



# SGM8045

## 710nA, Non-Unity Gain, Single Rail-to-Rail I/O Operational Amplifier

---

### GENERAL DESCRIPTION

The SGM8045 is a single, high precision operational amplifier which can operate from 1.4V to 5.5V single supply, while consuming only 710nA quiescent current. It provides rail-to-rail input and output operation. Therefore, the SGM8045 is suitable for use in portable instrumentation and battery-powered systems.

The SGM8045 is stable for gains  $\geq 10$ , and features a 100kHz gain-bandwidth product. It is designed to provide optimal performance in low frequency systems, when monitoring battery current and conditioning sensor signal.

The SGM8045 is available in Green SOT-23-5, SOIC-8 and MSOP-8 packages. It operates over an ambient temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

### FEATURES

- **Low Quiescent Current: 710nA (TYP)**
- **Rail-to-Rail Input and Output**
- **Gain-Bandwidth Product: 100kHz (TYP)**
- **Wide Supply Voltage Range: 1.4V to 5.5V**
- **Stable for Gains  $\geq 10$**
- **$-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  Operating Temperature Range**
- **Available in Green SOT-23-5, SOIC-8 and MSOP-8 Packages**

### APPLICATIONS

Temperature Measurements  
Toll Booth Tags  
Battery-Powered Systems  
Wearable Products

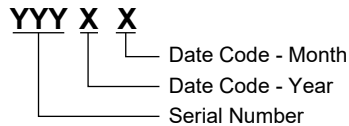
**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8045	SOT-23-5	-40°C to +85°C	SGM8045YN5G/TR	S25XX	Tape and Reel, 3000
	SOIC-8	-40°C to +85°C	SGM8045YS8G/TR	SGM8045YS8 XXXXX	Tape and Reel, 2500
	MSOP-8	-40°C to +85°C	SGM8045YMS8G/TR	SGM8045 YMS8 XXXXX	Tape and Reel, 3000

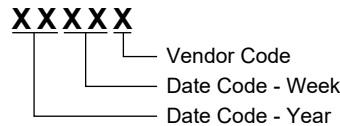
**MARKING INFORMATION**

NOTE: XX = Date Code. XXXXX = Date Code and Vendor Code.

**SOT-23-5**



**SOIC-8/MSOP-8**



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.....6V
- Analog Inputs (+IN, -IN)..... (-Vs) - 0.1V to (+Vs) + 0.1V
- Differential Input Voltage..... |(-Vs) - (+Vs)|
- Junction Temperature.....+150°C
- Storage Temperature Range .....-65°C to +150°C
- Lead Temperature (Soldering, 10s).....+260°C
- ESD Susceptibility
- HBM.....2000V
- MM.....400V

**RECOMMENDED OPERATING CONDITIONS**

- Operating Temperature Range .....-40°C to +85°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.

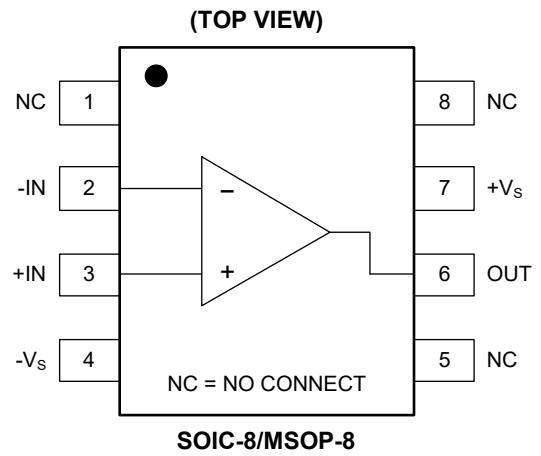
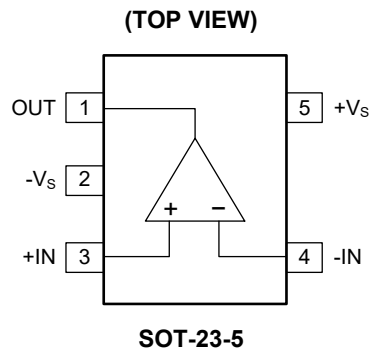
**ESD SENSITIVITY CAUTION**

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



**ELECTRICAL CHARACTERISTICS**

(At  $T_A = +25^\circ\text{C}$ ,  $+V_S = 1.4\text{V}$  to  $5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $A_V = 10$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC Electrical Characteristics</b>						
Input Offset Voltage	$V_{OS}$	$V_{CM} = +V_S/2$		0.4	2.5	mV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$V_{CM} = +V_S/2$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		2.5		$\mu\text{V}/^\circ\text{C}$
Power Supply Rejection Ratio	PSRR	$+V_S = 1.4\text{V}$ to $5.5\text{V}$	76	80		dB
Input Common Mode Voltage Range	$V_{CMR}$		$(-V_S) - 0.1$		$(+V_S) + 0.1$	V
Common Mode Rejection Ratio	CMRR	$+V_S = 5.0\text{V}$ , $V_{CM} = -0.1\text{V}$ to $5.1\text{V}$	68	84		dB
		$+V_S = 5.0\text{V}$ , $V_{CM} = 2.5\text{V}$ to $5.1\text{V}$	67	83		
		$+V_S = 5.0\text{V}$ , $V_{CM} = -0.1\text{V}$ to $2.5\text{V}$	63	78		
Large-Signal Voltage Gain	$A_{VO}$	$+V_S = 1.4\text{V}$ , $R_L = 50\text{k}\Omega$ , $V_{OUT} = (+V_S) - 0.1\text{V}$	70	80		dB
		$+V_S = 2.5\text{V}$ , $R_L = 50\text{k}\Omega$ , $V_{OUT} = (+V_S) - 0.1\text{V}$		88		
		$+V_S = 5.0\text{V}$ , $R_L = 50\text{k}\Omega$ , $V_{OUT} = (+V_S) - 0.1\text{V}$	80	93		
Input Bias Current	$I_B$			1		pA
Input Offset Current	$I_{OS}$			1		pA
Maximum Output Voltage Swing	$V_{OH}$	$+V_S = 1.4\text{V}$ , $R_L = 50\text{k}\Omega$	1.390	1.395		V
		$+V_S = 2.5\text{V}$ , $R_L = 50\text{k}\Omega$		2.497		
		$+V_S = 5.0\text{V}$ , $R_L = 50\text{k}\Omega$	4.990	4.997		
	$V_{OL}$	$+V_S = 1.4\text{V}$ , $R_L = 50\text{k}\Omega$		4.5	10	mV
		$+V_S = 2.5\text{V}$ , $R_L = 50\text{k}\Omega$		3.0		
		$+V_S = 5.0\text{V}$ , $R_L = 50\text{k}\Omega$		3.5	10	
Output Short-Circuit Current	$I_{SC}$	$+V_S = 2.5\text{V}$		5.5		mA
		$+V_S = 5.0\text{V}$	22	24		
Supply Voltage	$V_{CC}$		1.4		5.5	V
Quiescent Current	$I_Q$	$+V_S = 1.4\text{V}$		600		nA
		$+V_S = 2.5\text{V}$		660		
		$+V_S = 5.0\text{V}$		710	1500	

**ELECTRICAL CHARACTERISTICS (continued)**

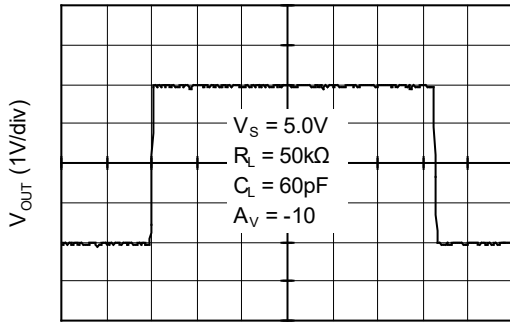
(At  $T_A = +25^\circ\text{C}$ ,  $+V_S = 1.4\text{V}$  to  $5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $A_v = 10$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ ,  $C_L = 60\text{pF}$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>AC Electrical Characteristics</b>						
Gain-Bandwidth Product	GBP			100		kHz
Slew Rate	SR	$+V_S = 1.4\text{V}$ , $V_{OUT} = 1\text{V}$ Step		13.5		V/ms
		$+V_S = 2.5\text{V}$ , $V_{OUT} = 1\text{V}$ Step		15		
		$+V_S = 5.0\text{V}$ , $V_{OUT} = 2\text{V}$ Step		16		
Phase Margin	PM	$+V_S = 1.4\text{V}$ to $5.5\text{V}$		60		$^\circ$
Input Voltage Noise	$e_n$ p-p	$+V_S = 1.4\text{V}$ , $f = 0.1\text{Hz}$ to $10\text{Hz}$		3.6		$\mu\text{V}_{P-P}$
		$+V_S = 2.5\text{V}$ , $f = 0.1\text{Hz}$ to $10\text{Hz}$		3.2		
		$+V_S = 5.0\text{V}$ , $f = 0.1\text{Hz}$ to $10\text{Hz}$		3.2		
Input Voltage Noise Density	$e_n$	$+V_S = 1.4\text{V}$ , $f = 1\text{kHz}$		170		$\text{nV}/\sqrt{\text{Hz}}$
		$+V_S = 2.5\text{V}$ , $f = 1\text{kHz}$		160		
		$+V_S = 5.0\text{V}$ , $f = 1\text{kHz}$		160		

TYPICAL PERFORMANCE CHARACTERISTICS

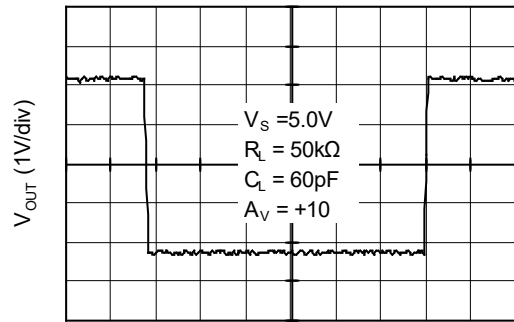
At  $T_A = +25^\circ\text{C}$ ,  $+V_S = 1.4\text{V}$  to  $5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $A_V = 10$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ ,  $C_L = 60\text{pF}$ , unless otherwise noted.

Large Signal Inverting Pulse Response



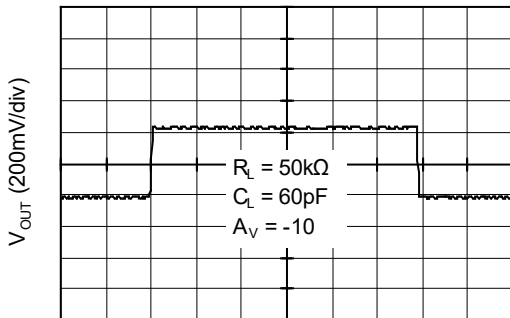
Time (5ms/div)

Large Signal Non-Inverting Pulse Response



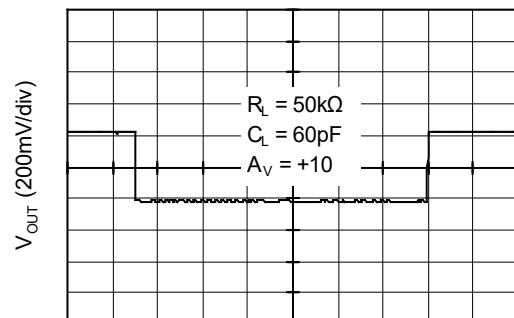
Time (5ms/div)

Small Signal Inverting Pulse Response



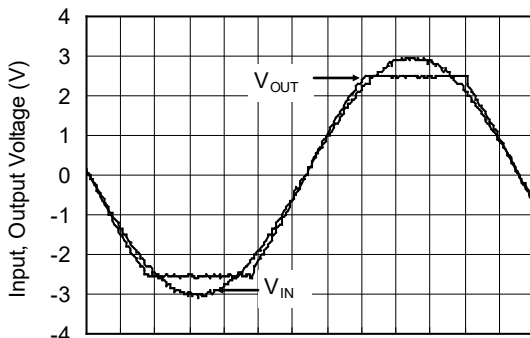
Time (5ms/div)

Small Signal Non-Inverting Pulse Response



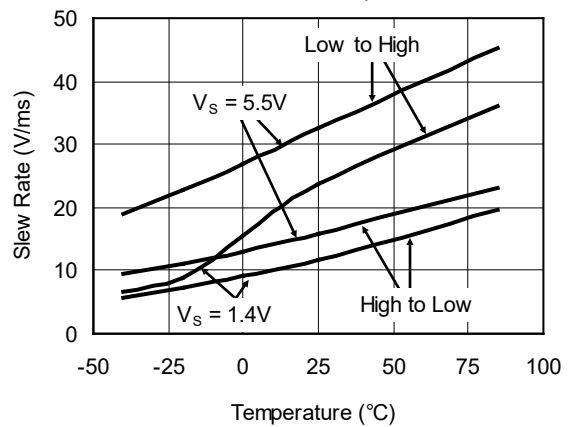
Time (5ms/div)

No Phase Reversal



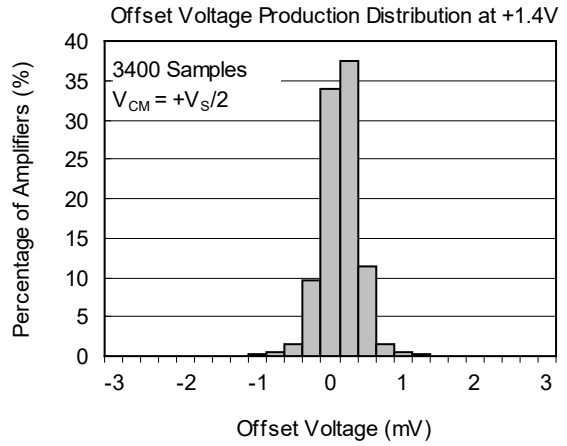
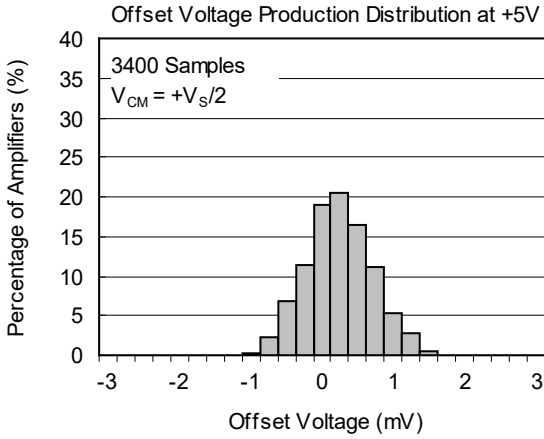
Time (5ms/div)

Slew Rate vs. Temperature



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At  $T_A = +25^\circ\text{C}$ ,  $+V_S = 1.4\text{V}$  to  $5.0\text{V}$ ,  $-V_S = \text{GND}$ ,  $A_V = 10$ ,  $V_{CM} = +V_S/2$ ,  $V_{OUT} \approx +V_S/2$  and  $R_L = 1\text{M}\Omega$  to  $+V_S/2$ ,  $C_L = 60\text{pF}$ , unless otherwise noted.



**REVISION HISTORY**

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

<b>JANUARY 2013 – REV.A.1 to REV.A.2</b>	<b>Page</b>
Added Tape and Reel Information section .....	10~11

---

<b>MAY 2011 – REV.A to REV.A.1</b>	<b>Page</b>
Updated Package Description .....	All

---

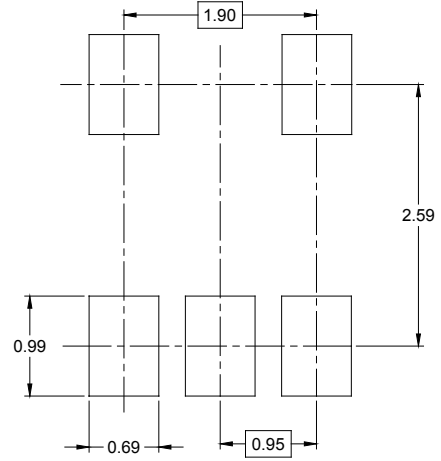
<b>Changes from Original (APRIL 2010) to REV.A</b>	<b>Page</b>
Changed from product preview to production data.....	All

---



PACKAGE OUTLINE DIMENSIONS

SOT-23-5



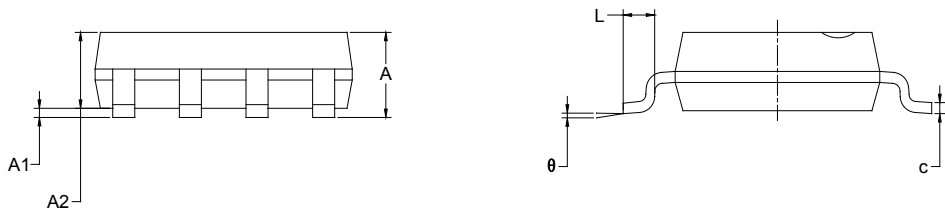
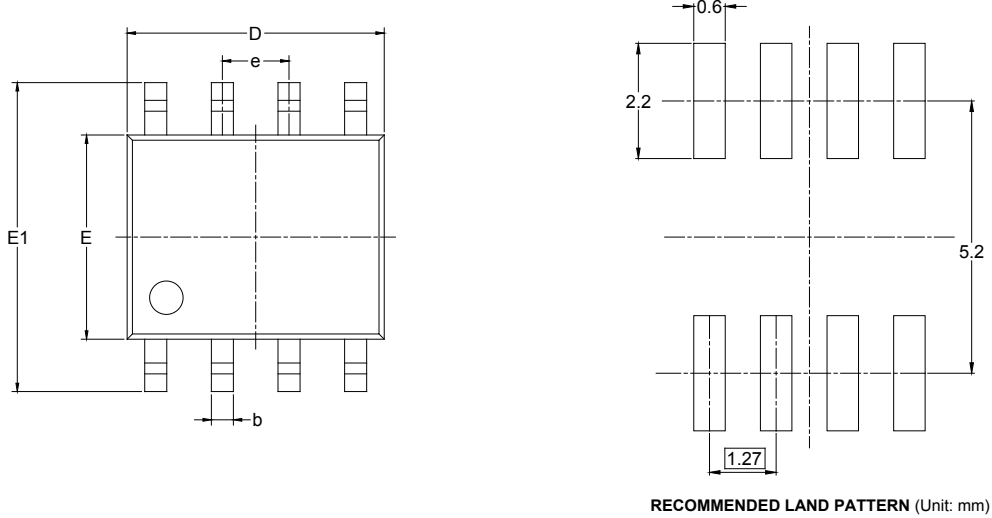
RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
$\theta$	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

SOIC-8



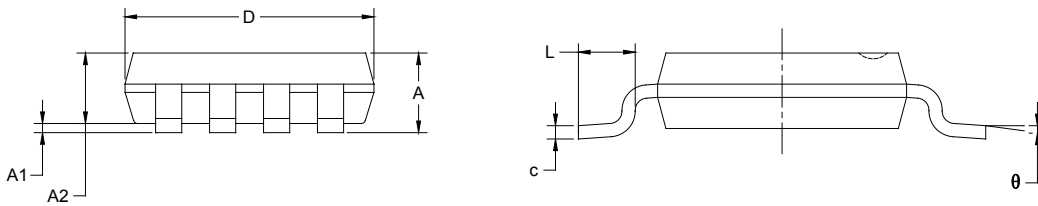
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

# 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
SOT-23-5	7"	9.5	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3
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

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
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

DD0002