



SGM8425/6/8

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 supplies.

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/Amplifier: 1.6mA**
- **High Slew Rate: 16V/ μ 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 (PDA)
Portable Instrumentation
A/D Converter Buffer
Active Filters

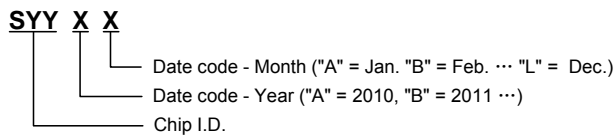


PACKAGE/ORDERING INFORMATION

MODEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION	MARKING INFORMATION
SGM8425	SGM8425AYN5G/TR	SOT-23-5	Tape and Reel, 3000	SN9XX
	SGM8425BYN5G/TR	SOT-23-5	Tape and Reel, 3000	SICXX
	SGM8425YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM 8425YS8 XXXXX
	SGM8425YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8425 YMS8 XXXXX
SGM8426	SGM8426YS8G/TR	SOIC-8	Tape and Reel, 2500	SGM 8426YS8 XXXXX
	SGM8426YMS8G/TR	MSOP-8	Tape and Reel, 3000	SGM8426 YMS8 XXXXX
SGM8428	SGM8428YS14G/TR	SOIC-14	Tape and Reel, 2500	SGM8428YS14 XXXXX
	SGM8428YTS14G/TR	TSSOP-14	Tape and Reel, 3000	SGM8428 YTS14 XXXXX

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

MARKING INFORMATION



For example: SICCA (2012, January)

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, +V _S to -V _S	32V
Input Common Mode Voltage Range(-V _S) - 0.1V to (+V _S) + 0.1V	
Input/Output Voltage Range.....(-V _S) - 0.3V to (+V _S) + 0.3V	
Storage Temperature Range.....	-65°C to +150°C
Junction Temperature.....	150°C
Operating Temperature Range.....	-40°C to +85°C
Lead Temperature (Soldering 10sec)	260°C
ESD Susceptibility	
HBM (SGM8425/6).....	3000V
MM (SGM8425/6).....	150V
HBM (SGM8428).....	4000V
MM (SGM8428).....	250V

NOTE:

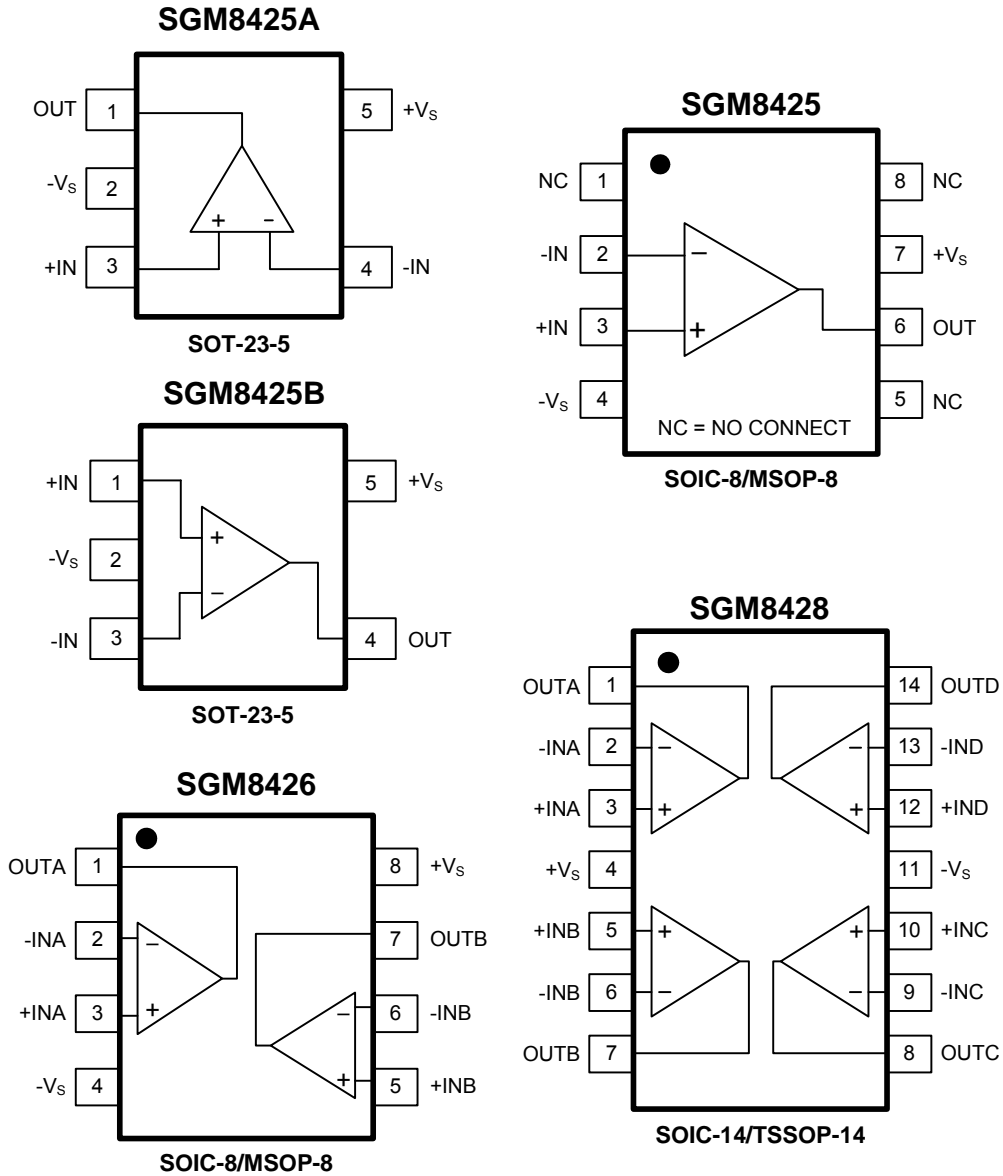
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

PIN CONFIGURATIONS (TOP VIEW)



ELECTRICAL CHARACTERISTICS: $V_S = +5V$ (At $T_A = +25^\circ\text{C}$, $R_L = 2k\Omega$ 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			
INPUT CHARACTERISTICS							
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)	$V_{CM} = -0.1V$ to $+5.1V$	62	47	45	dB	MIN	
Open-Loop Voltage Gain (A_{OL})	$V_{OUT} = +0.5V$ to $+4.5V$	94	77	75	dB	MIN	
OUTPUT CHARACTERISTICS							
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 $R_L = 10\Omega$ to $V_S/2$	93	72		mA	MIN	
	Source $R_L = 10\Omega$ to $V_S/2$	97	74				
POWER SUPPLY							
Power Supply Rejection Ratio (PSRR)	$V_S = +4.5V$ to $+30V$, $V_{CM} = V_S/2$	98	84	78	dB	MIN	
Quiescent Current/Amplifier (I_Q)	$I_{OUT} = 0A$	1.5	2.1	3.3	mA	MAX	
DYNAMIC PERFORMANCE							
Gain-Bandwidth Product (GBP)	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	9			MHz	TYP	
-3dB Bandwidth (BW)	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	18			MHz	TYP	
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$	13			$\text{V}/\mu\text{s}$	TYP	
Phase Margin	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	35			$^\circ$	TYP	
Gain Margin	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	-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			μs	TYP	
NOISE PERFORMANCE							
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: $V_S = +15V$ (At $T_A = +25^\circ\text{C}$, $R_L = 2k\Omega$ 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			
INPUT CHARACTERISTICS							
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)	$V_{CM} = -0.1V$ to $+15.1V$	71	57	55	dB	MIN	
Open-Loop Voltage Gain (A_{OL})	$V_{OUT} = +0.5V$ to $+14.5V$	92	80	75	dB	MIN	
OUTPUT CHARACTERISTICS							
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 $V_S = +19V$, Test Circuit 1	336			mA	TYP	
	Source $V_S = +19V$, Test Circuit 1	227					
Output Current (I_{OUT})		80			mA	TYP	
POWER SUPPLY							
Quiescent Current/Amplifier (I_Q)	$I_{OUT} = 0A$	1.6	2.2	3.4	mA	MAX	
DYNAMIC PERFORMANCE							
Gain-Bandwidth Product (GBP)	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	9			MHz	TYP	
-3dB Bandwidth (BW)	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	18			MHz	TYP	
Slew Rate (SR)	$V_{OUT} = 2V_{PP}$ step, $A_V = 1$	14			$\text{V}/\mu\text{s}$	TYP	
Phase Margin	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	35			$^\circ$	TYP	
Gain Margin	$R_L = 10k\Omega$, $C_L = 10\text{pF}$, $V_{CM} = V_S/2$	-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			μs	TYP	
NOISE PERFORMANCE							
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.

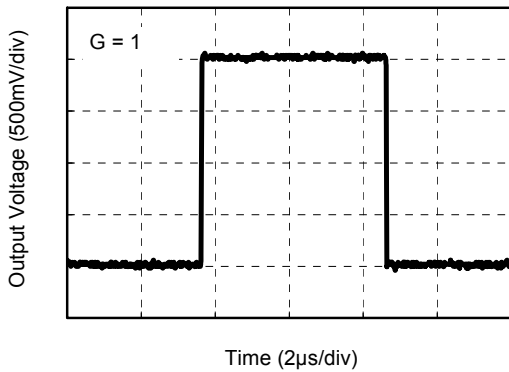
ELECTRICAL CHARACTERISTICS: $V_S = \pm 15V$ (At $T_A = +25^\circ C$, $R_L = 2k\Omega$ connected to 0V, $V_{OUT} = 0V$, unless otherwise noted.)

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

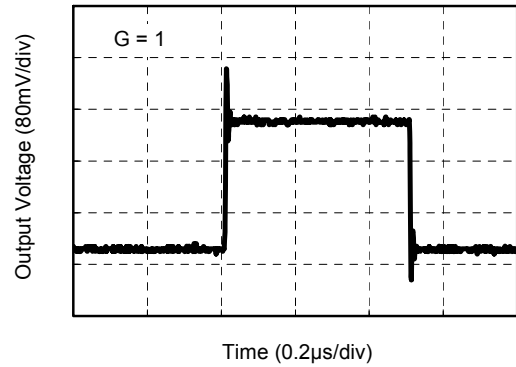
TYPICAL PERFORMANCE CHARACTERISTICS

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.

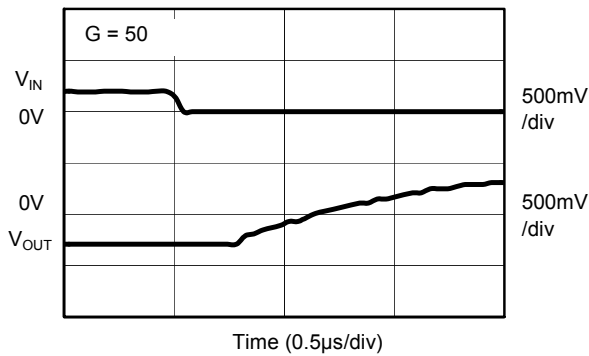
Large Signal Step Response



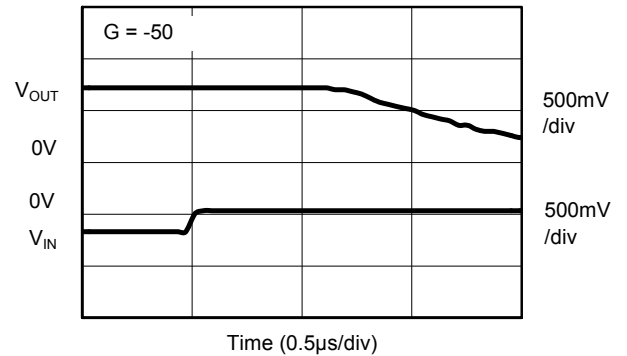
Small Signal Step Response



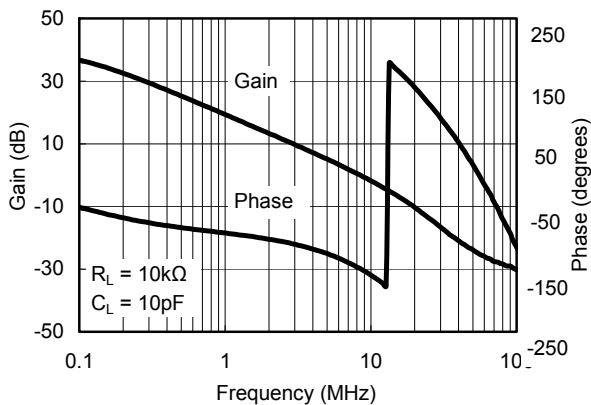
Negative Overload Recovery Time



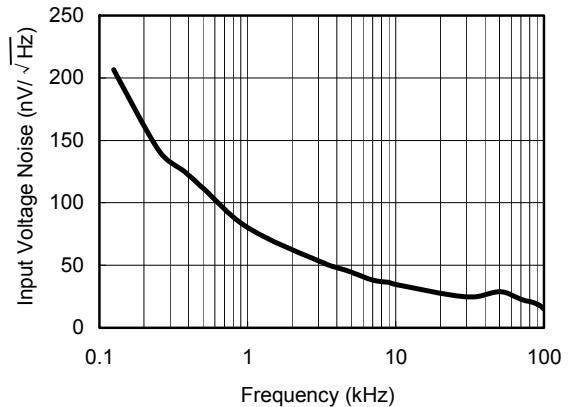
Positive Overload Recovery Time



Gain and Phase vs. Frequency

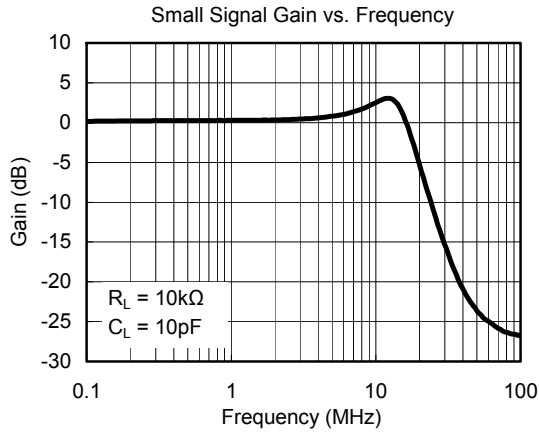


Input Voltage Noise Spectral Density vs. Frequency

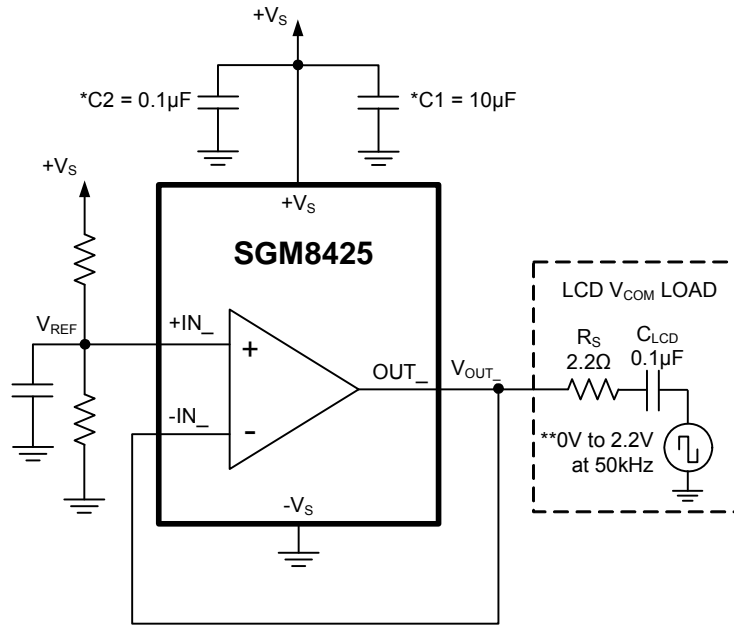


TYPICAL PERFORMANCE CHARACTERISTICS

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.



TEST CIRCUIT



*Place the 10μF and 0.1μF 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.

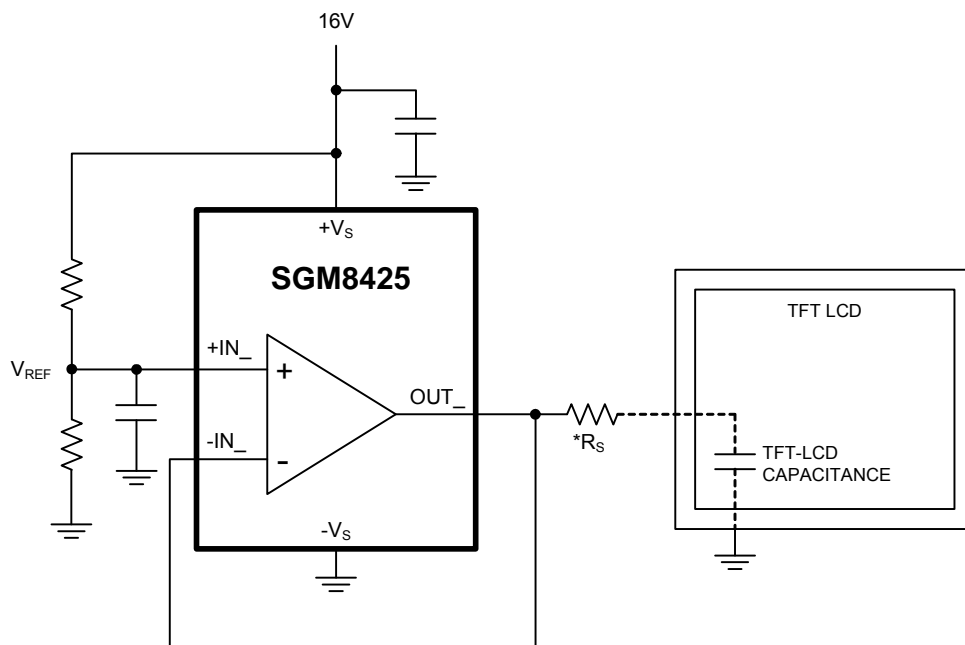
Test Circuit 1. Settling Time and Transient Peak Output Current

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.

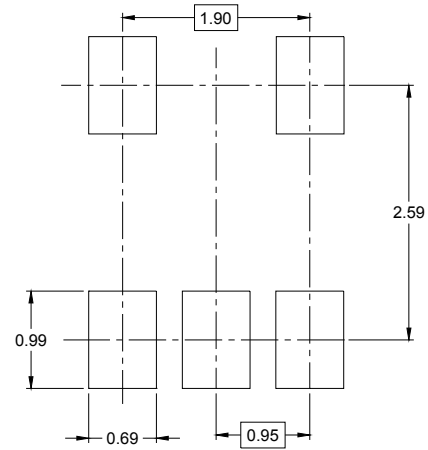
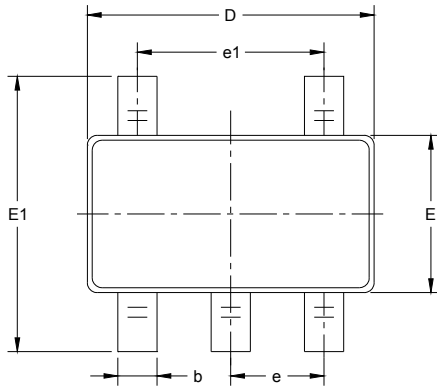
TYPICAL APPLICATION CIRCUIT



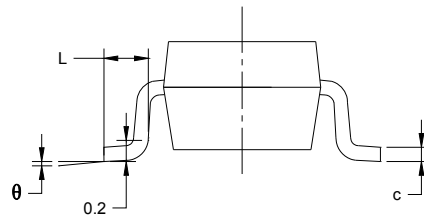
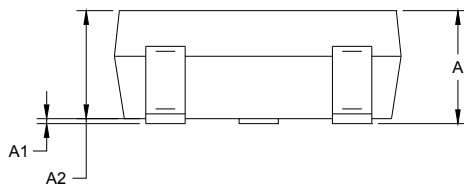
*R_S may be required for some applications.

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



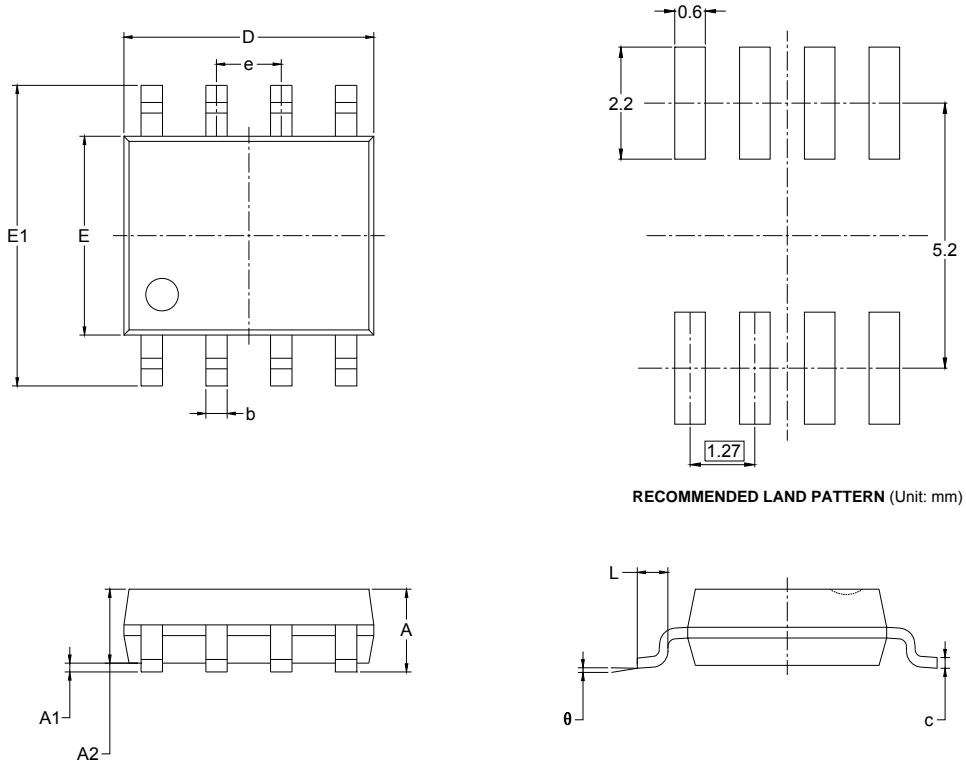
RECOMMENDED LAND PATTERN (Unit: mm)



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

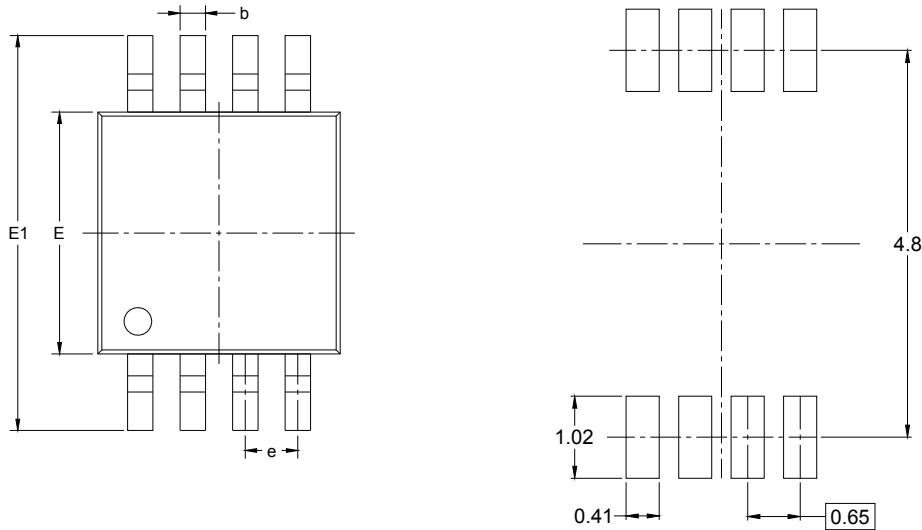


RECOMMENDED LAND PATTERN (Unit: mm)

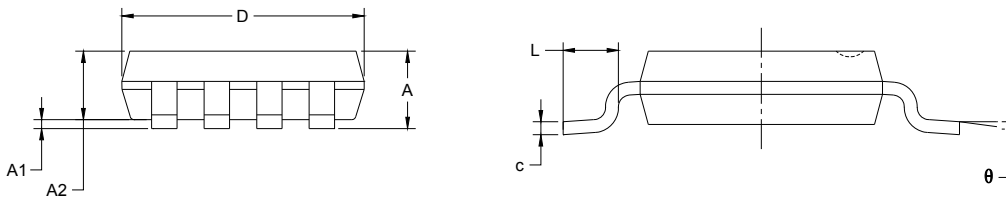
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

PACKAGE OUTLINE DIMENSIONS

MSOP-8



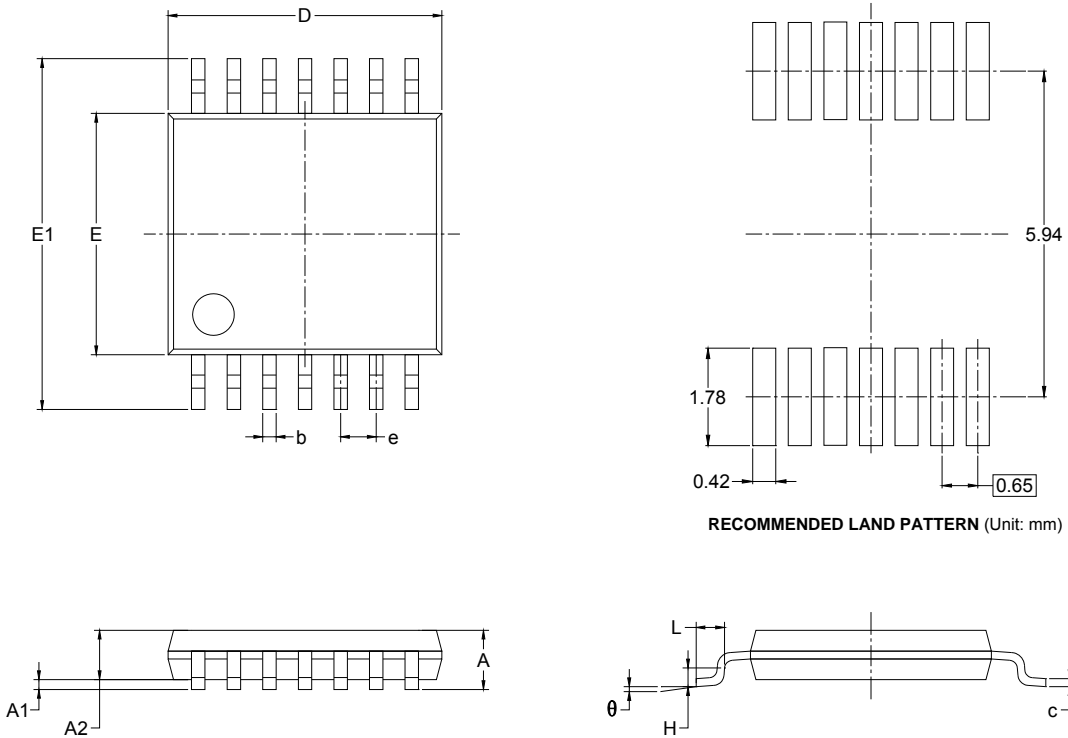
RECOMMENDED LAND PATTERN (Unit: mm)



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

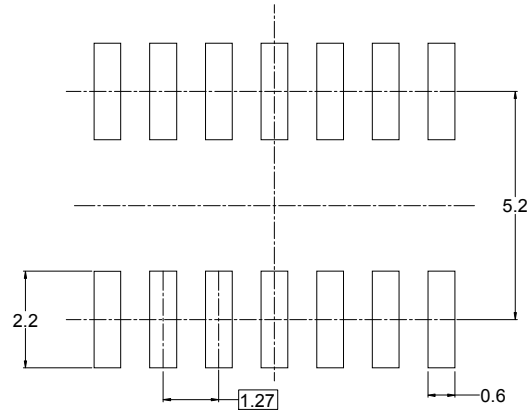
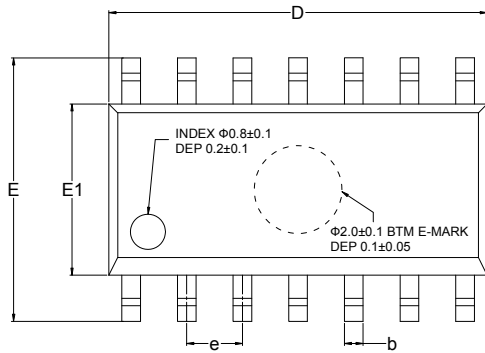
TSSOP-14



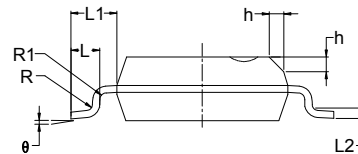
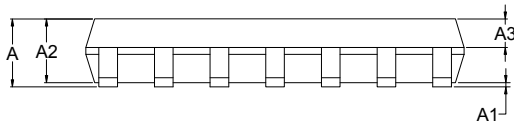
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500	0.700	0.02	0.028
H	0.25 TYP		0.01 TYP	
θ	1°	7°	1°	7°

PACKAGE OUTLINE DIMENSIONS

SOIC-14



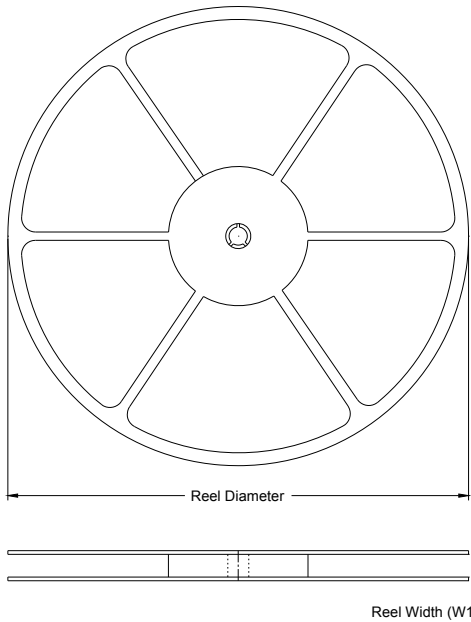
RECOMMENDED LAND PATTERN (Unit: mm)



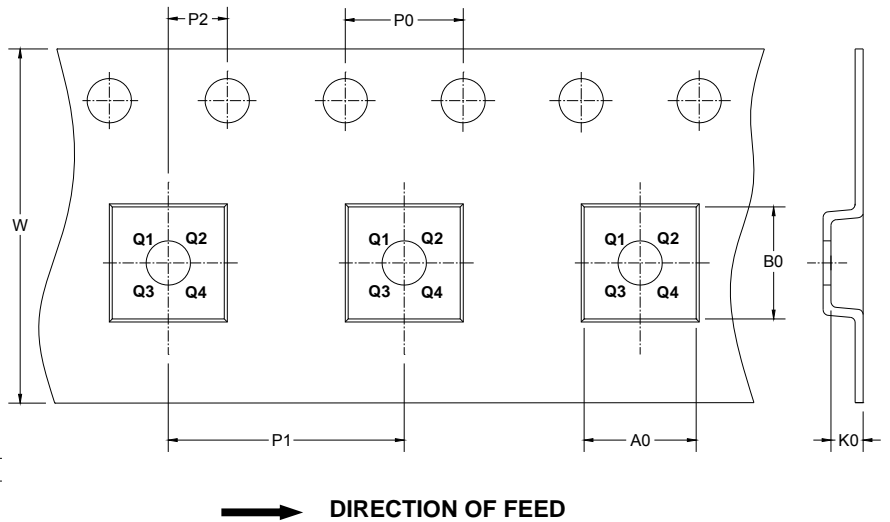
Symbol	Dimensions In Millimeters			Dimensions In Inches		
	MIN	MOD	MAX	MIN	MOD	MAX
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.25		1.65	0.049		0.065
A3	0.55		0.75	0.022		0.030
b	0.36		0.49	0.014		0.019
D	8.53		8.73	0.336		0.344
E	5.80		6.20	0.228		0.244
E1	3.80		4.00	0.150		0.157
e	1.27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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS

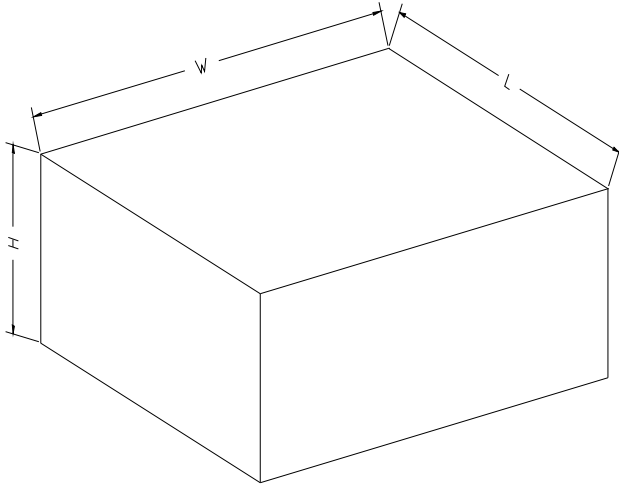


NOTE: The picture is only for reference. Please make the object as the standard.

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	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
SOIC-8	13"	12.4	6.4	5.4	2.1	4.0	8.0	2.0	12.0	Q1
MSOP-8	13"	12.4	5.2	3.3	1.5	4.0	8.0	2.0	12.0	Q1
SOIC-14	13"	16.4	6.6	9.3	2.1	4.0	8.0	2.0	16.0	Q1
TSSOP-14	13"	12.4	6.95	5.6	1.2	4.0	8.0	2.0	12.0	Q1

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