Industrial Standard Low-Voltage, 1MHz Operational Amplifier

1.Description

The low voltage industrial standard amplifier includes dual low-voltage (2.1V to 5.5V) operational amplifiers (op amps) with rail-to-rail input and output swing capabilities.These op amps provide a cost-effective solution for space-constrained applications such as smoke detectors, wearable electronics, and small appliances where low-voltage operation and high capacitive-load drive are required. The capacitive-load drive of the family is 500pF, and the resistive open-loop output impedance makes stabilization easier with much higher capacitive-loads.

The robust design of the family simplifies circuit design. The op amps feature unity-gain stability, an integrated RFI and EMI rejection filter, and no-phase reversal in overdrive conditions.

2.Features

- Rail-to-rail input and output
- Low input offset voltage: ±0.8mV
- Unity-gain bandwidth: 1 MHz
- Low broadband noise: 32 nV/$\sqrt{\text{Hz}}$
- Low input bias current: 10 pA
- Low quiescent current: 25 µA/Ch
- Unity-gain stable
- Internal RFI and EMI filter
- Operational at supply voltages as low as 2.1 V
- Easier to stabilize with higher capacitive load due to resistive open-loop output impedance
- Extended temperature range: –40°C to 125°C

3.Applications

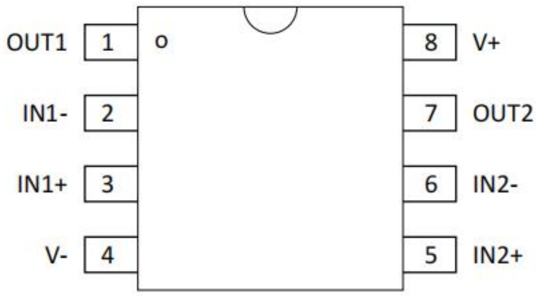
- Sensor signal conditioning
- Power modules
- Active filters
- Low-side current sensing
- Smoke detectors
- Motion detectors
- Wearable devices
- Large and small appliances
- EPOS
- Barcode scanners
- Personal electronics
- HVAC: heating, ventilating, and air conditioning
- Motor control: AC induction

4.Order information

Mode	Package	Ordering Number	Packing Option
LMV358	SOP8	LMV358YSOP8G/TR	Tape and Reel,4000
	MSOP8	LMV358YMSOP8G/TR	Tape and Reel,4000

5.Pin Configuration

(Top View)



SOP8,MSOP8

6.Pin Description

Pin		I/O	Description
Name	No.		
IN1–	2	I	Inverting input, channel 1
IN1+	3	I	Noninverting input, channel 1
IN2–	6	I	Inverting input, channel 2
IN2+	5	I	Noninverting input, channel 2
OUT1	1	O	Output, channel 1
OUT2	7	O	Output, channel 2
V+	8	I	Positive (high) supply
V-	4	I or —	Negative (low) supply or ground (for single-supply operation)

7.Absolute Maximum Ratings

Over operating ambient temperature (unless otherwise noted)[1]

Parameter			Min	Max	Unit
Supply voltage [(V+) – (V–)]				6	V
Signal input pins	Voltage[2]	Common-mode	(V–) – 0.5	(V+) + 0.5	V
		Differential		(V+) – (V–) + 0.2	V
	Current[2]		–10	10	mA
Output short-circuit[3]			Continuous		
Temperature	Operating, T_A		–55	150	°C
	Junction, T_J			150	
	Storage, T_{stg}		-65	150	

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability

(2) Input pins are diode-clamped to the power-supply rails.Input signals that may swing more than 0.5V beyond the supply rails must be current limited to 10 mA or less.

(3) Short-circuit to ground, one amplifier per package.

8.Recommended Operating Conditions

Over operating ambient temperature (unless otherwise noted)

Symbol	Parameter	Min	Max	Unit
V_S	Supply voltage (VS = [V+] – [V–])	2.1	5.5	V
T_A	Specified temperature	–40	125	°C

9.ESD Ratings

Symbol	Description	Value	Unit
V_{ESD} Electrostatic discharge	Human-body model (HBM),per ANSI/ESDA/JEDEC JS-001[1]	±5000	V
	Charged-device model (CDM),per JEDEC specification JESD22-C101[2]	±2000	

(1)JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process

(2)JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

10.Electrical Characteristics

For V_S(Total Supply Voltage) = (V+) – (V–) = 2.1 V to 5.5 V(±1.05 V to ±2.75 V), at T_A = 25°C, R_L = 100kΩ connected to V_S /2, V_{CM} = V_S/2, and V_{OUT} = V_S /2 (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
Offset Voltage						
V_{OS}	input offset voltage	V_S =5 V		±0.8	±3.2	mV
		V_S = 5 V, T_A = –40°C to 125°C			±3.5	
dVos/dT	Drift	V_S = 5 V, T_A = –40°C to 125°C		±0.5		μV/°C
PSRR	Power-supply rejection ratio	V_S = 2.1V – 5.5V, V_{CM} = (V–)	82	100		dB
Input Voltage Range						
V_{CM}	Common-mode voltage range	V_S = 2.1V to 5.5V	(V–) – 0.1		(V+) + 0.1	V
CMRR	Common-mode rejection ratio	V_S = 5.5V, (V–) – 0.1V<V_{CM} < (V+) – 1.7 V, T_A = –40°C to 125°C		95		dB
		V_S= 5.5 V, – 0.1 V < V_{CM} < 5.6 V, T_A = –40°C to 125°C	70	77		
		V_S = 2.1 V, (V–) – 0.1V < V_{CM} < (V+) – 1.4 V, T_A = –40°C to 125°C		95		
		V_S= 2.1 V, – 0.1 V < V_{CM} < 1.9 V, T_A = –40°C to 125°C		74		
Input Bias Current						
I_B	Input bias current			±10		pA
I_{OS}	Input offset current			±10		pA
Noise						
En	Input voltage noise (peak to peak)			2.7		μVrms
en	Input voltage noise density	V_S = 5 V, f = 10 kHz		32		nV/√Hz
		V_S = 5 V, f = 1 kHz		39		
in	Input current noise density	f= 1 kHz		5.4		fA/√Hz
Input Capacitance						
C_{ID}	Differential			0.9		pF
C_{IC}	Common-mode			2		pF

10.Electrical Characteristics (continued)

For V_S(Total Supply Voltage) = (V+) – (V–) = 2.1 V to 5.5 V(±1.05 V to ±2.75 V), at T_A = 25°C, R_L = 100kΩ connected to V_S /2, V_{CM} = V_S /2, and V_{OUT}=V_S /2 (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
Open-Loop Gain						
AOL	Open-loop voltage gain	V_S = 2.1 V, (V–) + 0.04 V < V_O < (V+) – 0.04V, R_L = 1MΩ	93	115		dB
		VS = 5.5 V, (V–) + 0.2 V < V_O < (V+) – 0.2V, R_L = 1MΩ	95	119		
		V_S = 2.1 V, (V–) + 0.5 V < V_O < (V+) – 0.5 V, R_L = 100kΩ		112		
		V_S = 5.5 V, (V–) + 0.5 V < V_O < (V+) – 0.5 V, R_L = 100kΩ		117		
Frequency Response						
GBW	Gain bandwidth product	V_S = 5 V, G = +1		1		MHz
φ_m	Phase margin	V_S = 5 V, G = +1		74		°
SR	Slew rate	V_S = 5 V, G = +1		0.95		V/μs
t_S	Settling time	To 0.1%, V_S = 5 V, 2-V step , G = +1, C_L = 100 pF		5.5		μs
		To 0.01%, V_S = 5 V, 2-V step , G = +1, C_L = 100 pF		12.3		
tor	Overload recovery time					μs
THD+N	Total harmonic distortion + noise1	V_S = 5.5 V, V_{CM} = 2.5 V, V_O = 1 V_{RMS}, G = +1,f = 1 kHz		0.0014%		
Output						
V_O	Output swing from supply rails	V_S = 5.5 V, R_L = 1 MΩ			3	mV
		V_O = 5.5 V, R_L = 100 kΩ			5	
I_{SC}	Short-circuit current	V_S = 5 V		±45		mA
Z_O	Open-loop output impedance	V_S = 5 V, f = 1 MHz		620		Ω
Power Supply						
I_Q	Quiescent current per amplifier	V_S = 5.5 V ,I_O = 0 mA		25	35	uA
		V_S = 5.5 V ,I_O = 0 mA, T_A = -40°C to 125°C			40	

[1] Third-order filter; bandwidth = 80 kHz at –3 dB.

11.Typical Characteristics

at T_A = 25°C, V_S = 5.5 V, R_L = 10 kΩ connected to V_S/ 2, V_{CM} = V_S/ 2, and V_{OUT} = V_S / 2 (unless otherwise noted)

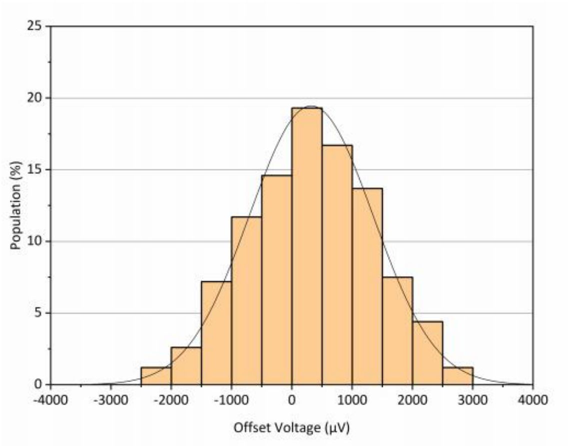


Figure 1: Offset Voltage Distribution Histogram

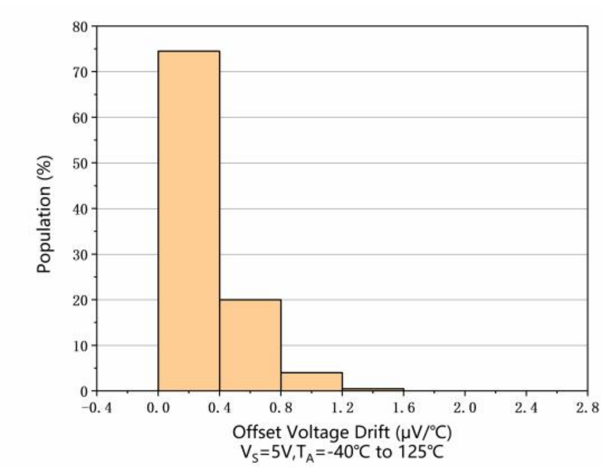


Figure 2: Offset Voltage Distribution Histogram

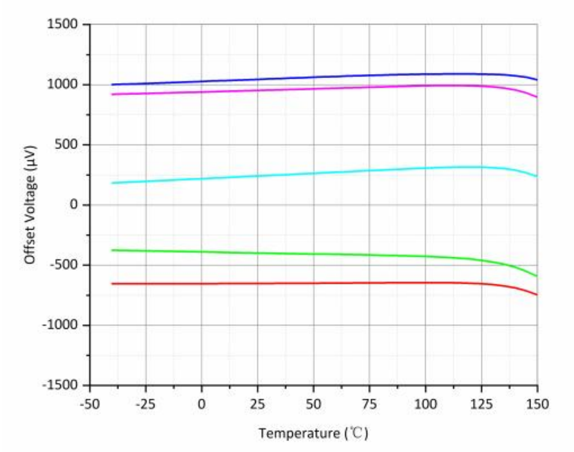


Figure 3: Input Offset Voltage vs Temperature

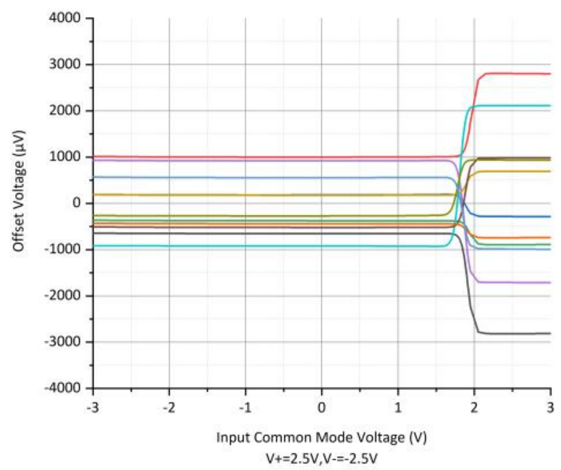


Figure 4: Offset Voltage vs Common-Mode

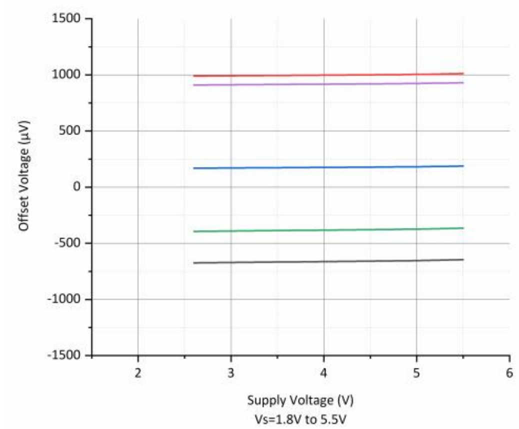


Figure 5: Offset Voltage vs Supply Voltage

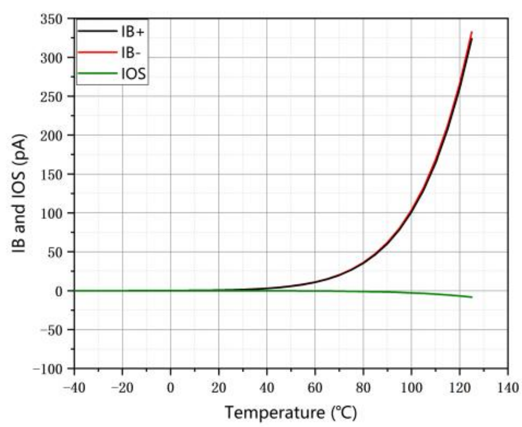


Figure 6: IB and IOS vs Temperature

For V_S(Total Supply Voltage) = (V+) – (V–) = 2.1 V to 5.5 V at T_A = 25°C, R_L = 10kΩ connected to V_S / 2, V_{CM} = V_S / 2, and V_{OUT} = V_S /2 (unless otherwise noted)

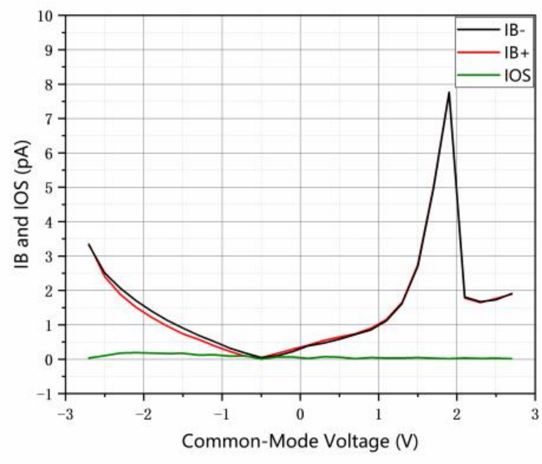


Figure 7: IB and IOS vs Common-Mode Voltage

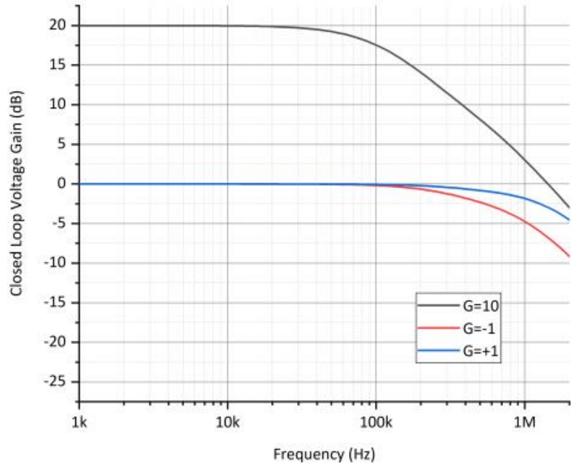


Figure 8: Closed-Loop Gain vs Frequency

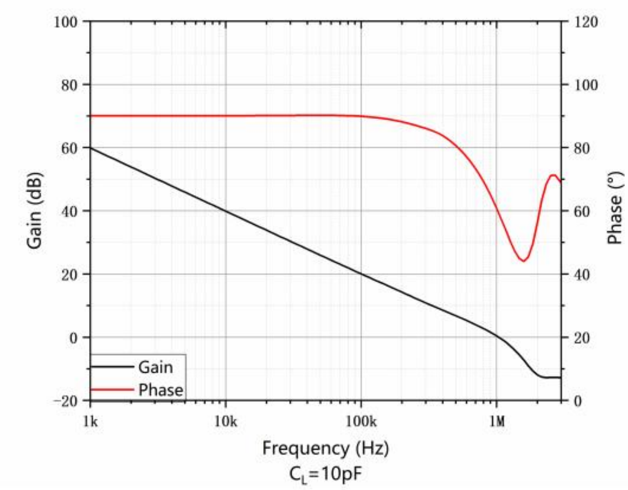


Figure 9: Open-Loop Gain and Phase vs Frequency

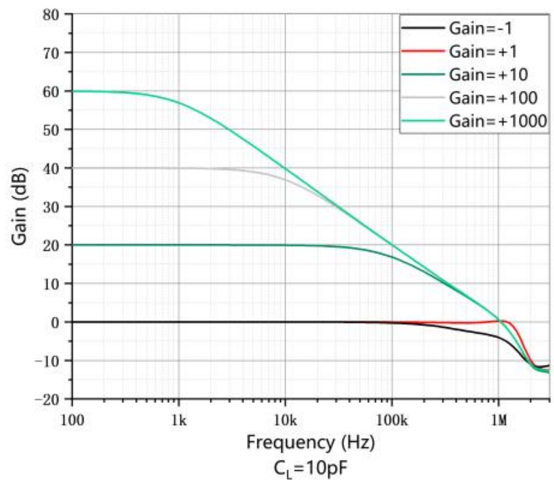


Figure 10: Closed-Loop Gain vs Frequency

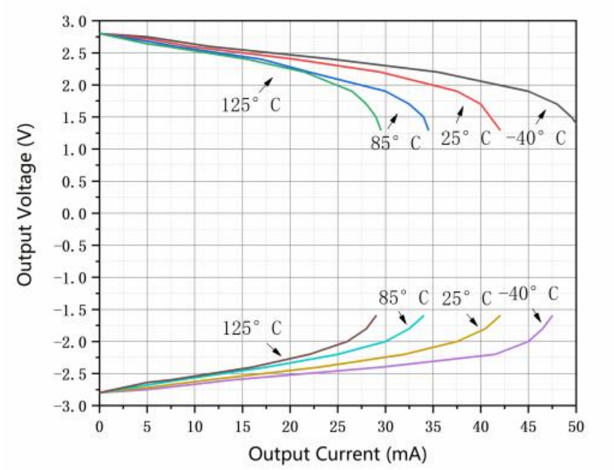


Figure 11: Output Voltage vs Output Current (Claw)

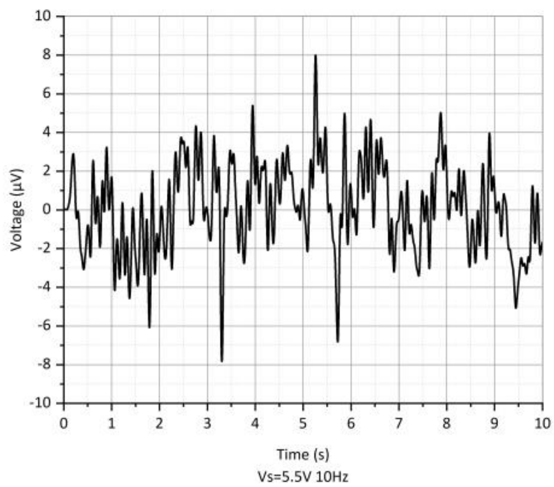


Figure 12: 0.1-Hz to 10-Hz Integrated Voltage

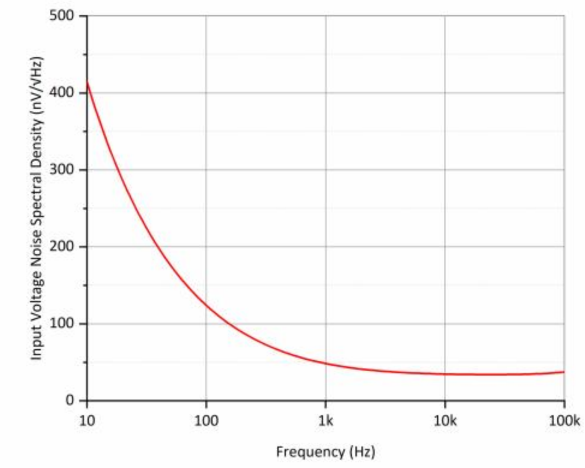


Figure 13: Input Voltage Noise Spectral Density

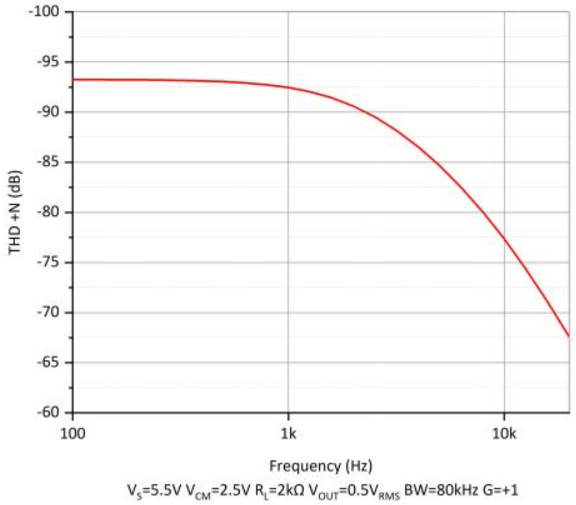


Figure 14: THD + N vs Frequency

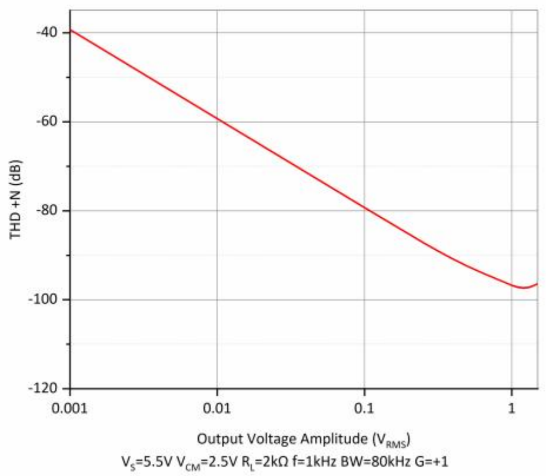


Figure 15: THD + N vs Amplitude,G = +1

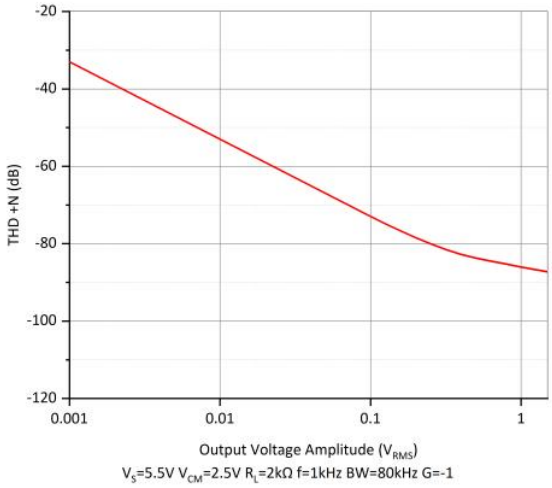


Figure 16: THD + N vs Amplitude,G = -1

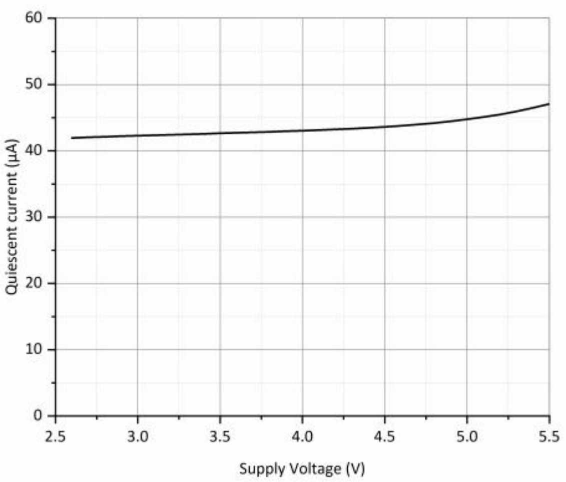


Figure 17: Quiescent Current vs Supply Voltage

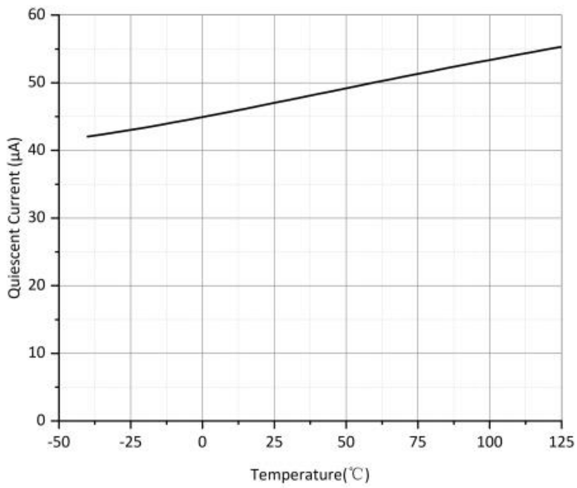


Figure 18: Quiescent Current vs Temperature

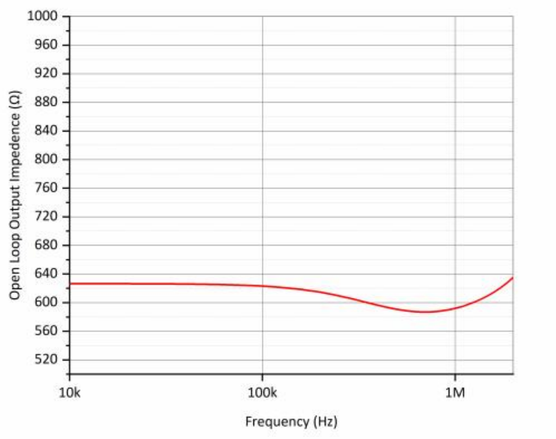


Figure 19: Open-Loop Output Impedance vs Frequency

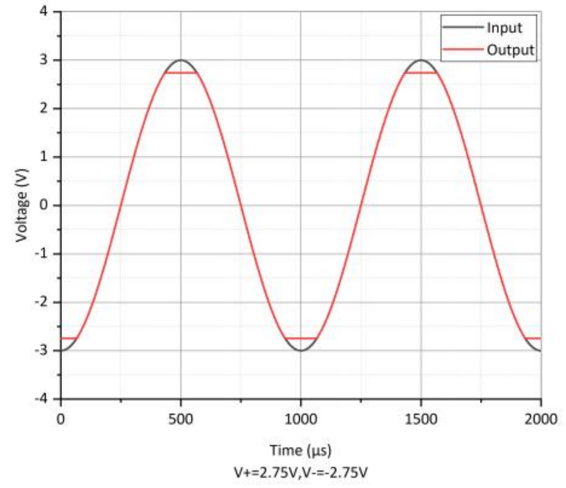


Figure 20: No Phase Reversal

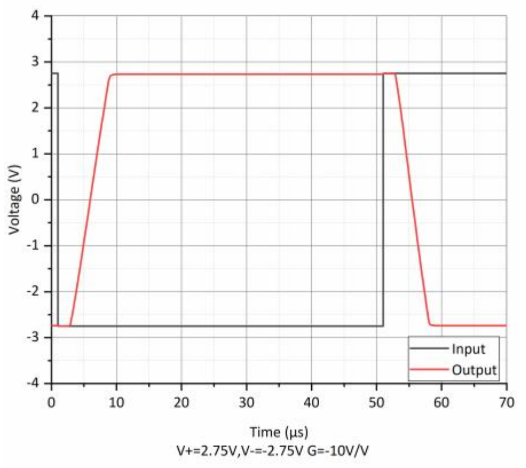


Figure 21: Overload Recovery

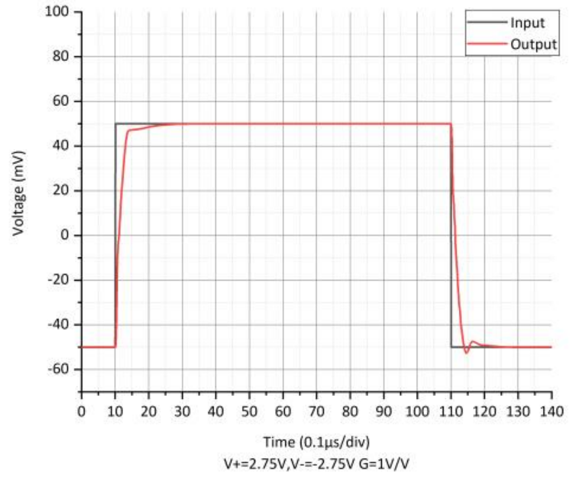


Figure 22: Small-Signal Step Response

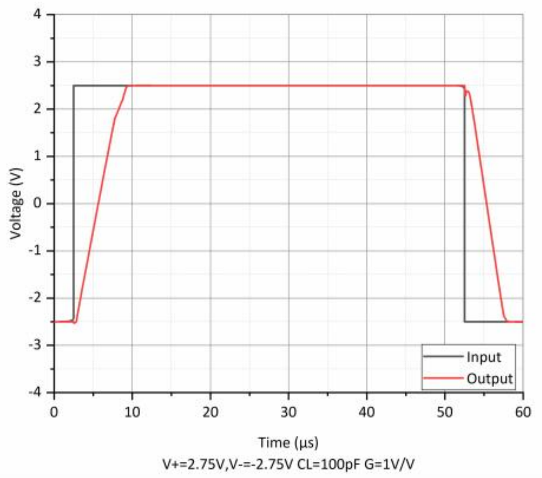


Figure 23: Large-Signal Step Response

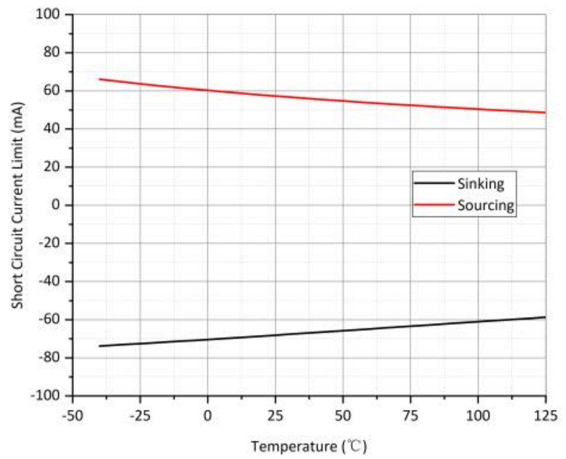
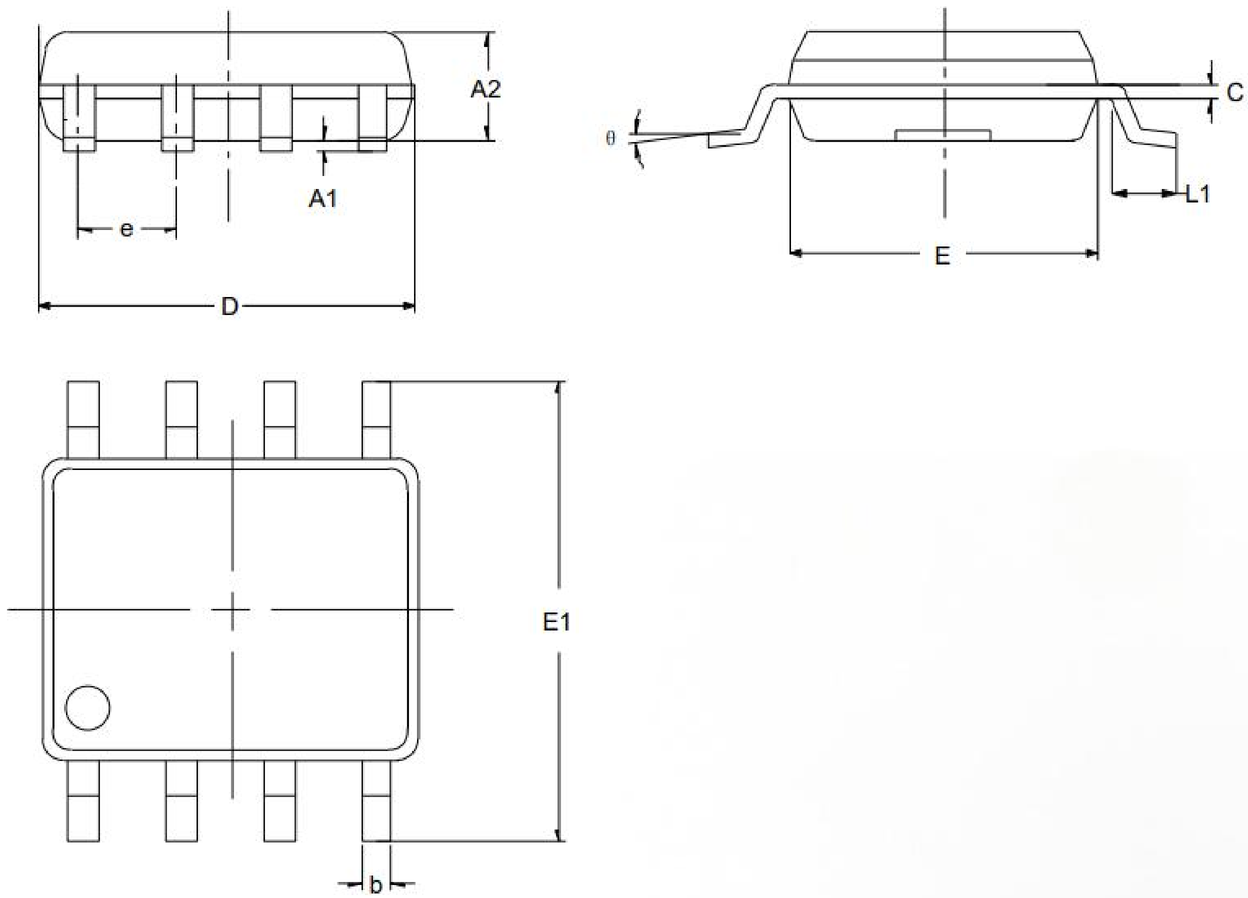


Figure 24: Short-Circuit Current vs Temperature

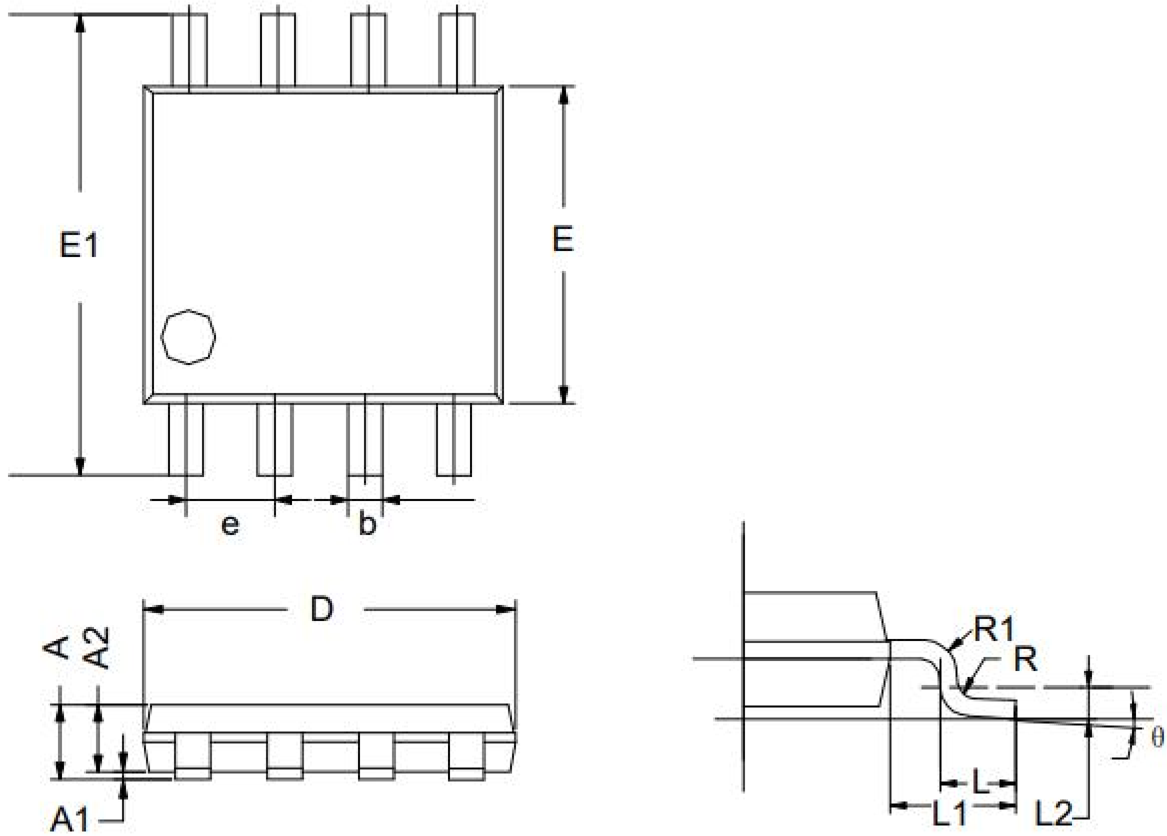
12.Package Outline Dimensions

(1) Package Type: SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
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	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270 TYP		0.050 TYP	
L1	0.400	1.270	0.016	0.050
θ	0 °	8 °	0 °	8 °

(2) Package Type: MSOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
C	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L1	0.410	0.650	0.016	0.026
θ	0 °	6 °	0 °	6 °

13.Important Notice And Disclaimer

● We reserves the right to change the instruction manual without prior notice.

● Any semiconductor product has a certain possibility of failure or malfunction under specific conditions. The buyer is responsible for complying with safety standards and taking safety measures when using our products for system design and overall manufacturing to avoid potential failure risks that may cause personal injury or property damage.

● The improvement of product quality is endless, our company will be dedicated to provide customers with better products.