt{\text{Hz}}$  at 100kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.2V to 5.5V**
- **Available in Green SOIC-8 and MSOP-8 Packages**

### APPLICATIONS

AEC-Q100 Grade 1 Applications  
Audio Processing  
Active Filters  
Signal Conditioning  
Sensor Amplification  
Data-Acquisition Systems  
Process Control  
Test Equipment  
Wideband Amplifiers

# SGM8965A-2Q 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

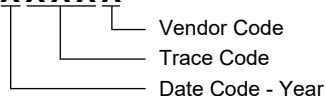
## PACKAGE/ORDERING INFORMATION

| MODEL       | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER    | PACKAGE TOP MARKING | PACKING OPTION      |
|-------------|---------------------|-----------------------------|--------------------|---------------------|---------------------|
| SGM8965A-2Q | SOIC-8              | -40°C to +125°C             | SGM8965A-2QS8G/TR  | 0ANS8<br>XXXXX      | Tape and Reel, 4000 |
|             | MSOP-8              | -40°C to +125°C             | SGM8965A-2QMS8G/TR | 0AMMS8<br>XXXXX     | Tape and Reel, 4000 |

## MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace 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,  $+V_S$  to  $-V_S$  ..... 6V  
 Input Voltage Range .....  $(-V_S) - 0.3V$  to  $(+V_S) + 0.3V$   
 Input Current (All pins except power supply pins).....  $\pm 10mA$   
 Output Short-Circuit ..... Continuous  
 Package Thermal Resistance  
     SOIC-8,  $\theta_{JA}$  ..... 116.3°C/W  
     SOIC-8,  $\theta_{JB}$  ..... 59.9°C/W  
     MSOP-8,  $\theta_{JA}$  ..... 153°C/W  
     MSOP-8,  $\theta_{JB}$  ..... 94.7°C/W  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature (Soldering, 10s) ..... +260°C  
 ESD Susceptibility  
 HBM .....  $\pm 5000V$   
 CDM .....  $\pm 1000V$

## RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... 2.2V to 5.5V  
 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.

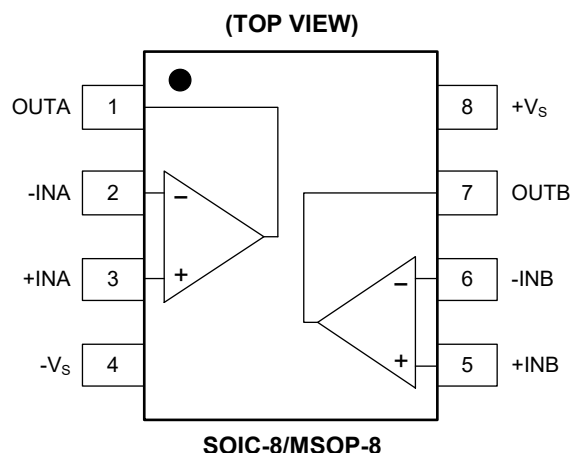
## ESD SENSITIVITY CAUTION

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



# 50MHz, Low Distortion, Rail-to-Rail I/O, SGM8965A-2Q Single-Supply, Automotive Operational Amplifier

## ELECTRICAL CHARACTERISTICS

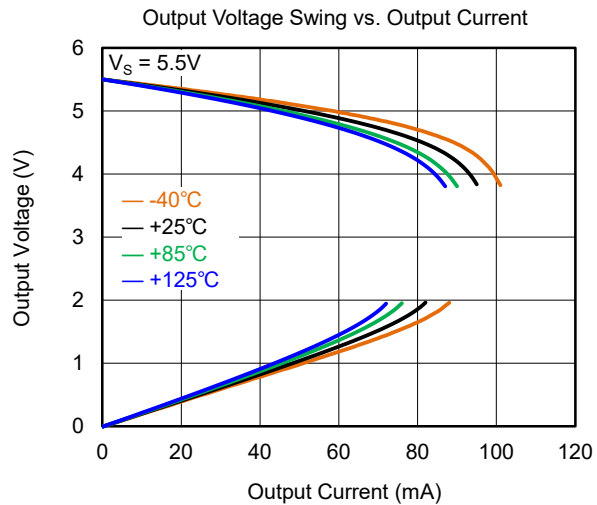
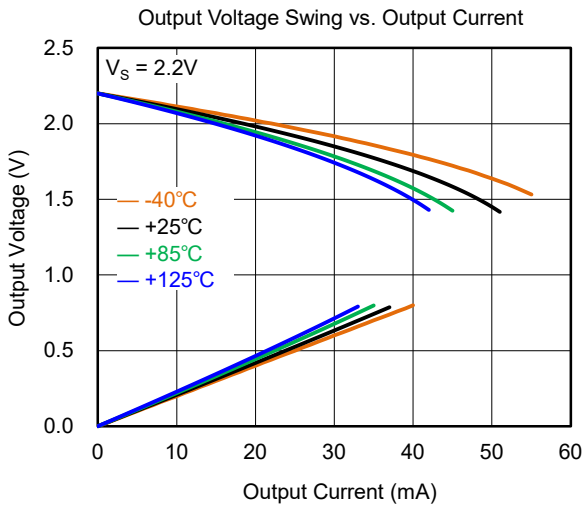
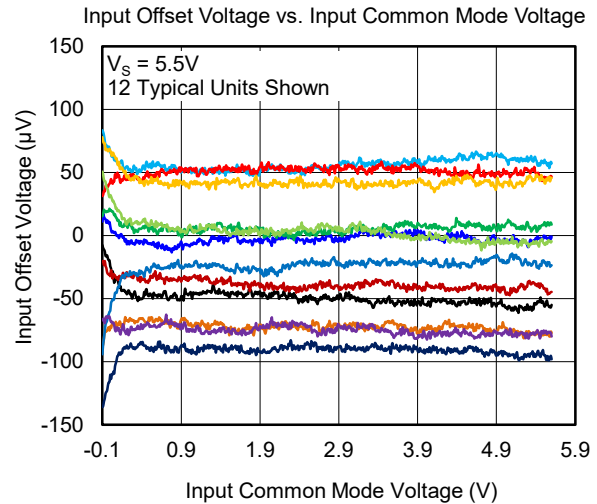
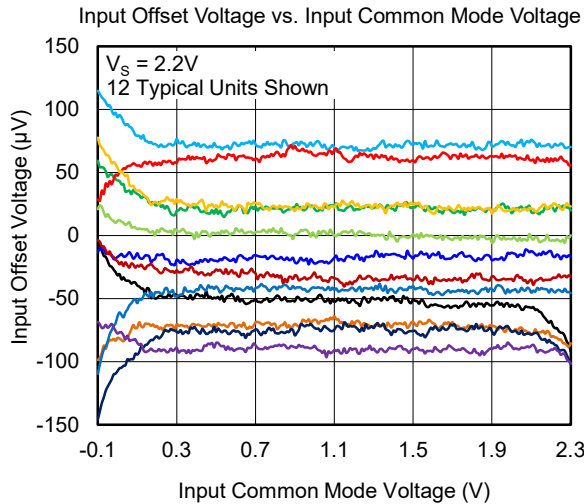
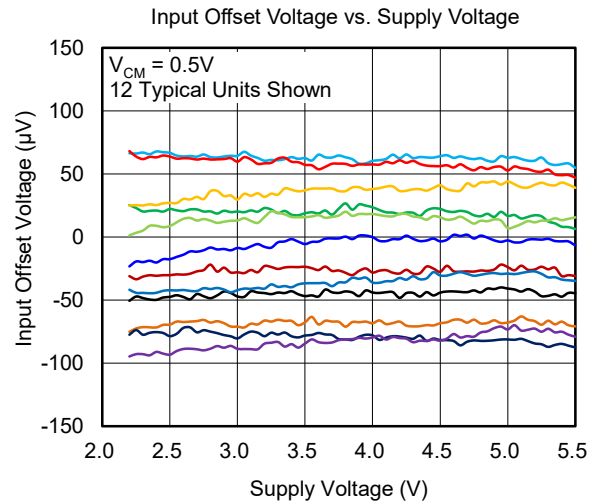
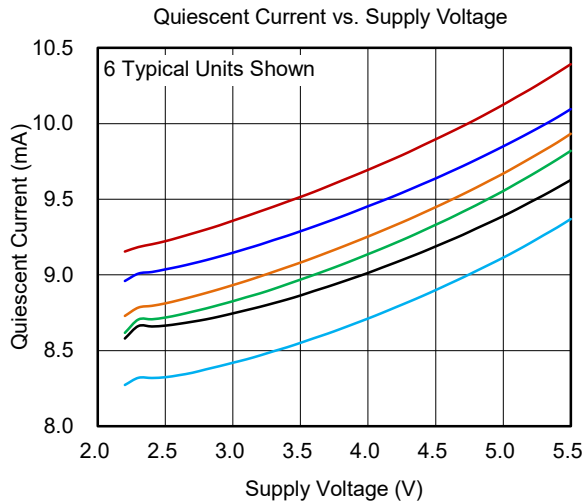
( $V_S = 2.2V$  to  $5.5V$ ,  $V_{CM} = V_S/2$ ,  $V_{OUT} = V_S/2$  and  $R_L = 10k\Omega$  connected to  $V_S/2$ , Full =  $-40^\circ C$  to  $+125^\circ C$ , typical values are at  $T_A = +25^\circ C$ , unless otherwise noted.)

| PARAMETER                                          | CONDITIONS                                                                     | TEMP  | MIN                      | TYP    | MAX                      | UNITS             |
|----------------------------------------------------|--------------------------------------------------------------------------------|-------|--------------------------|--------|--------------------------|-------------------|
| Input Characteristics                              |                                                                                |       |                          |        |                          |                   |
| Input Offset Voltage (V <sub>OS</sub> )            |                                                                                | +25°C |                          | ±50    | ±280                     | μV                |
|                                                    |                                                                                | Full  |                          |        | ±1000                    |                   |
| Input Offset Voltage Drift (ΔV <sub>OS</sub> /ΔT)  |                                                                                | Full  |                          | 2.2    | 8                        | μV/°C             |
| Input Bias Current (I <sub>B</sub> )               |                                                                                | Full  |                          | ±1     | ±2800                    | pA                |
| Input Offset Current (I <sub>OS</sub> )            |                                                                                | Full  |                          | ±1     | ±400                     | pA                |
| Input Common Mode Voltage Range (V <sub>CM</sub> ) |                                                                                | Full  | (-V <sub>S</sub> ) - 0.1 |        | (+V <sub>S</sub> ) + 0.1 | V                 |
| Common Mode Rejection Ratio (CMRR)                 | (-V <sub>S</sub> ) - 0.1V ≤ V <sub>CM</sub> ≤ (+V <sub>S</sub> ) + 0.1V        | +25°C | 76                       | 94     |                          | dB                |
|                                                    |                                                                                | Full  | 64                       |        |                          |                   |
| Open-Loop Voltage Gain (A <sub>OL</sub> )          | 0.25V < V <sub>OUT</sub> < (+V <sub>S</sub> ) - 0.25V, R <sub>L</sub> = 600Ω   | +25°C | 91                       | 118    |                          | dB                |
|                                                    |                                                                                | Full  | 88                       |        |                          |                   |
|                                                    | 0.1V < V <sub>OUT</sub> < (+V <sub>S</sub> ) - 0.1V, R <sub>L</sub> = 10kΩ     | +25°C | 92                       | 118    |                          |                   |
|                                                    |                                                                                | Full  | 89                       |        |                          |                   |
| Output Characteristics                             |                                                                                |       |                          |        |                          |                   |
| Output Voltage Swing from Rail                     | V <sub>S</sub> = 5.5V                                                          | Full  |                          | 6      | 12                       | mV                |
| Output Short-Circuit Current (I <sub>SC</sub> )    | V <sub>S</sub> = 5.5V                                                          | Full  | ±55                      | ±80    |                          | mA                |
| Open-Loop Output Impedance                         | f = 1MHz, I <sub>OUT</sub> = 0A                                                | +25°C |                          | 30     |                          | Ω                 |
| Power Supply                                       |                                                                                |       |                          |        |                          |                   |
| Specified Voltage Range (V <sub>S</sub> )          |                                                                                | Full  | 2.2                      |        | 5.5                      | V                 |
| Quiescent Current (I <sub>Q</sub> )                | I <sub>OUT</sub> = 0A                                                          | +25°C |                          | 10     | 13                       | mA                |
|                                                    |                                                                                | Full  |                          |        | 13.4                     |                   |
| Power Supply Rejection Ratio (PSRR)                |                                                                                | Full  |                          | 4      | 70                       | μV/V              |
| Dynamic Performance                                |                                                                                |       |                          |        |                          |                   |
| Gain-Bandwidth Product (GBP)                       | C <sub>L</sub> = 10pF                                                          | +25°C |                          | 50     |                          | MHz               |
| Phase Margin (φ <sub>O</sub> )                     | C <sub>L</sub> = 10pF                                                          | +25°C |                          | 55     |                          | °                 |
| Slew Rate (SR)                                     | G = +1                                                                         | +25°C |                          | 28     |                          | V/μs              |
| Settling Time to 0.1%                              | 4V step, G = -1                                                                | +25°C |                          | 380    |                          | ns                |
| Settling Time to 0.01%                             | 4V step, G = -1                                                                | +25°C |                          | 520    |                          | ns                |
| Overload Recovery Time                             | V <sub>IN</sub> × G > V <sub>S</sub>                                           | +25°C |                          | < 0.1  |                          | μs                |
| Total Harmonic Distortion + Noise (THD+N)          | V <sub>OUT</sub> = 4V <sub>P-P</sub> , R <sub>L</sub> = 600Ω, G = +1, f = 1kHz | +25°C |                          | 0.0002 |                          | %                 |
| Noise                                              |                                                                                |       |                          |        |                          |                   |
| Input Voltage Noise                                | f = 0.1Hz to 10Hz                                                              | +25°C |                          | 9.5    |                          | μV <sub>P-P</sub> |
| Input Voltage Noise Density (e <sub>n</sub> )      | f = 100kHz                                                                     | +25°C |                          | 5.5    |                          | nV/√Hz            |
| Input Current Noise Density (i <sub>n</sub> )      | f = 10kHz                                                                      | +25°C |                          | 20     |                          | fA/√Hz            |

# SGM8965A-2Q 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

## TYPICAL PERFORMANCE CHARACTERISTICS

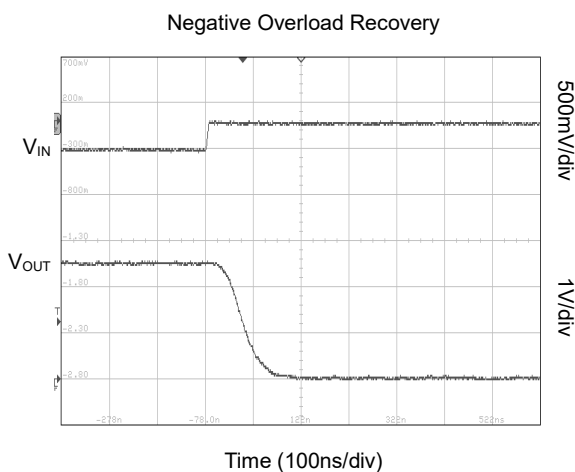
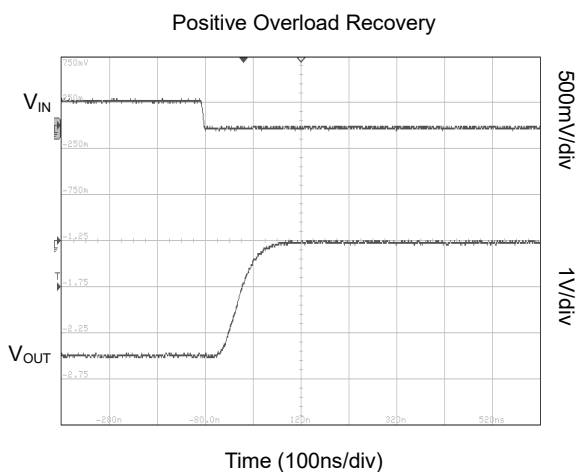
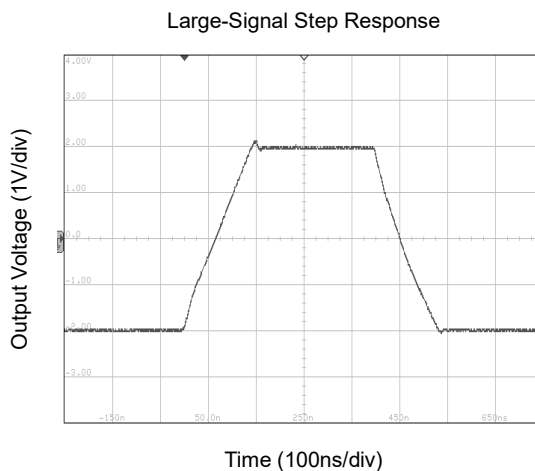
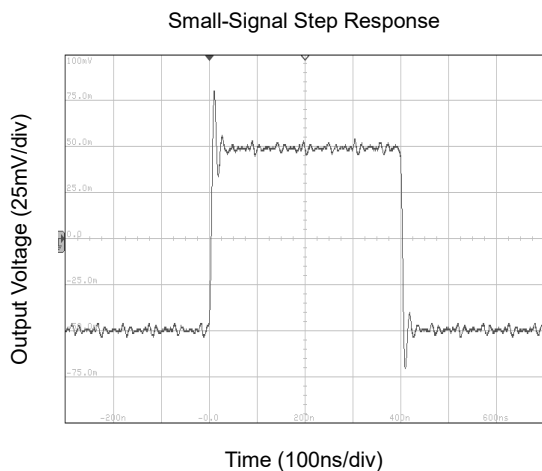
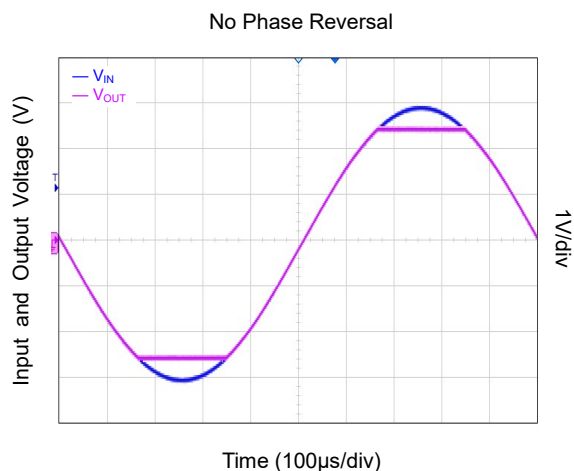
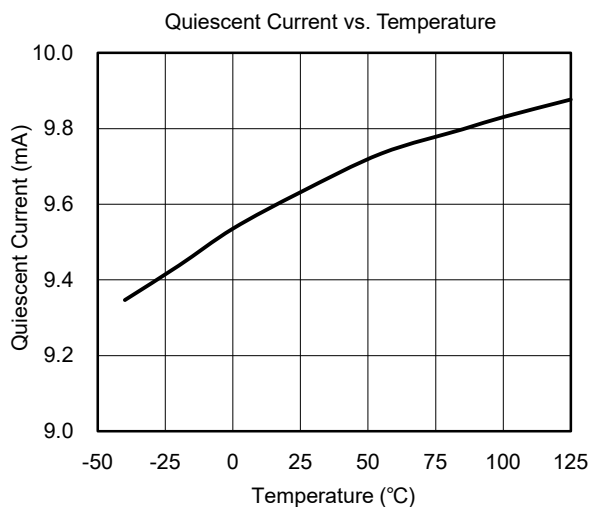
At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $V_{CM} = V_S/2$ , unless otherwise noted.



# SGM8965A-2Q 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $V_{CM} = V_S/2$ , unless otherwise noted.

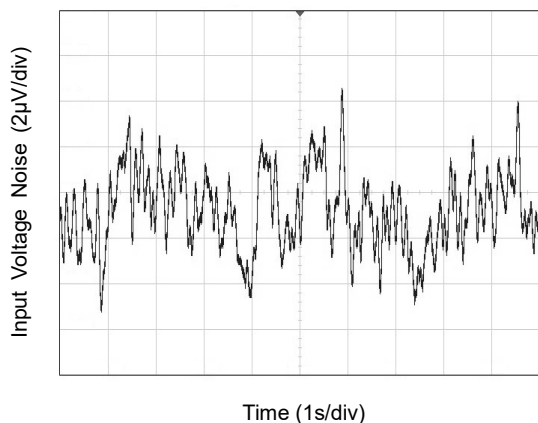


# 50MHz, Low Distortion, Rail-to-Rail I/O, SGM8965A-2Q Single-Supply, Automotive Operational Amplifier

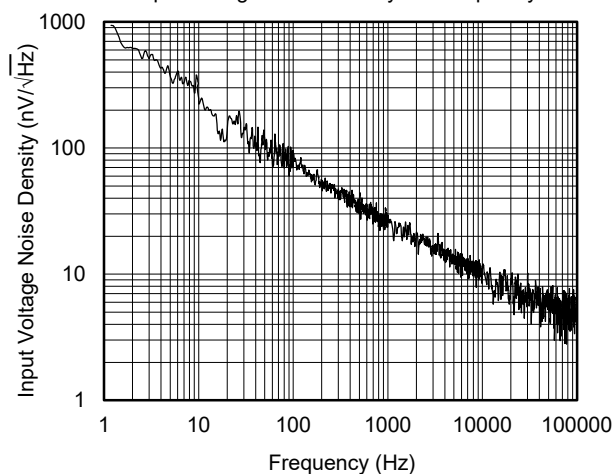
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $V_{CM} = V_S/2$ , unless otherwise noted.

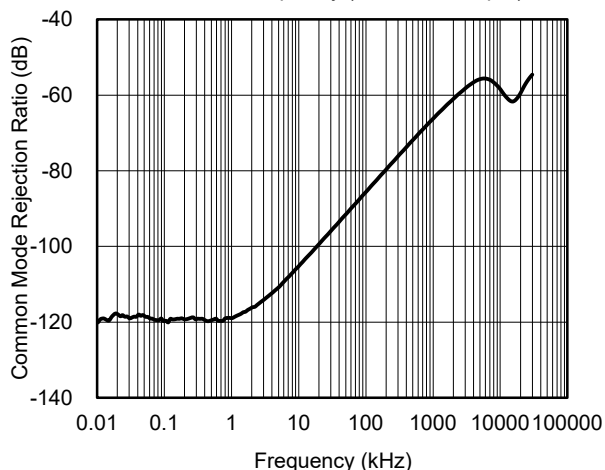
0.1Hz to 10Hz Input Voltage Noise



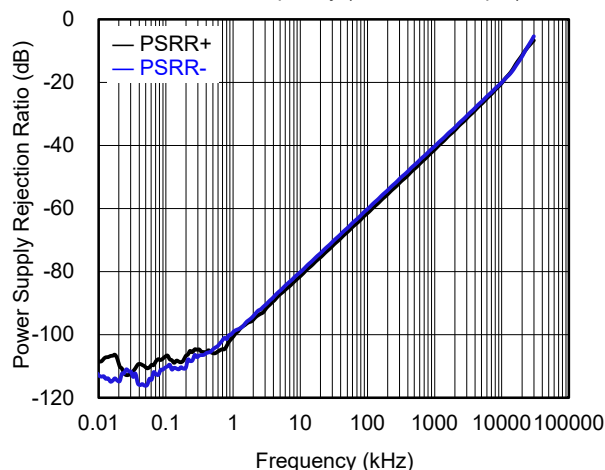
Input Voltage Noise Density vs. Frequency



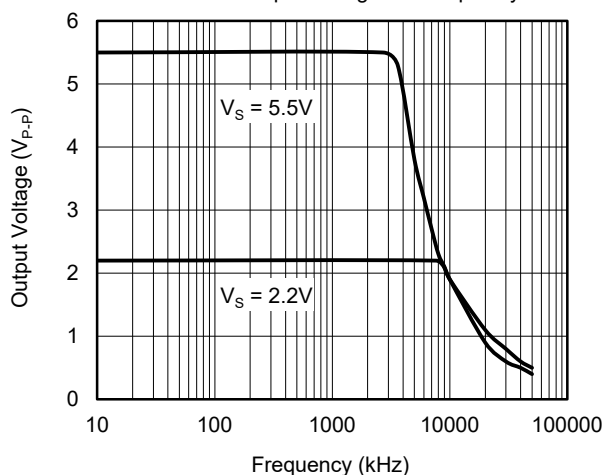
CMRR vs. Frequency (Referred-to-Input)



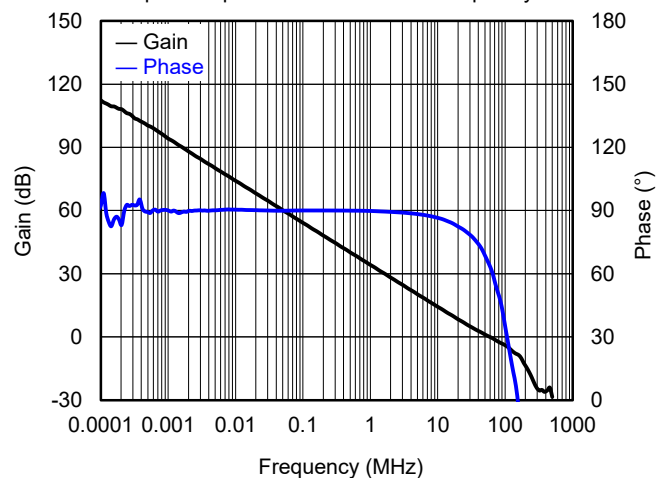
PSRR vs. Frequency (Referred-to-Input)



Maximum Output Voltage vs. Frequency



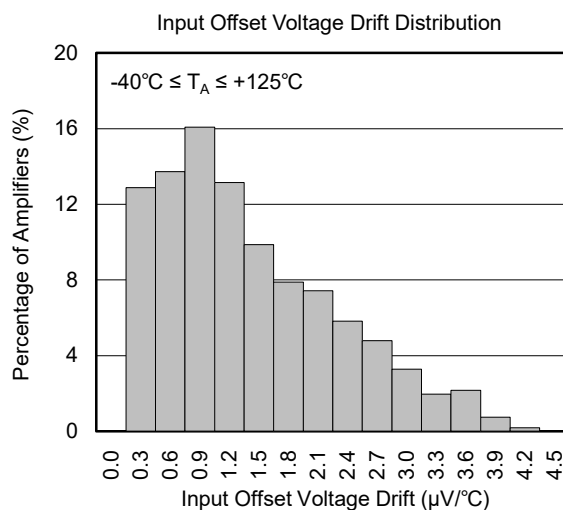
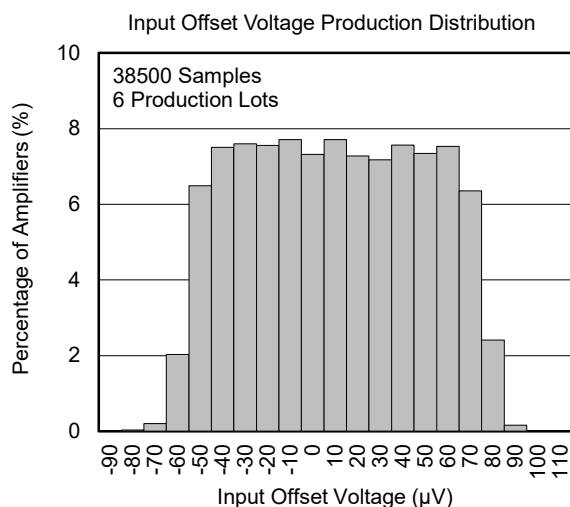
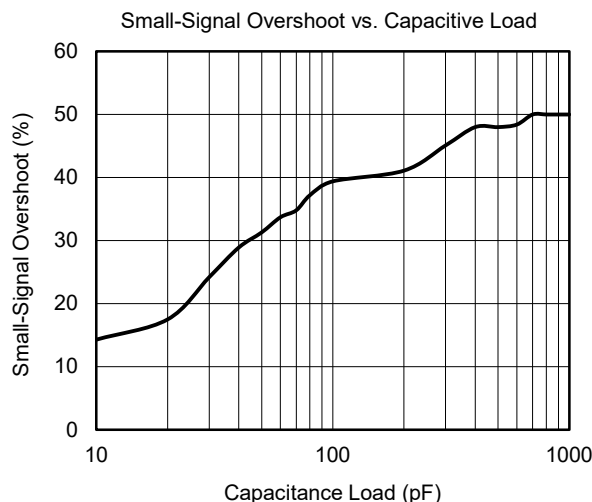
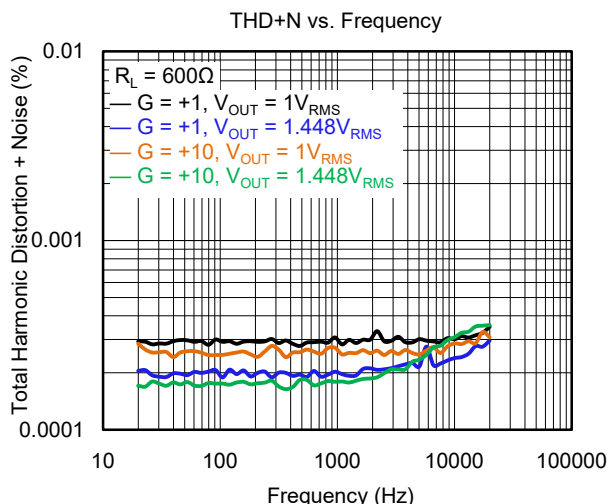
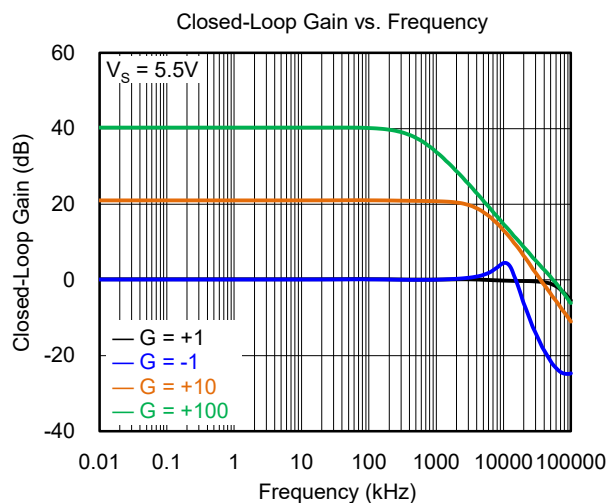
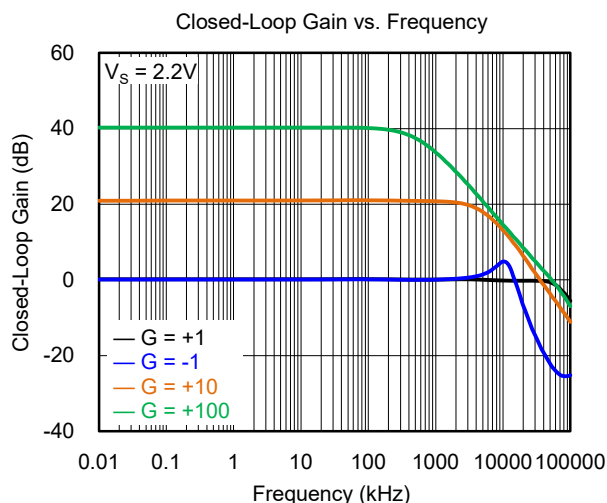
Open-Loop Gain and Phase vs. Frequency



# SGM8965A-2Q 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $V_{CM} = V_S/2$ , unless otherwise noted.



# SGM8965A-2Q 50MHz, Low Distortion, Rail-to-Rail I/O, Single-Supply, Automotive Operational Amplifier

## APPLICATION INFORMATION

### Basic Connection

The SGM8965A-2Q can operate on single supply or dual power supplies, as shown in Figure 1. This device is designed to be a basic inverting amplifier, whose gain is  $-10\text{V/V}$ . For single-supply operation, the output voltage takes input common mode voltage ( $V_{\text{CM}}$ ) as the

center voltage, which is  $1.5\text{V}$  as shown in the following circuit connection. Moreover, the input common mode voltage ( $V_{\text{CM}}$ ) is from  $(-V_{\text{S}}) - 0.1\text{V}$  to  $(+V_{\text{S}}) + 0.1\text{V}$ , and the output voltage can be any value in this range. For dual-supply operation, the output voltage takes  $0\text{V}$  as the center voltage.

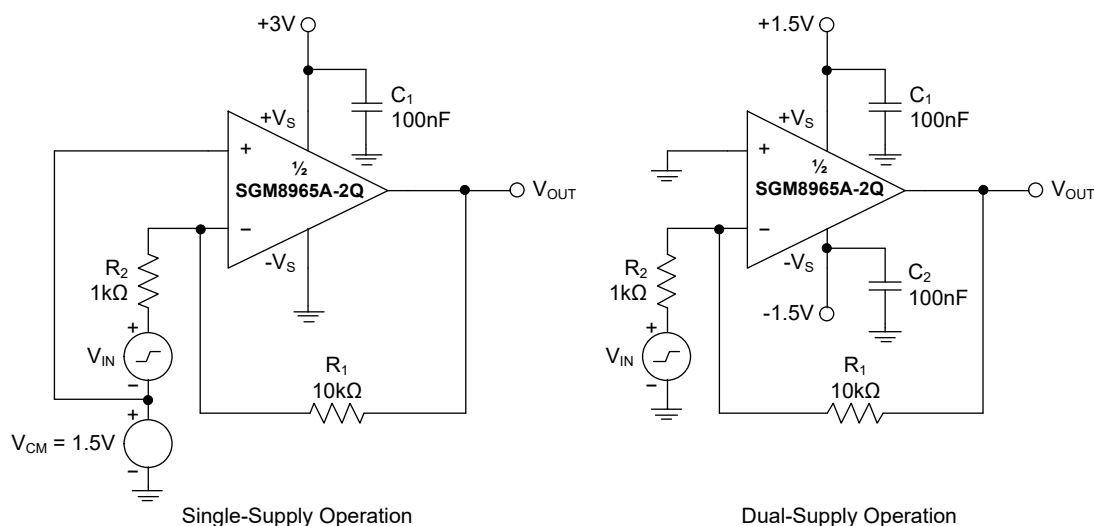


Figure 1. Basic Connections



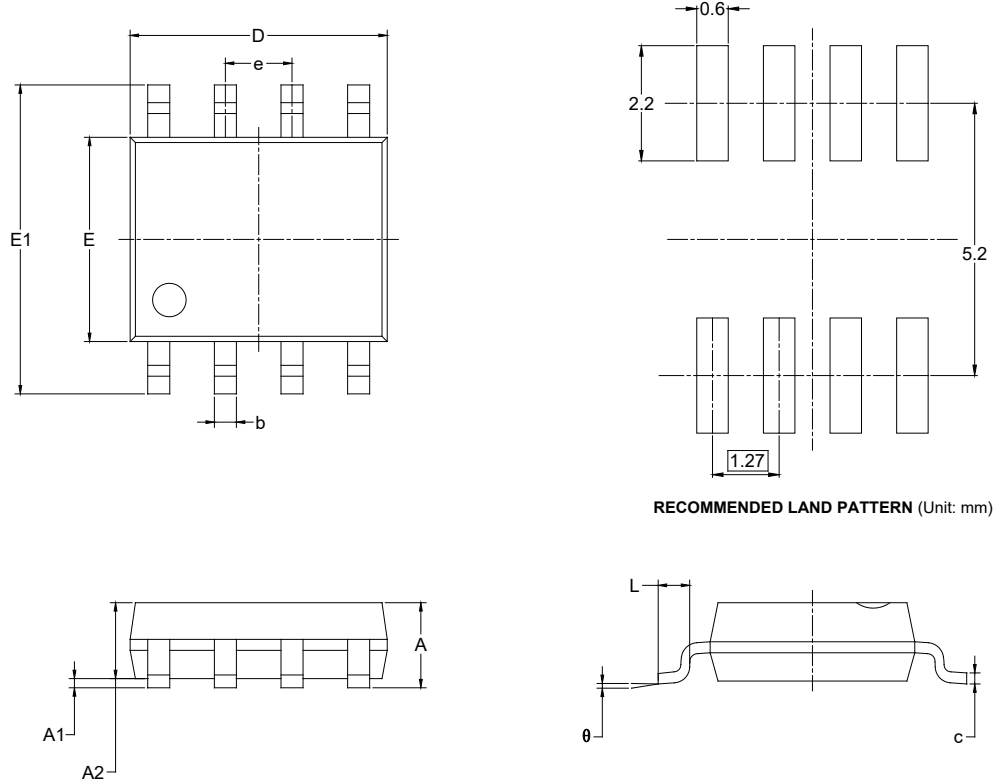
**REVISION HISTORY**

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

| <b>JANUARY 2026 – REV.A to REV.A.1</b>                    | <b>Page</b> |
|-----------------------------------------------------------|-------------|
| Updated Absolute Maximum Ratings section.....             | 2           |
| Updated Typical Performance Characteristics section ..... | 6, 7        |
| <hr/>                                                     |             |
| <b>Changes from Original to REV.A (DECEMBER 2023)</b>     | <b>Page</b> |
| Changed from product preview to production data.....      | All         |

## PACKAGE OUTLINE DIMENSIONS

### SOIC-8



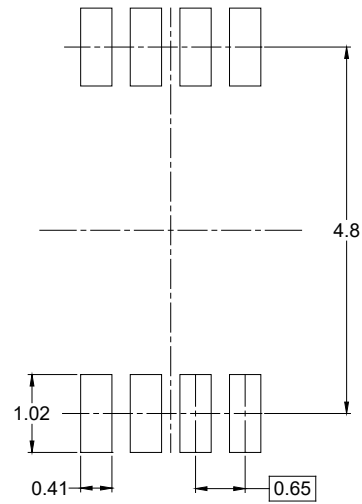
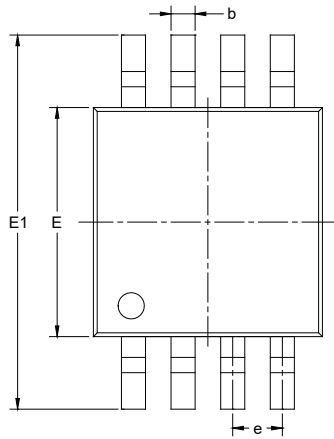
| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | MIN                          | MAX   | MIN                     | MAX   |
| A      | 1.350                        | 1.750 | 0.053                   | 0.069 |
| A1     | 0.100                        | 0.250 | 0.004                   | 0.010 |
| A2     | 1.350                        | 1.550 | 0.053                   | 0.061 |
| b      | 0.330                        | 0.510 | 0.013                   | 0.020 |
| c      | 0.170                        | 0.250 | 0.006                   | 0.010 |
| D      | 4.700                        | 5.100 | 0.185                   | 0.200 |
| E      | 3.800                        | 4.000 | 0.150                   | 0.157 |
| E1     | 5.800                        | 6.200 | 0.228                   | 0.244 |
| e      | 1.27 BSC                     |       | 0.050 BSC               |       |
| L      | 0.400                        | 1.270 | 0.016                   | 0.050 |
| θ      | 0°                           | 8°    | 0°                      | 8°    |

#### NOTES:

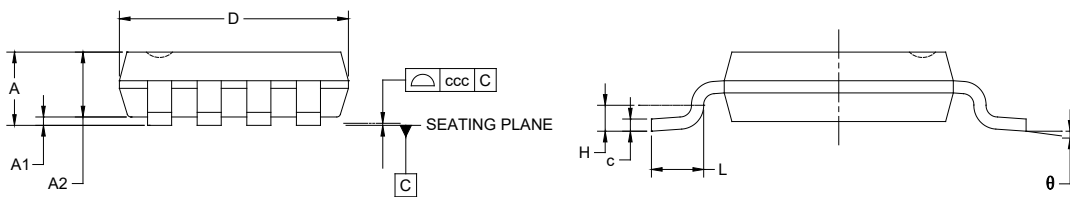
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

## PACKAGE OUTLINE DIMENSIONS

### MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)



| Symbol | Dimensions In Millimeters |     |       |
|--------|---------------------------|-----|-------|
|        | MIN                       | NOM | MAX   |
| A      | -                         | -   | 1.100 |
| A1     | 0.000                     | -   | 0.150 |
| A2     | 0.750                     | -   | 0.950 |
| b      | 0.220                     | -   | 0.380 |
| c      | 0.080                     | -   | 0.230 |
| D      | 2.800                     | -   | 3.200 |
| E      | 2.800                     | -   | 3.200 |
| E1     | 4.650                     | -   | 5.150 |
| e      | 0.650 BSC                 |     |       |
| L      | 0.400                     | -   | 0.800 |
| H      | 0.250 TYP                 |     |       |
| θ      | 0°                        | -   | 8°    |
| ccc    | 0.100                     |     |       |

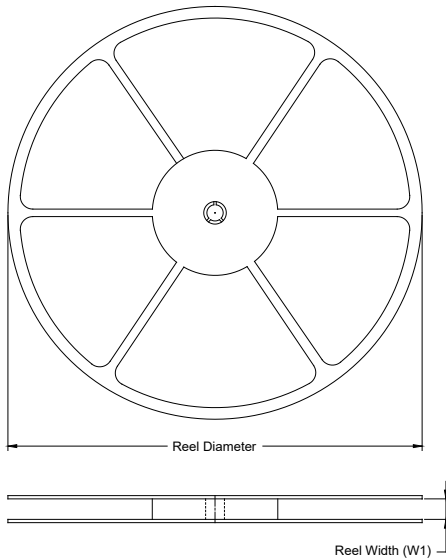
#### NOTES:

1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-187.

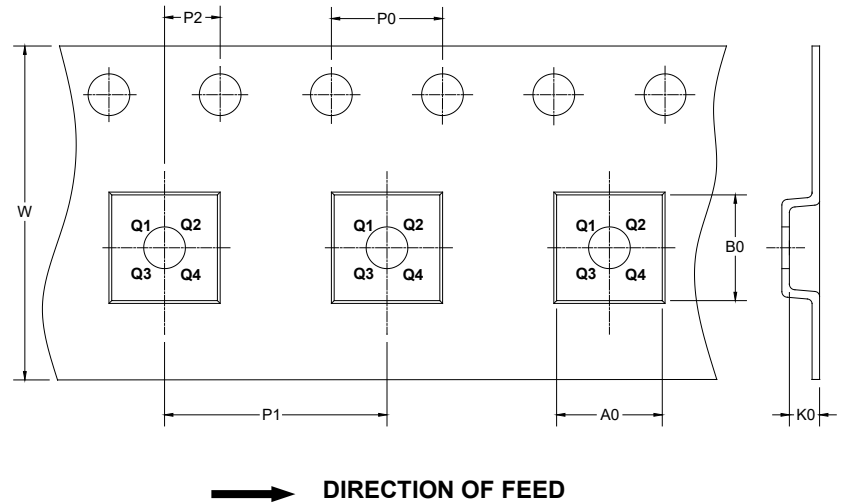
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



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

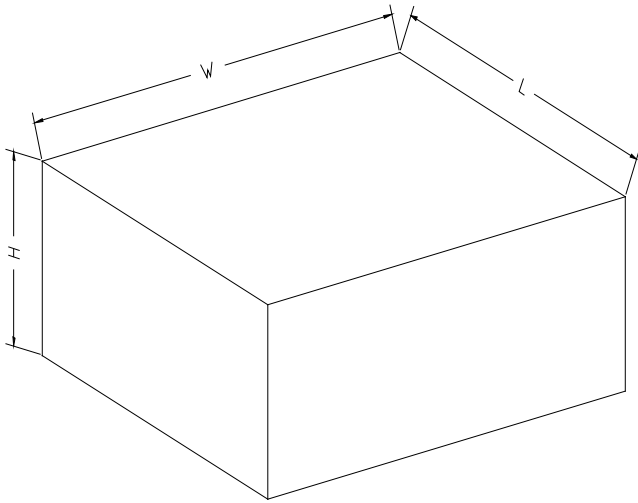
### KEY PARAMETER LIST OF TAPE AND REEL

| 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-8       | 13"           | 12.4               | 6.40    | 5.40    | 2.10    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |
| MSOP-8       | 13"           | 12.4               | 5.20    | 3.30    | 1.50    | 4.0     | 8.0     | 2.0     | 12.0   | Q1            |

DD00001

## 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<br>(mm) | Width<br>(mm) | Height<br>(mm) | Pizza/Carton |
|-----------|----------------|---------------|----------------|--------------|
| 13"       | 386            | 280           | 370            | 5            |

DD0002