



# SGM8416-1/SGM8416-2/SGM8416-4

## 24V, 800mA Peak Output Current

### Rail-to-Rail I/O Operational Amplifiers

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#### GENERAL DESCRIPTION

The SGM8416-1, SGM8416-2 and SGM8416-4 are low power, high slew rate, dual or single power supply, rail-to-rail input and output operational amplifiers.

The SGM8416-1 contains single amplifier, the SGM8416-2 contains dual amplifiers and SGM8416-4 contains quad amplifiers. The SGM8416-1/2/4 have a high slew rate (65V/ $\mu$ s), 800mA peak output current and offset voltage below 10mV. The SGM8416-1/2/4 are ideal for Thin Film Transistors Liquid Crystal Displays (TFT LCD).

The single SGM8416-1 is available in Green TDFN-3 $\times$ 3-8L package. The dual SGM8416-2 is available in Green MSOP-8 (Exposed Pad) package. The quad SGM8416-4 is offered in Green TSSOP-14 (Exposed Pad) package. They are specified over the -40°C to +85°C temperature range.

#### FEATURES

- Rail-to-Rail Output Swing
- Rail-to-Rail Input
- Supply Voltage Range: 4.5V to 26.5V
- Peak Output Current: 800mA
- High Slew Rate: 65V/ $\mu$ s
- Unity Gain Stable
- -40°C to +85°C Operating Temperature Range
- Small Packaging:
  - SGM8416-1 Available in Green TDFN-3 $\times$ 3-8L
  - SGM8416-2 Available in Green MSOP-8 (Exposed Pad)
  - SGM8416-4 Available in Green TSSOP-14 (Exposed Pad)

#### APPLICATIONS

TFT LCD Panels  
Notebook Computers  
Monitors  
LCD TVs

**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8416-1	TDFN-3x3-8L	-40°C to +85°C	SGM8416-1YTDB8G/TR	SGM G69DB XXXXX	Tape and Reel, 4000
SGM8416-2	MSOP-8 (Exposed Pad)	-40°C to +85°C	SGM8416-2YPMS8G/TR	SGM84162 YPMS8 XXXXX	Tape and Reel, 4000
SGM8416-4	TSSOP-14 (Exposed Pad)	-40°C to +85°C	SGM8416-4YPTS14G/TR	SGM84164 YPTS14 XXXXX	Tape and Reel, 4000

NOTE: XXXXXX = Date Code and Vendor Code.

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<sub>S</sub> to -V<sub>S</sub>)..... -0.3V to 28V  
 Input/Output Voltage to -V<sub>S</sub>..... -0.3V to (+V<sub>S</sub> + 0.3V)  
 +IN to -IN ..... ±5V  
 Package Thermal Resistance  
 TDFN-3x3-8L, θ<sub>JA</sub>..... 84°C/W  
 MSOP-8 (Exposed Pad), θ<sub>JA</sub>..... 82°C/W  
 TSSOP-14 (Exposed Pad), θ<sub>JA</sub>..... 50°C/W  
 Storage Temperature Range ..... -65°C to +150°C  
 Junction Temperature ..... +150°C  
 Lead Temperature (soldering, 10s)..... +260°C  
 ESD Susceptibility  
 HBM..... 8000V  
 MM..... 300V  
 CDM ..... 1000V

**RECOMMENDED OPERATING CONDITIONS**

Supply Voltage Range ..... 4.5V to 26.5V  
 Operating Temperature Range ..... -40°C to +85°C

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. 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 very small parametric changes could cause the device not to meet its published specifications.

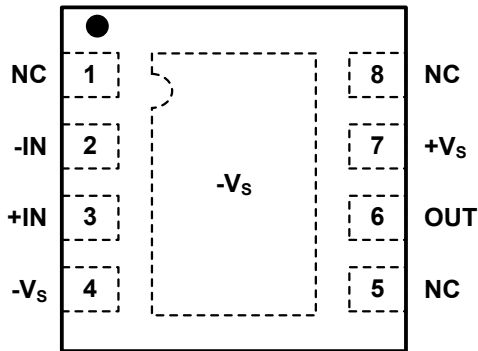
**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

**PIN CONFIGURATIONS**

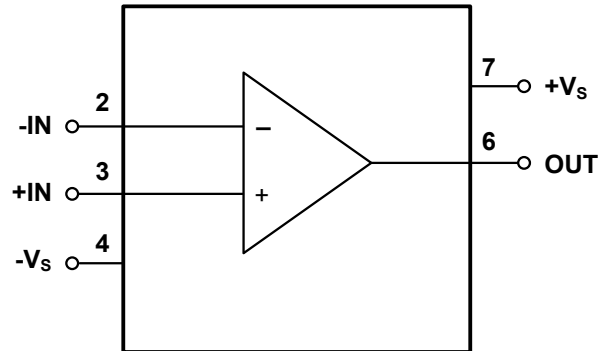
**FUNCTIONAL BLOCK DIAGRAMS**

**SGM8416-1 (TOP VIEW)**

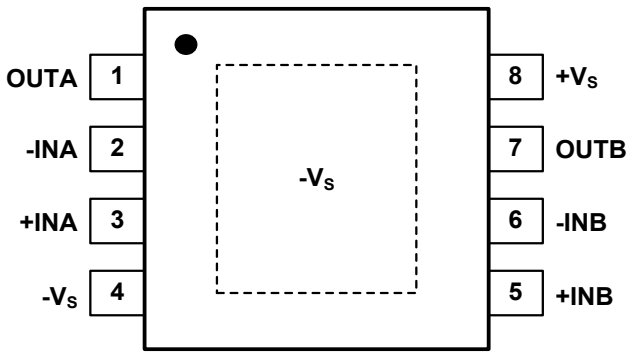


TDFN-3x3-8L

**SGM8416-1**

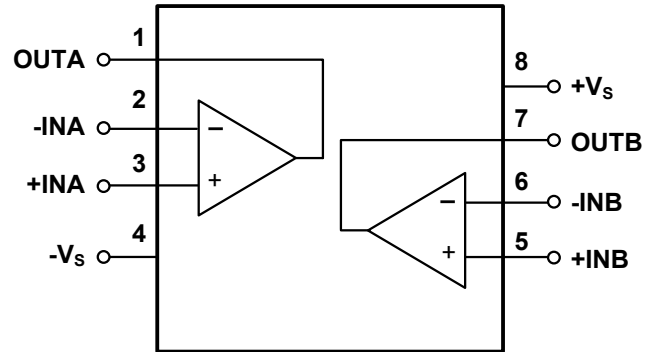


**SGM8416-2 (TOP VIEW)**

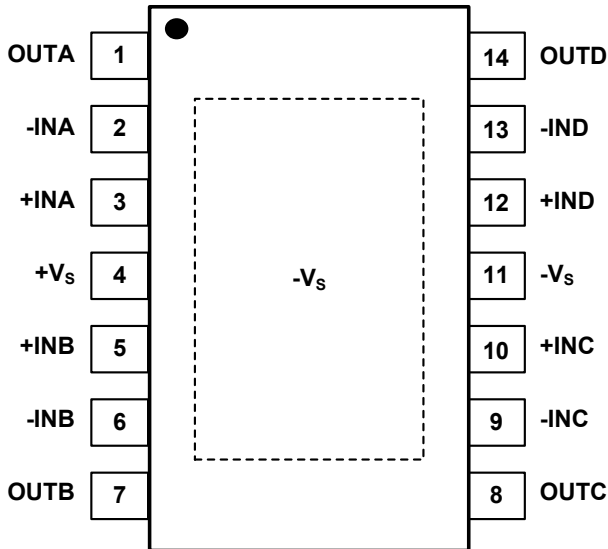


MSOP-8 (Exposed Pad)

**SGM8416-2**

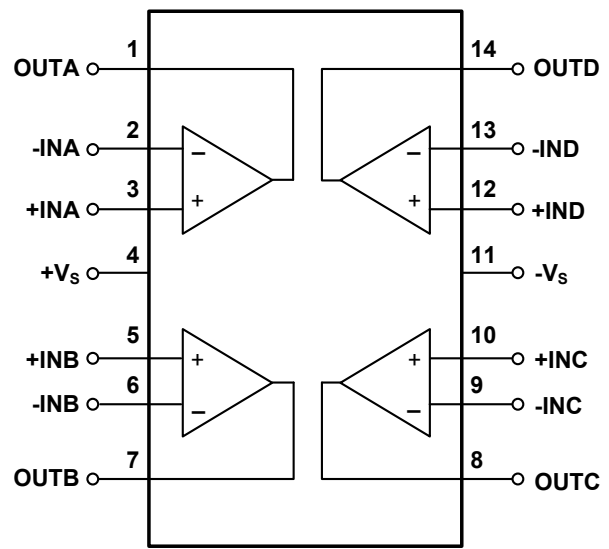


**SGM8416-4 (TOP VIEW)**



TSSOP-14 (Exposed Pad)

**SGM8416-4**



**NOTE:**

For all packages, connect thermal die pad to  $-V_s$ . Soldering the thermal pad improves heat dissipation and provides specified performance.

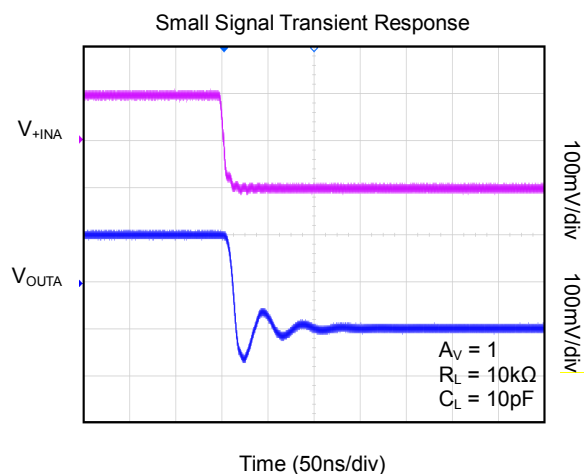
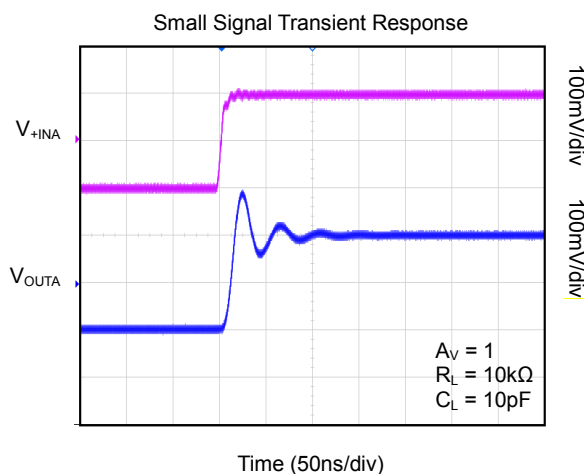
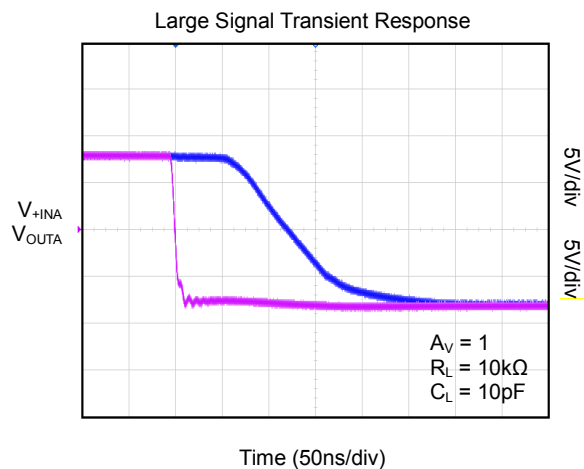
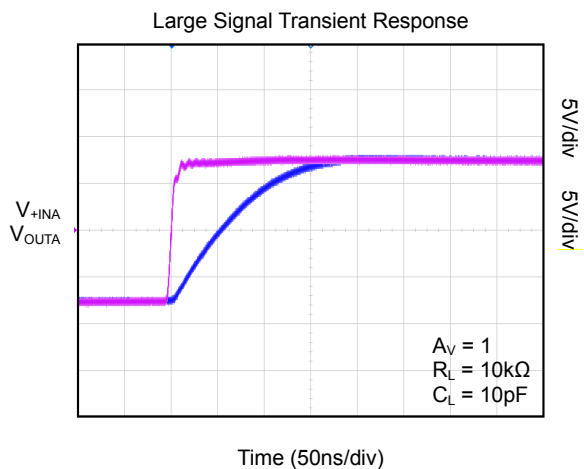
## ELECTRICAL CHARACTERISTICS

( $+V_S = 16V$ ,  $-V_S = 0V$ ,  $+V_{IN} = V_{OUT} = +V_S/2$ ,  $T_A = +25^\circ C$ , unless otherwise specified.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>INPUT CHARACTERISTICS</b>						
Supply Voltage Range			4.5		26.5	V
Input Offset Voltage	$V_{OS}$	$V_{CM} = +V_S/2$		2	10	mV
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$V_{CM} = +V_S/2$		3.6		$\mu V/^\circ C$
Input Bias Current	$I_B$	$V_{CM} = +V_S/2$		1		nA
Load Regulation	$\Delta V_{LOAD}$	$I_{OUT} = 0mA$ to $-80mA$		0.01		mV/mA
		$I_{OUT} = 0mA$ to $80mA$		-0.01		
Input Common Mode Voltage Range	$V_{CM}$		-0.1		$+V_S + 0.1$	V
Common Mode Rejection Ratio	CMRR	$-0.1V \leq V_{CM} \leq +V_S + 0.1V$		72		dB
Open-Loop Voltage Gain	$A_{OL}$	$0.5V \leq V_{OUT} \leq +V_S - 0.5V$		120		dB
<b>OUTPUT CHARACTERISTICS</b>						
Output Swing Low	$V_{OL}$	$I_L = -50mA$		0.26	0.34	V
Output Swing High	$V_{OH}$	$I_L = 50mA$	$+V_S - 0.55$	$+V_S - 0.42$		V
Transient Peak Output Current	$I_{PK}$			$\pm 800$		mA
Continuous Output Current	$I_O$			$\pm 300$		mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$+V_S = 4.5V$ to $26.5V$ , $V_{CM} = 3V$		94		dB
Quiescent Current/Amplifier	$I_Q$	No Load		2.6		mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	4V Step, $C_L = 50pF$ , $R_L = 10k\Omega$ , 20% to 80%, $A_V = 1$		65		V/ $\mu s$
Setting to $\pm 0.1\%$ ( $A_V = 1$ )	$t_S$	$A_V = 1$ , $V_{OUT} = 2V$ Step, $R_L = 10k\Omega$ , $C_L = 10pF$		160		ns
-3dB Bandwidth	BW	$R_L = 10k\Omega$ , $C_L = 10pF$		50		MHz
Gain-Bandwidth Product	GBP	$R_L = 10k\Omega$ , $C_L = 10pF$		25		MHz
Phase Margin		$R_L = 10k\Omega$ , $C_L = 10pF$		30		$^\circ$
<b>NOISE PERFORMANCE</b>						
Voltage Noise Density	$e_n$	$f = 1kHz$		115		$nV/\sqrt{Hz}$
<b>THERMAL PROTECTION</b>						
Thermal Shutdown Temperature	$T_{SHDN}$			150		$^\circ C$
Thermal Shutdown Hysteresis	$\Delta T_{SHDN}$			25		$^\circ C$

**TYPICAL PERFORMANCE CHARACTERISTICS**

+V<sub>S</sub> = 16V, -V<sub>S</sub> = 0V, T<sub>A</sub> = +25°C, unless otherwise specified.



## APPLICATION INFORMATION

The SGM8416-1/2/4 are high performance operational amplifiers capable of driving large loads for different applications. A high slew rate, rail-to-rail input and output capability, and low power consumption are the features which make the SGM8416-1/2/4 ideal for LCD applications.

### Operating Voltage

The SGM8416-1/2/4 total supply voltage range is guaranteed from 4.5V to 26.5V. The specifications are stable over both the full supply range and operating temperatures from -40°C to +85°C. Decreasing the load current will obtain an output swing even closer to the supply rails.

### LCD Panel Application

The SGM8416-1/2/4 are mainly designed for LCD  $V_{COM}$  buffer. The operational amplifiers have  $\pm 800\text{mA}$  instantaneous peak source/sink current.

### Thermal Consideration

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperatures.

The maximum power dissipation can be calculated by the following formula:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where  $T_{J(MAX)}$  is the maximum junction temperature,  $T_A$  is the ambient temperature, and  $\theta_{JA}$  is the junction to ambient thermal resistance.

For recommended operating condition specifications of the SGM8416-1/2/4, the maximum junction temperature is +150°C. The junction to ambient thermal resistance,  $\theta_{JA}$ , is layout dependent.

The maximum power dissipation depends on the operating ambient temperature for fixed  $T_{J(MAX)}$  and thermal resistance,  $\theta_{JA}$ .

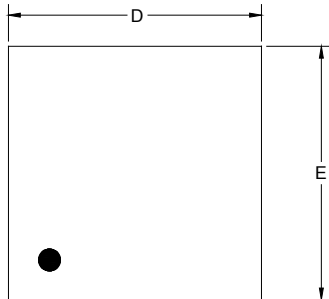
### Layout Consideration

PCB layout is very important for designing high power circuits. The following layout guidelines should be strictly followed for best performance of the SGM8416-1/2/4.

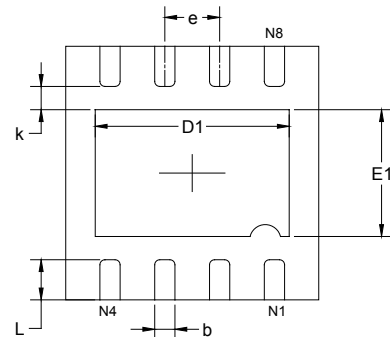
1. Place the power components as close to the IC as possible. The traces should be wide and short, especially for the high current loop.
2. A series resistance may be needed at the output for some applications.
3. Proper supply bypassing ensures stability while driving high transient loads. For single-supply operation, bypass the power supply  $+V_S$  to  $-V_S$  with a  $0.1\mu\text{F}$  ceramic capacitor which should be placed close to the  $+V_S$  pin. For dual-supply operation, both the  $+V_S$  and the  $-V_S$  supplies should be bypassed to ground with separate  $0.1\mu\text{F}$  ceramic capacitors. A  $10\mu\text{F}$  tantalum capacitor in parallel can be beneficial when delivering high transient output current.
4. Connect a  $0.1\mu\text{F}$  capacitor from +IN to ground and place it as close to the IC as possible for better performance.
5. The exposed pad of the chip must be connected to  $-V_S$  plane for maximum thermal consideration.

PACKAGE OUTLINE DIMENSIONS

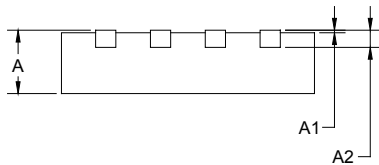
TDFN-3x3-8L



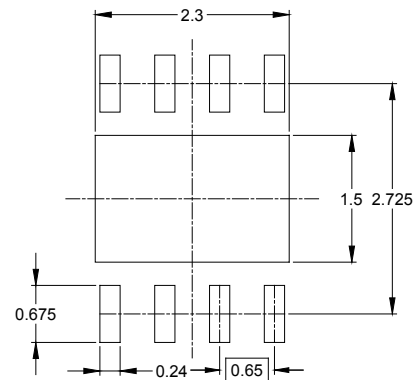
TOP VIEW



BOTTOM VIEW



SIDE VIEW

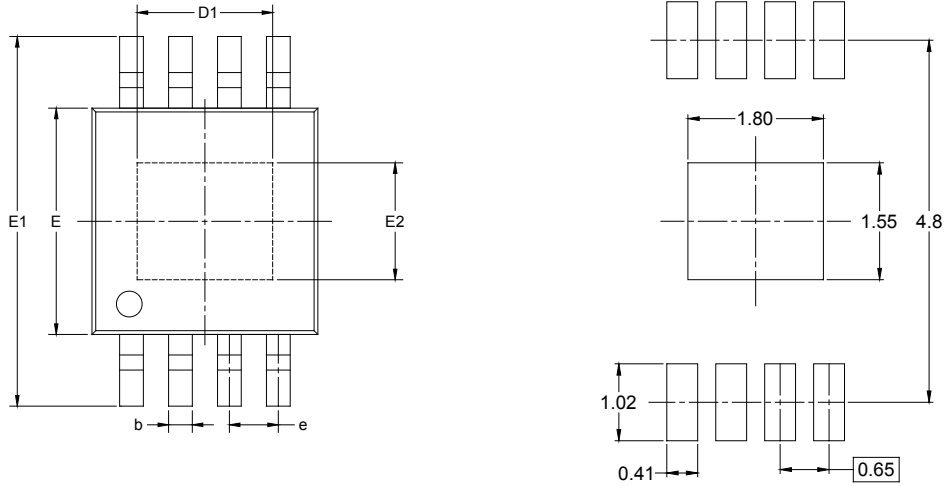


RECOMMENDED LAND PATTERN (Unit: mm)

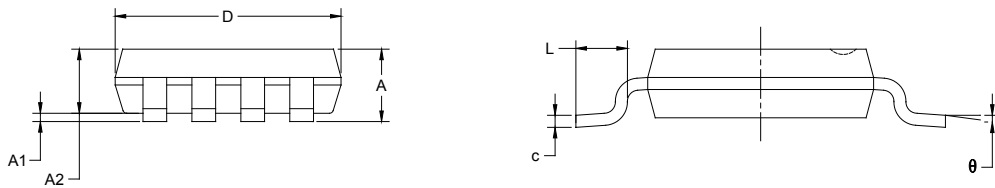
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	2.200	2.400	0.087	0.094
E	2.900	3.100	0.114	0.122
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.650 TYP		0.026 TYP	
L	0.375	0.575	0.015	0.023

PACKAGE OUTLINE DIMENSIONS

MSOP-8 (Exposed Pad)



RECOMMENDED LAND PATTERN (Unit: mm)

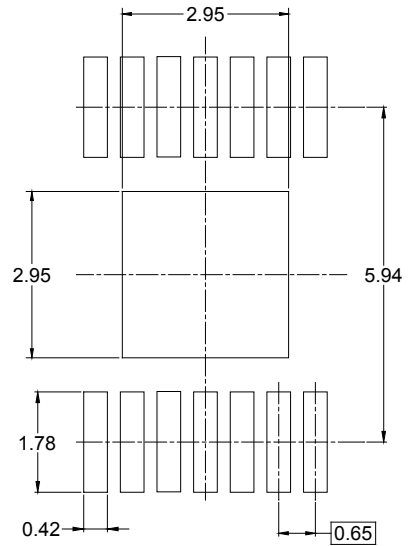
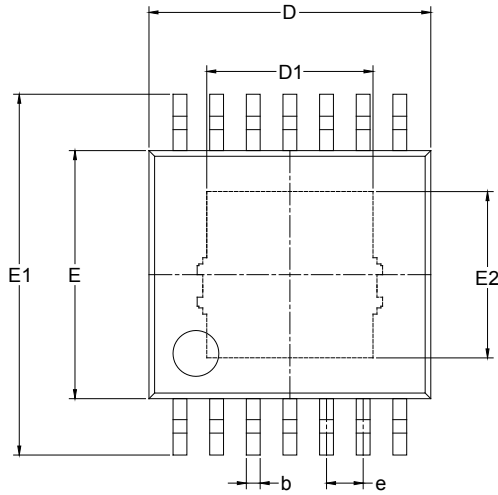


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
D1	1.700	1.900	0.067	0.075
e	0.65 BSC		0.026 BSC	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
E2	1.450	1.650	0.057	0.065
L	0.400	0.800	0.016	0.031
$\theta$	0°	6°	0°	6°

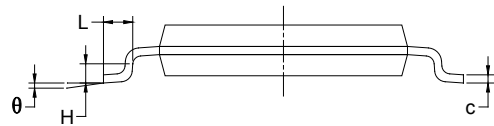
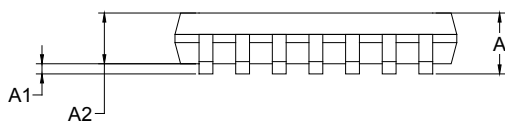


PACKAGE OUTLINE DIMENSIONS

TSSOP-14 (Exposed Pad)



RECOMMENDED LAND PATTERN (Unit: mm)



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	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
D1	2.850	3.050	0.112	0.120
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
E2	2.850	3.050	0.112	0.120
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.020	0.028
H	0.250 TYP		0.010 TYP	
θ	1°	7°	1°	7°

# 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
TDFN-3×3-8L	13"	12.4	3.35	3.35	1.13	4.00	8.00	2.00	12.00	Q1
MSOP-8 (Exposed Pad)	13"	12.4	5.2	3.3	1.5	4.0	8.0	2.0	12.0	Q1
TSSOP-14 (Exposed Pad)	13"	12.4	7.0	5.6	1.2	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