SGM8611-1
1.3MHz, 62μA, Rail-to-Rail I/O, CMOS Operational Amplifier

GENERAL DESCRIPTION

The SGM8611-1 is a single, low cost, voltage feedback amplifier. The device can operate from 1.8V to 5.5V single supply, while consuming only 62μA quiescent current. It provides rail-to-rail input and output operation. This feature makes SGM8611-1 appropriate for buffering ASIC.

The SGM8611-1 offers a gain-bandwidth product of 1.3MHz and an ultra-low input bias current of ±10pA. It is well suited for piezoelectric sensors, integrators and photodiode amplifiers.

The SGM8611-1 is designed into a wide range of applications, such as battery-powered instrumentation, safety monitoring, portable systems, and transducer interface circuits in low power systems.

The SGM8611-1 is available in a Green XTDFN-0.8×0.8-4AL package. It is specified over the extended industrial temperature range (-40℃ to +125℃).

FEATURES

- **Input Offset Voltage: ±1.8mV (MAX)**
- **Ultra-Low Input Bias Current: ±10pA (TYP)**
- **Unity-Gain Stable**
- **Gain-Bandwidth Product: 1.3MHz**
- **Rail-to-Rail Input and Output**
- **No Phase Reversal**
- **Supply Voltage Range: 1.8V to 5.5V**
- **Input Voltage Range:**
  -0.1V to 5.6V with V_S = 5.5V
- **Low Quiescent Current: 62μA (TYP)**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green XTDFN-0.8×0.8-4AL Package**

APPLICATIONS

Industrial Equipment

Medical Equipment

Battery-Powered Equipment

Telecom Equipment

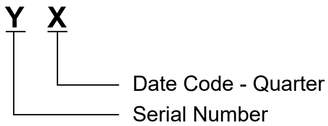
Notebook PC

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8611-1	XTDFN-0.8×0.8-4AL	-40℃ to +125℃	SGM8611-1XXGO4G/TR	7X	Tape and Reel, 10000

MARKING INFORMATION

NOTE: X = Date Code.



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 $-V_S$ 7V

Input Common Mode Voltage Range (1)

.... $(-V_S)$ - 0.5V to $(+V_S)$ + 0.5V

Differential Input Voltage Range (1)...........$(+V_S)$ - $(-V_S)$ + 0.2V

Signal Input Pins Current (1) .... -10mA to 10mA

Output Short-Circuit (2) .... Continuous

Junction Temperature...+150℃

Storage Temperature Range ....-65℃ to +150℃

Lead Temperature (Soldering, 10s)............................+260℃

ESD Susceptibility (3) (4)

HBM..±5000V

CDM ....±1000V

NOTES:

1. A clamping diode is added between the input and supply pin, so the input signal can be 0.5V higher than power supply voltage. However, the current of the input signal should be limited within the range of 10mA.
2. Each package contains one amplifier, which can be shorted to ground.
3. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
4. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Operating Voltage Range....................................1.8V to 5.5V

Operating Temperature Range ....-40℃ to +125℃

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

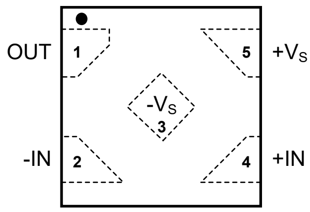
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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 CONFIGURATION

(TOP VIEW)



XTDFN-0.8×0.8-4AL

ELECTRICAL CHARACTERISTICS

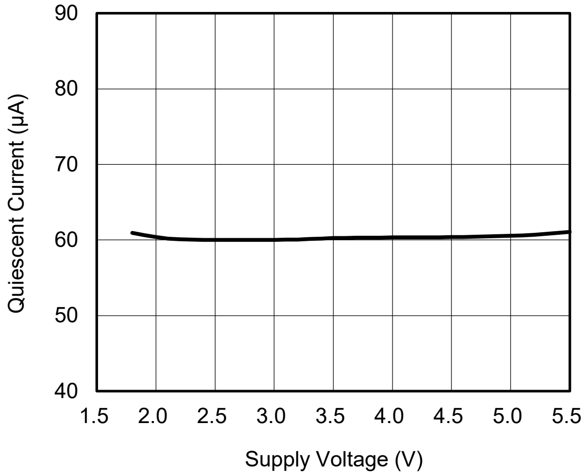
(V_S = 1.8V to 5.5V (±0.9V to ±2.75V), V_{CM} = V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, Full = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Characteristics								
Input Offset Voltage		V_{OS}	V_S = 5V	+25℃		±0.45	±1.8	mV
				Full			±2.0	
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T$	V_S = 5V	Full		±2		μV/℃
Input Bias Current		I_B	V_S = 5V	+25℃		±10		pA
Input Offset Current		I_{OS}		+25℃		±5		pA
Input Common Mode Voltage Range		V_{CM}	No phase reversal, rail-to-rail input	+25℃	$(-V_S)$ - 0.1		$(+V_S)$ + 0.1	V
Common Mode Rejection Ratio		CMRR	V_S = 1.8V, $(-V_S)$ - 0.1V < V_{CM} < $(+V_S)$ - 1.4V	Full		84		dB
			V_S = 5.5V, $(-V_S)$ - 0.1V < V_{CM} < $(+V_S)$ - 1.4V	Full		95		
			V_S = 1.8V, $(-V_S)$ - 0.1V < V_{CM} < $(+V_S)$ + 0.1V	Full		67		
			V_S = 5.5V, $(-V_S)$ - 0.1V < V_{CM} < $(+V_S)$ + 0.1V	Full	60	75		
Input Capacitance	Differential	C_{ID}		+25℃		1.2		pF
	Common Mode	C_{IC}		+25℃		8		
Open-Loop Voltage Gain		A_{OL}	V_S = 1.8V, $(-V_S)$ + 0.04V < V_{OUT} < $(+V_S)$ - 0.04V, R_L = 10kΩ,	+25℃		120		dB
			V_S = 5.5V, $(-V_S)$ + 0.05V < V_{OUT} < $(+V_S)$ - 0.05V, R_L = 10kΩ,	+25℃	98	124		
			V_S = 1.8V, $(-V_S)$ + 0.1V < V_{OUT} < $(+V_S)$ - 0.1V, R_L = 2kΩ	+25℃		120		
			V_S = 5.5V, $(-V_S)$ + 0.15V < V_{OUT} < $(+V_S)$ - 0.15V, R_L = 2kΩ	+25℃		123		
Output Characteristics								
Output Voltage Swing from Rail		V_{OUT}	V_S = 5.5V, R_L = 10kΩ	+25℃		10	15	mV
			V_S = 5.5V, R_L = 2kΩ	+25℃		35	45	
Output Short-Circuit Current		I_{SC}	V_S = 5.5V	+25℃		±40		mA
Open-Loop Output Impedance		Z_{OUT}	V_S = 5V, f = 1MHz	+25℃		1200		Ω
Power Supply								
Specified Voltage Range		V_S		+25℃	1.8		5.5	V
Power Supply Rejection Ratio		PSRR	V_S = 1.8V to 5.5V, V_{CM} = $-V_S$	+25℃	76	92		dB
Quiescent Current		I_Q	V_S = 5.5V, I_{OUT} = 0mA	+25℃		62	82	μA
				Full			85	
Dynamic Performance								
Gain-Bandwidth Product		GBP	V_S = 5V	+25℃		1.3		MHz
Phase Margin		φ_O	V_S = 5.5V, G = +1	+25℃		75		°
Slew Rate		SR	V_S = 5V	+25℃		2		V/μs
Settling Time	To 0.1%	t_S	V_S = 5V, 2V step, G = -1, C_L = 100pF	+25℃		2.8		μs
	To 0.01%		V_S = 5V, 2V step, G = -1, C_L = 100pF	+25℃		3.5		
Overload Recovery Time		ORT	V_S = 5V, V_{IN} × G > V_S	+25℃		1.3		μs
Total Harmonic Distortion + Noise		THD+N	V_S = 5.5V, V_{CM} = 2.5V, V_{OUT} = $1V_{RMS}$, G = +1, f = 1kHz, 80kHz measurement BW	+25℃		0.004		%
Noise								
Input Voltage Noise			V_S = 5V, f = 0.1Hz to 10Hz	+25℃		4.8		μV_{P-P}
Input Voltage Noise Density		e_n	V_S = 5V, f = 1kHz	+25℃		33		$nV/\sqrt{Hz}$
			V_S = 5V, f = 10kHz	+25℃		28		
Input Current Noise Density		i_n	V_S = 5V, f = 1kHz	+25℃		21		$fA/\sqrt{Hz}$

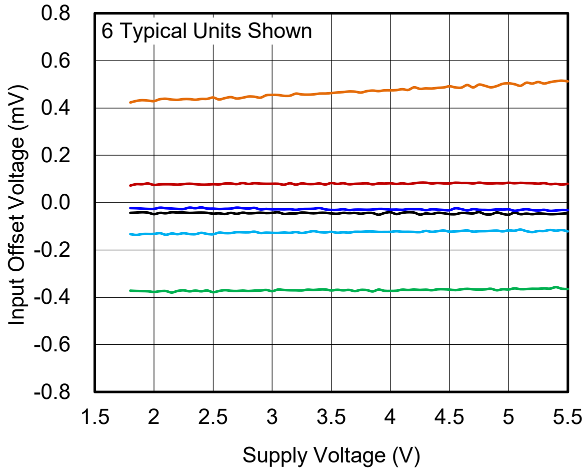
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.

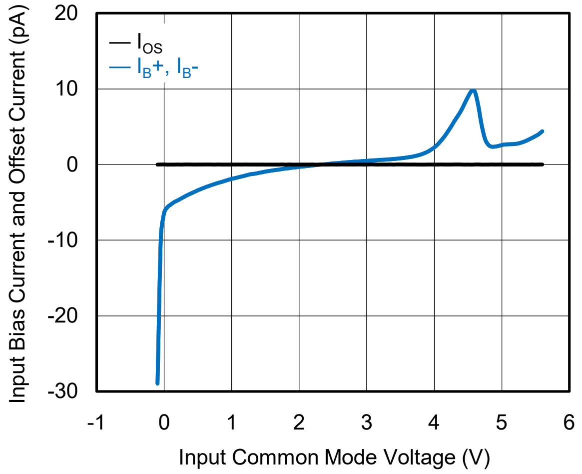
Quiescent Current vs. Supply Voltage



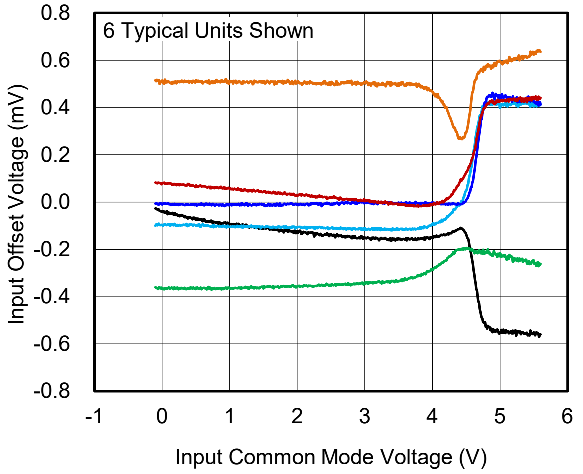
Input Offset Voltage vs. Supply Voltage



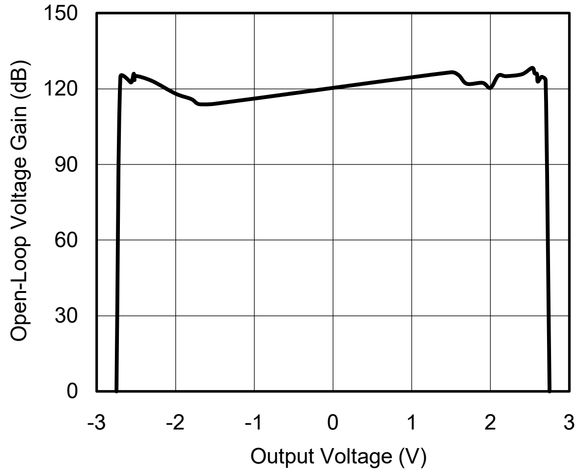
Input Bias Current and Offset Current vs. Input Common Mode Voltage



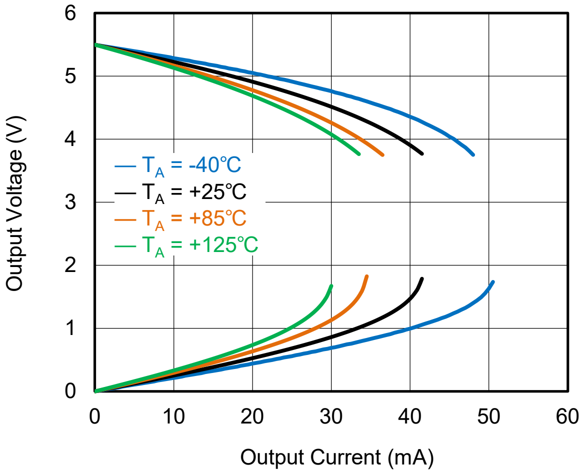
Input Offset Voltage vs. Input Common Mode Voltage



Open-Loop Voltage Gain vs. Output Voltage



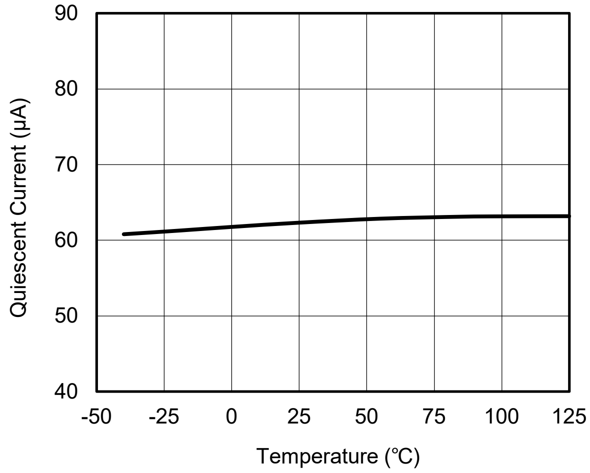
Output Voltage vs. Output Current



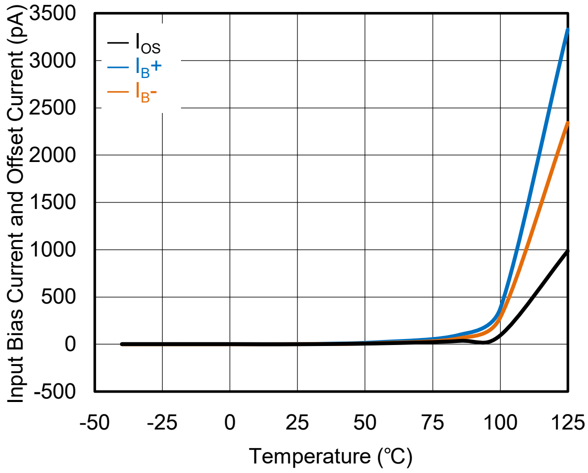
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.

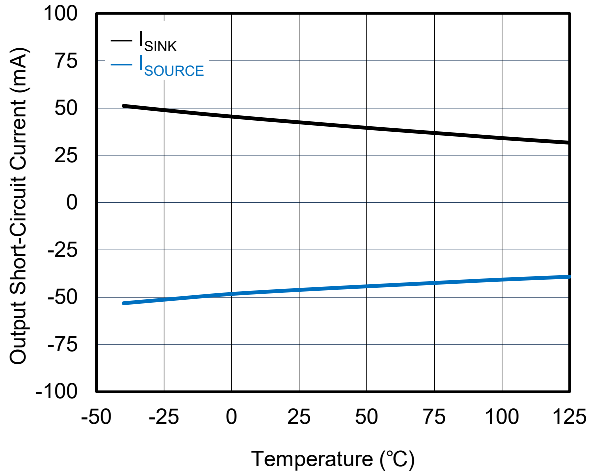
Quiescent Current vs. Temperature



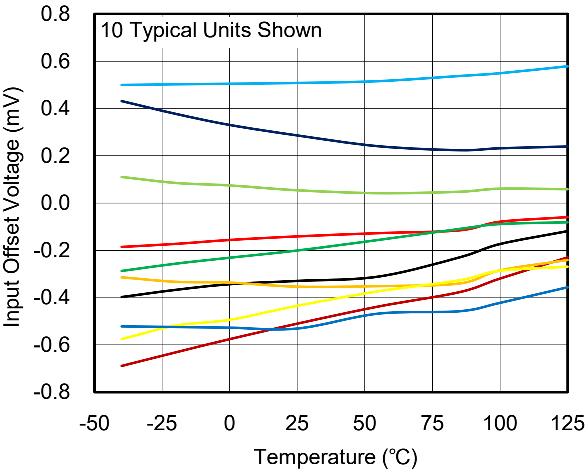
Input Bias Current and Offset Current vs. Temperature



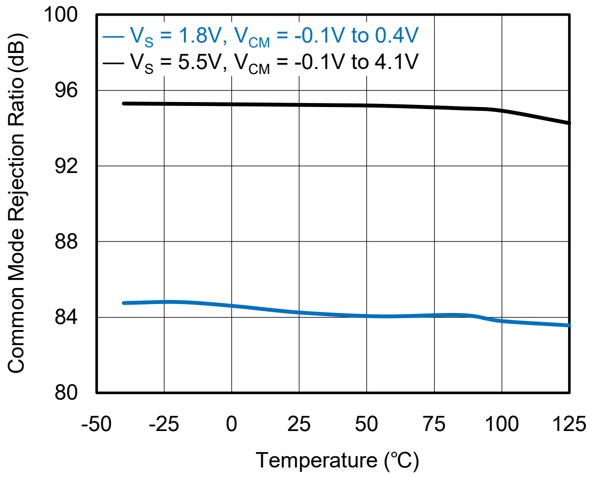
Output Short-Circuit Current vs. Temperature



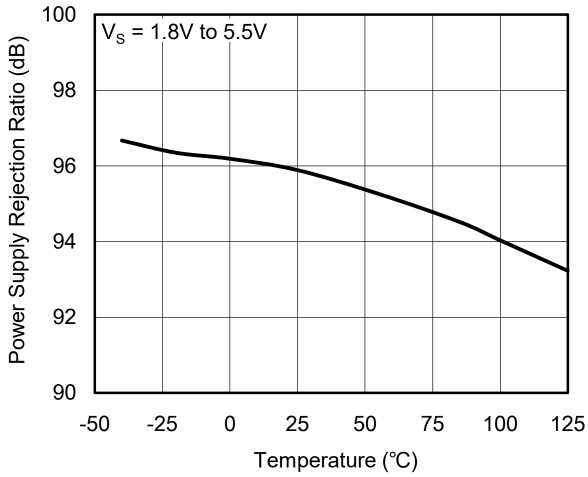
Input Offset Voltage vs. Temperature



CMRR vs. Temperature



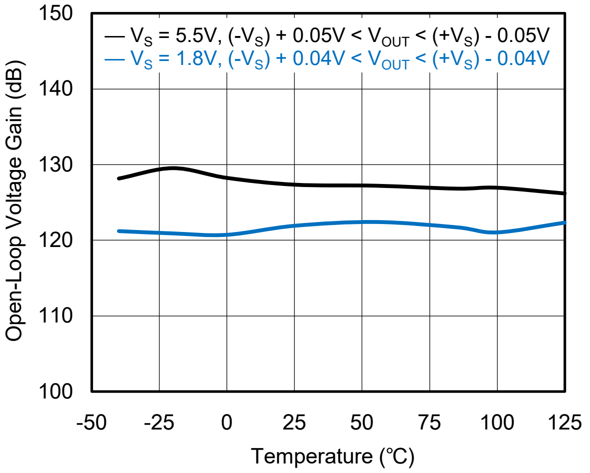
PSRR vs. Temperature



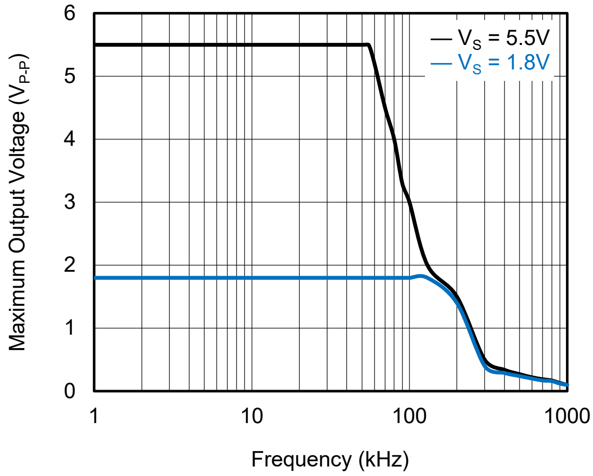
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.

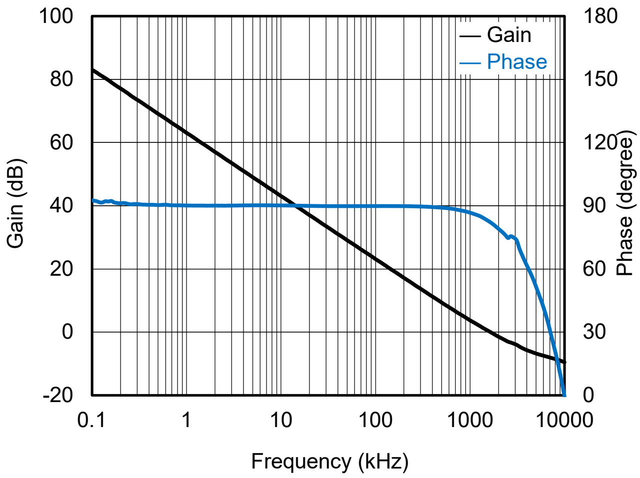
Open-Loop Voltage Gain vs. Temperature



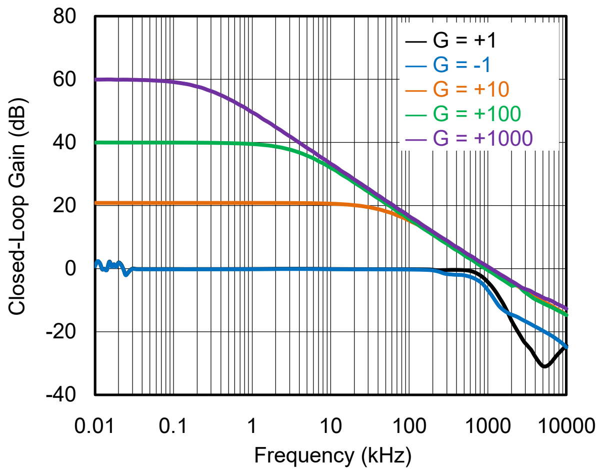
Maximum Output Voltage vs. Frequency



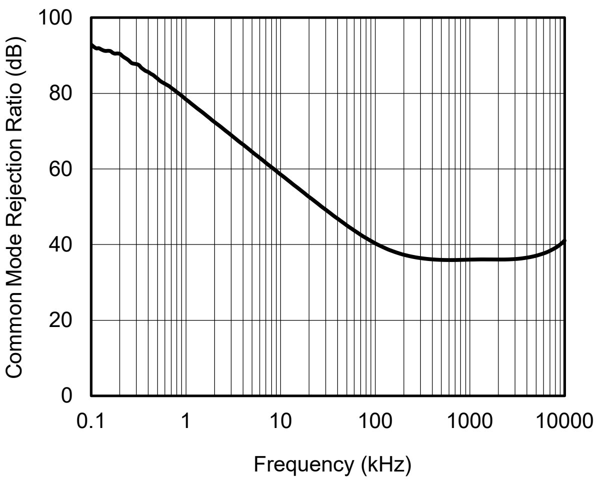
Open-Loop Voltage Gain and Phase vs. Frequency



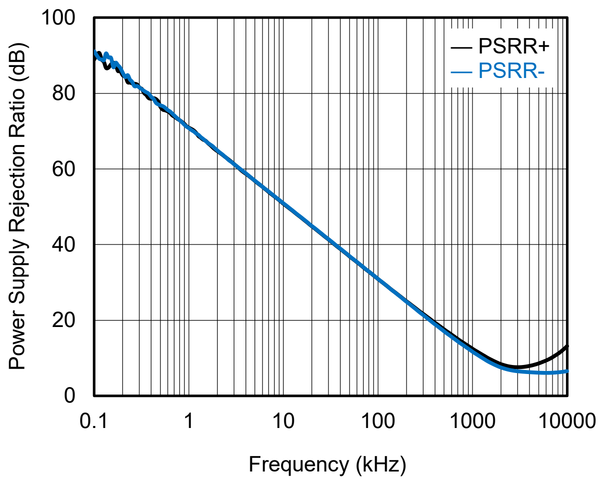
Closed-Loop Gain vs. Frequency



CMRR vs. Frequency



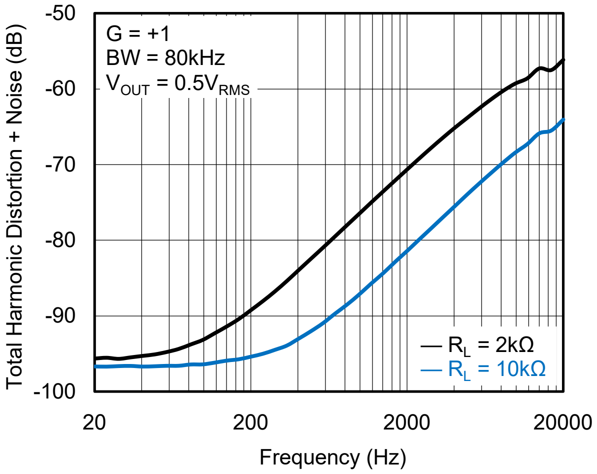
PSRR vs. Frequency



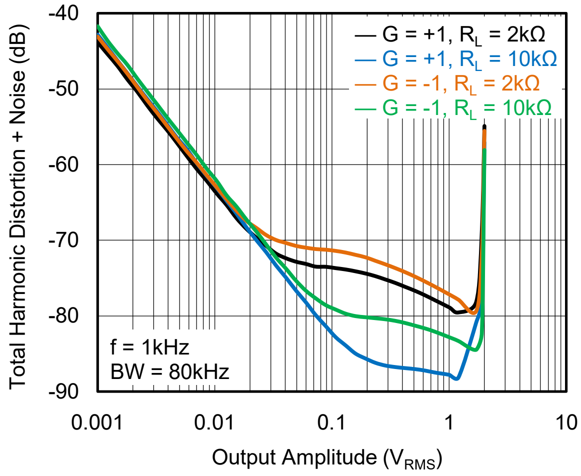
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.

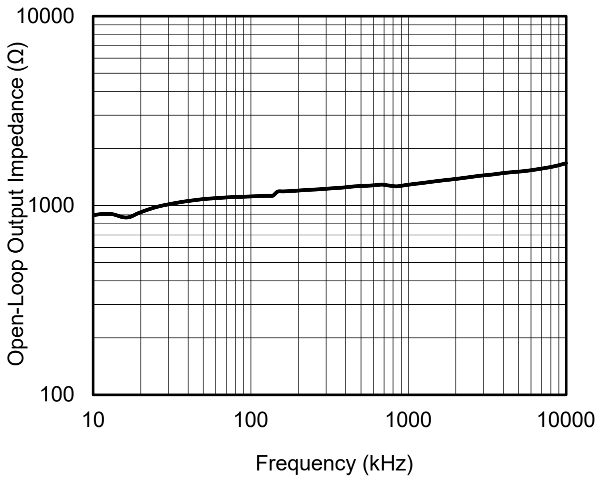
THD+N vs. Frequency



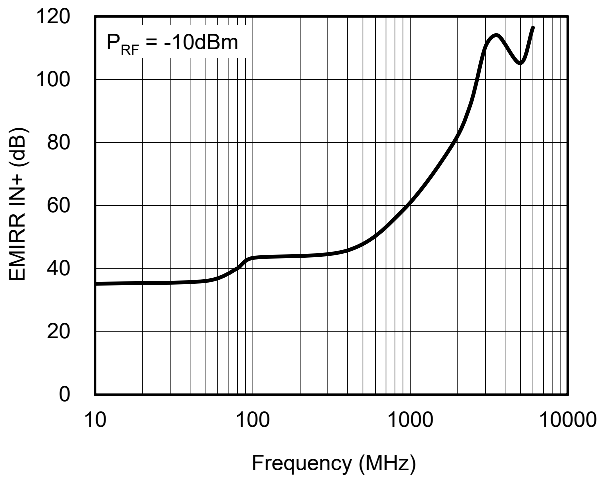
THD+N vs. Output Amplitude



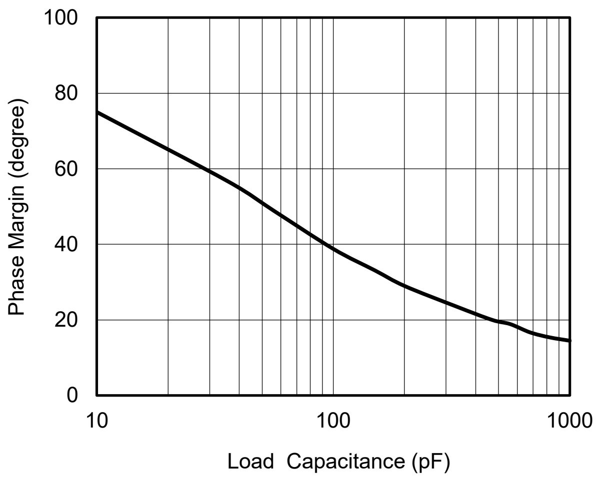
Open-Loop Output Impedance vs. Frequency



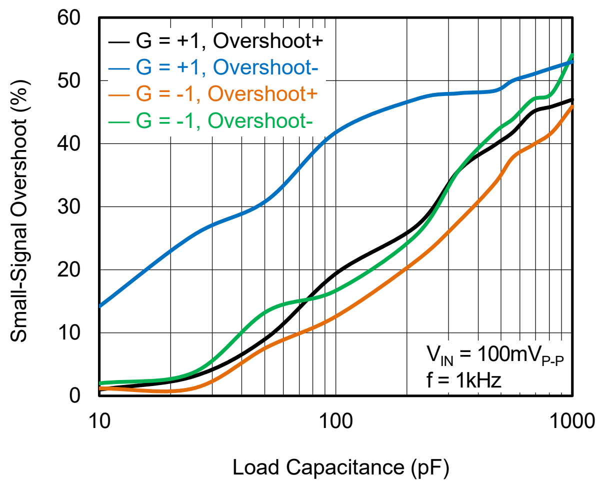
EMIRR IN+ vs. Frequency



Phase Margin vs. Capacitive Load



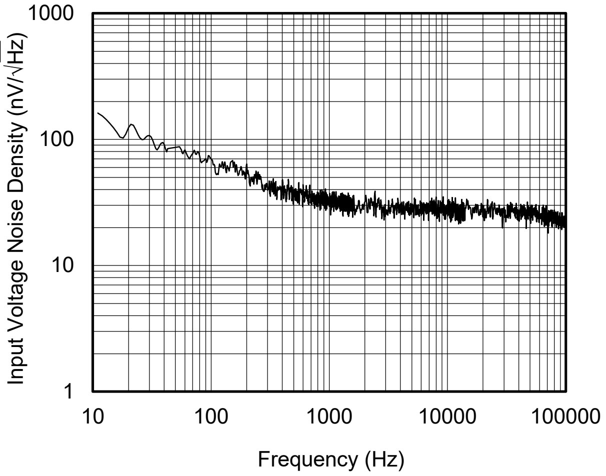
Small-Signal Overshoot vs. Capacitive Load



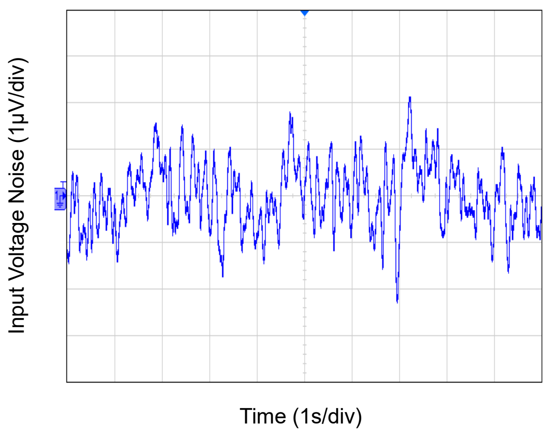
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.

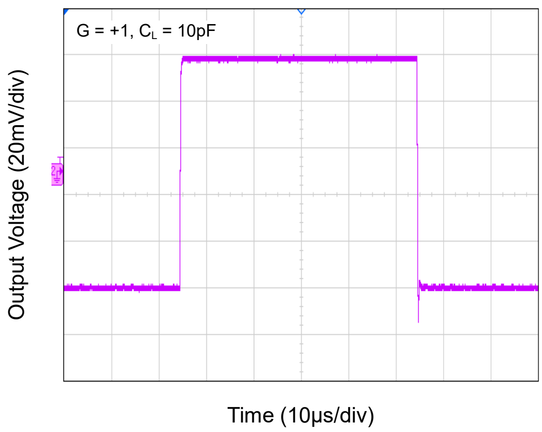
Input Voltage Noise Density vs. Frequency



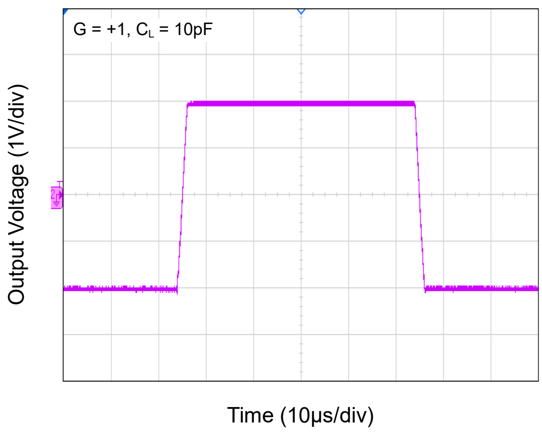
0.1Hz to 10Hz Input Voltage Noise



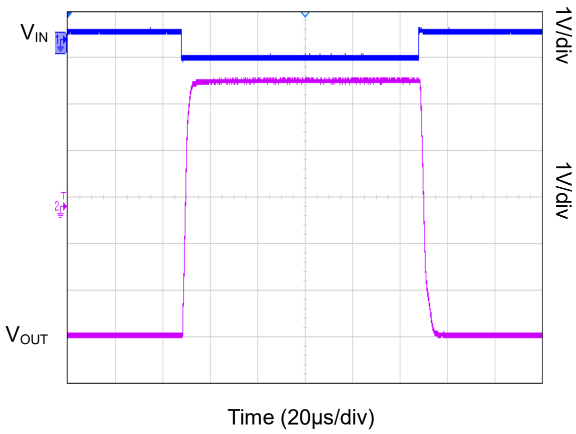
Small-Signal Step Response



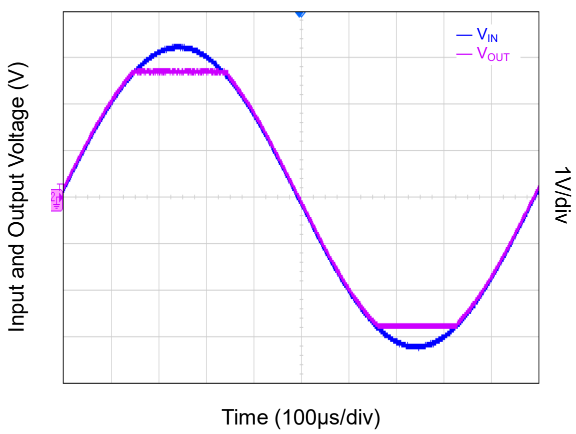
Large-Signal Step Response



Overload Recovery Time

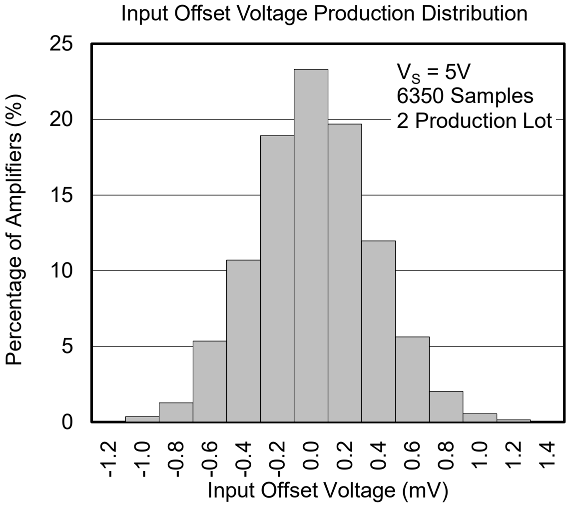


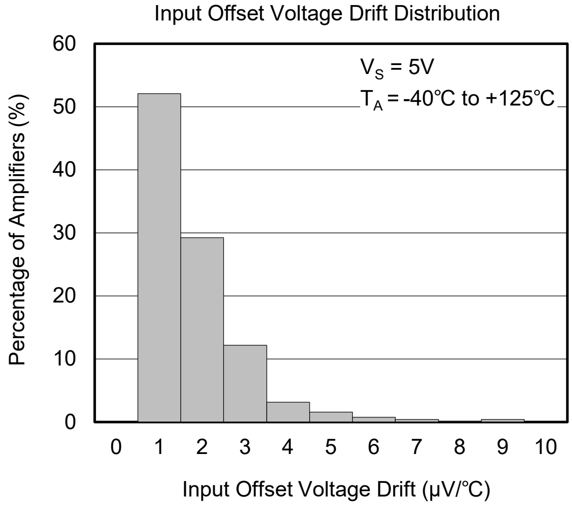
No Phase Reversal



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, V_{CM} = V_S/2, V_{OUT} = V_S/2, and R_L = 10kΩ connected to V_S/2, unless otherwise noted.





APPLICATION INFORMATION

Rail-to-Rail Input

When SGM8611-1 works at the power supply between 1.8V and 5.5V, the input common mode voltage range is from $(-V_S) - 0.1V$ to $(+V_S) + 0.1V$. In Figure 1, the ESD diodes between the inputs and the power supply rails will clamp the input voltage so that it does not exceed the rails.

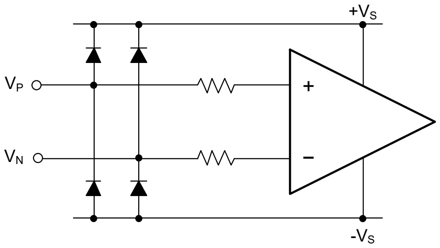


Figure 1. Input Equivalent Circuit

Rail-to-Rail Output

The SGM8611-1 supports rail-to-rail output operation. In single power supply application, for example, when $+V_S = 5.5V$, $-V_S = GND$, 10kΩ load resistor is tied from OUT pin to $V_S/2$, the typical output swing range is from 0.01V to 5.49V.

Driving Capacitive Loads

The SGM8611-1 is designed for driving the 500pF capacitive load with unity-gain stable. If greater capacitive load must be driven in application, the circuit in Figure 2 can be used. In this circuit, the IR drop voltage generated by R_{ISO} is compensated by feedback loop.

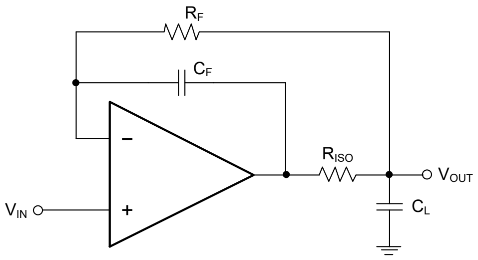


Figure 2. Circuit to Drive Heavy Capacitive Load

Power Supply Decoupling and Layout

A clean and low noise power supply is very important in amplifier circuit design. Besides of input signal noise, the power supply is one of important source of noise to the amplifier through $+V_S$ and $-V_S$ pins. Power supply bypassing is an effective method to clear up the noise at power supply, and the low impedance path to ground of decoupling capacitor will bypass the noise to GND. In application, 10μF ceramic capacitor paralleled with 0.1μF or 0.01μF ceramic capacitor is used in Figure 3. The ceramic capacitors should be placed as close as possible to $+V_S$ and $-V_S$ power supply pins.

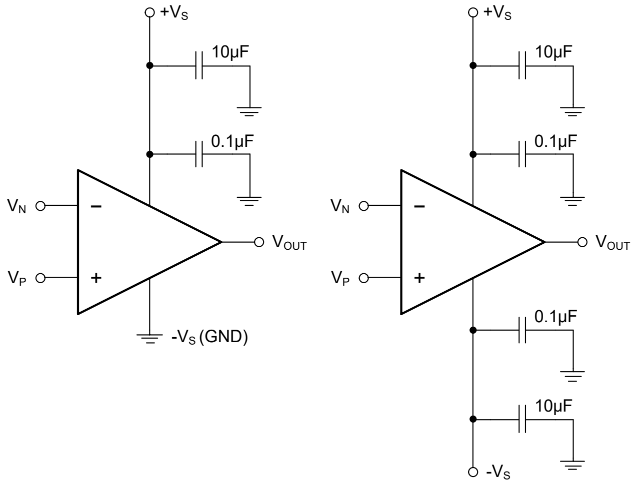


Figure 3. Amplifier Power Supply Bypassing

APPLICATION INFORMATION (continued)

Typical Application Circuits

Difference Amplifier

The circuit in Figure 4 is a design example of classical difference amplifier. If $R_4/R_3 = R_2/R_1$, then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

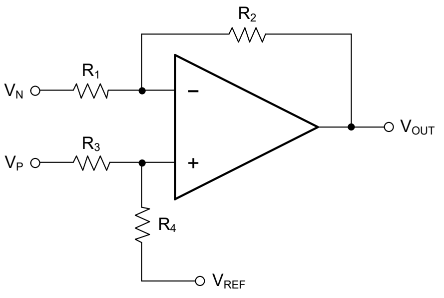


Figure 4. Difference Amplifier

High Input Impedance Difference Amplifier

The circuit in Figure 5 is a design example of high input impedance difference amplifier. The added amplifiers at the input are used to increase the input impedance and eliminate drawback of low input impedance in Figure 4.

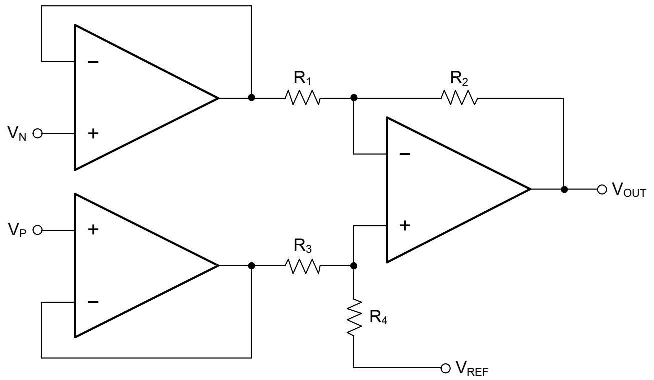


Figure 5. High Input Impedance Difference Amplifier

Active Low-Pass Filter

The circuit in Figure 6 is a design example of active low-pass filter, the DC gain is equal to $-R_2/R_1$ and the -3dB corner frequency is equal to $1/(2\pi R_2C)$. In this design, the filter bandwidth must be less than the bandwidth of the amplifier, and the resistor values must be selected as low as possible to reduce ringing or oscillation generated by the parasitic parameters in PCB layout.

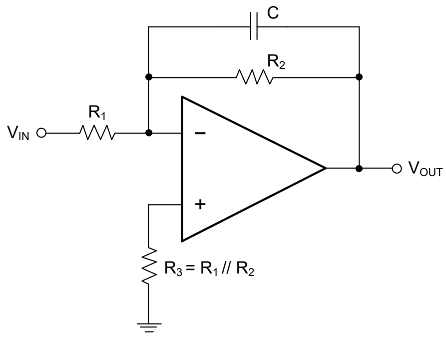


Figure 6. Active Low-Pass Filter

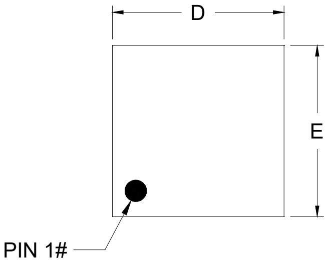
REVISION HISTORY

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

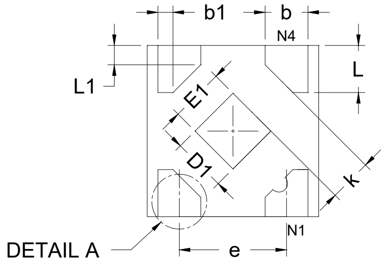
Changes from Original (DECEMBER 2024) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

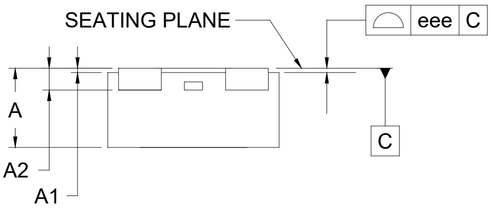
XTDFN-0.8×0.8-4AL



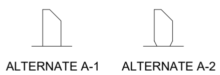
TOP VIEW



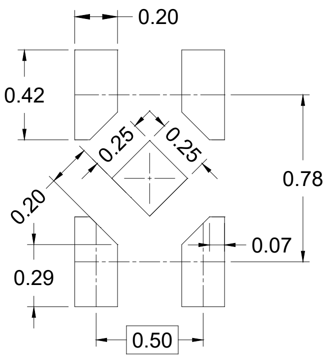
BOTTOM VIEW



SIDE VIEW



DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



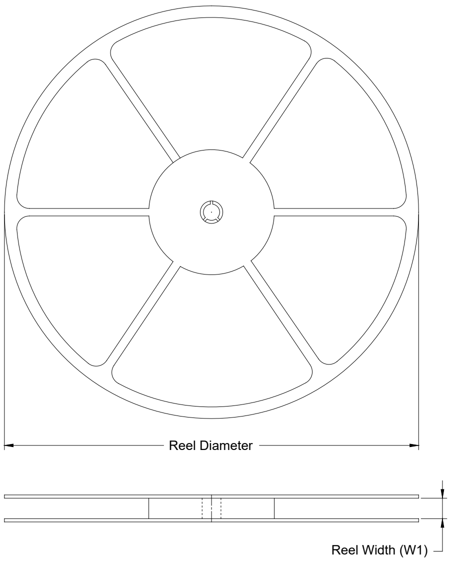
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.320	-	0.400
A1	0.000	-	0.050
A2	0.102 REF		
b	0.150	-	0.250
b1	0.070 REF		
D	0.700	-	0.900
E	0.700	-	0.900
D1	0.150	-	0.350
E1	0.150	-	0.350
L	0.170	-	0.270
L1	0.090 REF		
e	0.500 BSC		
k	0.200 REF		
eee	0.050		

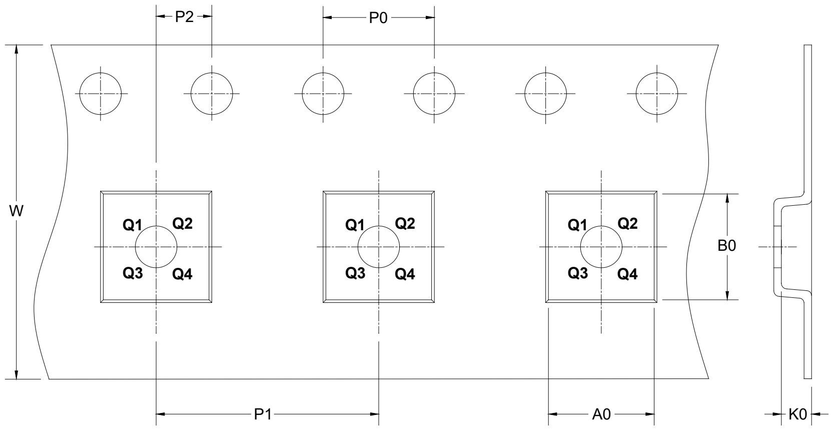
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

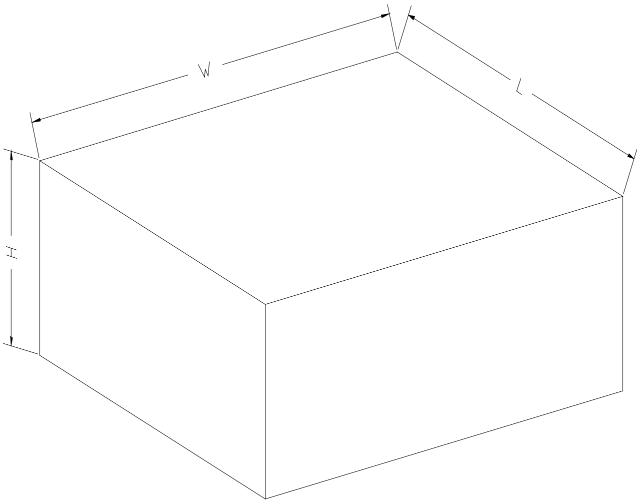
NOTE: The picture is only for reference. Please make the object as the standard.

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
XTDFN-0.8×0.8-4AL	7″	9.5	0.94	0.94	0.50	4.0	2.0	2.0	8.0	Q2

DD0001

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