

AXOP38802

400nA Ultra Low Power RRIO
Dual Operational Amplifiers



Datasheet – Jun 2022

Description

The AXOP38802 is dual ultra-low power, low voltage (1.5V to 5.5V) operational amplifiers (opamps) with rail-to-rail input and output swing capabilities. This device is very suitable for applications where ultra-low voltage operation and small footprint are required.

Features

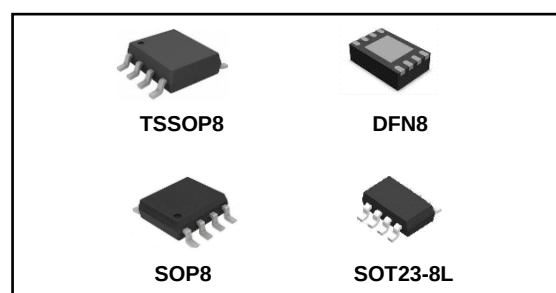
- Ultra-low quiescent current (per opamp): 400nA typ
- Low input offset voltage: $\pm 0.5\text{mV}$ typ
- Rail-to-rail input and output
- Unity-gain bandwidth: 25kHz
- Operational at supply voltages as low as 1.5V
- Easier to stabilize with higher capacitive load due to resistive open-loop output impedance

Applications

- Motion detectors using PIR sensors
- Gas detectors
- Ionization smoke alarms
- Thermostats
- IoT remote sensors
- Portable equipment
- Portable glucose monitors

Table 1 Device Summary

Order code	Package	Packing
AXOP38802A	TSSOP8	Reel
AXOP38802B	DFN8	Reel
AXOP38802C	SOP8	Reel
AXOP38802D	SOT23-8L	Reel



Contents

Description.....	1
Features.....	1
Applications	1
1 Block Diagram and Application Circuit.....	4
2 Pin Description	5
3.1 Absolute Maximum Ratings	6
3.2 Thermal Data.....	6
3.3 ESD and Latch Up.....	6
3.4 Electrical Characteristics	7
3.5 Typical Characteristics.....	9
4 Functional Description.....	9
4.1 Overview	10
4.2 Rail to Rail Input	10
4.3 Rail to Rail Output	10
4.4 EMI Rejection	10
5 Package Information	11
5.1 Package Dimensions	11
5.2 Marking Information	15
6 Packing Information.....	17
7 Revision History	18

List of Figures

Figure 1 Block Diagram.....	4
Figure 2 PIR Motion Sensor Amplifier	4
Figure 3 AXOP38802A/B/C/D Pinouts	5
Figure 4 Signal to Noise Performance.....	9
Figure 5 TSSOP8 Mechanical Data and Package Dimensions	11
Figure 6 DFN8 Mechanical Data and Package Dimensions	12
Figure 7 SOP8 Mechanical Data and Package Dimensions	13
Figure 8 SOT23-8L Mechanical Data and Package Dimensions	14
Figure 9 TSSOP8 Marking Information	15
Figure 10 DFN8 Marking Information	15
Figure 11 SOP8 Marking Information	16
Figure 12 SOT23-8L Marking Information	16
Figure 13 Reel Packing Information	17

List of Tables

Table 1 Device Summary	1
Table 2 Absolute Maximum Ratings	6
Table 3 Thermal Data	6
Table 4 ESD and Latch up	6
Table 5 Electrical Characteristics	7
Table 6 Document Revision History	18

1 Block Diagram and Application Circuit

Figure 1 Block Diagram

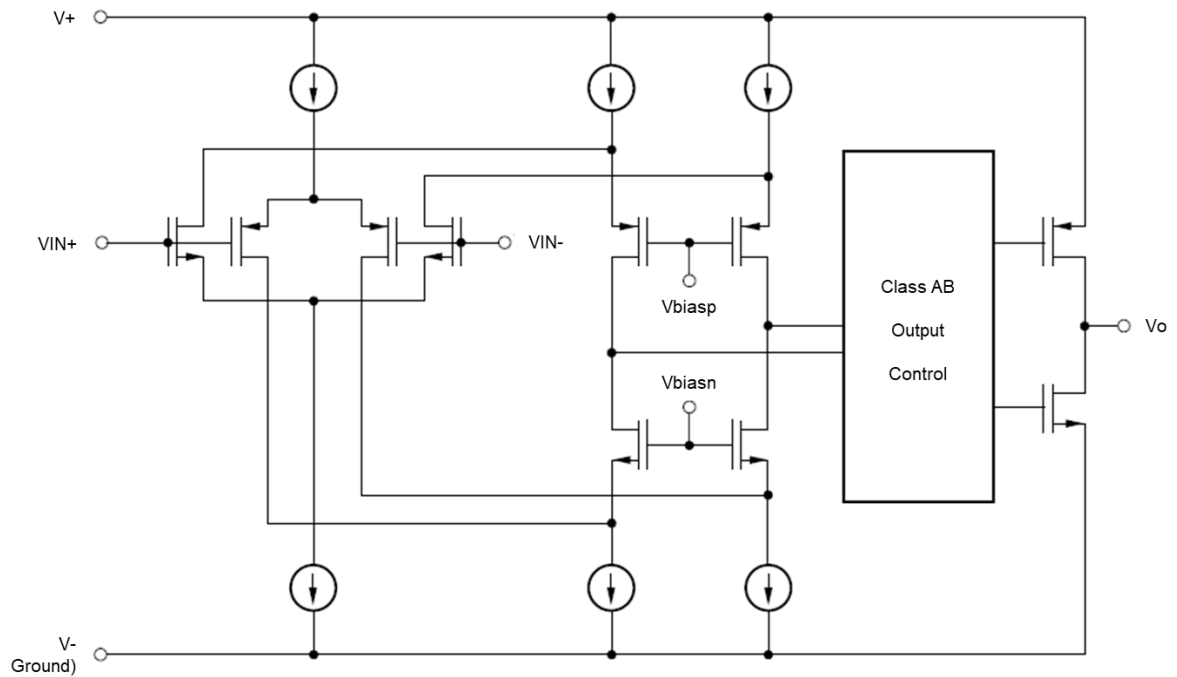
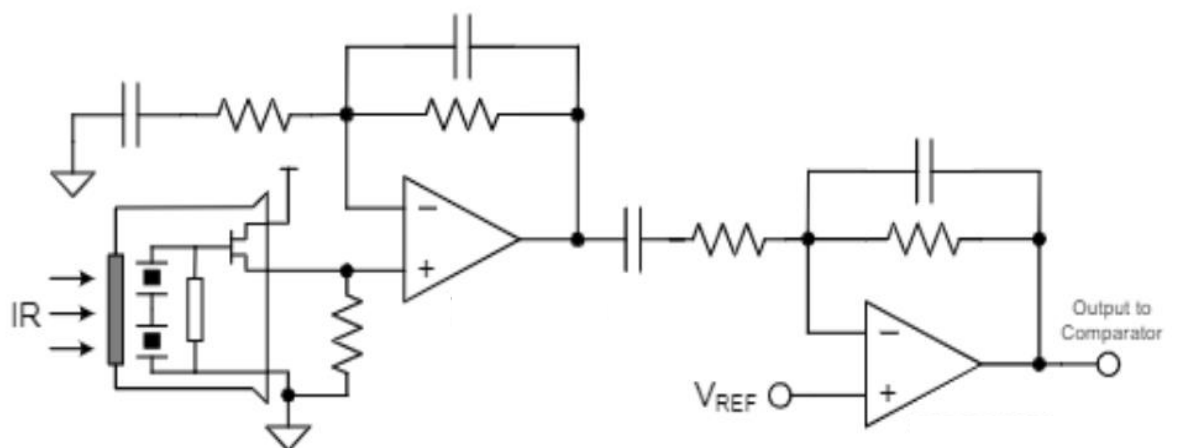
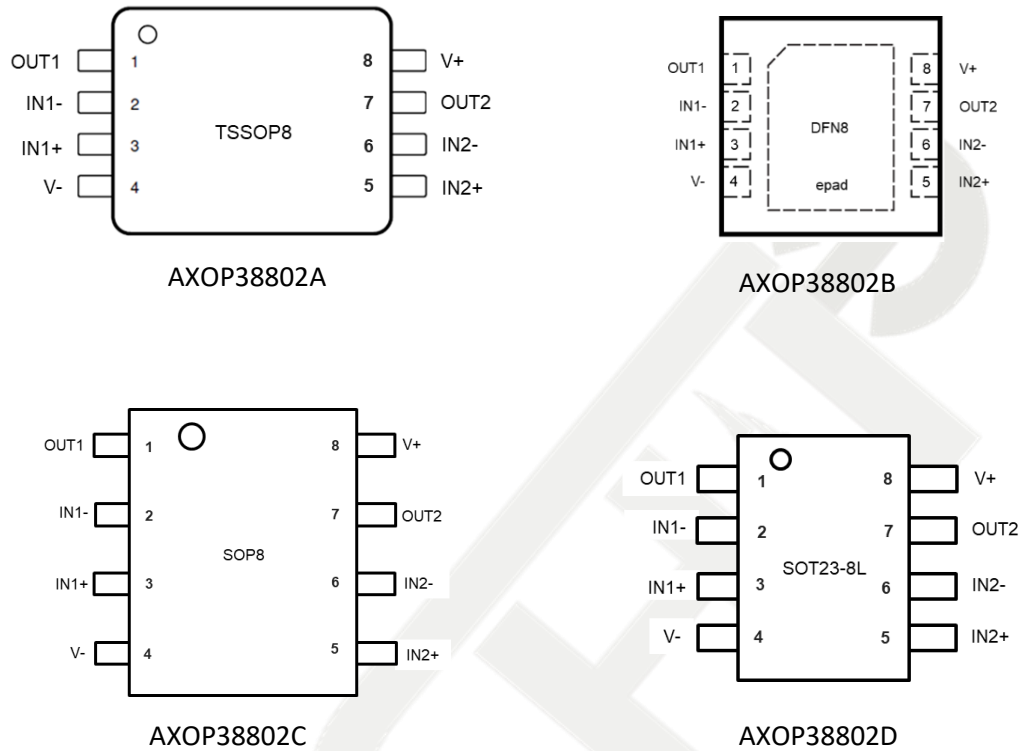


Figure 2 PIR Motion Sensor Amplifier



2 Pin Description

Figure 3 AXOP38802A/B/C/D Pinouts



Pin number	Pin name	Description
1	OUT1	Output 1
2	IN1-	Inverting input 1
3	IN1+	Non-inverting input 1
4	V-	Negative supply or ground
5	IN2+	Non-inverting input 2
6	IN2-	Inverting input 2
7	OUT2	Output 2
8	V+	Positive supply

3 Electrical Specifications

3.1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
Vs	Supply voltage (V+) - (V-)	-0.3 to +6	V
IN+, IN-	Input pin voltage	(V-) - 0.5 to (V+) +0.5	V
OUT	Output pin voltage	(V-) - 0.5 to (V+) +0.5	V
Tj	Junction temperature	150	°C
Tstg	Storage temperature	-55 to +150	°C

3.2 Thermal Data

Table 3 Thermal Data

Package	Rth j-amb	Rth j-case	Unit
TSSOP8	206	107	°C/W
DFN8	43	5	°C/W
SOP8			°C/W
SOT23-8L			°C/W

3.3 ESD and Latch Up

Table 4 ESD and Latch up

Symbol	Parameter	Value	Unit
All pins	ESD (HBM)	±2,000	V
	ESD (CDM)	±500	V
All pins	Latch Up JESD78, Class A	≥ 100	mA

3.4 Electrical Characteristics

For $V_s = (V^+) - (V^-) = 1.5V$ to $5.5V$ at $T_a = 25^\circ C$, $R_L = 10M\Omega$ connected to $V_s/2$, $V_{cm} = V_s/2$, and $V_{out} = V_s/2$ (unless otherwise noted).

Table 5 Electrical Characteristics

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
Vs	Supply voltage (V+) - (V-)		1.5		5.5	V
Ta	Operating ambient temperature		-40		125	°C
Power Supply						
Iq	Quiescent current per amplifier	Vs=3.3V, Io=0		400	500	nA
		all temp			600	
Offset Voltage						
Vos	Input offset voltage			±0.5	±3.0	mV
		all temp			±5.0	mV
dVos/dT	Drift	all temp		±0.5		µV/°C
PSRR	Power-supply rejection ratio	At DC		110		dB
Csep	Channel separation	At DC		120		dB
Input Voltage Range						
Vcm	Common mode voltage range	Vs=1.5V to 5V	(V-)-0.1		(V+)+0.1	V
CMRR	Common mode rejection ratio	At DC		100		dB
Input Bias Current						
Ib	Input bias current			±0.5		pA
Ios	Input offset current			±0.05		pA
Noise						
En	Input voltage noise	f=0.1Hz to 10Hz		5.5		µVpp
en	Input voltage noise density	f=100Hz		285		nV/√Hz
		f=1kHz		280		
Input Capacitance						
Cid	Differential			2		pF
Cic	Common mode			4		pF
Open Loop Gain						
Aol	Open loop voltage gain			95		dB
Frequency Response						
GBP	Gain bandwidth product	G=+1, CL=10pF		25		kHz
Cload	Capacitive load	G=+1			500	pF
SR	Slew rate	G=+1, CL=10pF Vs=5V		7		V/ms

Ts	Settling time	To 0.1%, 2V step, G=+1, CL=10pF		0.4		ms
SNR	Signal to Noise Ratio			110		dB
Output						
Vo	Voltage output swing from supply rails	Vs=1.8V, RL=1MΩ		2.5	5	mV
Isc	Short circuit current			±10		mA
Zo	Open loop output impedance	f=1kHz		100		kΩ

3.5 Typical Characteristics

Figure 4 Signal to Noise Performance



4 Functional Description

4.1 Overview

The AXOP38802 is an ultra-low power, rail-to-rail input and output opamp. This device operates from 1.5V to 5.5V, is unity gain stable, and is designed for a wide range of applications and used in virtually any single supply application.

4.2 Rail to Rail Input

The input common mode voltage range of the AXOP38802 extends 100mV beyond the supply rails for the full supply voltage range of 1.5V to 5.5V. This performance is achieved with a complementary input stage: a N-channel input differential pair in parallel with a P-channel differential pair, as shown in Figure 1. The N-channel pair is active for input voltages close to the positive rail, typically $(V^+) - 1.4V$ to 200mV above the positive supply, whereas the P-channel pair is active for inputs from 200mV below the negative supply to approximately $(V^+) - 1.4V$. There is a transition region, in which both pairs are on. Within this transition region, PSRR, CMRR, offset voltage, offset drift, and THD can degrade compared to device operation outside this region.

4.3 Rail to Rail Output

Designed as an ultra-low power, low voltage operational amplifier, the AXOP38802 delivers a robust output drive capability. A class AB output stage with common source Mosfets achieves full rail-to-rail output swing capability. For resistive loads of $1M\Omega$, the output swings to within 2.5mV (typ) of either supply rail, regardless of the applied power supply voltage. Different load conditions change the ability of the amplifier to swing close to the rails.

4.4 EMI Rejection

The AXOP38802 uses integrated electromagnetic interference (EMI) filtering to reduce the effects of EMI from sources such as wireless communications and densely populated boards with a mix of analog signal chain and digital components.

5 Package Information

5.1 Package Dimensions

Figure 5 TSSOP8 Mechanical Data and Package Dimensions

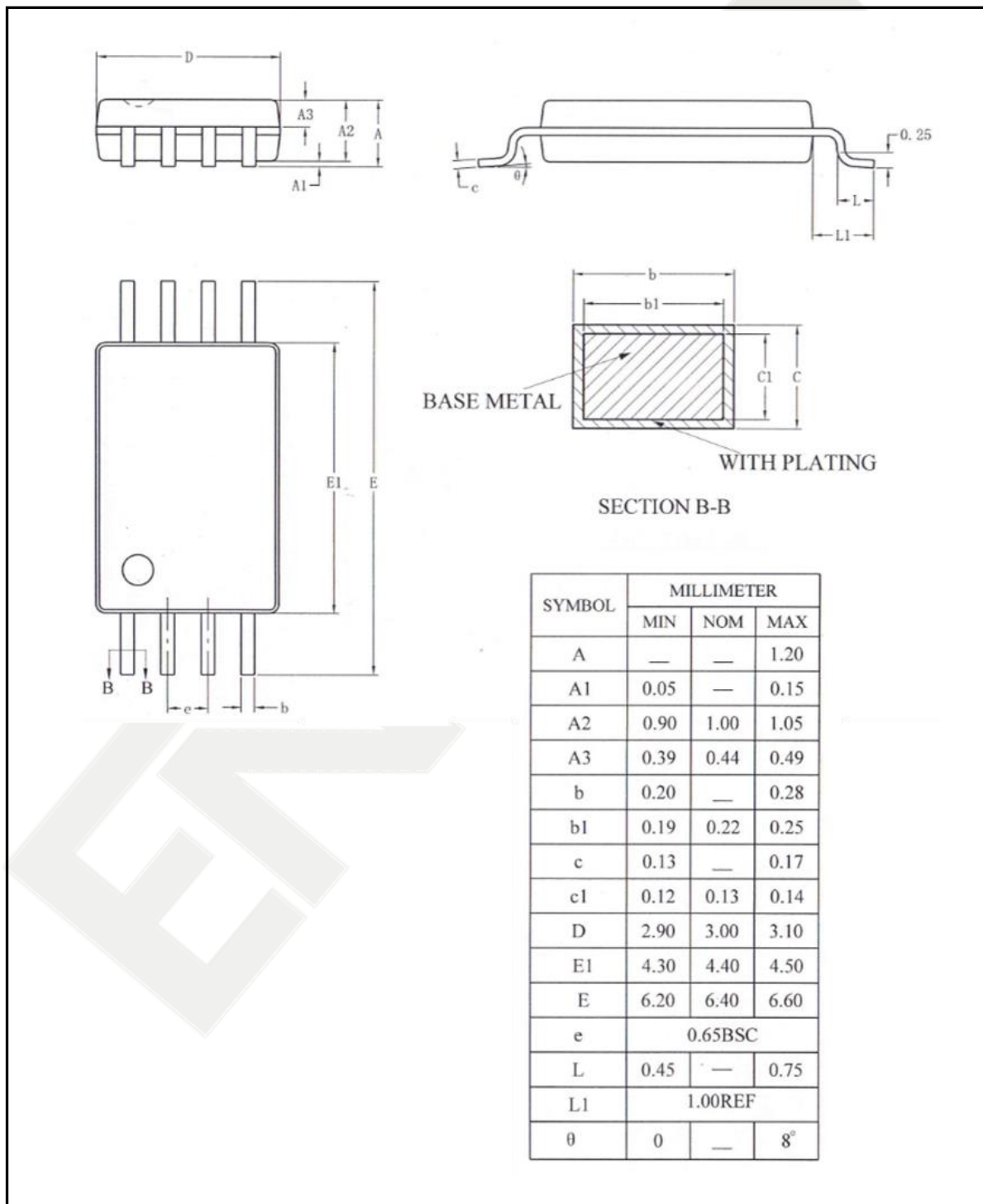


Figure 6 DFN8 Mechanical Data and Package Dimensions

	Min (mm)	Typ (mm)	Max (mm)		Min (mm)	Typ (mm)	Max (mm)
A	0.70	0.75	0.80	e	0.50BSC		
A1	0.00	0.02	0.05	E	1.95	2.00	2.05
b	0.18	0.25	0.30	E2	0.65	0.70	0.75
b1	0.18REF			L	0.25	0.30	0.35
c	0.20REF			h	0.15	0.20	0.25
D	1.95	2.00	2.05				
D2	1.15	1.20	1.25				

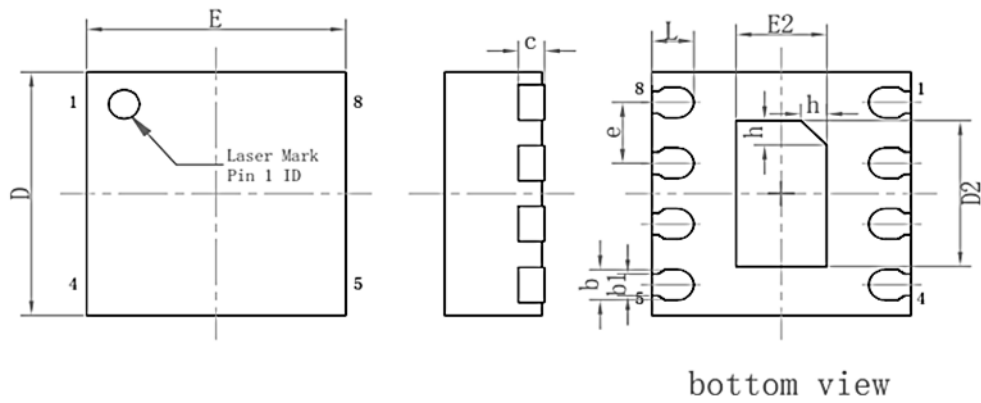


Figure 7 SOP8 Mechanical Data and Package Dimensions

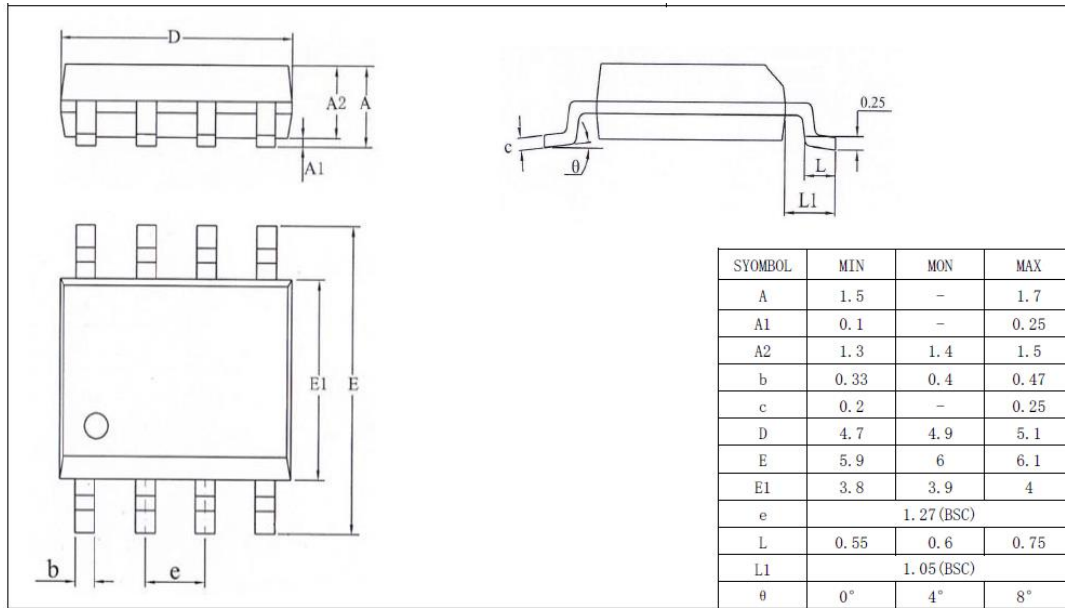
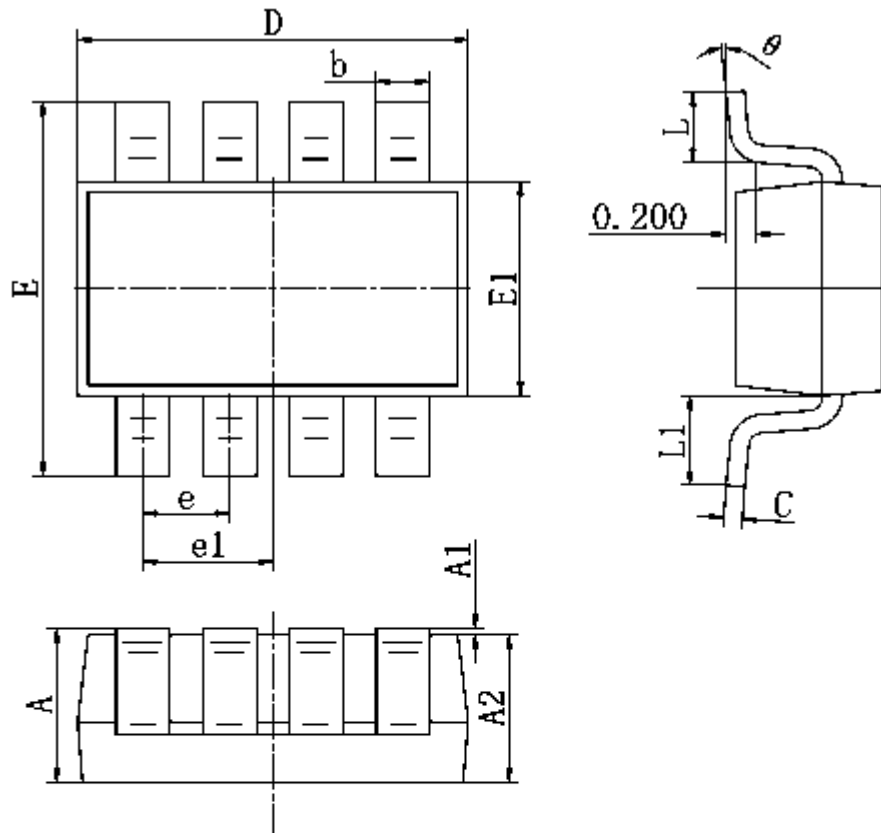


Figure 8 SOT23-8L Mechanical Data and Package Dimensions



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
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.650BSC.		0.026BSC.	
e1	0.975BSC.		0.038BSC.	
L	0.300	0.600	0.012	0.024
L1	0.600REF.		0.024REF.	
θ	0°	8°	0°	8°

5.2 Marking Information

Figure 9 TSSOP8 Marking Information

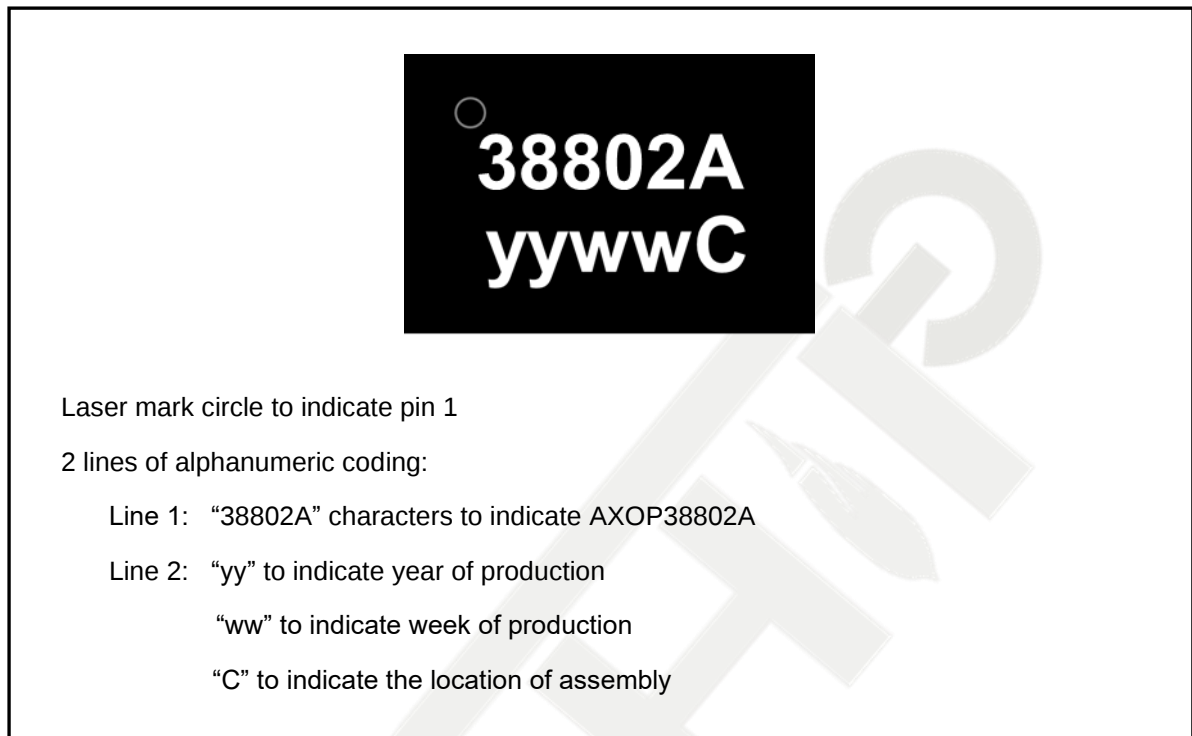


Figure 10 DFN8 Marking Information

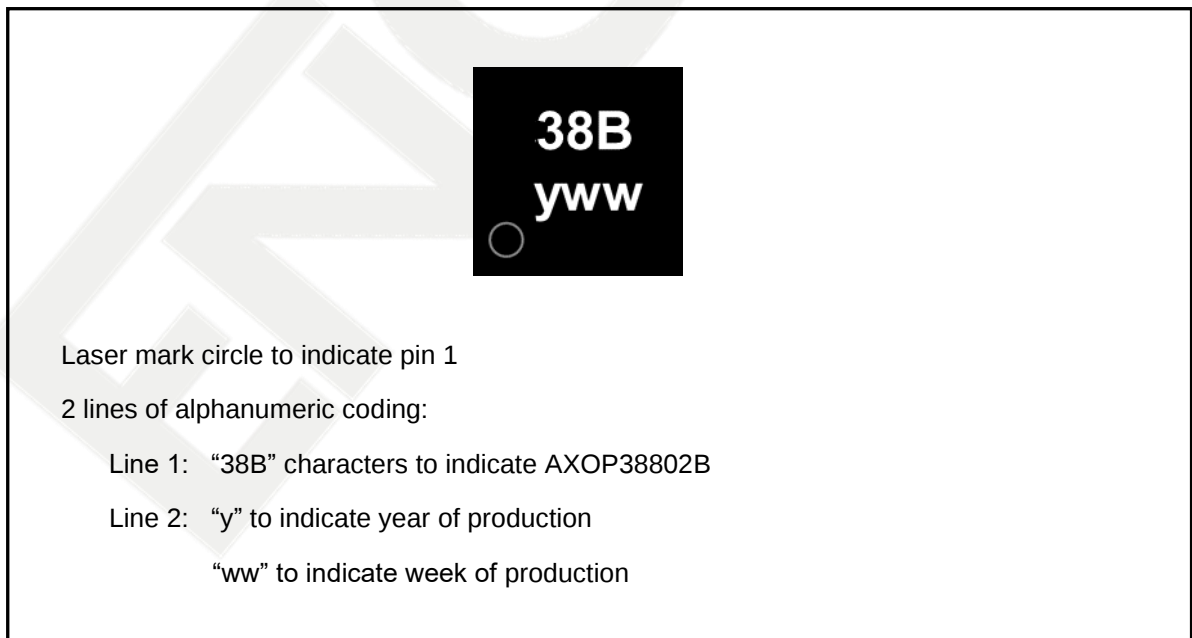


Figure 11 SOP8 Marking Information

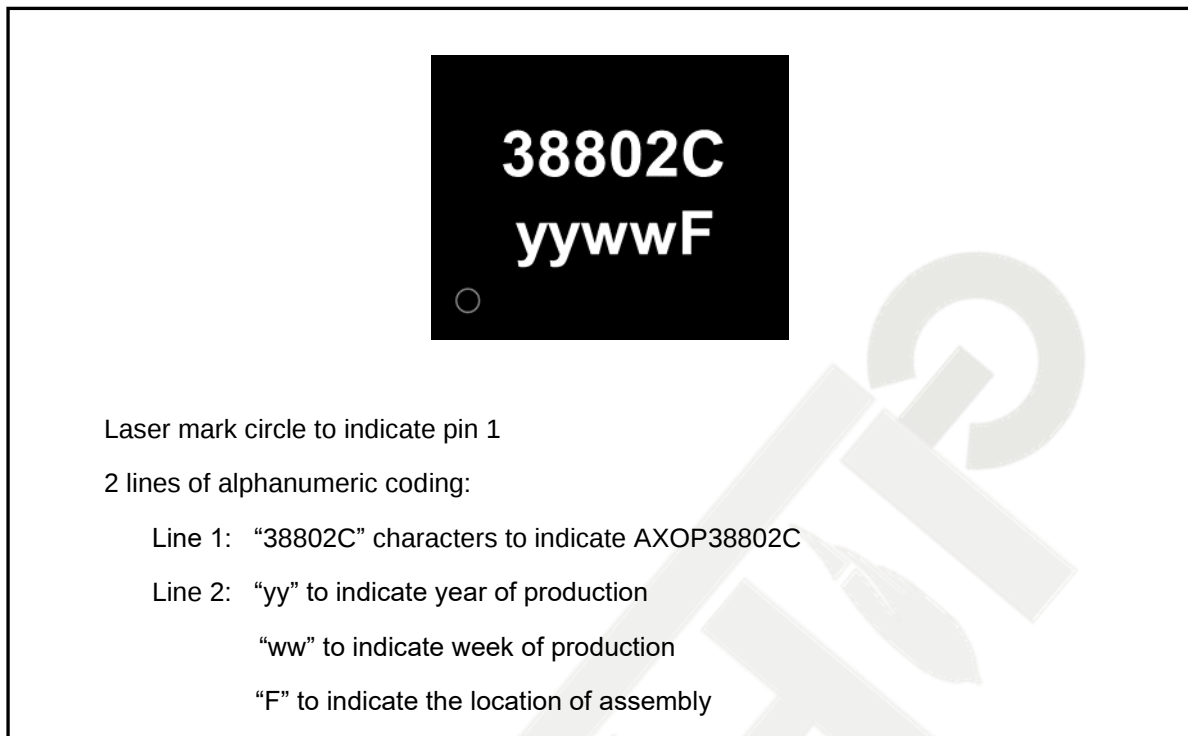
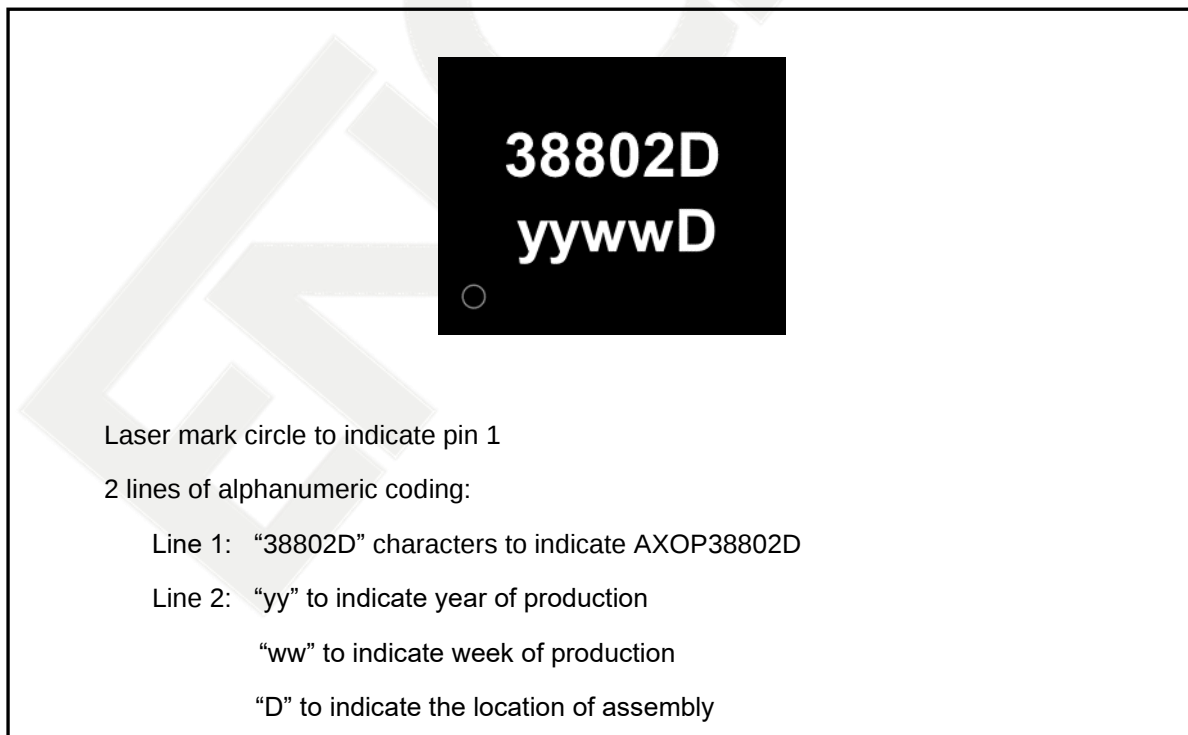
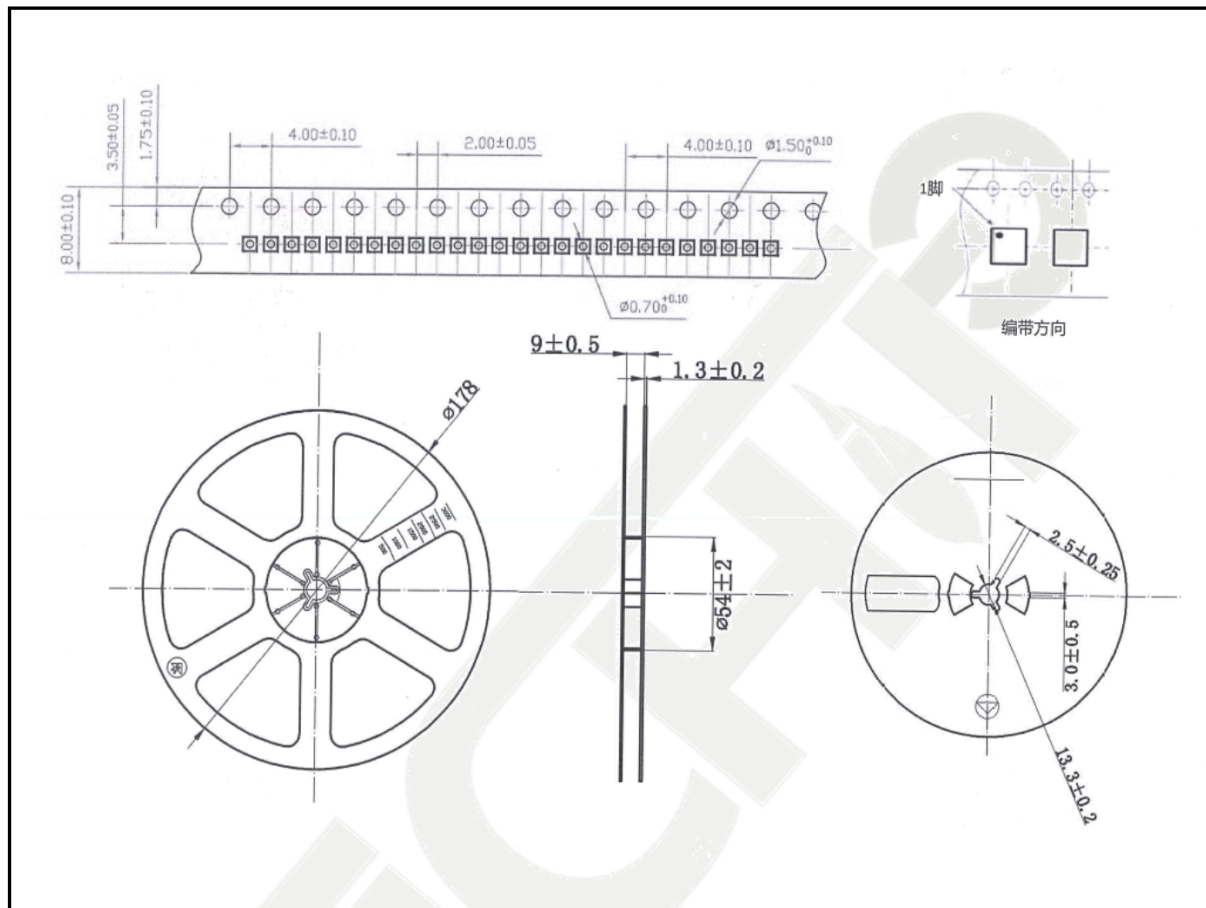


Figure 12 SOT23-8L Marking Information



6 Packing Information

Figure 13 Reel Packing Information



7 Revision History

Table 6 Document Revision History

Date	Version	Description
Jun 2022	1.00	First version.