SGM8040S-1
550nA, Rail-to-Rail I/O, High Precision Operational Amplifier

GENERAL DESCRIPTION

The SGM8040S-1 is a single, high precision operational amplifier which can operate from 1.4V to 5.5V single supply, while consuming only 550nA quiescent current. It is capable of rail-to-rail input and output. Therefore, the SGM8040S-1 is suitable for use in portable instrumentation and battery-powered equipment.

The SGM8040S-1 is unity-gain stable, and features an 11kHz gain-bandwidth product. It is designed to provide optimal performance in low-frequency systems, when monitoring battery current and conditioning sensor signal.

The SGM8040S-1 is available in a Green SOT-23-5 package. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Low Quiescent Current: 550nA (TYP)**
- **Low Offset Voltage: 420μV (MAX)**
- **Unity-Gain Stable**
- **Gain-Bandwidth Product: 11kHz (TYP)**
- **Rail-to-Rail Input and Output**
- **Supply Voltage Range: 1.4V to 5.5V**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

APPLICATIONS

Battery-Powered Equipment
Temperature Measurements
Tollbooth Tags
Wearable Devices

TYPICAL APPLICATION

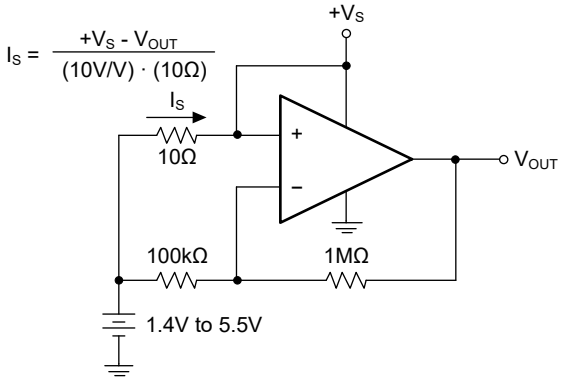


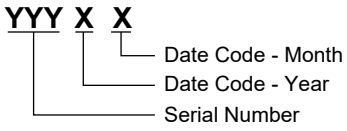
Figure 1. High-side Battery Current Sensor

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8040S-1	SOT-23-5	-40℃ to +85℃	SGM8040S-1YN5G/TR	MD6XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = 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 6V
Analog Inputs (V_{IN+}, V_{IN-}) ..... ($-V_S$) - 0.3V to ($+V_S$) + 0.3V
Differential Input Voltage ..... $|(-V_S) - (+V_S)|$
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
MM 400V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +85℃

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

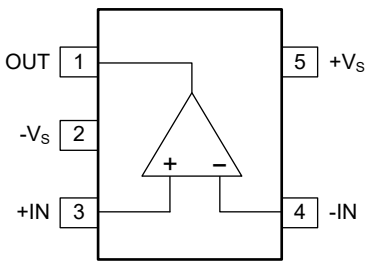
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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



SOT-23-5

ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, Full = -40℃ to +85℃, V_S = ±0.7V to ±2.75V and R_L = 1MΩ [1] connected to 0V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
DC Electrical Characteristics							
Input Offset Voltage	V_{OS}	V_{CM} = 0V	+25℃		200	420	μV
			Full			660	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		1		μV/℃
Input Bias Current	I_B	V_{CM} = 0V	+25℃		±10	±200	pA
Input Offset Current	I_{OS}	V_{CM} = 0V	+25℃		±10	±300	pA
Input Common Mode Voltage Range	V_{CM}		Full	$(-V_S)$ - 0.1		$(+V_S)$ + 0.1	V
Common Mode Rejection Ratio	CMRR	V_S = ±2.5V, $(-V_S)$ - 0.1V < V_{CM} < $(+V_S)$ + 0.1V	+25℃	82	92		dB
			Full	76			
		V_S = ±2.5V, 0 < V_{CM} < $(+V_S)$ + 0.1V	+25℃	76	86		
			Full	70			
		V_S = ±2.5V, $(-V_S)$ - 0.1V < V_{CM} < 0	+25℃	90	110		
			Full	86			
Open-Loop Voltage Gain	A_{OL}	V_S = ±0.7V, $(-V_S)$ + 0.1V < V_{OUT} < $(+V_S)$ - 0.1V, R_L = 50kΩ	+25℃	88	110		dB
			Full	85			
		V_S = ±2.5V, $(-V_S)$ + 0.1V < V_{OUT} < $(+V_S)$ - 0.1V, R_L = 50kΩ	+25℃	102	120		
			Full	94			
Output Voltage Swing from Rail		R_L = 50kΩ	+25℃		3	9	mV
			Full			10	
Output Short-Circuit Current	I_{SC}	V_S = ±0.7V	+25℃		2		mA
		V_S = ±2.5V	+25℃	8	18		
Supply Voltage	V_S		Full	1.4		5.5	V
Quiescent Current	I_Q		+25℃		550	850	nA
			Full			900	
Power Supply Rejection Ratio	PSRR	V_S = 1.4V to 5.5V	+25℃	86	104		dB
			Full	82			
AC Electrical Characteristics							
Gain-Bandwidth Product	GBP	C_L = 60pF	+25℃		11		kHz
Slew Rate	SR	V_S = ±0.7V, V_{OUT} = $1V_{P-P}$, G = +1	+25℃		2		V/ms
		V_S = ±1.25V, V_{OUT} = $1V_{P-P}$, G = +1	+25℃		3.5		
		V_S = ±2.5V, V_{OUT} = $2V_{P-P}$, G = +1	+25℃		4		
Input Voltage Noise		f = 0.1Hz to 10Hz	+25℃		5		μV_{P-P}
Input Voltage Noise Density	e_n	f = 1kHz	+25℃		180		$nV/\sqrt{HZ}$
Input Current Noise Density	i_n	f = 1kHz	+25℃		300		$fA/\sqrt{HZ}$

NOTE: 1. Refer to Figure 2 and Figure 3.

TEST CIRCUITS

Figure 2 and Figure 3 show the AC and DC test circuits.

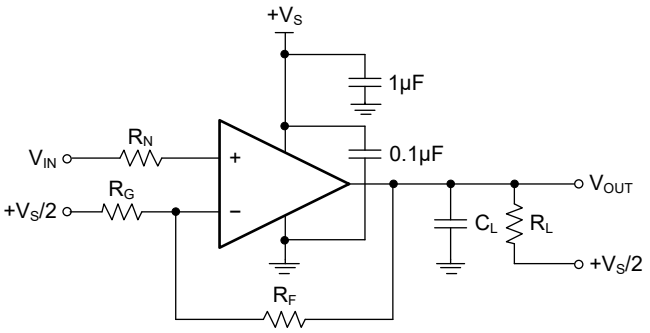


Figure 2. AC and DC Test Circuit for Most Non-Inverting Gain Configurations

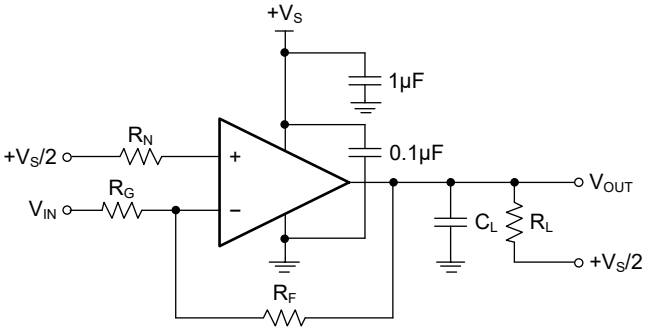
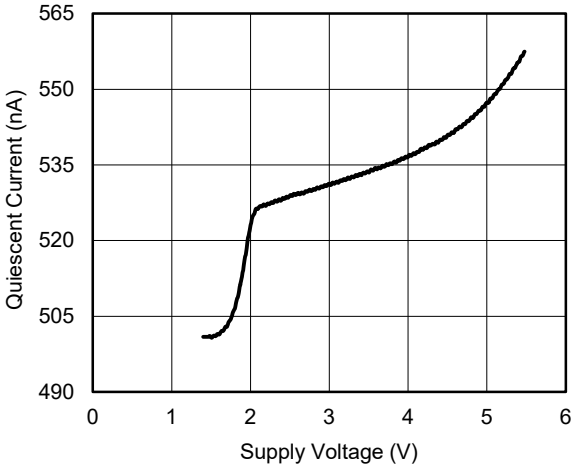


Figure 3. AC and DC Test Circuit for Most Inverting Gain Configurations

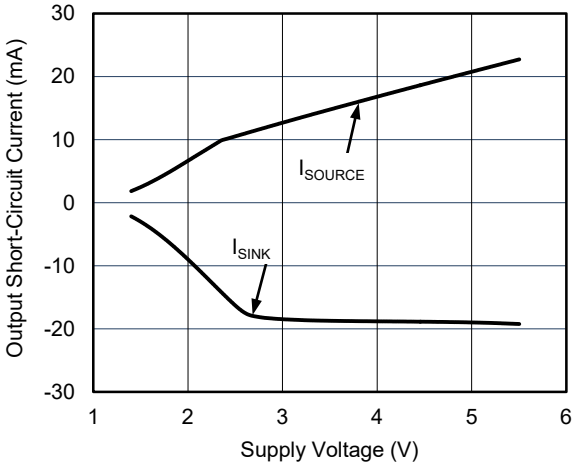
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_S = 5V, R_L = 1MΩ, unless otherwise noted.

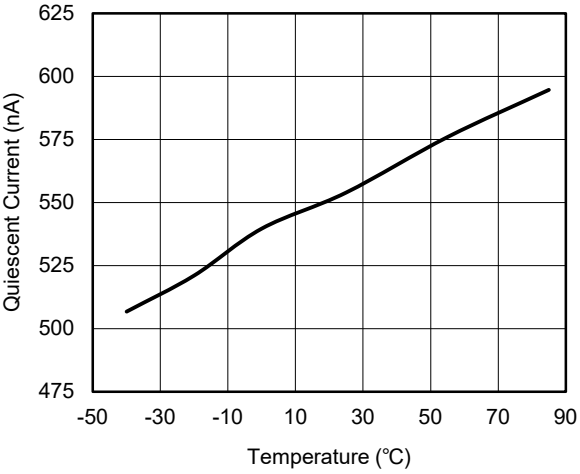
Quiescent Current vs. Supply Voltage



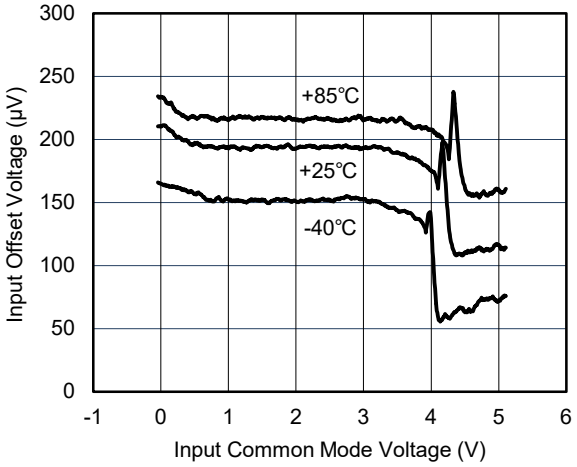
Output Short-Circuit Current vs. Supply Voltage



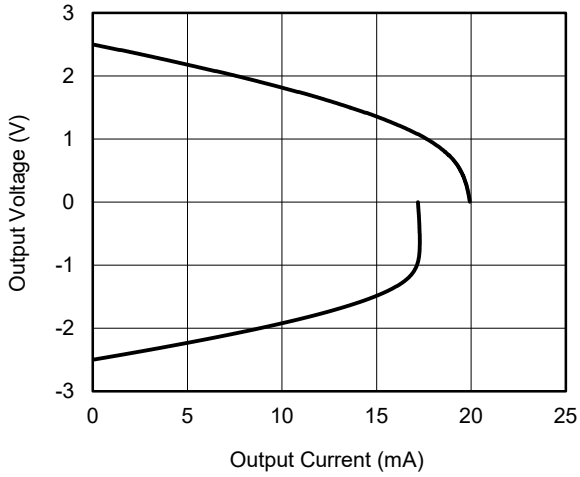
Quiescent Current vs. Temperature



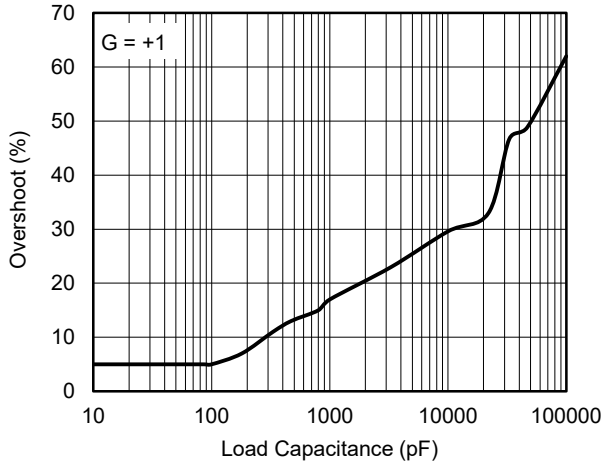
Input Offset Voltage vs. Input Common Mode Voltage



Output Voltage vs. Output Current



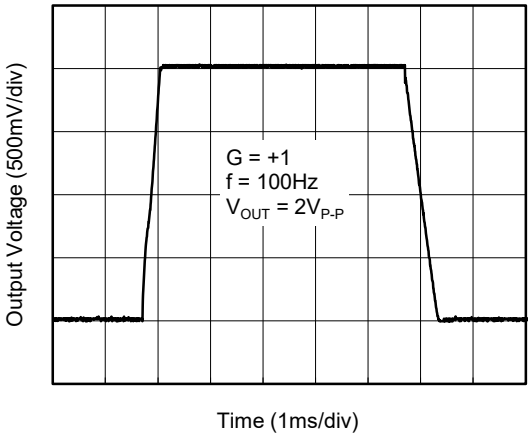
Small-Signal Overshoot vs. Capacitive Load



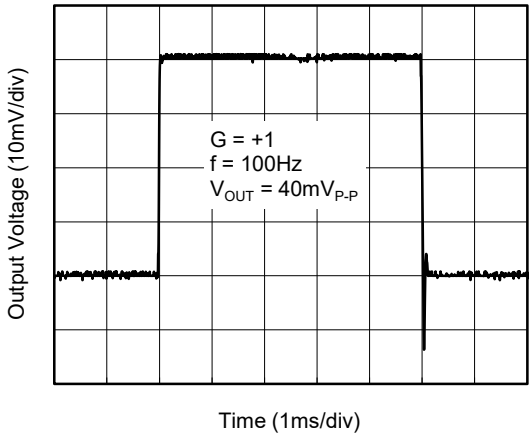
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5V, R_L = 1MΩ, unless otherwise noted.

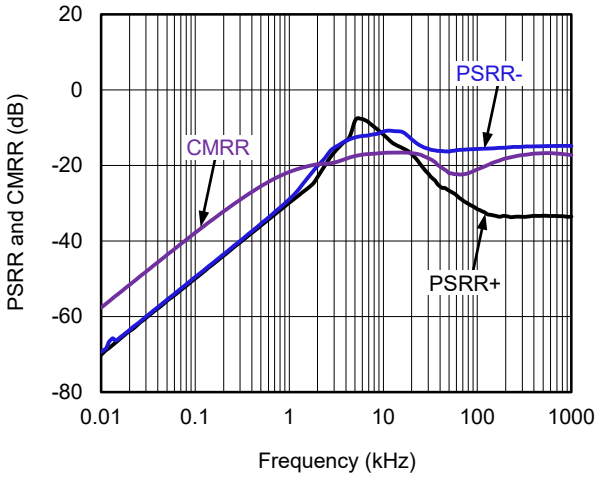
Large-Signal Step Response



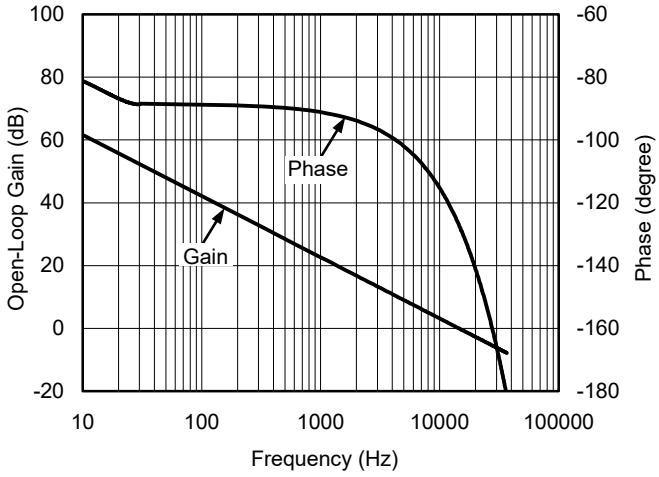
Small-Signal Step Response



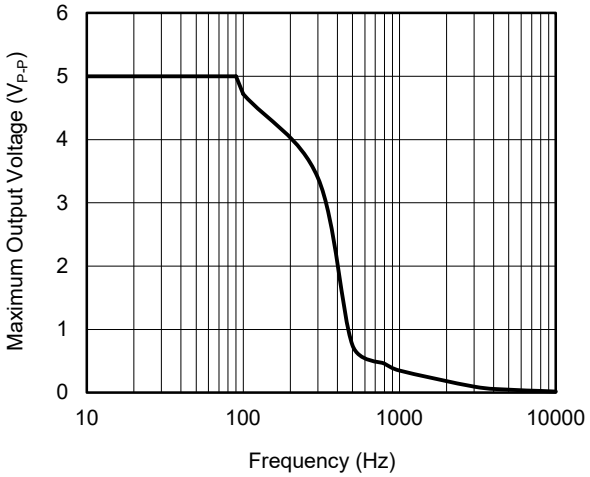
CMRR and PSRR vs. Frequency



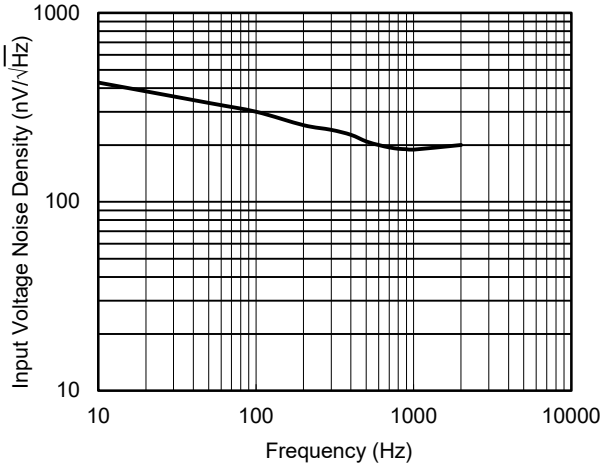
Open-Loop Gain and Phase vs. Frequency



Maximum Output Voltage vs. Frequency



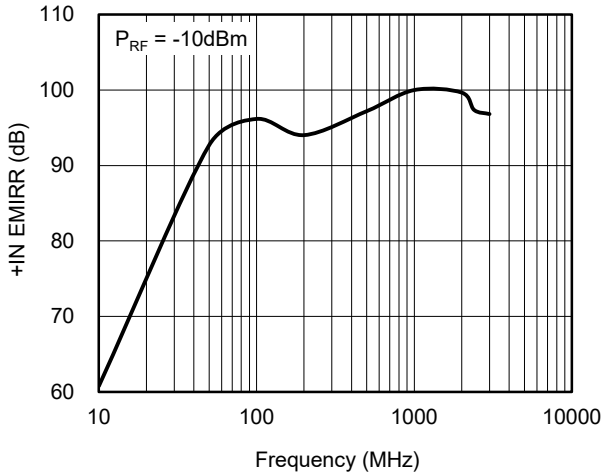
Input Voltage Noise Density vs. Frequency



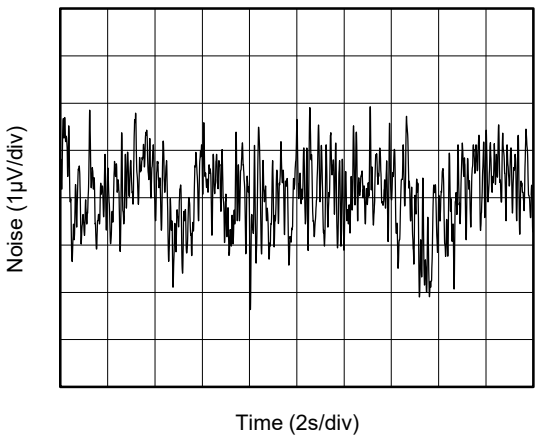
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5V, R_L = 1MΩ, unless otherwise noted.

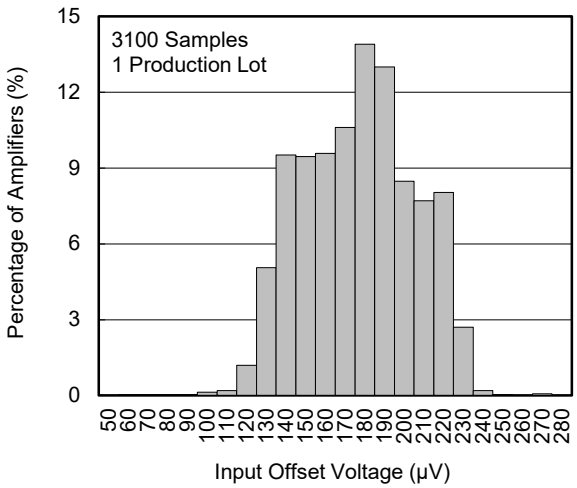
+IN EMIRR vs. Frequency



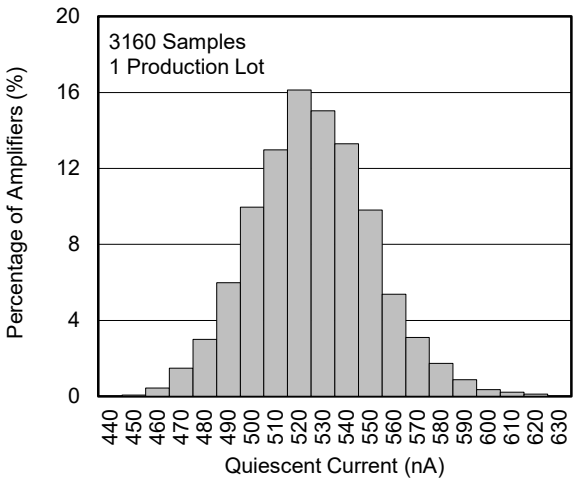
0.1Hz to 10Hz Input Voltage Noise



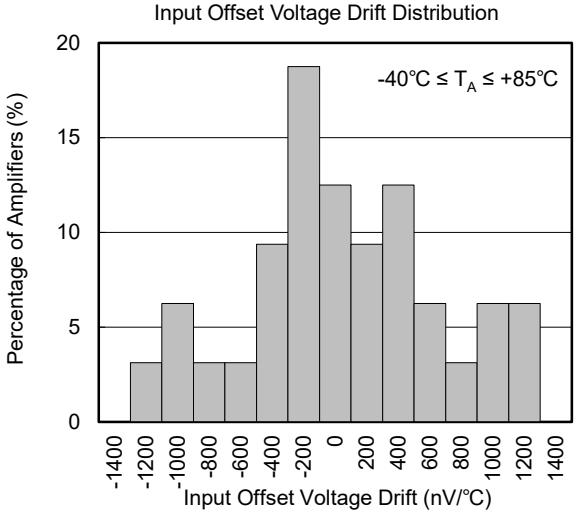
Input Offset Voltage Production Distribution



Quiescent Current Production Distribution



Input Offset Voltage Drift Distribution



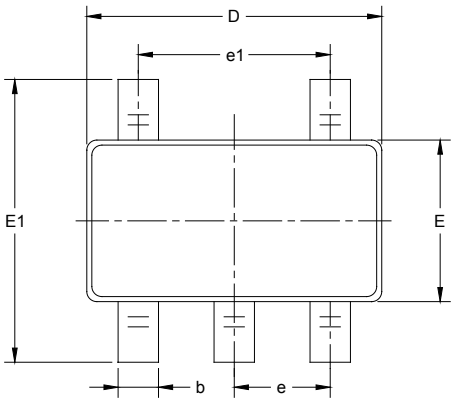
REVISION HISTORY

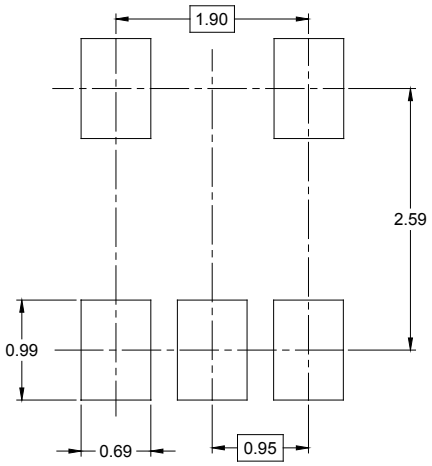
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBER 2018) to REV.A	Page
Changed from product preview to production data	All

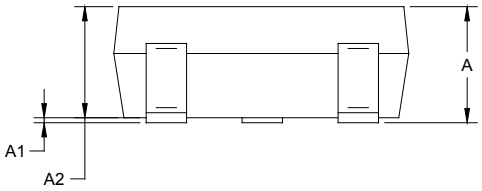
PACKAGE OUTLINE DIMENSIONS

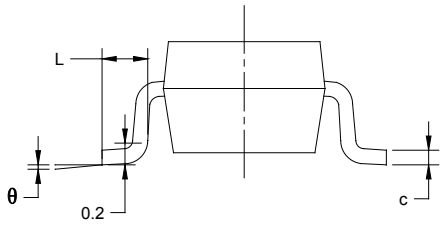
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)

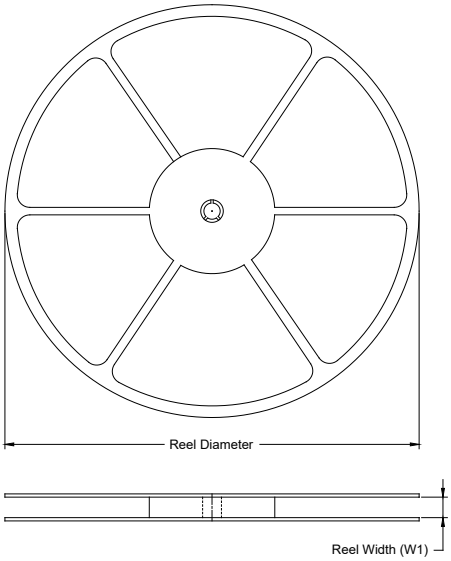




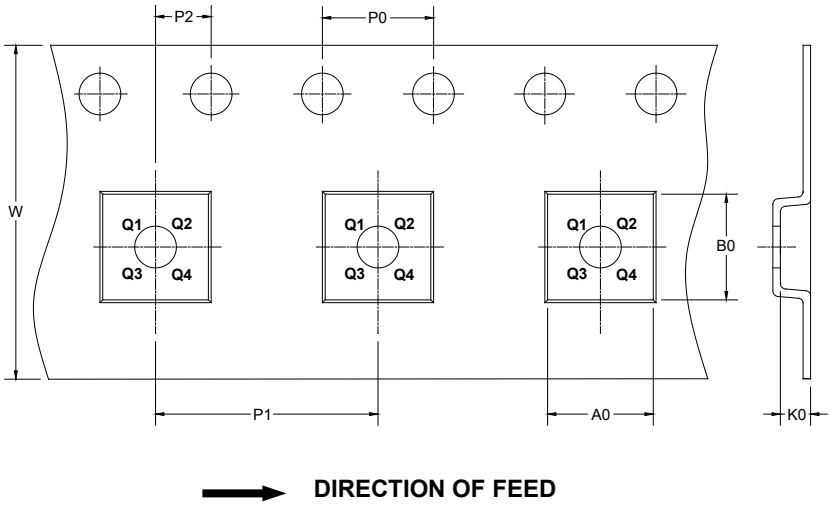
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



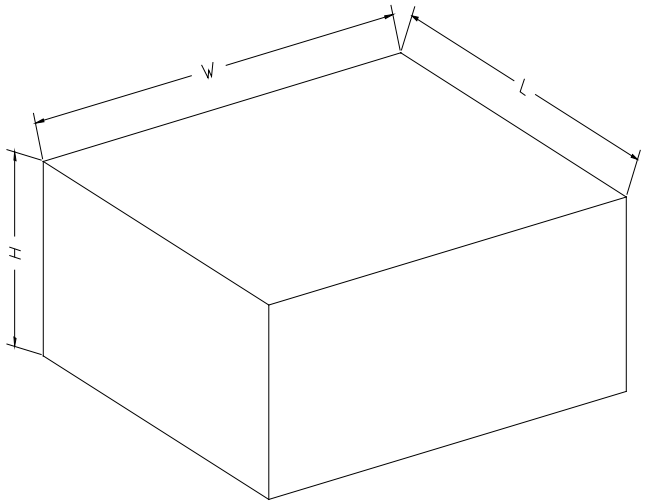
NOTE: The picture is only for reference. Please make the object as the standard.

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	3.20	3.20	1.40	4.0	4.0	2.0	8.0	Q3

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