



SGM8602

2.2mA, 12MHz, Low Noise, Rail-to-Rail I/O Tiny Package, CMOS Operational Amplifier

GENERAL DESCRIPTION

The SGM8602 is a dual, low voltage, low noise and low power operational amplifier, which can operate from 2.1V to 5.5V single supply, while consuming only 2.2mA quiescent current at 5V.

The minimum input common mode voltage is within 0.1V below the negative rail, and the output swing is rail-to-rail with heavy loads. The SGM8602 exhibits a high gain-bandwidth product of 12MHz and a slew rate of 9V/ μ s. These specifications make the operational amplifier appropriate for various applications.

The SGM8602 is available in Green SOT-23-8 and TDFN-2 $\times$ 3-8L packages. It is specified over the extended -40°C to +125°C industrial temperature range.

FEATURES

- **Input Offset Voltage: 5.1mV (MAX)**
- **High Gain-Bandwidth Product: 12MHz**
- **High Slew Rate: 9V/ μ s**
- **Settling Time to 0.1% with 2V Step: 0.2 μ s**
- **Overload Recovery Time: 0.4 μ s**
- **Low Noise: 9nV/ $\sqrt{\text{Hz}}$ at 10kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.1V to 5.5V**
- **Input Voltage Range: -0.1V to +5.6V with $V_S = 5.5V$**
- **Low Power: 2.2mA (TYP) Supply Current**
- **-40°C to +125°C Operating Temperature Range**
- **Available in Green SOT-23-8 and TDFN-2 $\times$ 3-8L Packages**

APPLICATIONS

Sensors
Audio
Active Filters
A/D Converters
Communications
Test Equipment
Cellular and Cordless Phones
Laptops and PDAs
Photodiode Amplification
Battery-Powered Instrumentation

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8602	SOT-23-8	-40°C to +125°C	SGM8602XN8G/TR	SUDXX	Tape and Reel, 3000
	TDFN-2×3-8L	-40°C to +125°C	SGM8602XTDC8G/TR	8602 XXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code. XXXX = Date Code.

SOT-23-8

YYY X X

Date Code - Month

Date Code - Year

Serial Number

TDFN-2×3-8L

XXXX

Date Code - Week

Date Code - Year

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_S to -V_S6V

Input Common Mode Voltage Range

..... (-V_S) - 0.3V to (+V_S) + 0.3V

Junction Temperature+150°C

Storage Temperature Range-65°C to +150°C

Lead Temperature (Soldering, 10s)+260°C

ESD Susceptibility

HBM 8000V

MM 400V

CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range2.1V to 5.5V

Operating Temperature Range-40°C to +125°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.

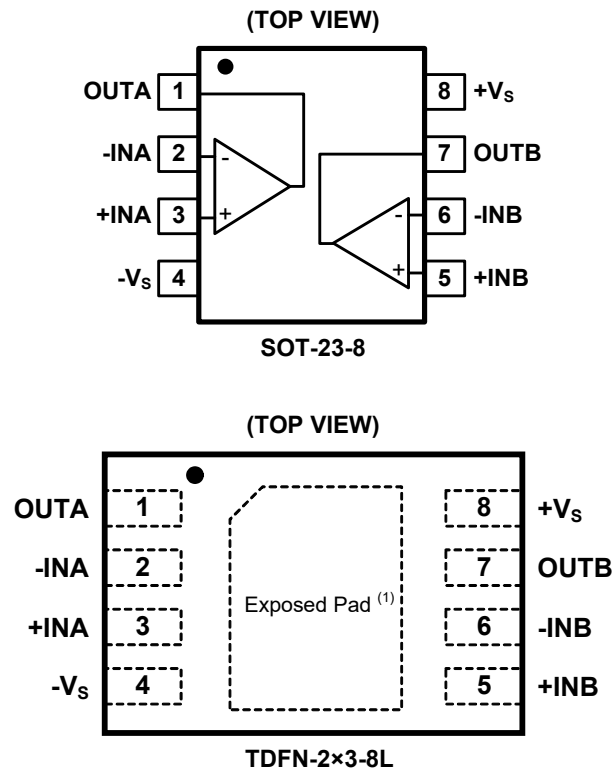
ESD SENSITIVITY CAUTION

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



NOTE: 1. Exposed pad can be connected to -Vs or left floating.

ELECTRICAL CHARACTERISTICS

(At $T_A = +25^\circ\text{C}$, $V_S = 5\text{V}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Input Offset Voltage (V _{OS})			1.2	5.1	mV
	T _A = -40°C to +125°C			5.5	
Input Bias Current (I _B)			1		pA
Input Offset Current (I _{OS})			1		pA
Input Common Mode Voltage Range (V _{CM})	V _S = 5.5V	-0.1		5.6	V
Common Mode Rejection Ratio (CMRR)	V _S = 5.5V, V _{CM} = - 0.1V to 4V	67	84		dB
	T _A = -40°C to +125°C	66			
	V _S = 5.5V, V _{CM} = - 0.1V to 5.6V	60	75		dB
	T _A = -40°C to +125°C	59			
Open-Loop Voltage Gain (A _{OL})	R _L = 10kΩ, V _{OUT} = 0.05V to 4.95V	97	104		dB
	T _A = -40°C to +125°C	72			
	R _L = 600Ω, V _{OUT} = 0.15V to 4.85V	84	92		dB
	T _A = -40°C to +125°C	64			
Input Offset Voltage Drift (ΔV _{OS} /ΔT)			4.7		μV/°C
Output Characteristics					
Output Voltage Swing from Rail (V _{OL})	R _L = 10kΩ		6	12	mV
	T _A = -40°C to +125°C			17	
	R _L = 600Ω		75	100	mV
	T _A = -40°C to +125°C			144	
Output Current (I _{OUT})		52	65		mA
	T _A = -40°C to +125°C	36			
Power Supply					
Operating Voltage Range		2.1		5.5	V
Power Supply Rejection Ratio (PSRR)	V _S = +2.1V to +5.5V, V _{CM} = (-V _S) + 0.5V	68	82		dB
	T _A = -40°C to +125°C	63			
Quiescent Current (I _Q)	I _{OUT} = 0		2.2	2.8	mA
	T _A = -40°C to +125°C			3.6	
Dynamic Performance					
Gain-Bandwidth Product (GBP)	R _L = 600Ω		12		MHz
Slew Rate (SR)	G = 1, 2V output step		9.0		V/μs
Settling Time to 0.1% (t _s)	G = 1, 2V output step		0.2		μs
Overload Recovery Time	V _{IN} × Gain = V _S		0.4		μs
Phase Margin (φ _O)	R _L = 600Ω		65		°
Noise Performance					
Input Voltage Noise Density (e _n)	f = 1kHz		13		nV/√Hz
	f = 10kHz		9		

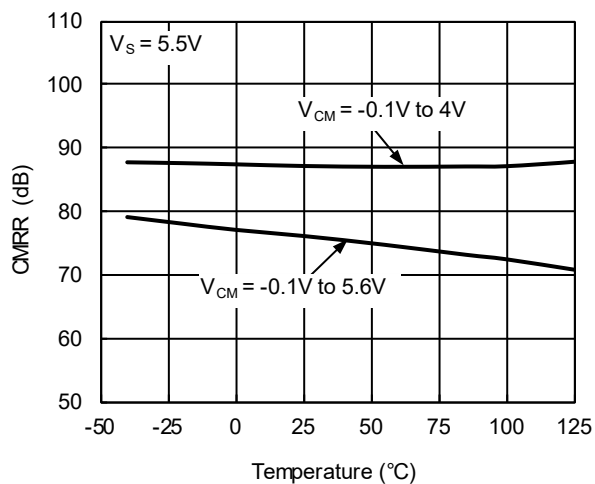
ELECTRICAL CHARACTERISTICS (continued)(At $T_A = +25^\circ\text{C}$, $V_S = 2.1\text{V}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Input Offset Voltage (V _{OS})			1.2	5.5	mV
	T _A = -40°C to +125°C			5.9	
Input Bias Current (I _B)			1		pA
Input Offset Current (I _{OS})			1		pA
Input Common Mode Voltage Range (V _{CM})	V _S = 2.1V	-0.1		2.2	V
Common Mode Rejection Ratio (CMRR)	V _S = 2.1V, V _{CM} = - 0.1V to 0.6V	60	77		dB
	T _A = -40°C to +125°C	51			
	V _S = 2.1V, V _{CM} = - 0.1V to 2.2V	53	68		dB
	T _A = -40°C to +125°C	46			
Open-Loop Voltage Gain (A _{OL})	R _L = 10kΩ, V _{OUT} = 0.05V to 2.05V	90	100		dB
	T _A = -40°C to +125°C	68			
	R _L = 600Ω, V _{OUT} = 0.15V to 1.95V	75	88		dB
	T _A = -40°C to +125°C	63			
Input Offset Voltage Drift (ΔV _{OS} /ΔT)			4.5		μV/°C
Output Characteristics					
Output Voltage Swing from Rail (V _{OL})	R _L = 10kΩ		4	10	mV
	T _A = -40°C to +125°C			12	
	R _L = 600Ω		36	51	mV
	T _A = -40°C to +125°C			67	
Output Current (I _{OUT})		15	30		mA
	T _A = -40°C to +125°C	7			
Power Supply					
Quiescent Current (I _Q)	I _{OUT} = 0		2.2	2.8	mA
	T _A = -40°C to +125°C			3.6	
Dynamic Performance					
Gain-Bandwidth Product (GBP)	R _L = 600Ω		11.5		MHz
Slew Rate (SR)	G = 1, 2V output step		8.6		V/μs
Settling Time to 0.1% (t _S)	G = 1, 2V output step		0.2		μs
Overload Recovery Time	V _{IN} × Gain = V _S		0.7		μs
Phase Margin (φ _O)	R _L = 600Ω		65		°
Noise Performance					
Input Voltage Noise Density (e _n)	f = 1kHz		15		nV/√Hz
	f = 10kHz		9		

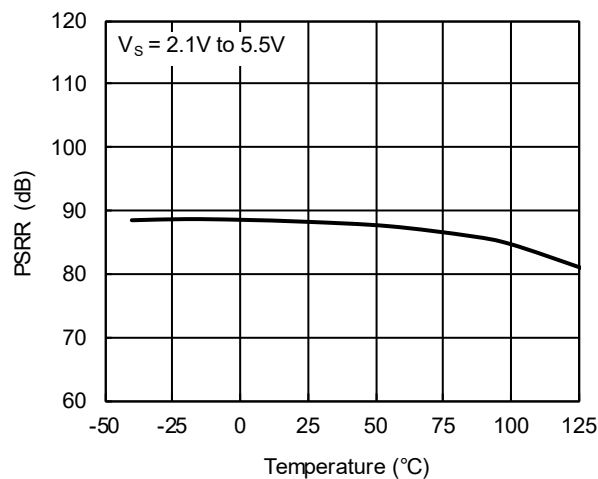
TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.

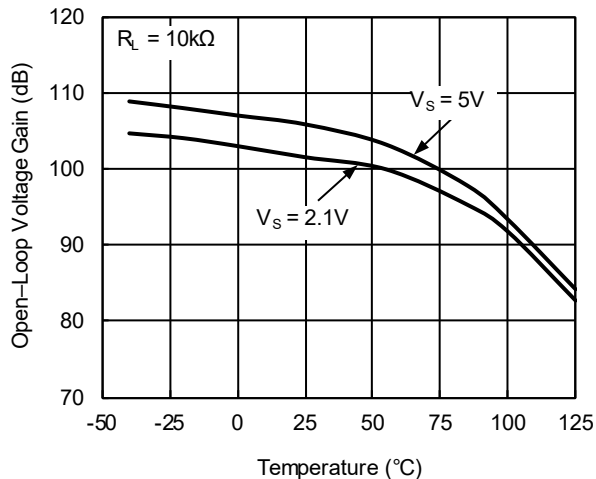
CMRR vs. Temperature



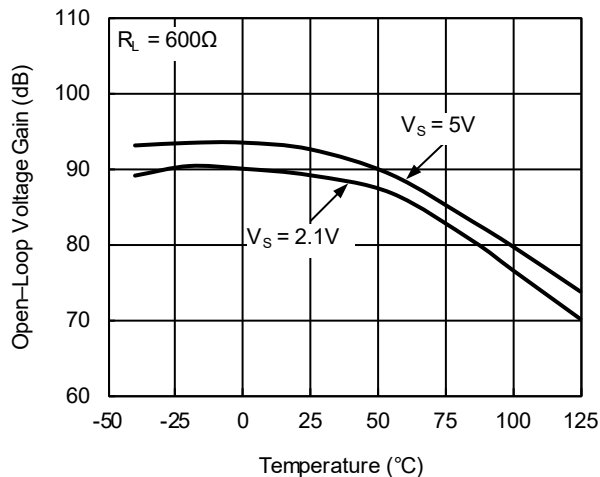
PSRR vs. Temperature



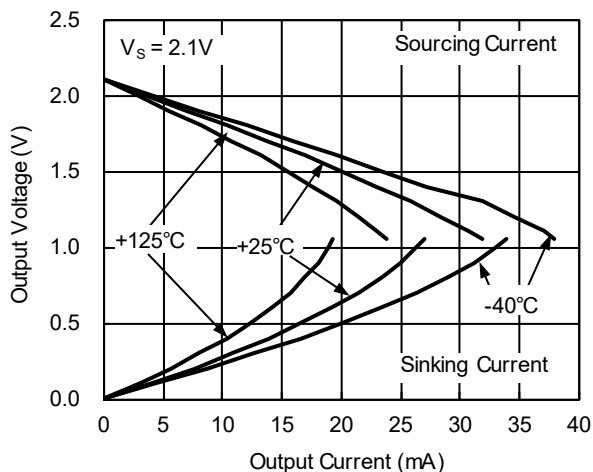
Open-Loop Voltage Gain vs. Temperature



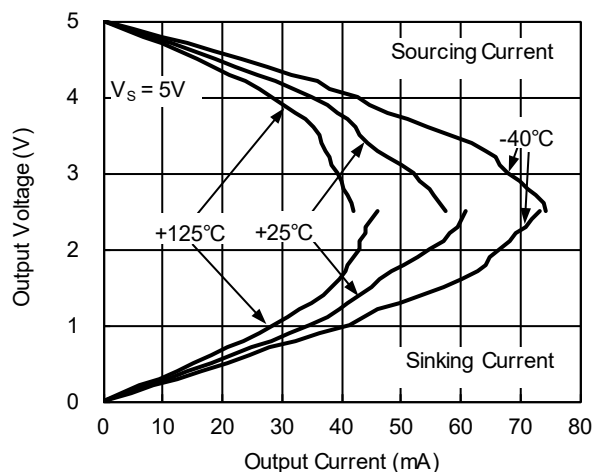
Open-Loop Voltage Gain vs. Temperature



Output Voltage Swing vs. Output Current



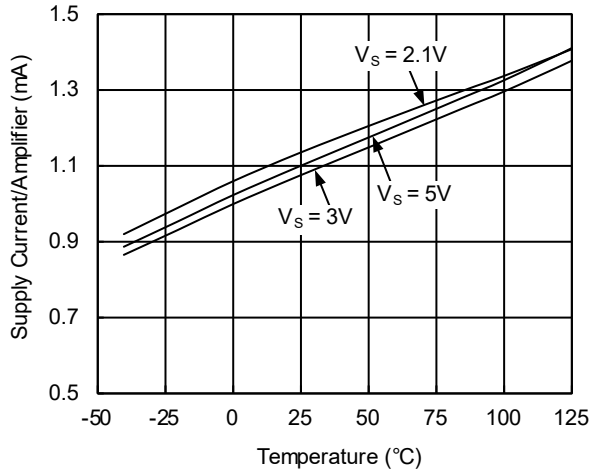
Output Voltage Swing vs. Output Current



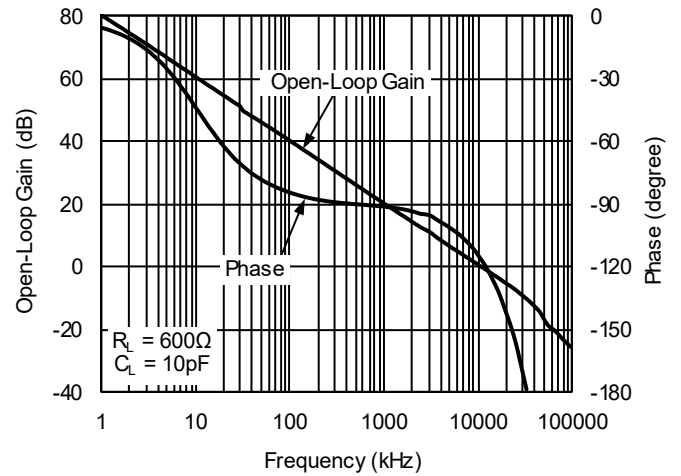
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.

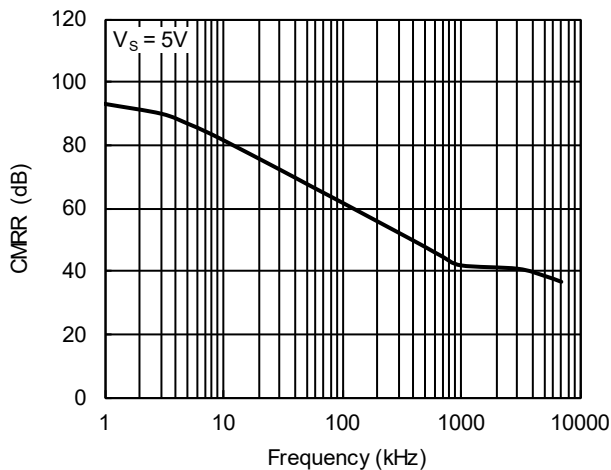
Supply Current vs. Temperature



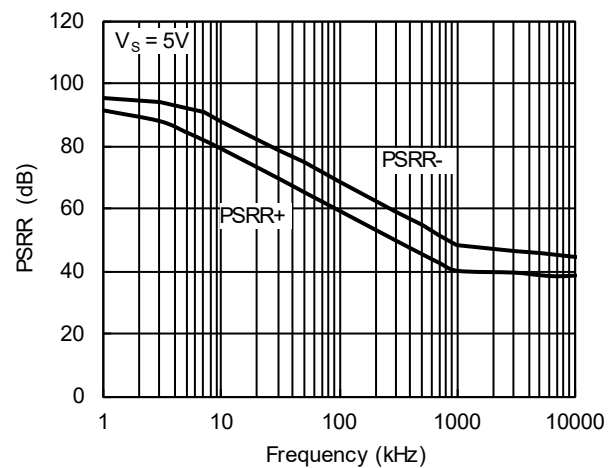
Open-Loop Gain and Phase vs. Frequency



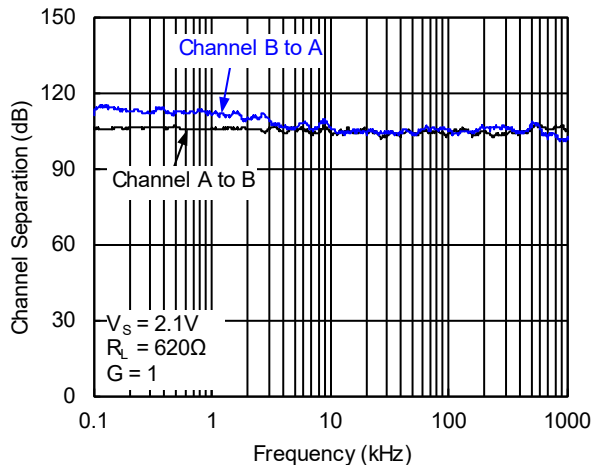
CMRR vs. Frequency



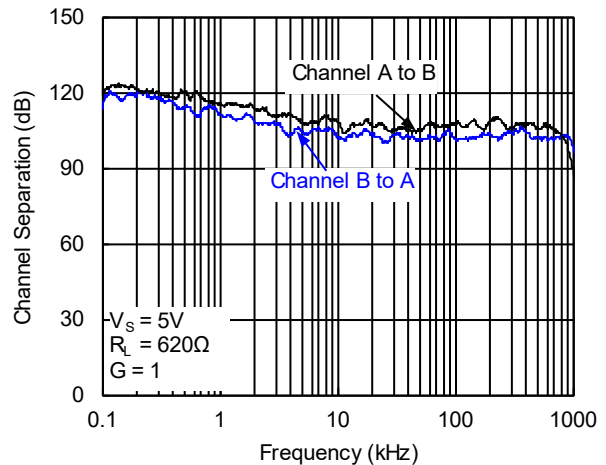
PSRR vs. Frequency



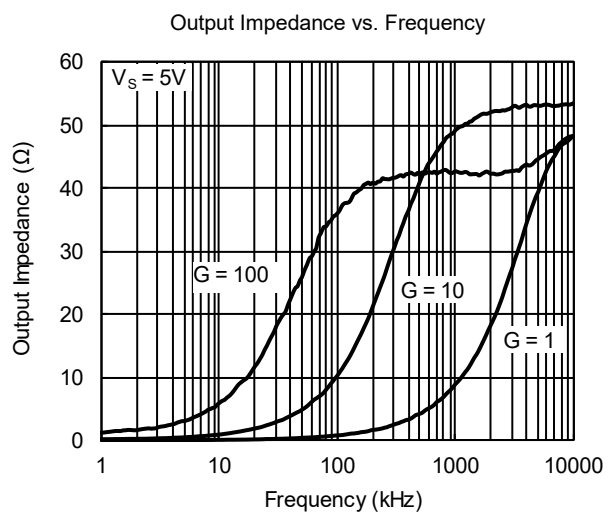
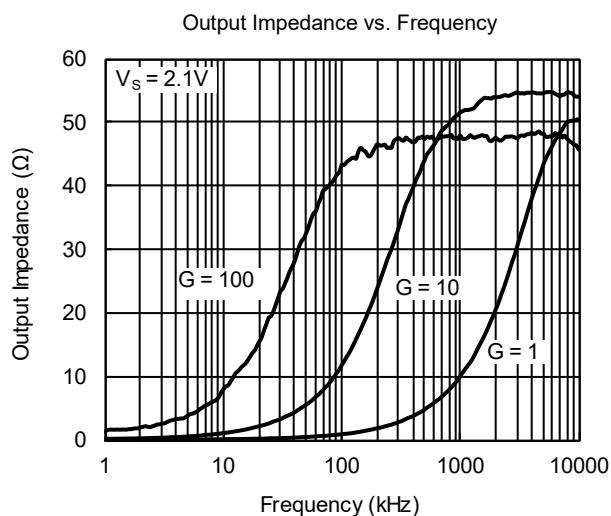
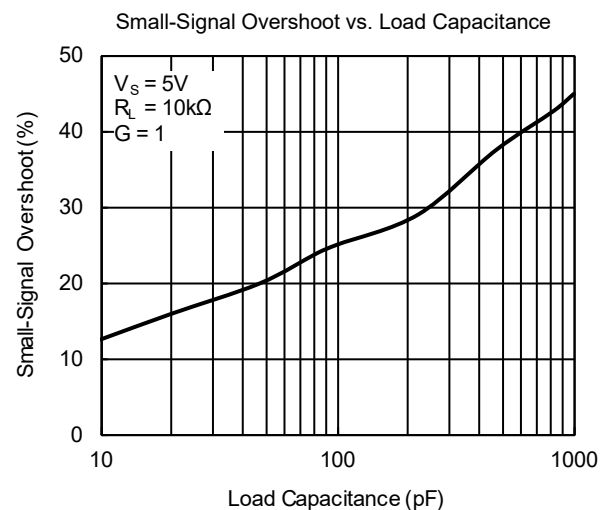
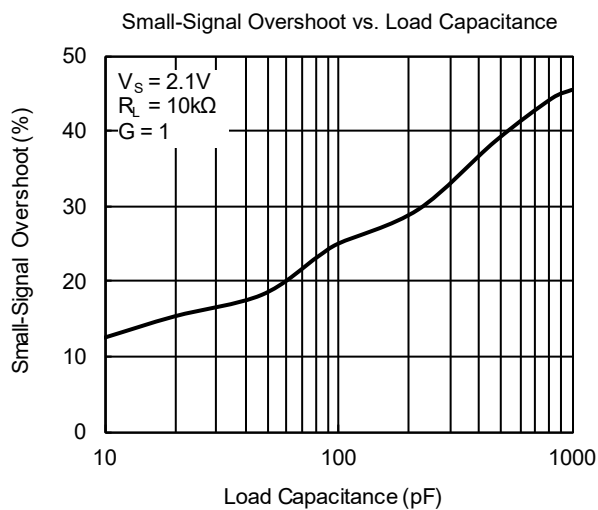
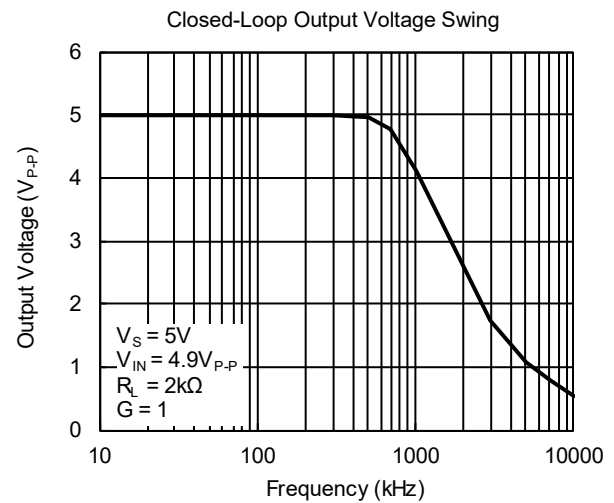
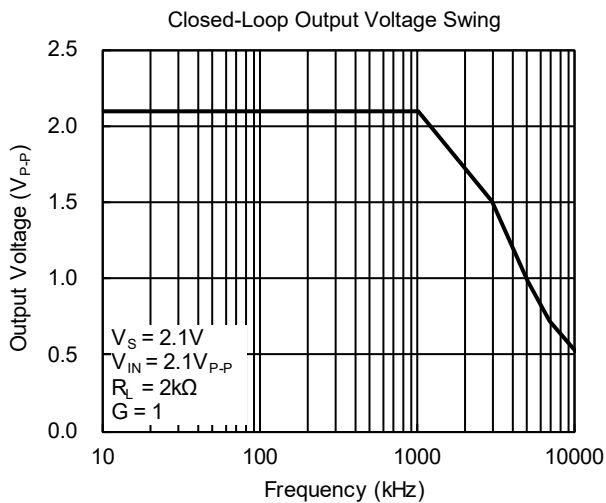
Channel Separation vs. Frequency



Channel Separation vs. Frequency



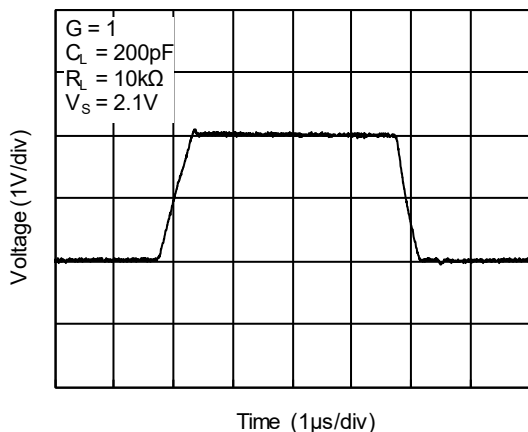
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.

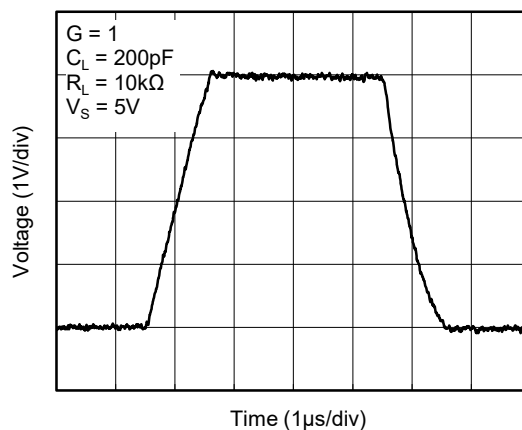
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.

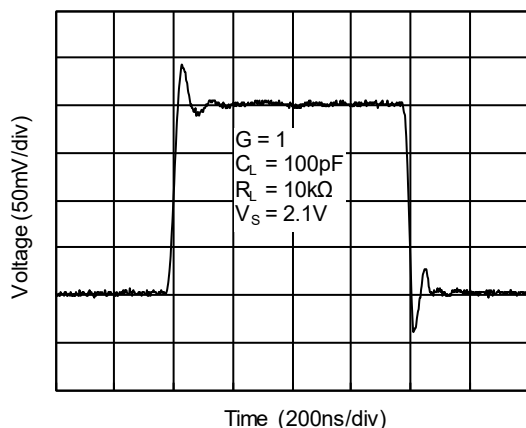
Large-Signal Step Response



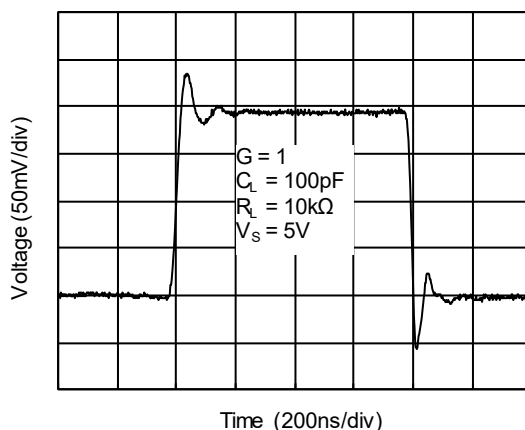
Large-Signal Step Response



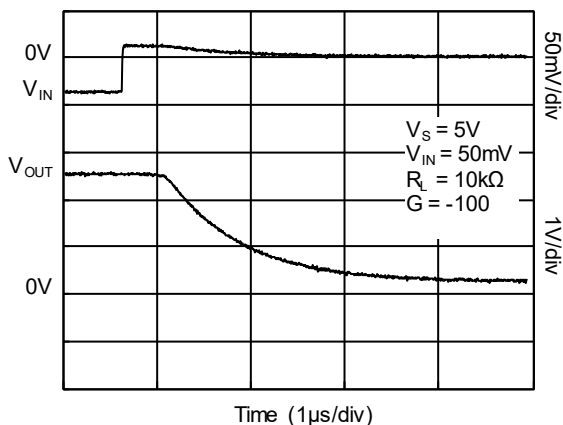
Small-Signal Step Response



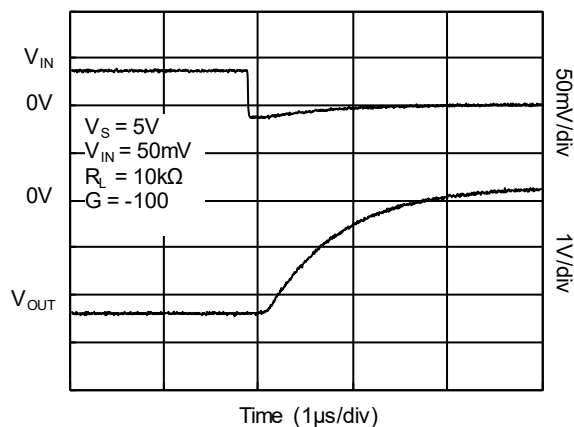
Small-Signal Step Response



Positive Overload Recovery

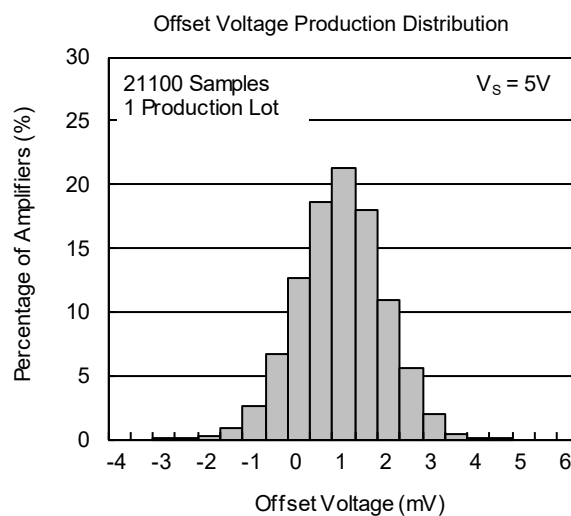
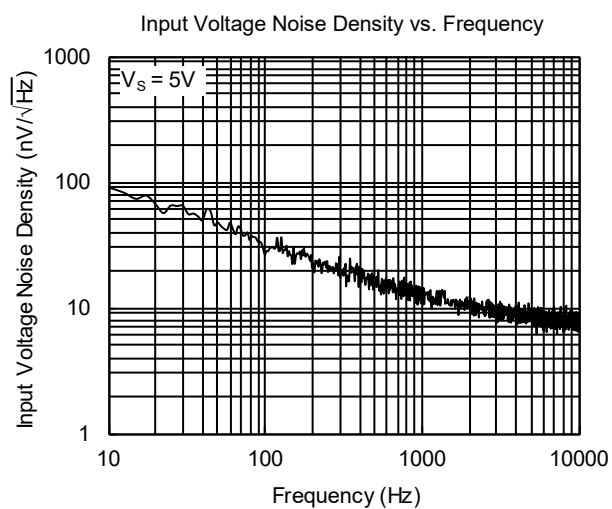


Negative Overload Recovery



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.



REVISION HISTORY

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

JANUARY 2018 – REV.A to REV.A.1

Page

Added Open-Loop Gain and Phase vs. Frequency 6

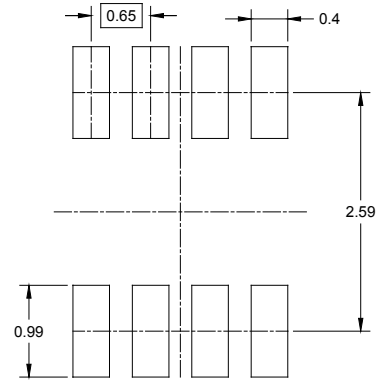
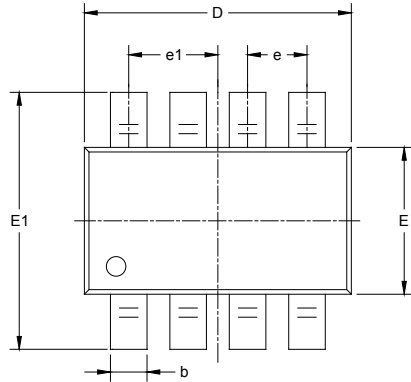
Changes from Original (AUGUST 2015) to REV.A

Page

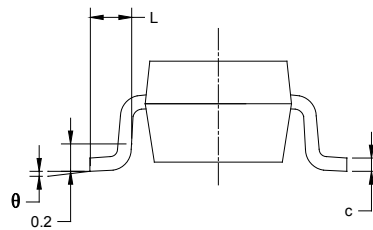
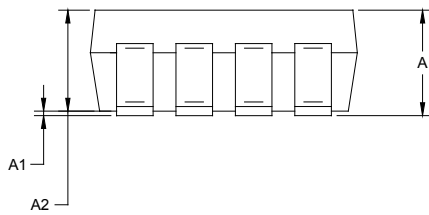
Changed from product preview to production data..... All

PACKAGE OUTLINE DIMENSIONS

SOT-23-8



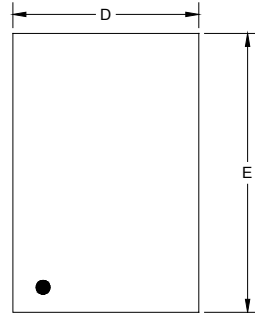
RECOMMENDED LAND PATTERN (Unit: mm)



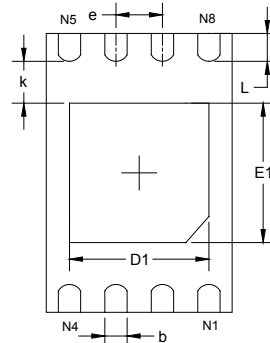
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.650 BSC		0.026 BSC	
e1	0.975 BSC		0.038 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

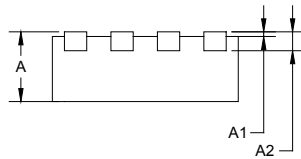
TDFN-2×3-8L



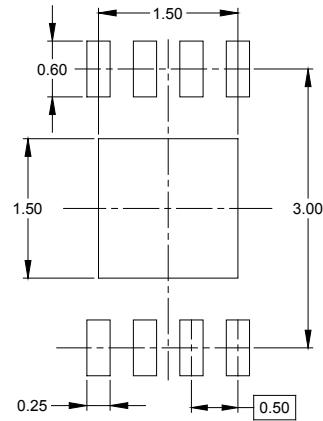
TOP VIEW



BOTTOM VIEW



SIDE VIEW



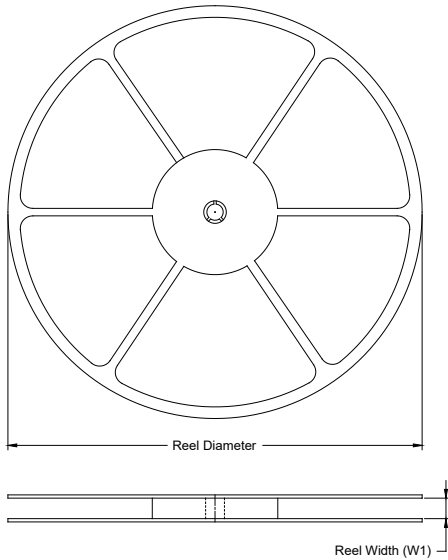
RECOMMENDED LAND PATTERN (Unit: mm)

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	1.924	2.076	0.076	0.082
D1	1.400	1.600	0.055	0.063
E	2.924	3.076	0.115	0.121
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.200	0.300	0.008	0.012
e	0.500 TYP		0.020 TYP	
L	0.224	0.376	0.009	0.015

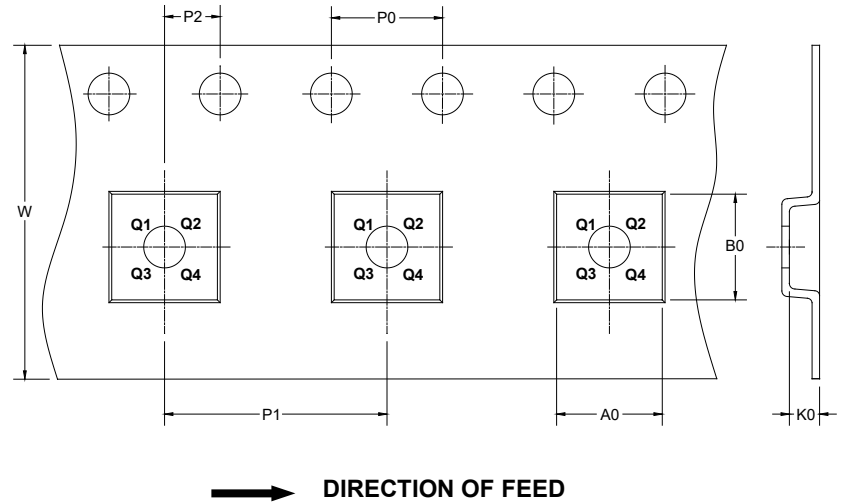
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

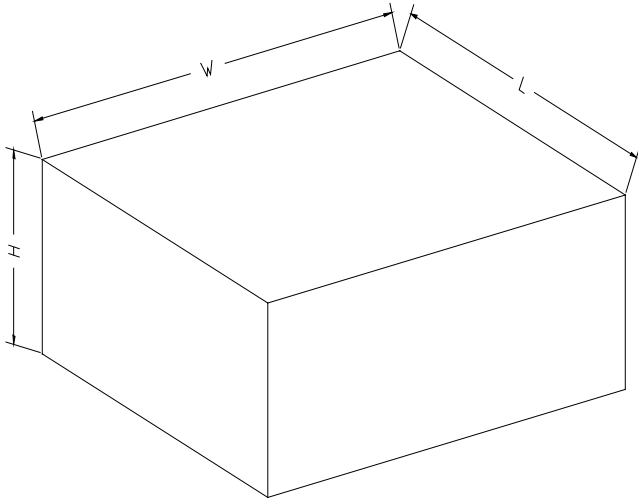
KEY PARAMETER LIST OF TAPE AND REEL

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-23-8	7"	9.5	3.17	3.23	1.37	4.0	4.0	2.0	8.0	Q3
TDFN-2×3-8L	7"	9.5	2.30	3.30	1.10	4.0	4.0	2.0	8.0	Q2

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

DD0002