



# SGM8425/SGM8426/SGM8428 18MHz, High Voltage, Rail-to-Rail I/O Operational Amplifiers

## GENERAL DESCRIPTION

The SGM8425 (single), SGM8426 (dual) and SGM8428 (quad) are low power, high voltage, rail-to-rail input and output operational amplifiers. These devices can operate from  $\pm 2.25V$  to  $\pm 15V$  dual power supplies or from 4.5V to 30V single supply.

The SGM8425/6/8 have a bandwidth of 18MHz (-3dB), while consuming only 1.6mA per amplifier. They also provide common mode input ability beyond the supply rails, as well as rail-to-rail output capability. This enables the SGM8425/6/8 to offer maximum dynamic range at any supply voltage.

The SGM8425/6/8 also feature fast slewing and settling times. These features make these amplifiers ideal for use as voltage reference buffers in Thin Film Transistor Liquid Crystal Displays (TFT-LCD). Other applications include battery power, portable devices, and anywhere low power consumption is important.

The SGM8425 single is available in Green SOT-23-5, SOIC-8 and MSOP-8 packages. The SGM8426 dual is available in Green SOIC-8 and MSOP-8 packages. The SGM8428 quad is available in Green TSSOP-14 and SOIC-14 packages. They are rated over the  $-40^{\circ}C$  to  $+85^{\circ}C$  temperature range.

## FEATURES

- **-3dB Bandwidth: 18MHz**
- **Supply Current: 1.6mA/Amplifier**
- **High Slew Rate: 16V/ $\mu$ s**
- **Beyond the Rails Input Capability**
- **Rail-to-Rail Output Swing**
- **$-40^{\circ}C$  to  $+85^{\circ}C$  Operating Temperature Range**
- **Small Packaging:**
  - SGM8425 Available in SOT-23-5, SOIC-8 and MSOP-8 Packages**
  - SGM8426 Available in SOIC-8 and MSOP-8 Packages**
  - SGM8428 Available in SOIC-14 and TSSOP-14 Packages**

## APPLICATIONS

TFT-LCD Drive Circuits  
Electronics Notebooks  
Electronics Games  
Touch-Screen Displays  
Wireless LANs  
Office Automation  
Personal Communication Devices  
Personal Digital Assistants (PDAs)  
Portable Instrumentation  
A/D Converter Buffers  
Active Filters



**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage, +V <sub>S</sub> to -V <sub>S</sub> .....	32V
Input Common Mode Voltage Range .....	(-V <sub>S</sub> ) - 0.1V to (+V <sub>S</sub> ) + 0.1V
Input/Output Voltage Range .....	(-V <sub>S</sub> ) - 0.3V to (+V <sub>S</sub> ) + 0.3V
Junction Temperature .....	+150°C
Storage Temperature Range .....	-65°C to +150°C
Lead Temperature (Soldering, 10s) .....	+260°C
ESD Susceptibility	
HBM (SGM8425/6) .....	3000V
MM (SGM8425/6) .....	150V
HBM (SGM8428) .....	4000V
MM (SGM8428) .....	250V

**RECOMMENDED OPERATING CONDITIONS**

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

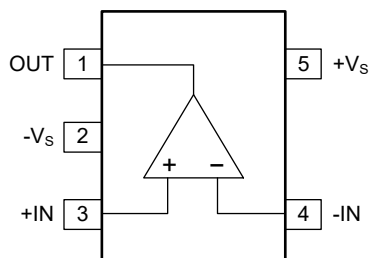
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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, or specifications without prior notice.

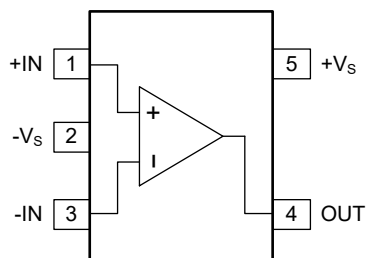
**PIN CONFIGURATIONS**

**SGM8425AYN5G (TOP VIEW)**



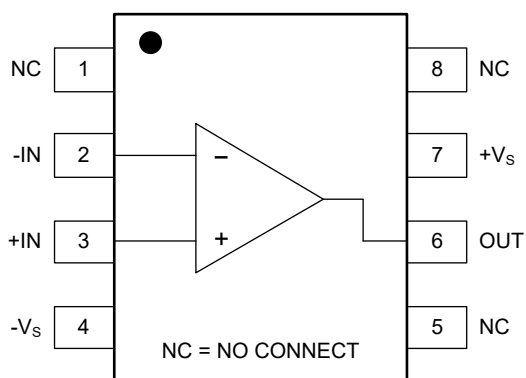
**SOT-23-5**

**SGM8425BYN5G (TOP VIEW)**



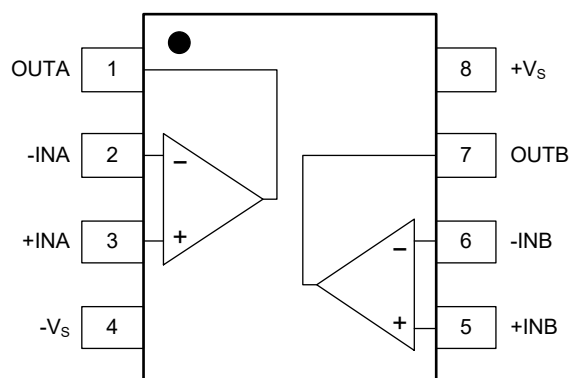
**SOT-23-5**

**SGM8425 (TOP VIEW)**



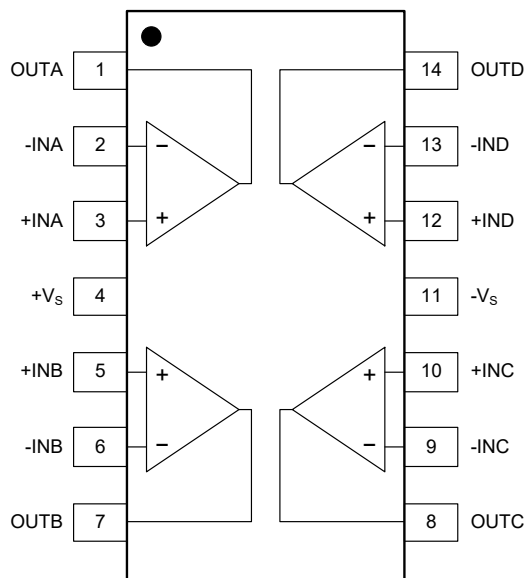
**SOIC-8/MSOP-8**

**SGM8426 (TOP VIEW)**



**SOIC-8/MSOP-8**

**SGM8428 (TOP VIEW)**



**SOIC-14/TSSOP-14**

**ELECTRICAL CHARACTERISTICS**

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 5\text{V}$ ,  $R_L = 2\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8425/6/8					
		TYP	MIN/MAX OVER TEMPERATURE			UNITS	MIN/MAX
		+25°C	+25°C	-40°C to +85°C			
<b>Input Characteristics</b>							
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = V_S/2$	1.0	6.5	7.5	mV	MAX	
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )		4.9			$\mu\text{V}/^\circ\text{C}$	TYP	
Input Common Mode Voltage Range ( $V_{CM}$ )		-0.1 to 5.1			V	TYP	
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1\text{V to } 5.1\text{V}$	62	47	45	dB	MIN	
Open-Loop Voltage Gain ( $A_{OL}$ )	$V_{OUT} = 0.5\text{V to } 4.5\text{V}$	94	77	75	dB	MIN	
<b>Output Characteristics</b>							
Output Voltage Swing from Rail	$V_{OH}$   $I_{OUT} = 5\text{mA}$	78	116	161	mV	MAX	
	$V_{OL}$   $I_{OUT} = -5\text{mA}$	83	120	165	mV	MAX	
Output Short-Circuit Current ( $I_{SC}$ )	Sink   $R_L = 10\Omega \text{ to } V_S/2$	93	72		mA	MIN	
	Source   $R_L = 10\Omega \text{ to } V_S/2$	97	74				
<b>Power Supply</b>							
Power Supply Rejection Ratio (PSRR)	$V_S = 4.5\text{V to } 30\text{V}$ , $V_{CM} = V_S/2$	98	84	78	dB	MIN	
Quiescent Current/Amplifier ( $I_Q$ )	$I_{OUT} = 0\text{A}$	1.5	2.1	3.3	mA	MAX	
<b>Dynamic Performance</b>							
Gain-Bandwidth Product (GBP)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	9			MHz	TYP	
-3dB Bandwidth (BW)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	18			MHz	TYP	
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$	13			$\text{V}/\mu\text{s}$	TYP	
Phase Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	35			$^\circ$	TYP	
Gain Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	-5			dB	TYP	
Crosstalk	$f = 5\text{MHz}$	78			dB	TYP	
Settling Time ( $t_s$ )	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$ , Test Circuit 1	0.37			$\mu\text{s}$	TYP	
<b>Noise Performance</b>							
Input Voltage Noise Density ( $e_n$ )	$f = 1\text{kHz}$ , $V_{CM} = V_S/2$	80			$\text{nV}/\sqrt{\text{Hz}}$	TYP	
	$f = 10\text{kHz}$ , $V_{CM} = V_S/2$	36					

**ELECTRICAL CHARACTERISTICS (continued)**

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = 15\text{V}$ ,  $R_L = 2\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8425/6/8					
		TYP	MIN/MAX OVER TEMPERATURE			UNITS	MIN/MAX
		+25°C	+25°C	-40°C to +85°C			
<b>Input Characteristics</b>							
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = V_S/2$	1.0	6.5	7.4	mV	MAX	
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )		4.9			$\mu\text{V}/^\circ\text{C}$	TYP	
Input Common Mode Voltage Range ( $V_{CM}$ )		-0.1 to 15.1			V	TYP	
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -0.1\text{V to } 15.1\text{V}$	71	57	55	dB	MIN	
Open-Loop Voltage Gain ( $A_{OL}$ )	$V_{OUT} = 0.5\text{V to } 14.5\text{V}$	92	80	75	dB	MIN	
<b>Output Characteristics</b>							
Output Voltage Swing from Rail	$V_{OH}$ $I_{OUT} = 5\text{mA}$	84	133	164	mV	MAX	
	$V_{OL}$ $I_{OUT} = -5\text{mA}$	84	121	181	mV	MAX	
Transient Peak Output Current ( $I_{PK}$ ) (1)	Sink $V_S = 19\text{V}$ , Test Circuit 1	336			mA	TYP	
	Source $V_S = 19\text{V}$ , Test Circuit 1	227					
Output Current ( $I_{OUT}$ )		80			mA	TYP	
<b>Power Supply</b>							
Quiescent Current/Amplifier ( $I_Q$ )	$I_{OUT} = 0\text{A}$	1.6	2.2	3.4	mA	MAX	
<b>Dynamic Performance</b>							
Gain-Bandwidth Product (GBP)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	9			MHz	TYP	
-3dB Bandwidth (BW)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	18			MHz	TYP	
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$	14			$\text{V}/\mu\text{s}$	TYP	
Phase Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	35			$^\circ$	TYP	
Gain Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = V_S/2$	-5			dB	TYP	
Crosstalk	$f = 5\text{MHz}$	77			dB	TYP	
Settling Time ( $t_s$ )	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$ , Test Circuit 1	0.34			$\mu\text{s}$	TYP	
<b>Noise Performance</b>							
Input Voltage Noise Density ( $e_n$ )	$f = 1\text{kHz}$ , $V_{CM} = V_S/2$	79			$\text{nV}/\sqrt{\text{Hz}}$	V	
	$f = 10\text{kHz}$ , $V_{CM} = V_S/2$	35					

NOTE: 1. See the Thermal Shutdown with Temperature Hysteresis section.

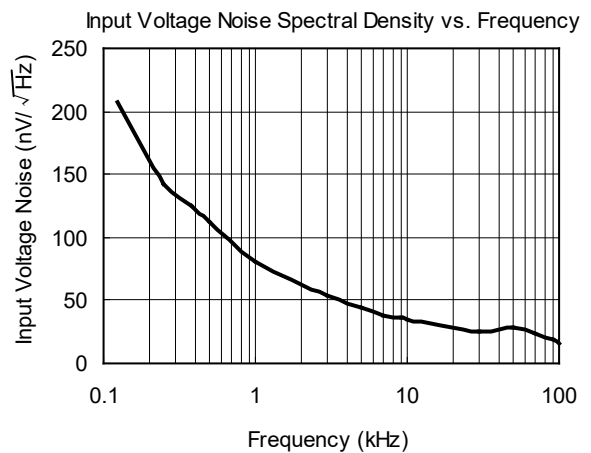
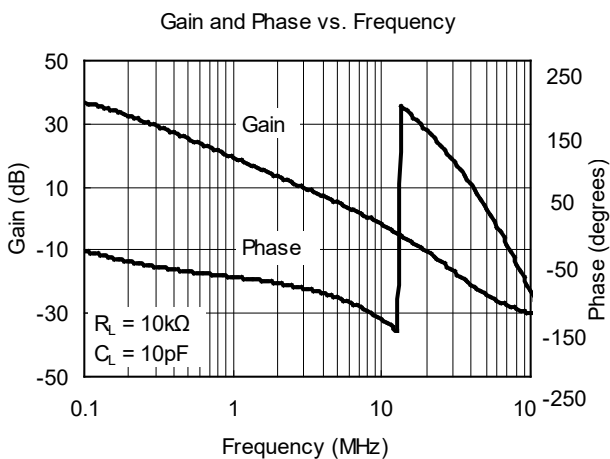
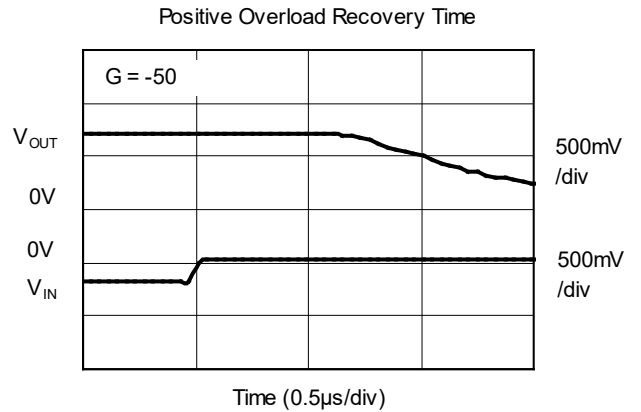
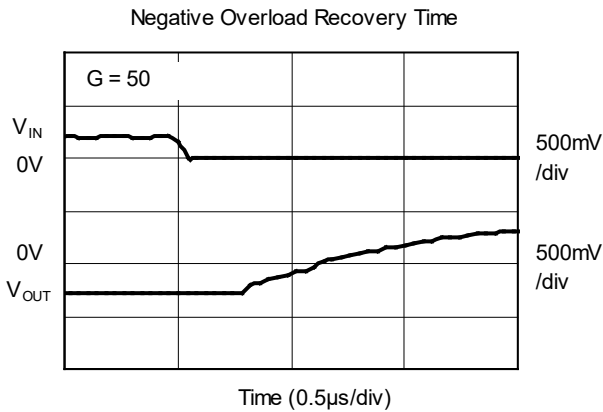
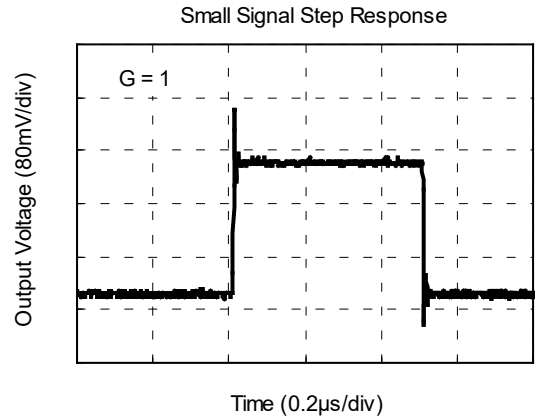
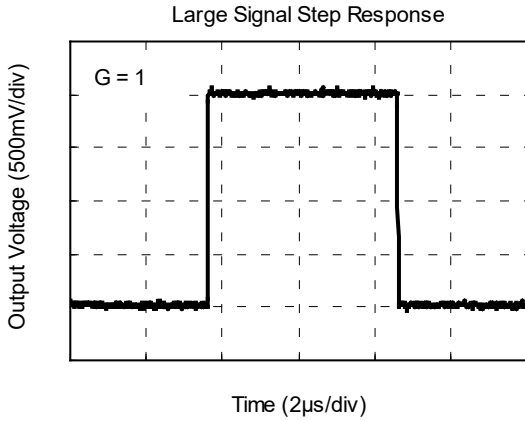
**ELECTRICAL CHARACTERISTICS (continued)**

(At  $T_A = +25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ ,  $R_L = 2\text{k}\Omega$  connected to  $0\text{V}$ ,  $V_{OUT} = 0\text{V}$ , unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8425/6/8					
		TYP	MIN/MAX OVER TEMPERATURE			UNITS	MIN/MAX
		+25°C	+25°C	-40°C to +85°C			
<b>Input Characteristics</b>							
Input Offset Voltage ( $V_{OS}$ )	$V_{CM} = 0\text{V}$	1.0	6.5	7.3	mV	MAX	
Input Offset Voltage Drift ( $\Delta V_{OS}/\Delta T$ )		4.9			$\mu\text{V}/^\circ\text{C}$	TYP	
Input Common Mode Voltage Range ( $V_{CM}$ )		-15.1 to 15.1			V	TYP	
Common Mode Rejection Ratio (CMRR)	$V_{CM} = -15.1\text{V}$ to $15.1\text{V}$	77	63	60	dB	MIN	
Large-Signal Voltage Gain ( $A_{VO}$ )	$V_{OUT} = -14.5\text{V}$ to $14.5\text{V}$	95	84	80	dB	MIN	
<b>Output Characteristics</b>							
Output Voltage Swing from Rail	$V_{OH}$ $I_{OUT} = 5\text{mA}$	94	151	192	mV	MAX	
	$V_{OL}$ $I_{OUT} = -5\text{mA}$	97	135	202	mV	MAX	
Output Current ( $I_{OUT}$ )		80			mA	TYP	
<b>Power Supply</b>							
Quiescent Current/Amplifier ( $I_Q$ )	$I_{OUT} = 0\text{A}$	1.6	2.3	3.5	mA	MAX	
<b>Dynamic Performance</b>							
Gain-Bandwidth Product (GBP)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = 0\text{V}$	9			MHz	TYP	
-3dB Bandwidth (BW)	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = 0\text{V}$	19			MHz	TYP	
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$	16			$\text{V}/\mu\text{s}$	TYP	
Phase Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = 0\text{V}$	35			$^\circ$	TYP	
Gain Margin	$R_L = 10\text{k}\Omega$ , $C_L = 10\text{pF}$ , $V_{CM} = 0\text{V}$	-5			dB	TYP	
Crosstalk	$f = 5\text{MHz}$	78			dB	TYP	
Settling Time ( $t_s$ )	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$ , Test Circuit 1	0.36			$\mu\text{s}$	TYP	
<b>Noise Performance</b>							
Input Voltage Noise Density ( $e_n$ )	$f = 1\text{kHz}$ , $V_{CM} = 0\text{V}$	75			$\text{nV}/\sqrt{\text{Hz}}$	TYP	
	$f = 10\text{kHz}$ , $V_{CM} = 0\text{V}$	34					

**TYPICAL PERFORMANCE CHARACTERISTICS**

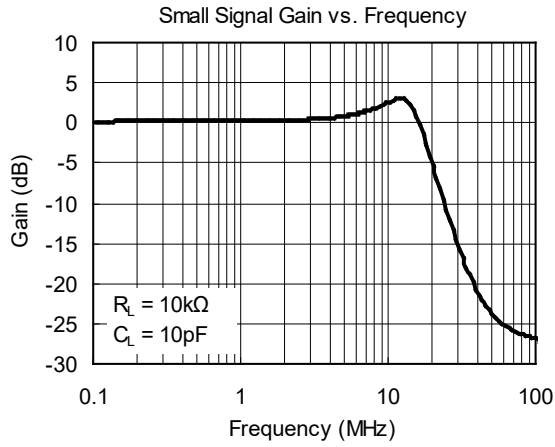
At  $T_A = +25^\circ\text{C}$ ,  $V_S = 15\text{V}$ ,  $V_{CM} = V_S/2$ ,  $R_L = 2\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.



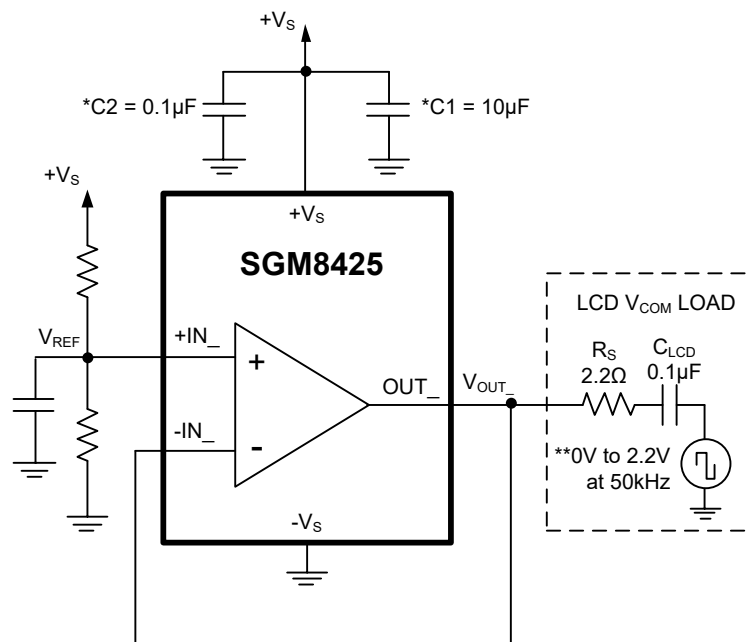


**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

At  $T_A = +25^\circ\text{C}$ ,  $V_S = 15\text{V}$ ,  $V_{CM} = V_S/2$ ,  $R_L = 2\text{k}\Omega$  connected to  $V_S/2$ ,  $V_{OUT} = V_S/2$ , unless otherwise noted.



TEST CIRCUIT



NOTES: \* Place the 10 $\mu$ F and 0.1 $\mu$ F capacitors as close as possible to the pin.  
\*\*  $(R_s = R_{GEN}) \times C_{LCD} \times 6 < 2\mu s$ , where  $R_{GEN}$  = generator source impedance.

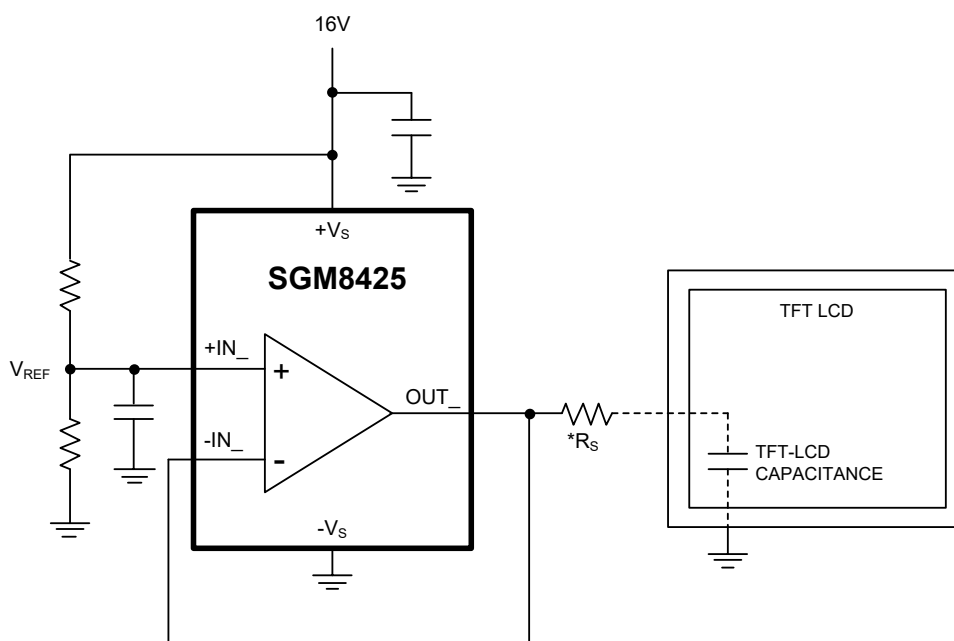
Test Circuit 1. Settling Time and Transient Peak Output Current

## APPLICATION INFORMATION

### Thermal Shutdown with Temperature Hysteresis

The SGM8425/6/8 are capable of high output currents and feature thermal-shutdown protection with temperature hysteresis. When the die temperature reaches +145°C, the device shuts down. When the die cools down by +15°C, the device turns on again. In a TFT-LCD application, the duty cycle is very low. Even with high values of voltage and current, the power dissipation is low and the chip does not shut down.

## TYPICAL APPLICATION CIRCUIT



NOTES: \*  $R_S$  may be required for some applications.

## REVISION HISTORY

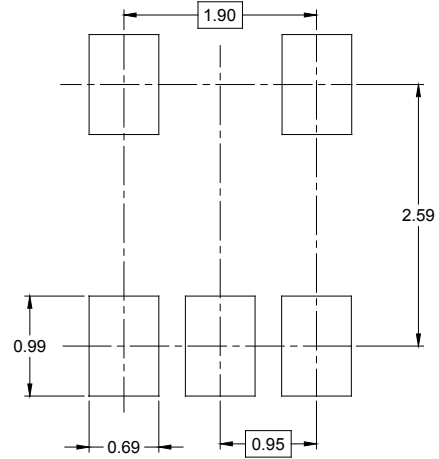
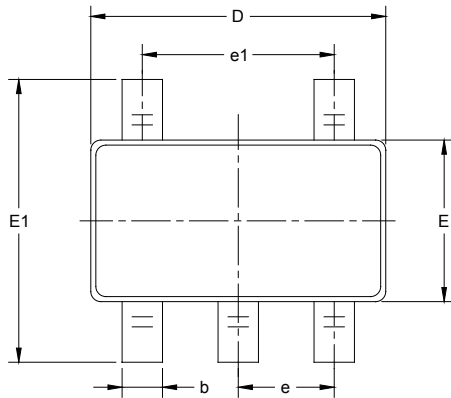
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

JUNE 2013 – REV.A to REV.A.1	Page
Added SGM8425AYN5G package.....	All
Changes from Original (DECEMBER 2012) to REV.A	Page
Changed from product preview to production data.....	All

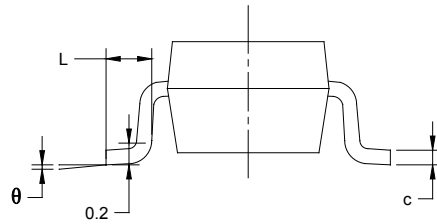
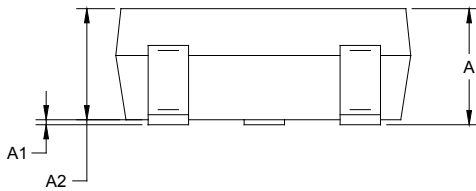
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOT-23-5



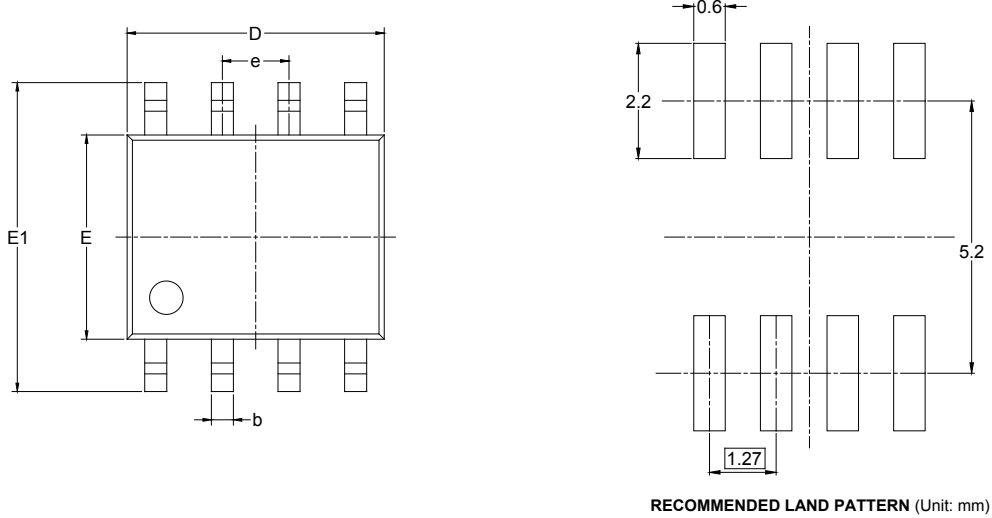
RECOMMENDED LAND PATTERN (Unit: mm)



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

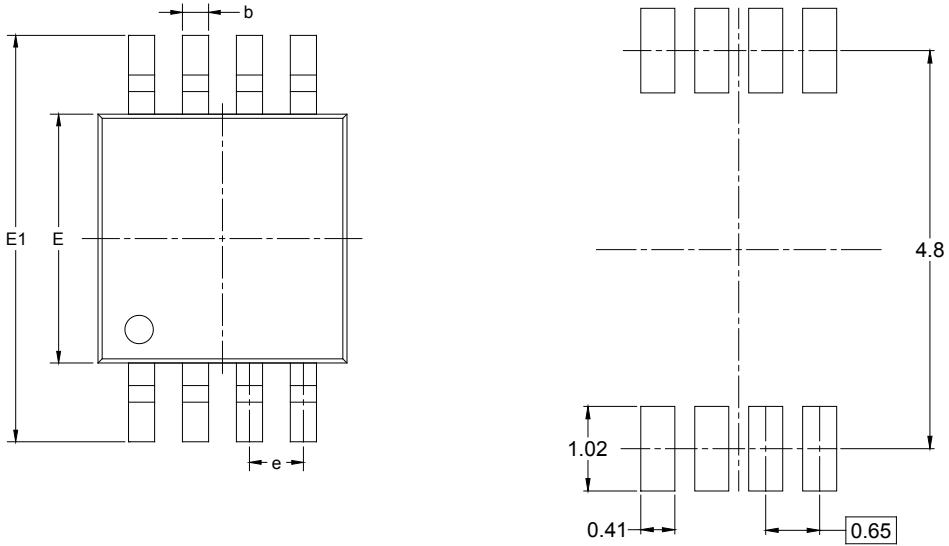
SOIC-8



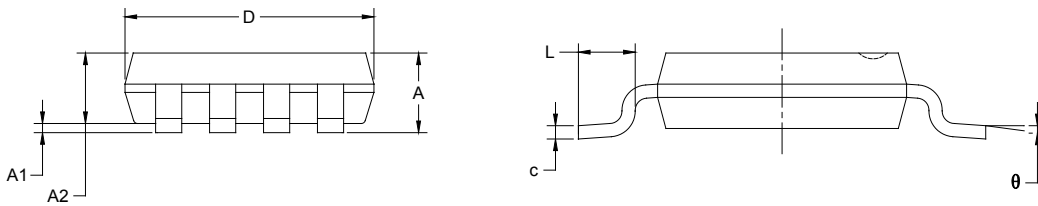
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



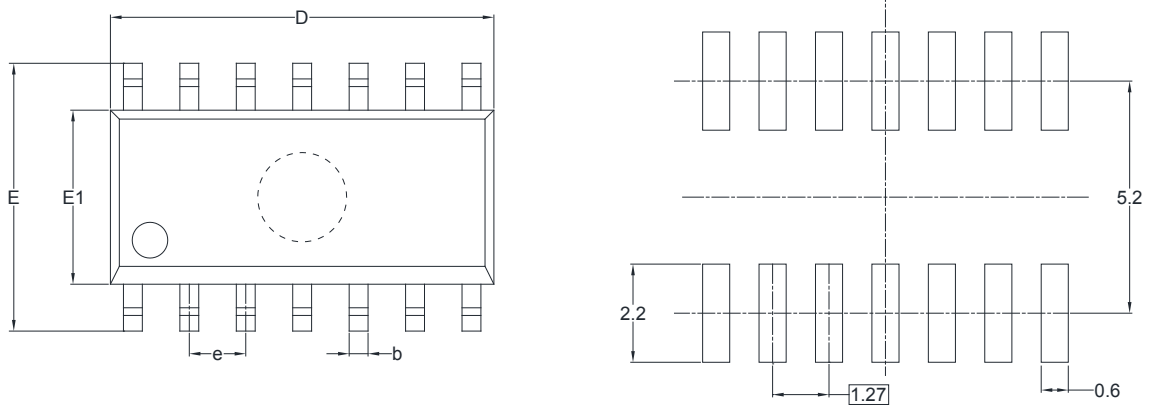
RECOMMENDED LAND PATTERN (Unit: mm)



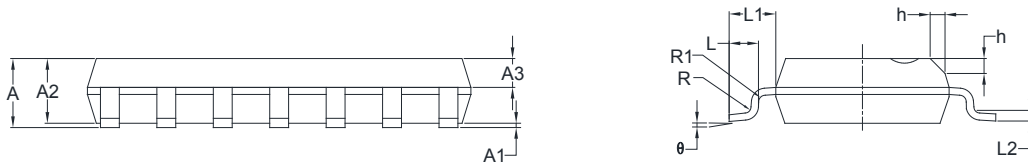
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650 BSC		0.026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

PACKAGE OUTLINE DIMENSIONS

SOIC-14



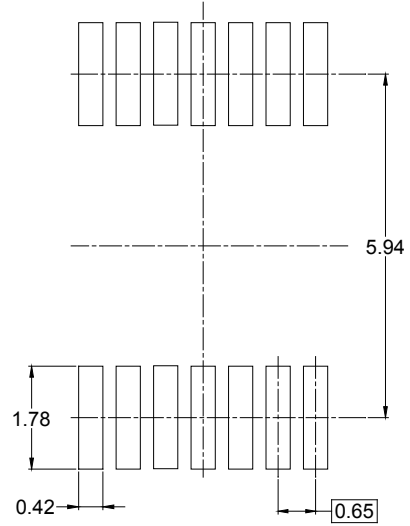
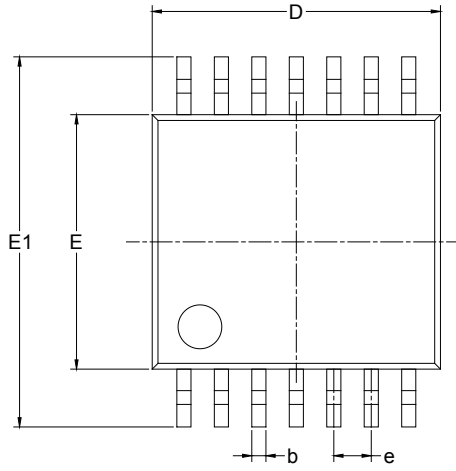
RECOMMENDED LAND PATTERN (Unit: mm)



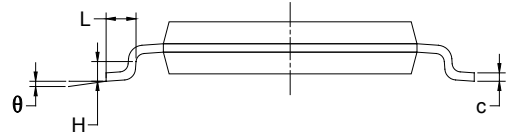
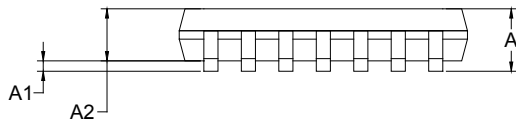
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
A2	1.25	1.65	0.049	0.065
A3	0.55	0.75	0.022	0.030
b	0.36	0.49	0.014	0.019
D	8.53	8.73	0.336	0.344
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
L	0.45	0.80	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°

PACKAGE OUTLINE DIMENSIONS

TSSOP-14



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	1.050	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°



# 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
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	1.20	4.0	8.0	2.0	12.0	Q1

D20001

# 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