



SGM8594

Single-Supply, Quad Rail-to-Rail I/O Precision Operational Amplifier

PRODUCT DESCRIPTION

The SGM8594 is a quad rail-to-rail input and output precision operational amplifier which has low input offset voltage, and bias current. It is guaranteed to operate from 2.5V to 5.5V single supply.

The rail-to-rail input and output swings provided by the SGM8594 make both high-side and low-side sensing easy. The combination of characteristics makes the SGM8594 good choices for temperature, position and pressure sensors, medical equipment and strain gauge amplifiers, or any other 2.5V to 5.5V application requiring precision and long term stability.

The SGM8594 is specified over the extended industrial (-40°C to +85°C) temperature range. The SGM8594 comes in the Green SOIC-14 and TSSOP-14 packages.

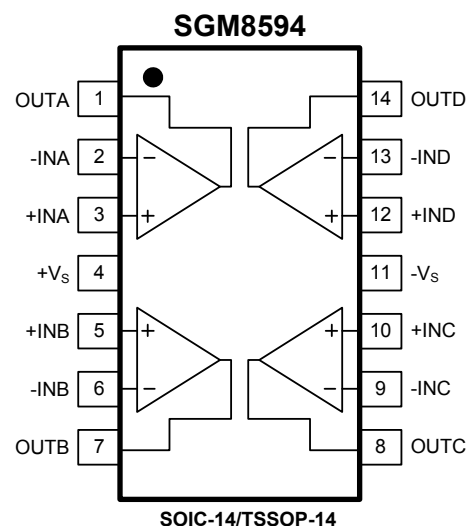
APPLICATIONS

- Temperature Measurements
- Pressure Sensors
- Precision Current Sensing
- Electronic Scales
- Strain Gage Amplifiers
- Medical Instrumentation
- Thermocouple Amplifiers
- Handheld Test Equipment

FEATURES

- **Low Offset Voltage: 150 μ V (TYP)**
- **Rail-to-Rail Input and Output Swing**
- **2.5V to 5.5V Single Supply Operation**
- **Voltage Gain: 135dB (TYP) at +5V**
- **PSRR: 115dB (TYP)**
- **EMIRR at 1.8GHz: 118dB**
- **CMRR: 92dB (TYP)**
- **Low Input Bias Current: 60pA**
- **Low Supply Current: 430 μ A/Channel**
- **Overload Recovery Time: 30 μ s (at $V_s = +5V$)**
- **No External Capacitors Required**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green SOIC-14 and TSSOP-14 Packages**

PIN CONFIGURATIONS (TOP VIEW)



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PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8594	SOIC-14	SGM8594YS14G/TR	SGM8594YS14	Tape and Reel, 2500
	TSSOP-14	SGM8594YTS14G/TR	SGM8594YTS14	Tape and Reel, 3000

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
Input Voltage.....	-V _S to (+V _S) + 0.1V
Differential Input Voltage.....	-5V to 5V
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 (TSSOP-14).....	8000V
HBM (SOIC-14)	7000V
MM.....	400V

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.

ELECTRICAL CHARACTERISTICS(V_S = +5V, V_{CM} = +2.5V, V_O = +2.5V, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Input Offset Voltage (V _{OS})			150	500	μV
	-40°C ≤ T _A ≤ +85°C			550	
Input Bias Current (I _B)			60		pA
Input Offset Current (I _{OS})			50		pA
Input Voltage Range		0		5	V
Common Mode Rejection Ratio ⁽¹⁾ (CMRR)	V _{CM} = 0V to 5V	88	92		dB
	-40°C ≤ T _A ≤ +85°C	77			
Large Signal Voltage Gain (A _{VO})	R _L = 10kΩ, V _O = 0.3V to 4.7V	120	135		dB
	-40°C ≤ T _A ≤ +85°C	104			
Input Offset Voltage Drift (ΔV _{OS} /ΔT)	-40°C ≤ T _A ≤ +85°C		200		nV/°C
OUTPUT CHARACTERISTICS					
Output Voltage High (V _{OH})	R _L = 100kΩ to -V _S	4.9	4.998		V
	-40°C ≤ T _A ≤ +85°C	4.894			
	R _L = 10kΩ to -V _S	4.9	4.994		V
	-40°C ≤ T _A ≤ +85°C	4.888			
Output Voltage Low (V _{OL})	R _L = 100kΩ to +V _S		3.5	6	mV
	-40°C ≤ T _A ≤ +85°C			8	
	R _L = 10kΩ to +V _S		7	10	mV
	-40°C ≤ T _A ≤ +85°C			23	
Short Circuit Limit (I _{SC})	V _O = 2.5V, R _L = 10Ω to GND	30	40		mA
	-40°C ≤ T _A ≤ +85°C	22			
POWER SUPPLY					
Power Supply Rejection Ratio ⁽¹⁾ (PSRR)	V _S = 2.5V to 5.5V	90	115		dB
	-40°C ≤ T _A ≤ +85°C	80			
Quiescent Current/Channel (I _Q)	V _O = +V _S /2		430	555	μA
	-40°C ≤ T _A ≤ +85°C			710	
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	A _V = +100		1.5		MHz
Slew Rate (SR)	A _V = +1, R _L = 10kΩ, 2V Output Step		0.9		V/μs
Overload Recovery Time	A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND)		0.03		ms
NOISE PERFORMANCE					
Voltage Noise (e _n p-p)	0.1Hz to 10Hz		1.4		μV _{P-P}
Voltage Noise Density (e _n)	f = 1kHz		78		nV/√Hz

NOTE 1: PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

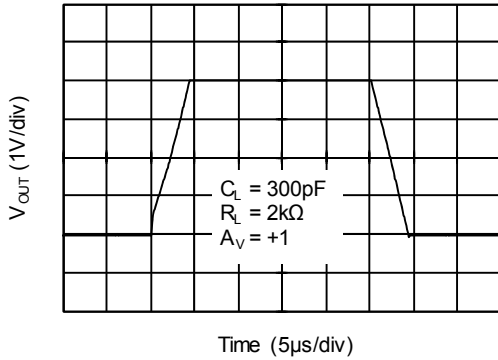
ELECTRICAL CHARACTERISTICS(V_S = +2.5V, V_{CM} = +1.25V, V_O = +1.25V, T_A = +25°C, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS					
Input Offset Voltage (V _{OS})			150	500	μV
	-40°C ≤ T _A ≤ +85°C			550	
Input Bias Current (I _B)			30		pA
Input Offset Current (I _{OS})			20		pA
Input Voltage Range		0		2.5	V
Common Mode Rejection Ratio ⁽¹⁾ (CMRR)	V _{CM} = 0V to 2.5V	79	85		dB
	-40°C ≤ T _A ≤ +85°C	70			
Large Signal Voltage Gain (A _{VO})	R _L = 10kΩ, V _O = 0.3V to 2.4V	120	130		dB
	-40°C ≤ T _A ≤ +85°C	104			
Input Offset Voltage Drift (ΔV _{OS} /ΔT)	-40°C ≤ T _A ≤ +85°C		200		nV/°C
OUTPUT CHARACTERISTICS					
Output Voltage High (V _{OH})	R _L = 100kΩ to -V _S	2.4	2.499		V
	-40°C ≤ T _A ≤ +85°C	2.38			
	R _L = 10kΩ to -V _S	2.4	2.497		V
	-40°C ≤ T _A ≤ +85°C	2.389			
Output Voltage Low (V _{OL})	R _L = 100kΩ to +V _S		4	6	mV
	-40°C ≤ T _A ≤ +85°C			7	
	R _L = 10kΩ to +V _S		6	8	mV
	-40°C ≤ T _A ≤ +85°C			12	
Short Circuit Limit (I _{SC})	V _O = 1.25V, R _L = 10Ω to GND	20	28		mA
	-40°C ≤ T _A ≤ +85°C	13			
POWER SUPPLY					
Power Supply Rejection Ratio ⁽¹⁾ (PSRR)	V _S = 2.5V to 5.5V	90	115		dB
	-40°C ≤ T _A ≤ +85°C	80			
Quiescent Current/Channel (I _Q)	V _O = +V _S /2		430	550	μA
	-40°C ≤ T _A ≤ +85°C			710	
DYNAMIC PERFORMANCE					
Gain-Bandwidth Product (GBP)	A _V = +100		1.5		MHz
Slew Rate (SR)	A _V = +1, R _L = 10kΩ, 2V Output Step		1.0		V/μs
Overload Recovery Time	A _V = -100, R _L = 10kΩ, V _{IN} = 200mV (RET to GND)		0.02		ms
NOISE PERFORMANCE					
Voltage Noise (e _n p-p)	0.1Hz to 10Hz		1.7		μV _{p-p}
Voltage Noise Density (e _n)	f = 1kHz		108		nV/√Hz

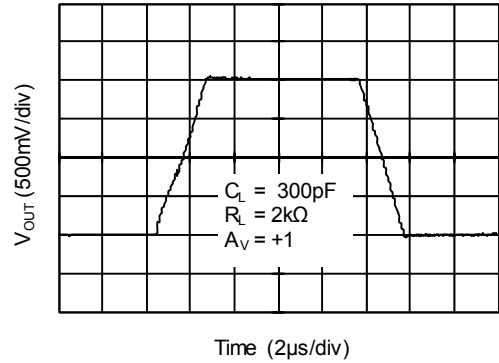
NOTE 1: PSRR and CMRR are affected by the matching between external gain-setting resistor ratios.

TYPICAL PERFORMANCE CHARACTERISTICS

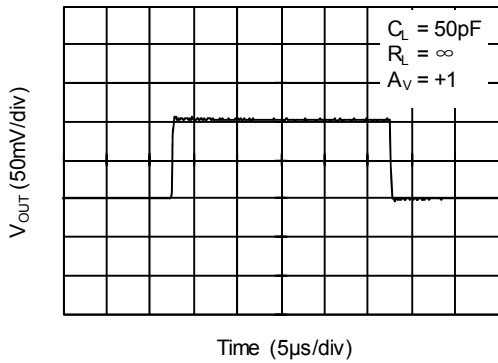
Large Signal Transient Response at +5V



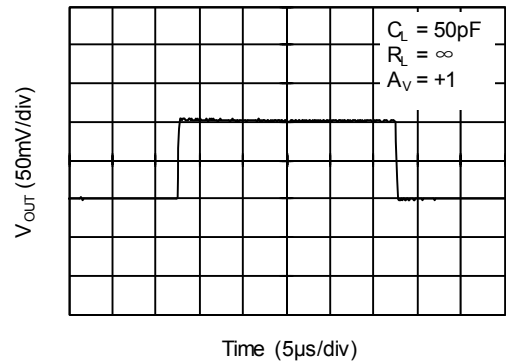
Large Signal Transient Response at +2.5V



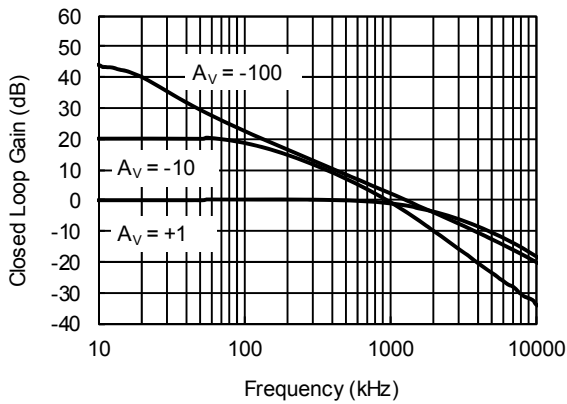
Small Signal Transient Response at +5V



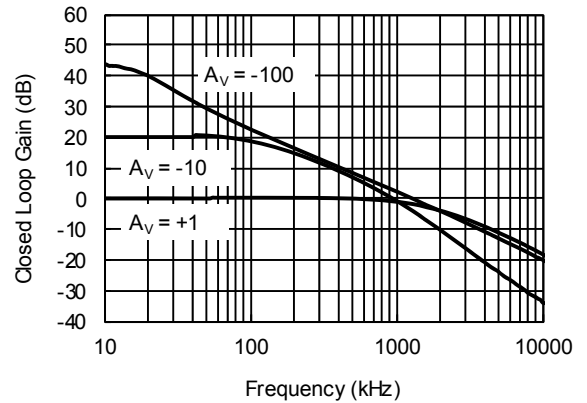
Small Signal Transient Response at +2.5V



Closed Loop Gain vs. Frequency at +5V

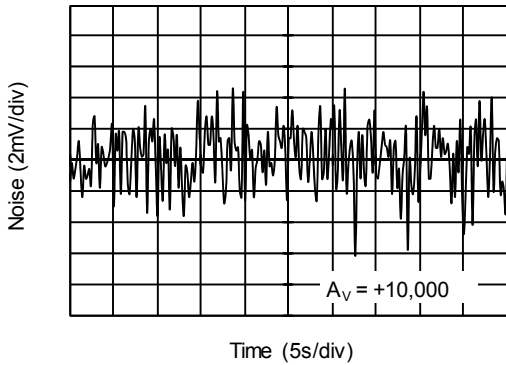


Closed Loop Gain vs. Frequency at +2.5V

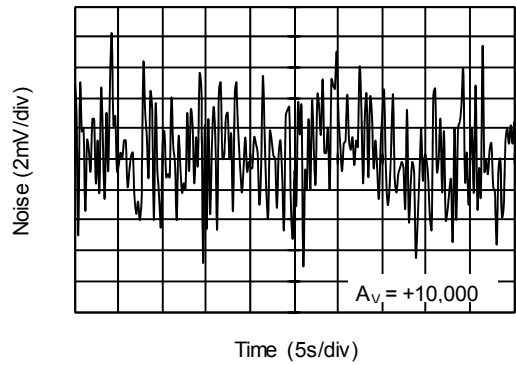


TYPICAL PERFORMANCE CHARACTERISTICS

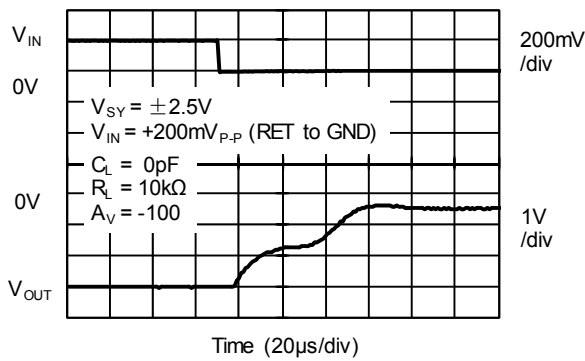
0.1Hz to 10Hz Noise at +5V



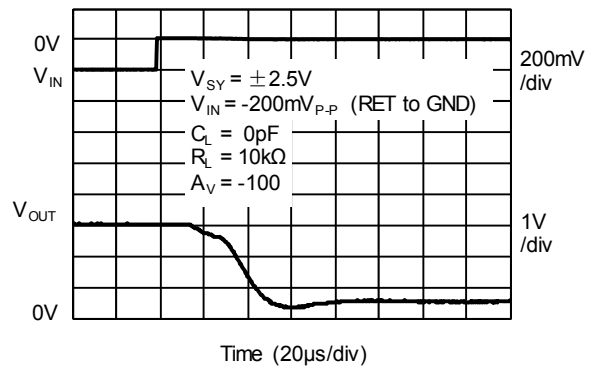
0.1Hz to 10Hz Noise at +2.5V



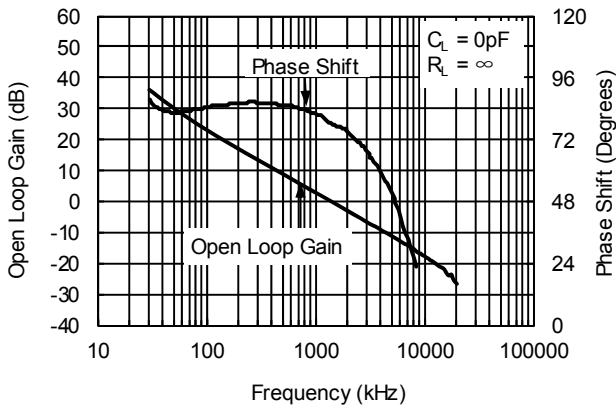
Negative Overvoltage Recovery



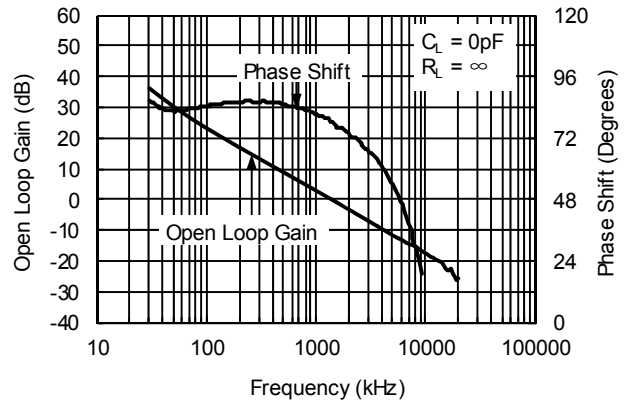
Positive Overvoltage Recovery



Open Loop Gain, Phase Shift vs. Frequency at +5V

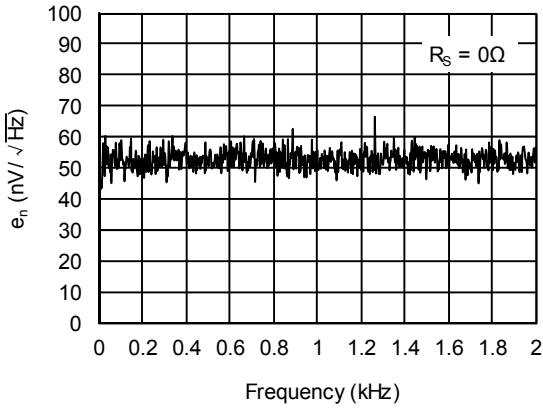


Open Loop Gain, Phase Shift vs. Frequency at +2.5V

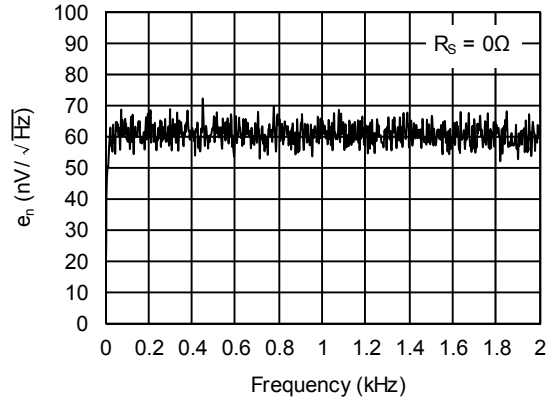


TYPICAL PERFORMANCE CHARACTERISTICS

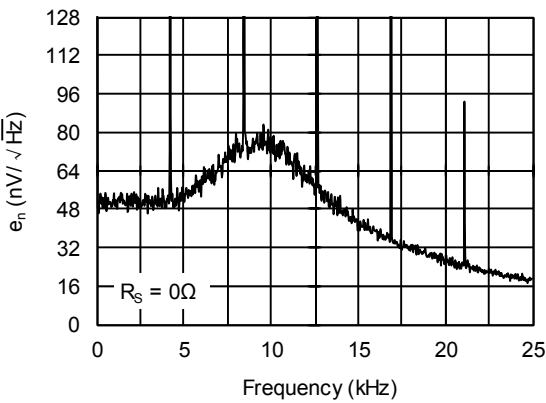
Voltage Noise Density at +5V from 0.1Hz to 2.5kHz



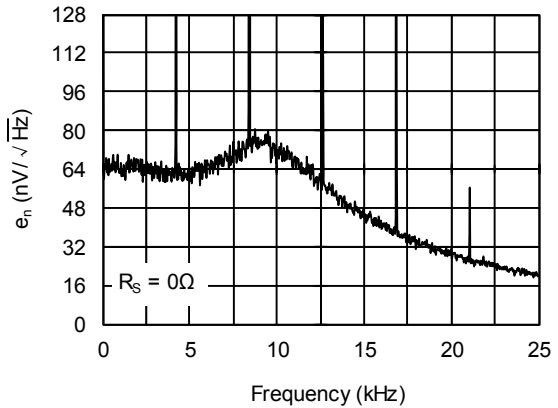
Voltage Noise Density at +2.5V from 0.1Hz to 2.5kHz



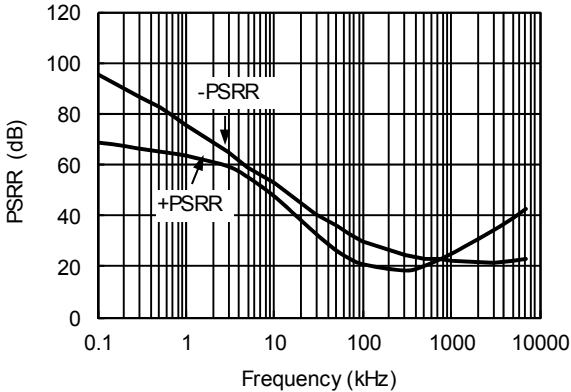
Voltage Noise Density at +5V from 0.1Hz to 25kHz



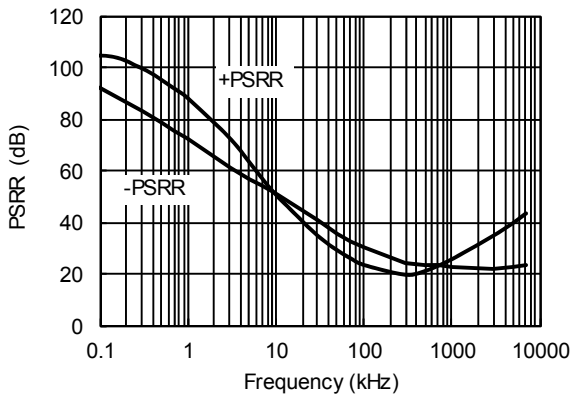
Voltage Noise Density at +2.5V from 0.1Hz to 25kHz



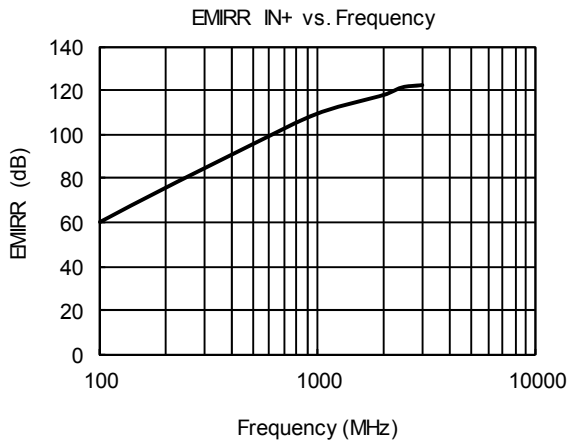
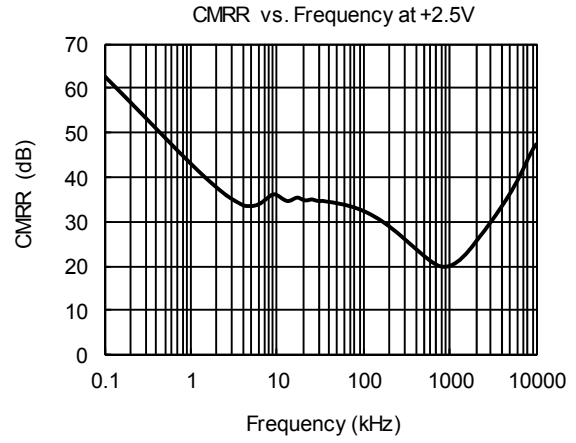
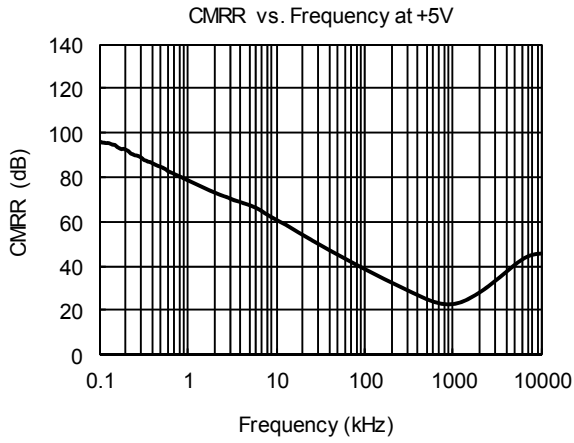
PSRR vs. Frequency at ±2.5V



PSRR vs. Frequency at ±1.25V

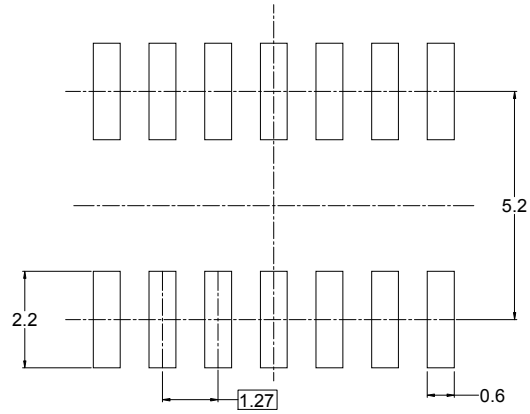
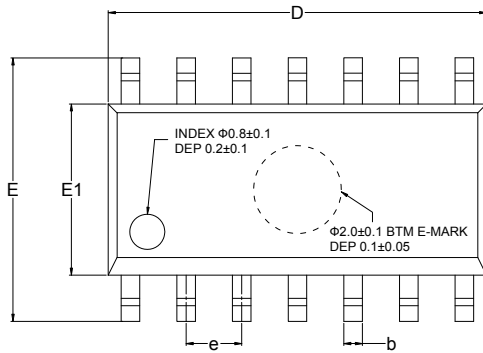


TYPICAL PERFORMANCE CHARACTERISTICS

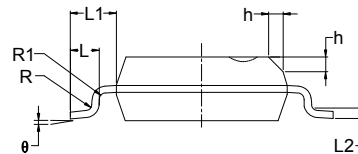
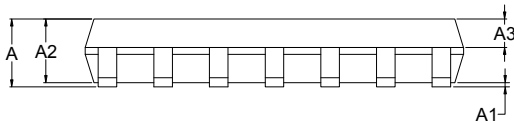


PACKAGE OUTLINE DIMENSIONS

SOIC-14



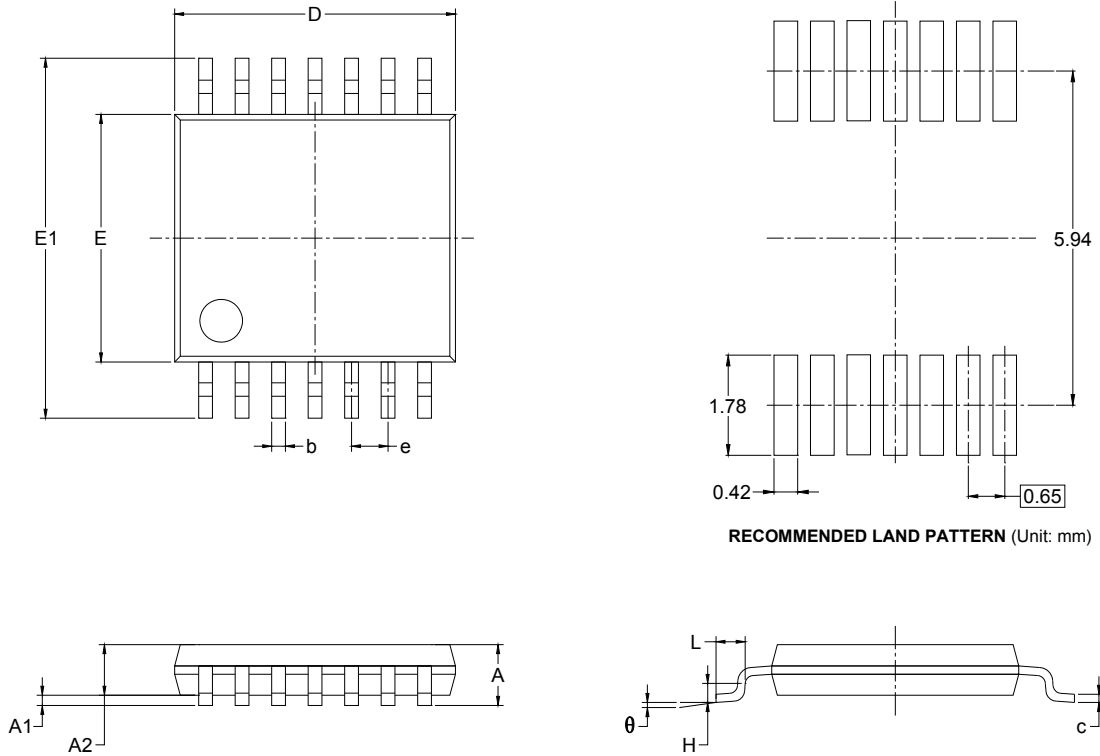
RECOMMENDED LAND PATTERN (Unit: mm)



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°

PACKAGE OUTLINE DIMENSIONS

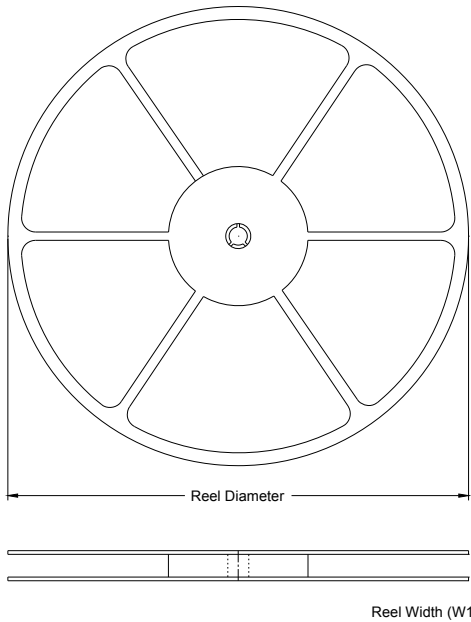
TSSOP-14



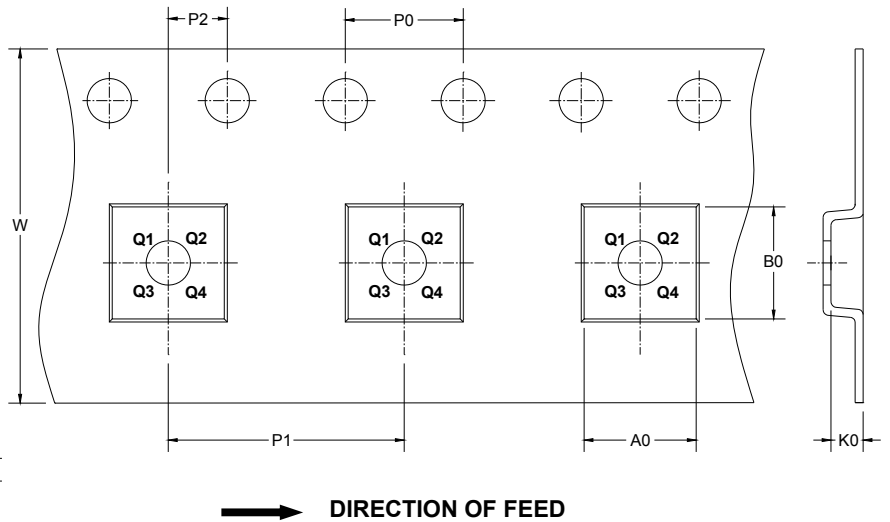
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650 BSC		0.026 BSC	
L	0.500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

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

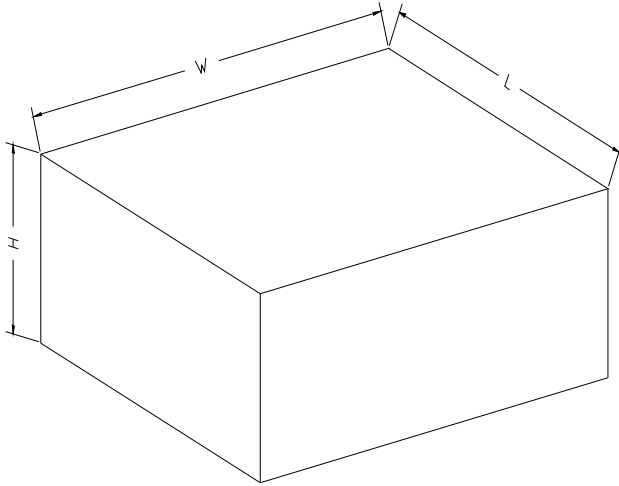
KEY PARAMETER LIST OF TAPE AND REEL

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-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

SGM8594

Single-Supply, Quad Rail-to-Rail I/O Precision Operational Amplifier

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