



SGM8600

2.2mA, 11MHz, Low Noise, Rail-to-Rail I/O Tiny Package, CMOS Operational Amplifier

GENERAL DESCRIPTION

The SGM8600 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 SGM8600 features a 4mV maximum input offset voltage. The SGM8600 exhibits a high gain-bandwidth product of 11MHz and a slew rate of 8.5V/ μ s. These specifications make the operational amplifier appropriate for various applications.

The SGM8600 is available in Green SOIC-8 and TDFN-2 \times 2-8L packages. It is specified over the extended -40°C to +125°C industrial temperature range.

FEATURES

- **Offset Voltage Range: 0mV to 4mV**
- **High Gain-Bandwidth Product: 11MHz**
- **High Slew Rate: 8.5V/ μ s**
- **Settling Time to 0.1% with 2V Step: 0.21 μ s**
- **Overload Recovery Time: 0.6 μ s**
- **Low Noise: 8.5nV/ $\sqrt{\text{Hz}}$ at 10kHz**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 2.1V to 5.5V**
- **Input Common Mode 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 SOIC-8 and TDFN-2 \times 2-8L Packages**

APPLICATIONS

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

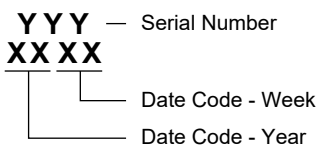
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8600	SOIC-8	-40°C to +125°C	SGM8600XS8G/TR	SGM 8600XS8 XXXXX	Tape and Reel, 2500
	TDFN-2x2-8L	-40°C to +125°C	SGM8600XTDE8G/TR	8600 XXXX	Tape and Reel, 3000

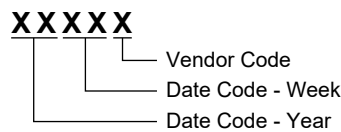
MARKING INFORMATION

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

TDFN-2x2-8L



SOIC-8



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, +Vs to -Vs6V
- Input Common Mode Voltage Range(-Vs) - 0.3V to (+Vs) + 0.3
- 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.

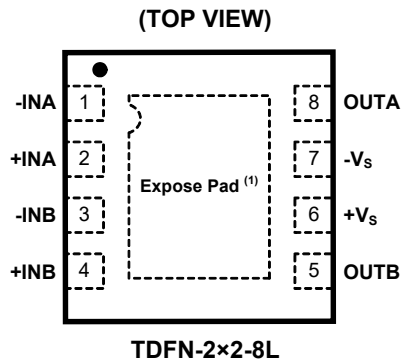
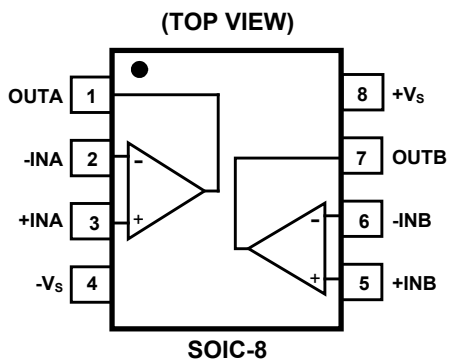
ESD SENSITIVITY CAUTION

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.

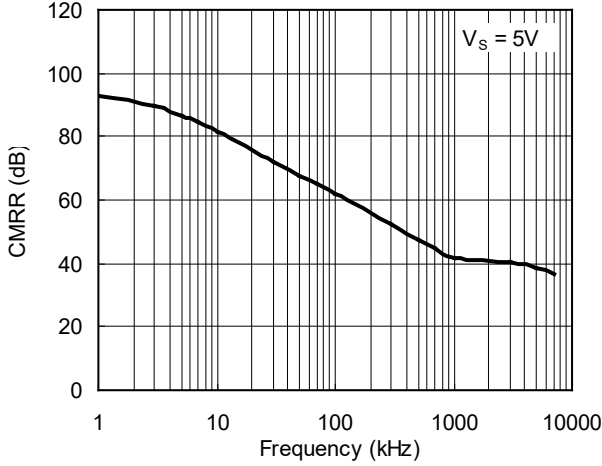
ELECTRICAL CHARACTERISTICS(At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, $V_{CM} = V_S/2$, $R_L = 600\Omega$, unless otherwise noted.)

PARAMETER	CONDITIONS	SGM8600						
		TYP	MIN/MAX OVER TEMPERATURE				UNITS	MIN/ MAX
		+25°C	+25°C	-40°C to +85°C	-40°C to +125°C			
Input Characteristics								
Input Offset Voltage (V_{OS})			0			mV	MIN	
		2	4	4.5	5	mV	MAX	
Input Bias Current (I_B)		1				pA	TYP	
Input Offset Current (I_{OS})		1				pA	TYP	
Input Common Mode Voltage Range (V_{CM})	$V_S = 5.5\text{V}$	-0.1 to +5.6				V	TYP	
Common Mode Rejection Ratio (CMRR)	$V_S = 5.5\text{V}$, $V_{CM} = -0.1\text{V}$ to 4V	82	67	66	65	dB	MIN	
	$V_S = 5.5\text{V}$, $V_{CM} = -0.1\text{V}$ to 5.6V	70	59	58	57	dB	MIN	
Open-Loop Voltage Gain (A_{OL})	$R_L = 600\Omega$, $V_{OUT} = 0.15\text{V}$ to 4.85V	92	84	74	65	dB	MIN	
	$R_L = 10\text{k}\Omega$, $V_{OUT} = 0.05\text{V}$ to 4.95V	105	96	87	72	dB	MIN	
Input Offset Voltage Drift ($\Delta V_{OS}/\Delta T$)		8.7				$\mu\text{V}/^\circ\text{C}$	TYP	
Output Characteristics								
Output Voltage Swing from Rail	$R_L = 600\Omega$	76	90	110	135	mV	MAX	
	$R_L = 10\text{k}\Omega$	7	11	13	18	mV	MAX	
Output Current (I_{OUT})		63	50	41	36	mA	MIN	
Closed-Loop Output Impedance	$f = 1\text{MHz}$, $G = 1$	8.5				Ω	TYP	
Power Supply								
Operating Voltage Range		2.1	2.1	2.1	2.1	V	MIN	
		5.5	5.5	5.5	5.5	V	MAX	
Power Supply Rejection Ratio (PSRR)	$V_S = +2.1\text{V}$ to $+5.5\text{V}$, $V_{CM} = (-V_S) + 0.5\text{V}$	79	69	68	64	dB	MIN	
Quiescent Current (I_Q)	$I_{OUT} = 0$	2.2	2.7	3	3.5	mA	MAX	
Dynamic Performance								
Gain-Bandwidth Product (GBP)	$R_L = 10\text{k}\Omega$	11				MHz	TYP	
Phase Margin (ϕ_O)		62				$^\circ$	TYP	
Full Power Bandwidth (BW_P)	< 1% distortion	400				kHz	TYP	
Slew Rate (SR)	$G = 1$, 2V output step	8.5				$\text{V}/\mu\text{s}$	TYP	
Settling Time to 0.1% (t_S)	$G = 1$, 2V output step	0.21				μs	TYP	
Overload Recovery Time	$V_{IN} \times G = V_S$	0.6				μs	TYP	
Noise Performance								
Input Voltage Noise Density (e_n)	$f = 1\text{kHz}$	12.5				$\text{nV}/\sqrt{\text{Hz}}$	TYP	
	$f = 10\text{kHz}$	8.5				$\text{nV}/\sqrt{\text{Hz}}$	TYP	

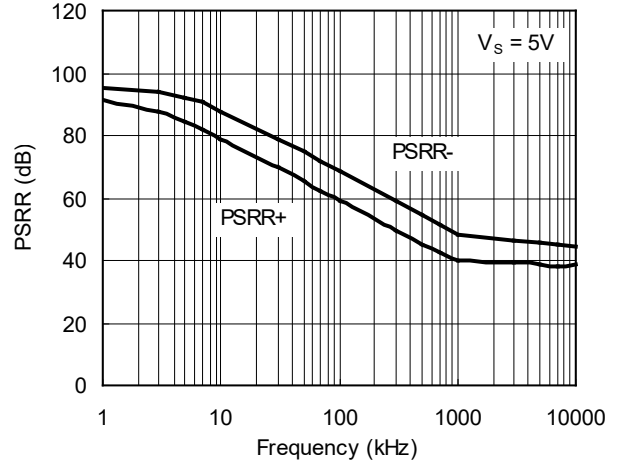
TYPICAL PERFORMANCE CHARACTERISTICS

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

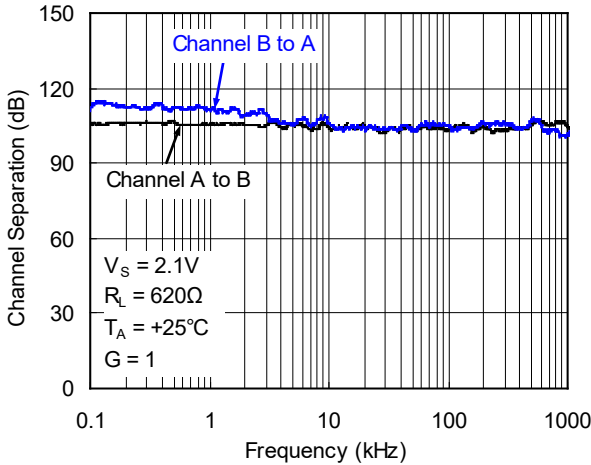
CMRR vs. Frequency



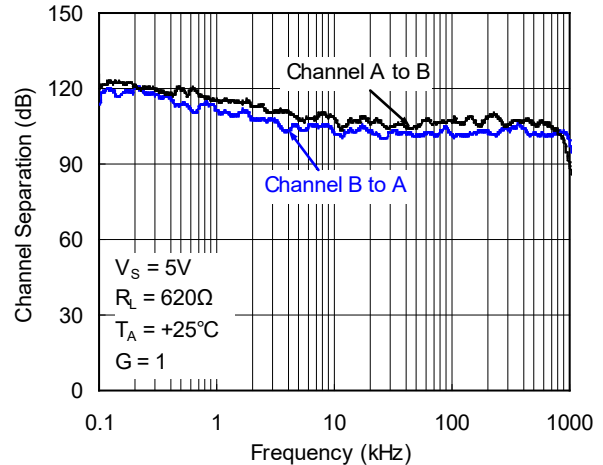
PSRR vs. Frequency



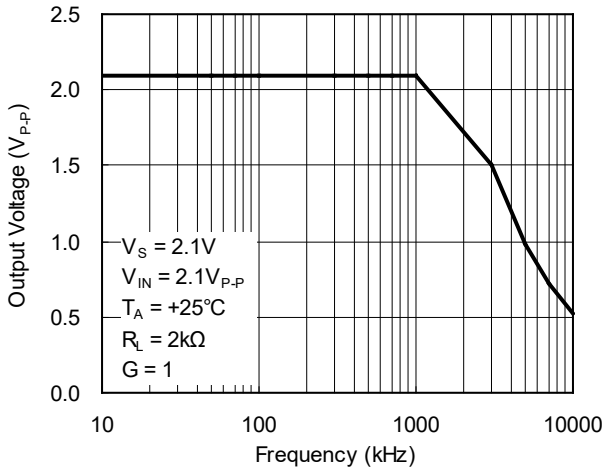
Channel Separation vs. Frequency



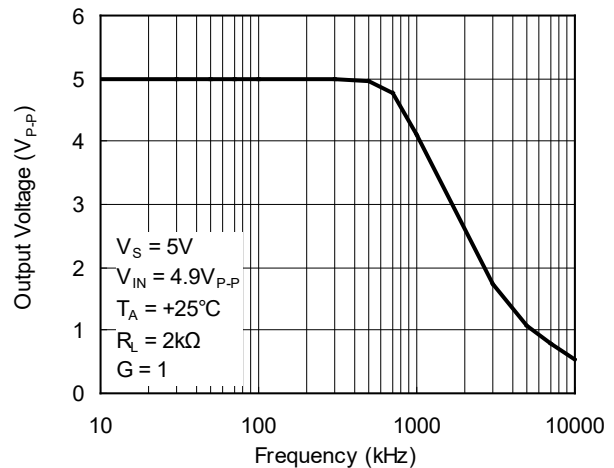
Channel Separation vs. Frequency



Closed-Loop Output Voltage Swing



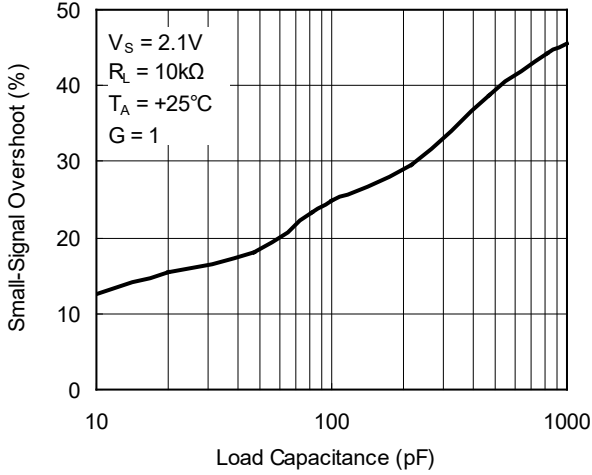
Closed-Loop Output Voltage Swing



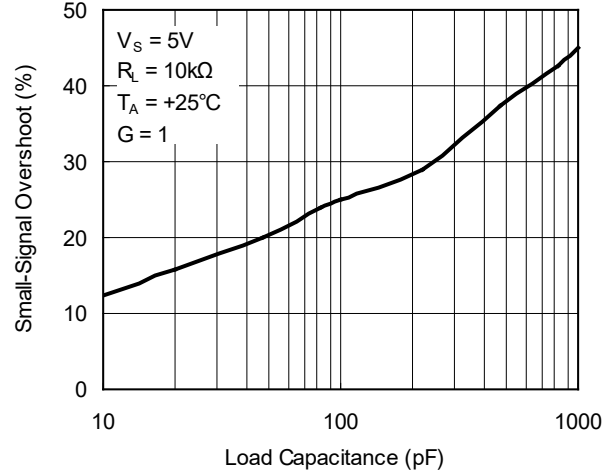
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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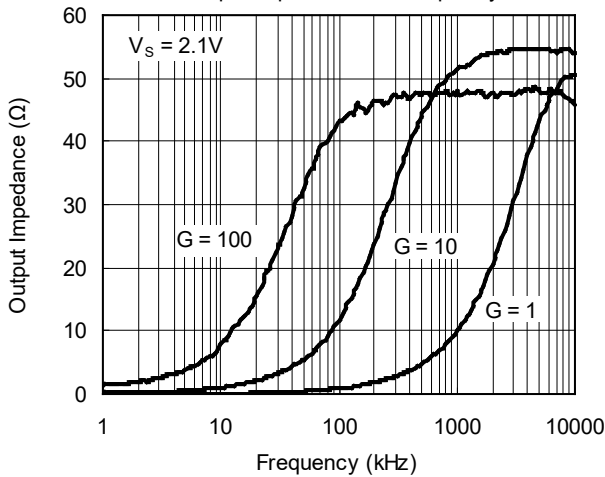
Small-Signal Overshoot vs. Load Capacitance



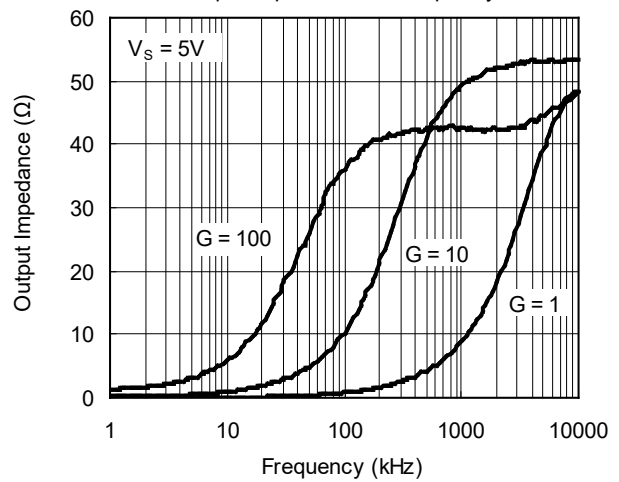
Small-Signal Overshoot vs. Load Capacitance



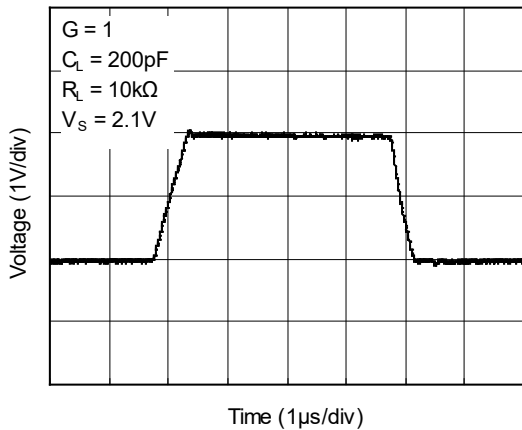
Output Impedance vs. Frequency



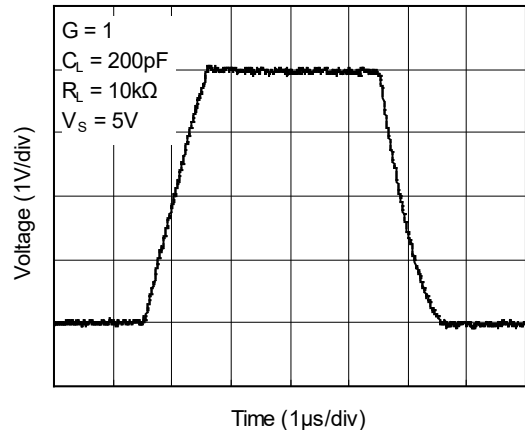
Output Impedance vs. Frequency



Large-Signal Step Response



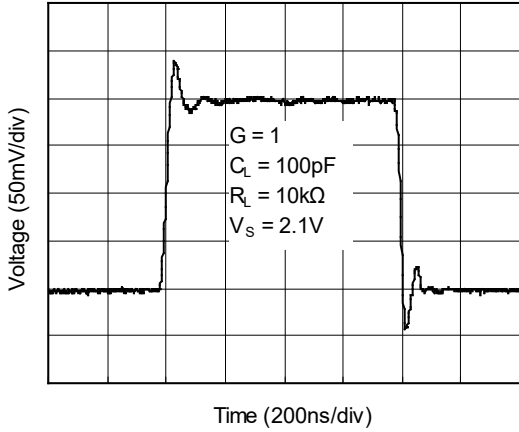
Large-Signal Step Response



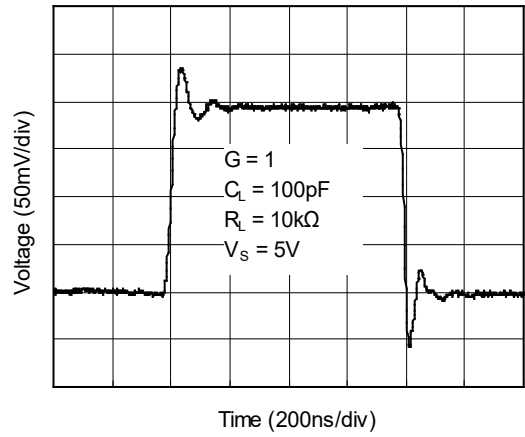
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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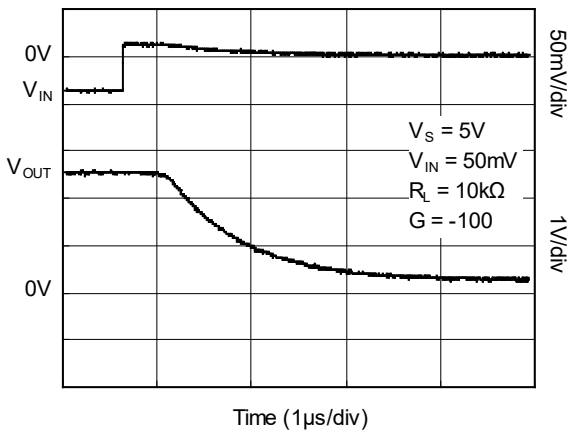
Small-Signal Step Response



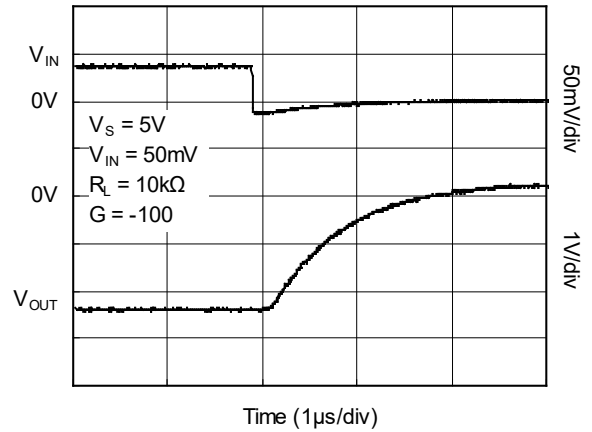
Small-Signal Step Response



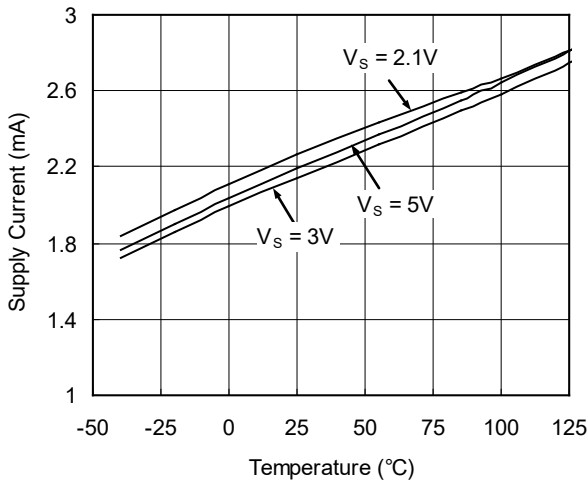
Positive Overload Recovery



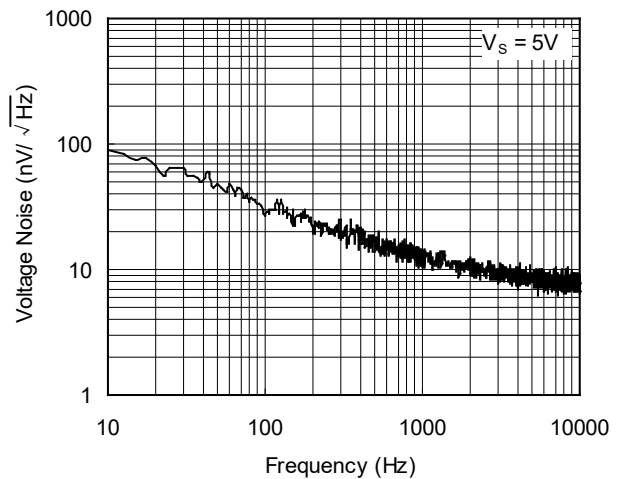
Negative Overload Recovery



Supply Current vs. Temperature



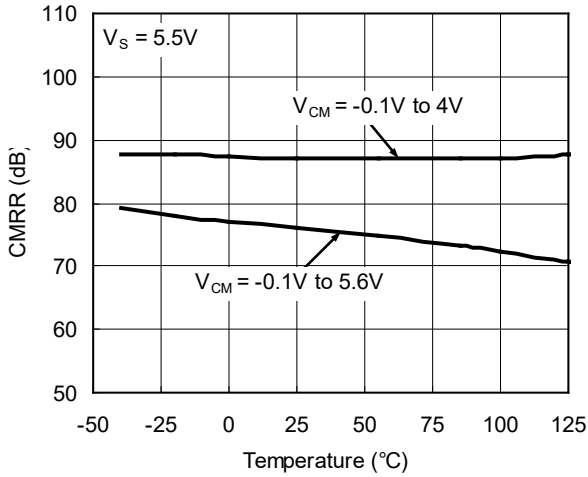
Input Voltage Noise Spectral Density vs. Frequency



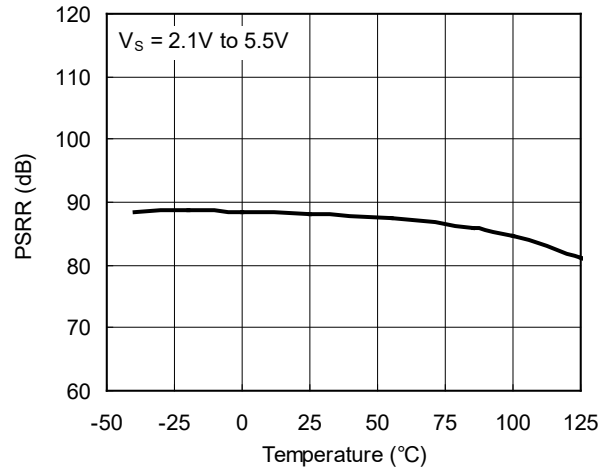
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

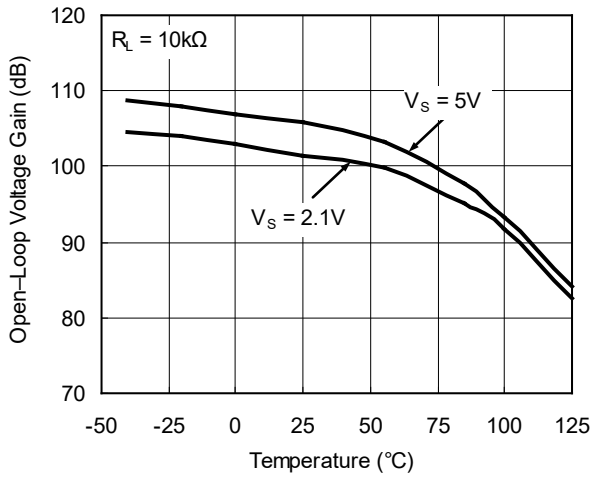
CMRR vs. Temperature



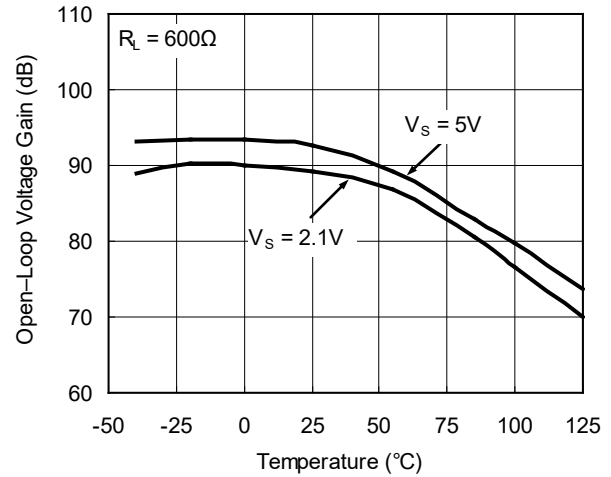
PSRR vs. Temperature



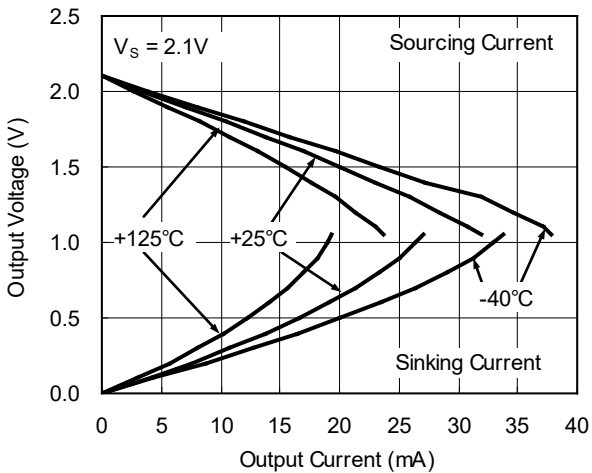
Open-Loop Voltage Gain vs. Temperature



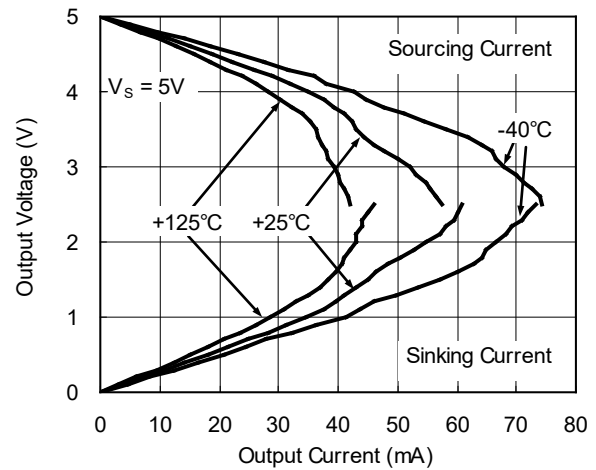
Open-Loop Voltage Gain vs. Temperature



Output Voltage Swing vs. Output Current



Output Voltage Swing vs. Output Current



REVISION HISTORY

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

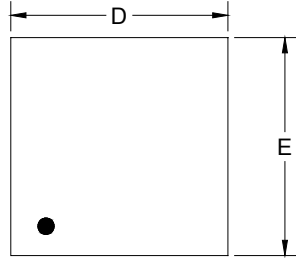
Changes from Original (SEPTEMBER 2015) to REV.A

Page

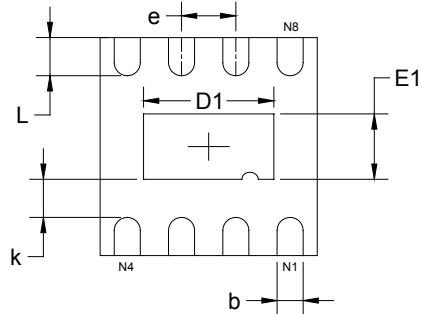
Changed from product preview to production data.....All

PACKAGE OUTLINE DIMENSIONS

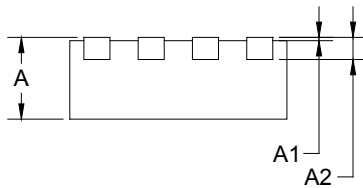
TDFN-2x2-8L



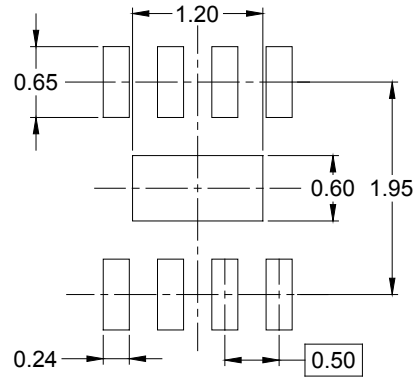
TOP VIEW



BOTTOM VIEW



SIDE VIEW

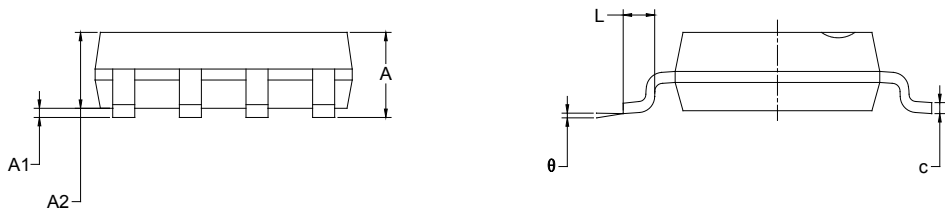
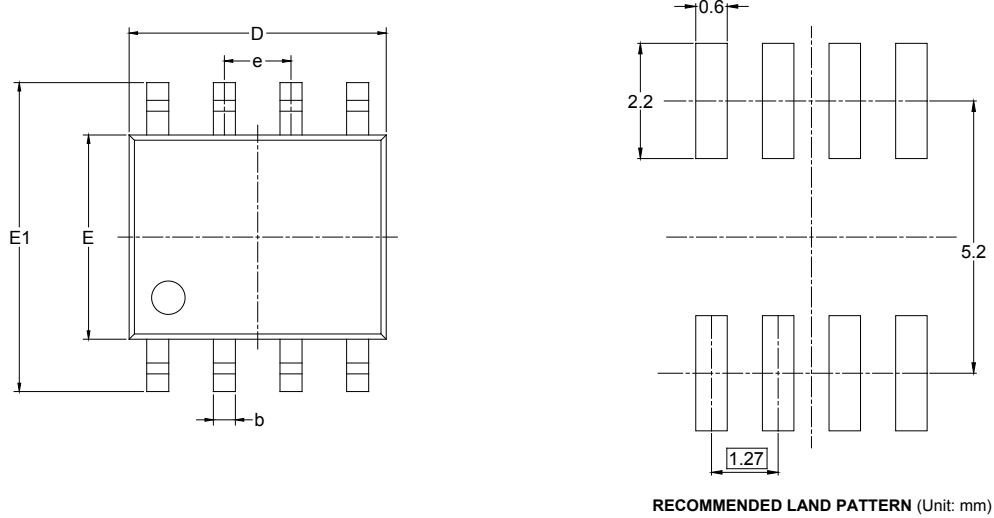


RECOMMENDED LAND PATTERN (Unit: mm)

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	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.500	0.700	0.020	0.028
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.250	0.450	0.010	0.018

PACKAGE OUTLINE DIMENSIONS

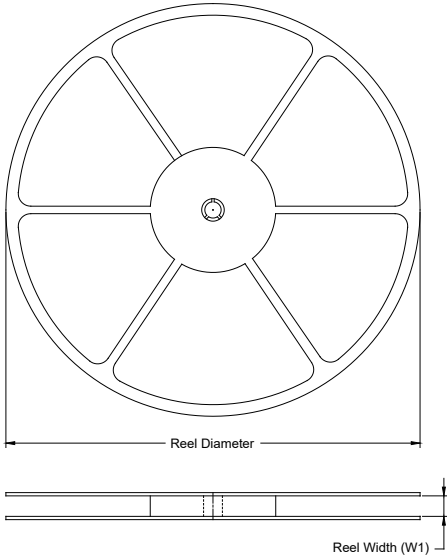
SOIC-8



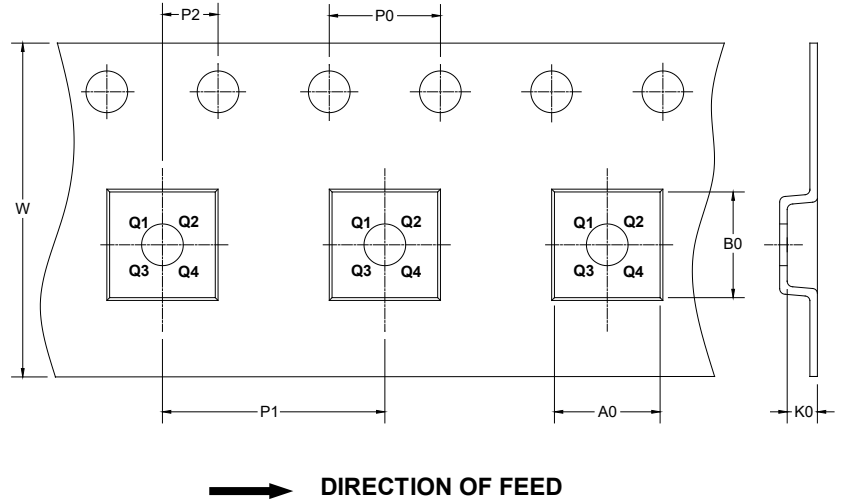
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050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

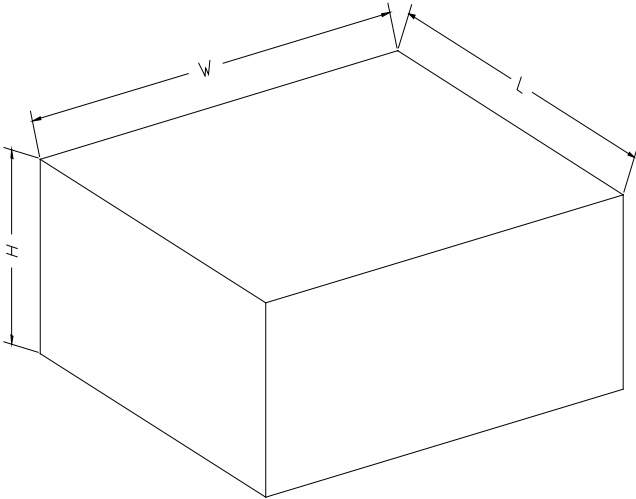
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TDFN-2x2-8L	7"	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1
SOIC-8	13"	12.4	6.40	5.40	2.10	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
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

DD0002