AXOP38802

400nA Ultra Low Power RRIO Dual Operational Amplifiers

Datasheet – Jan 2023

Description

The AXOP38802 is dual ultra-low power (400nA per opamp), 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 power and voltage operation as well as small footprint are required.

Features

- Ultra-low quiescent current (per opamp): 400nA typ
- Low input offset voltage: ±0.5mV typ
- Rail-to-rail input and output
- Unity-gain bandwidth: 100kHz
- Operational at supply voltages as low as 1.5V
- Easier to stabilize with higher capacitive load due to resistive open-loop output impedance

Applications

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

Table 1 Device Summary

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

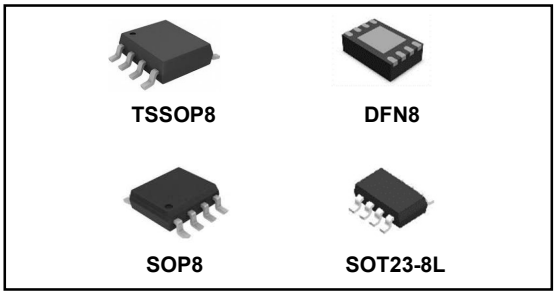

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Figure 1 Block Diagram

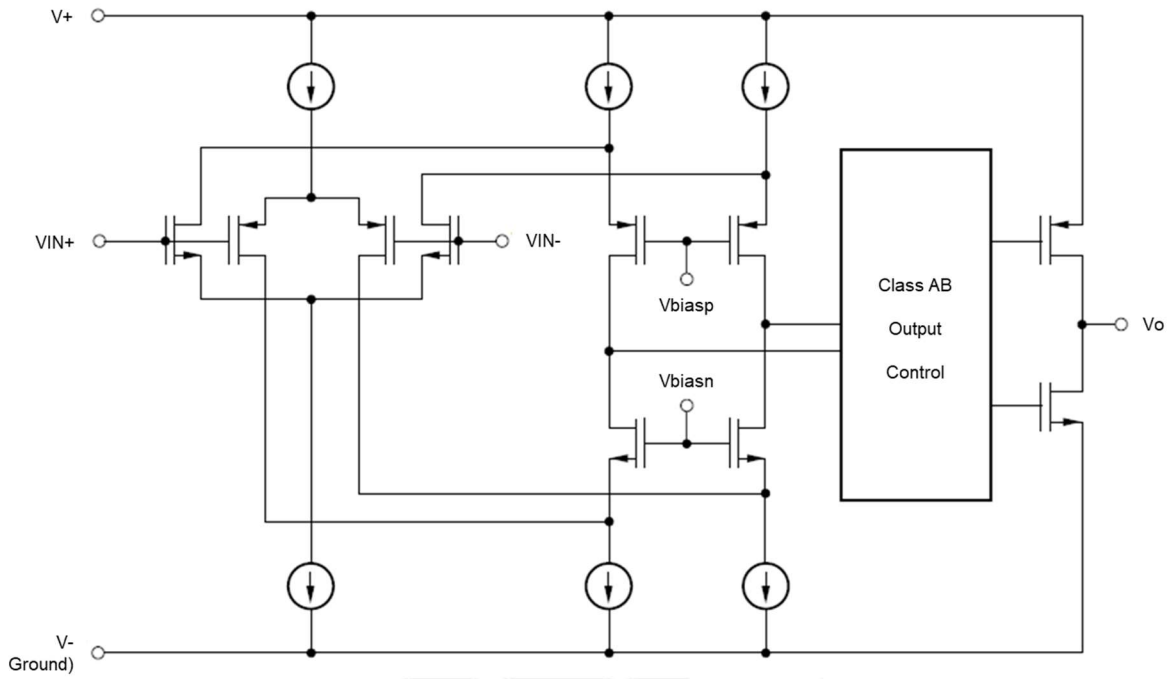
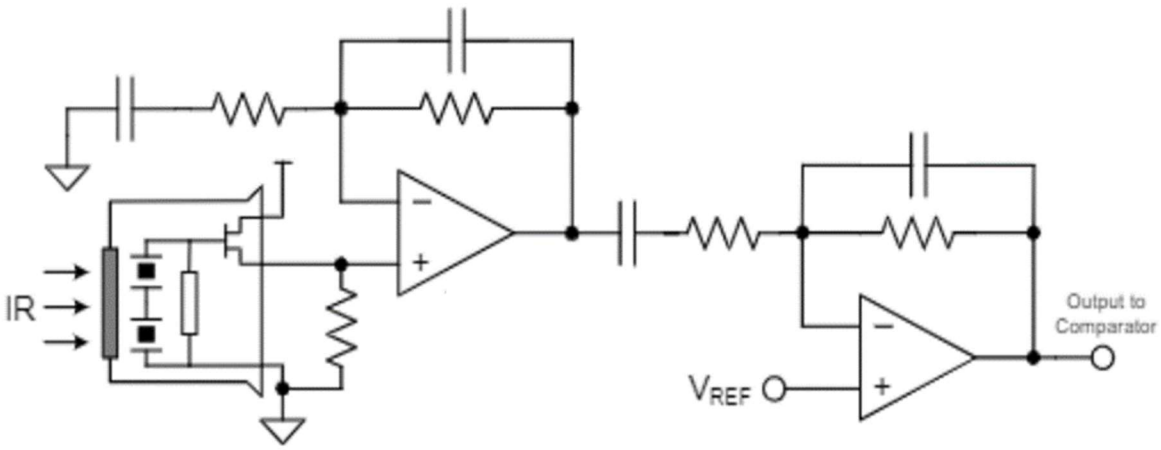
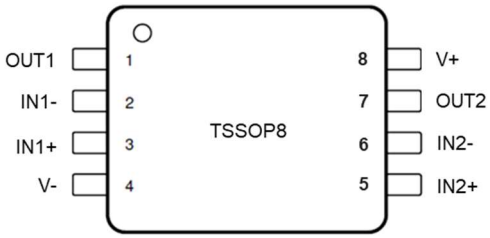


Figure 2 Typical Application Circuit (PIR Motion Sensor Amplifier)

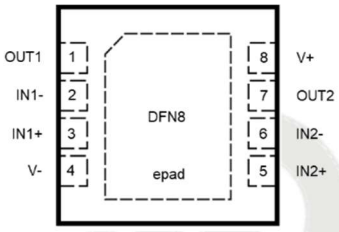


2 Pin Description

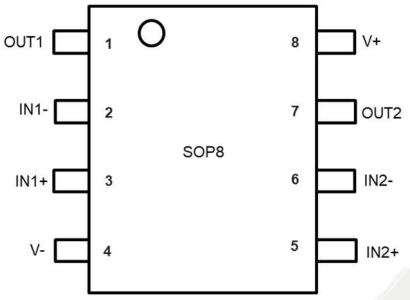
Figure 3 AXOP38802A/B/C/D Pinouts



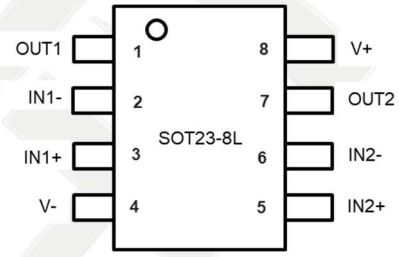
AXOP38802A



AXOP38802B



AXOP38802C



AXOP38802D

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	98	°C/W
DFN8	43	5	°C/W
SOP8	136	77	°C/W
SOT23-8L	184	100	°C/W

3.3 ESD and Latch Up

Table 4 ESD and Latch up

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

3.4 Electrical Characteristics

For Vs = (V+) - (V-) = 1.5V to 5.5V at Ta = 25°C, RL = 10MΩ connected to Vs/2, CL = 20pF, Vcm = Vs/2, and Vout = Vs/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	800	nA
		all temp			1,000	
Offset Voltage						
Vos	Input offset voltage			±0.5	±2.5	mV
		all temp			±4.0	mV
dVos/dT	Drift	all temp		±1		μV/°C
PSRR	Power-supply rejection ratio	At DC		110		dB
Csep	Channel separation	At DC		110		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		6		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			100		dB
Frequency Response						
GBP	Gain bandwidth product	G=+1, CL=20pF, RL=10MΩ to Vs/2		100		kHz
Cload	Capacitive load	G=+1			500	pF
SR	Slew rate	G=+1, CL=20pF, RL=10MΩ to Vs/2		8		V/ms

Ts	Settling time	To 0.1%, 2V step, G=+1, CL=20pF		0.3		ms
SNR	Signal to Noise Ratio			110		dB
Output						
Vo	Voltage output swing from supply rails	Vs=1.5V, RL=100kΩ to Vs/2		1	5	mV
Isc	Short circuit current			±15		mA

3.5 Typical Electrical Characteristics

Figure 4 Vos Distribution

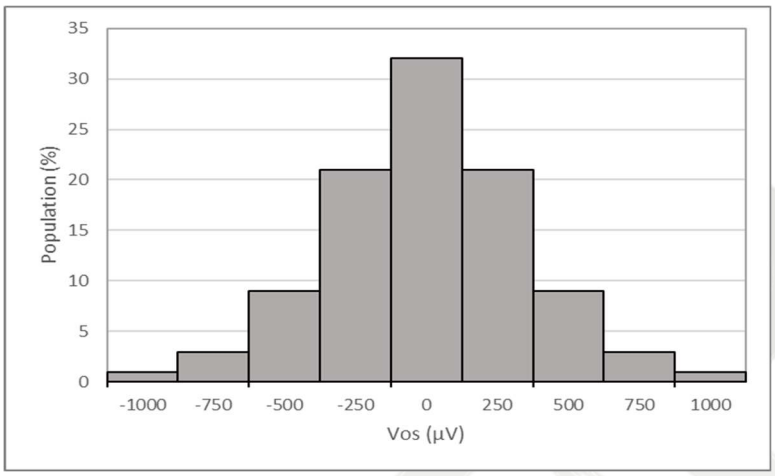


Figure 5 Vos vs Input Common Mode Voltage

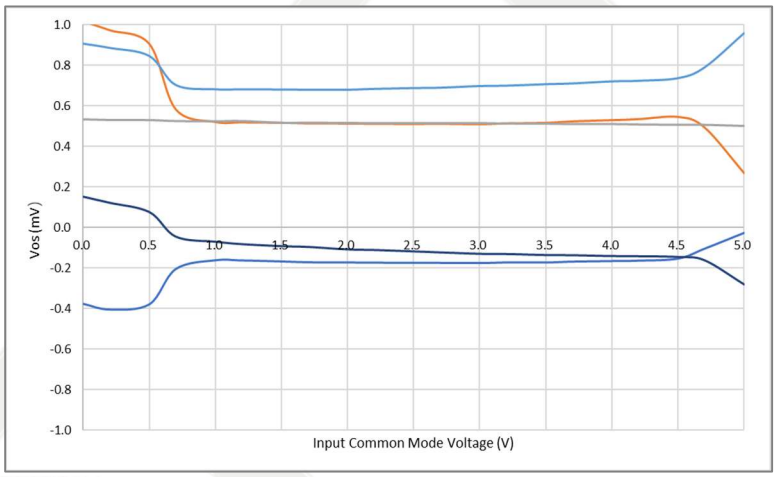


Figure 6 Vos vs Vs

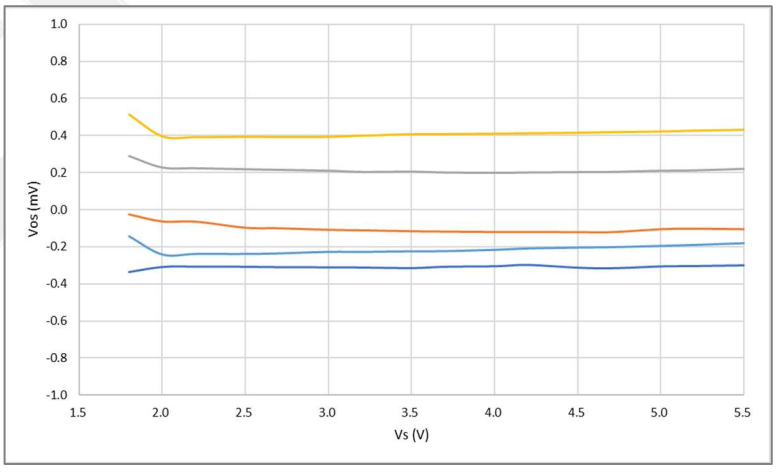


Figure 7 Iq (per opamp) vs Input Common Mode Voltage

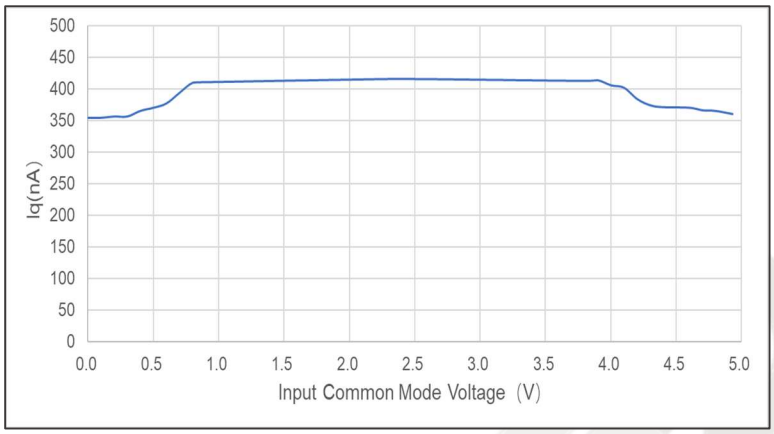


Figure 8 Iq (per opamp) vs Vs

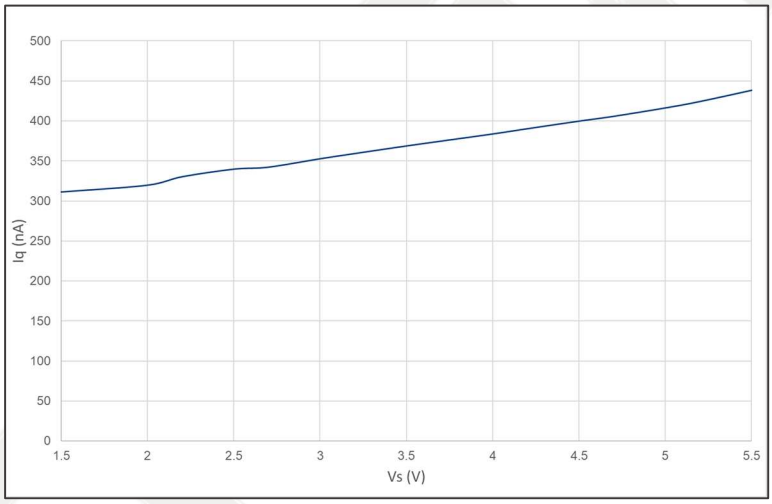
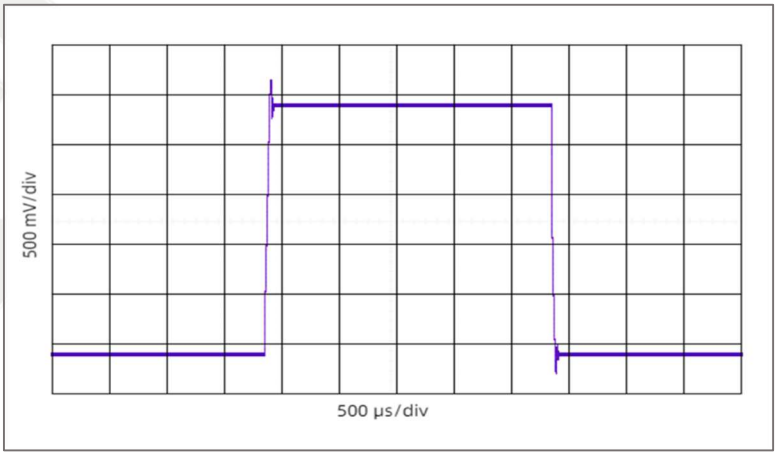


Figure 9 Large Signal Step Response



4 Functional Description

4.1 Overview

The AXOP38802 is an ultra-low power (400nA per opamp), 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 1MΩ, 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.

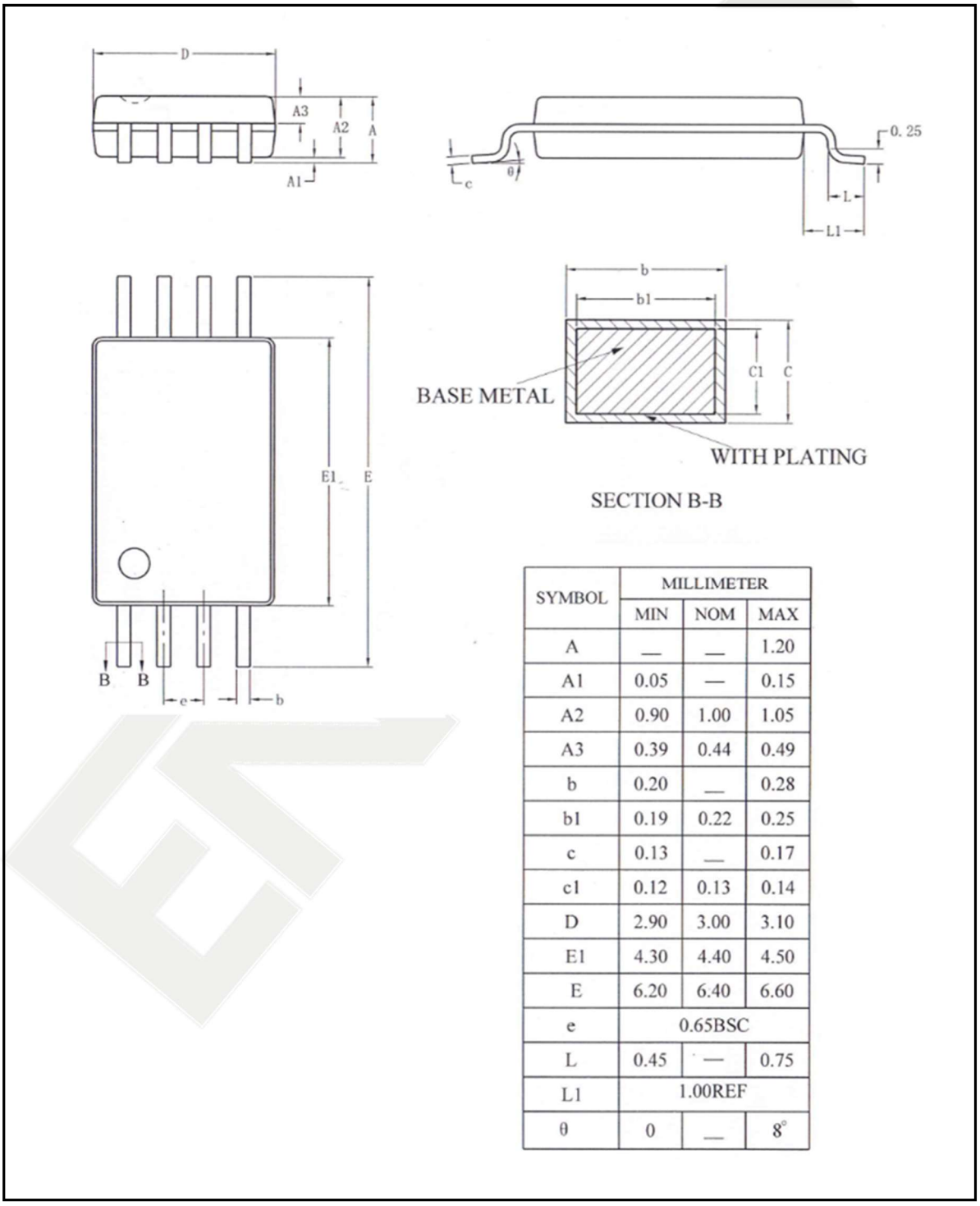
4.4 EMI Rejection

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 10 TSSOP8 Mechanical Data and Package Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	2.90	3.00	3.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	—	0.75
L1	1.00REF		
θ	0	—	8°

Figure 11 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				

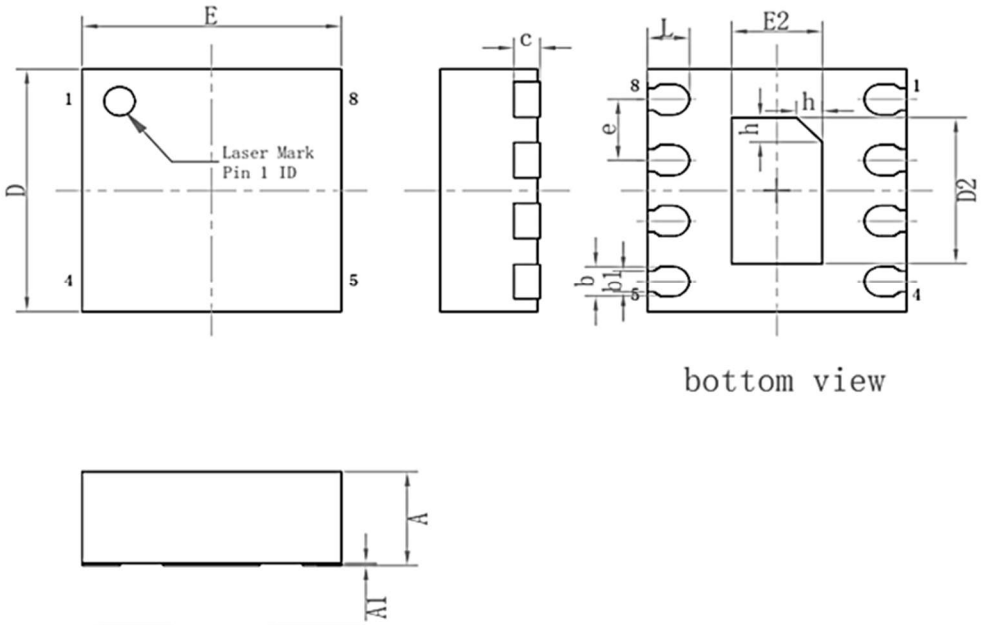
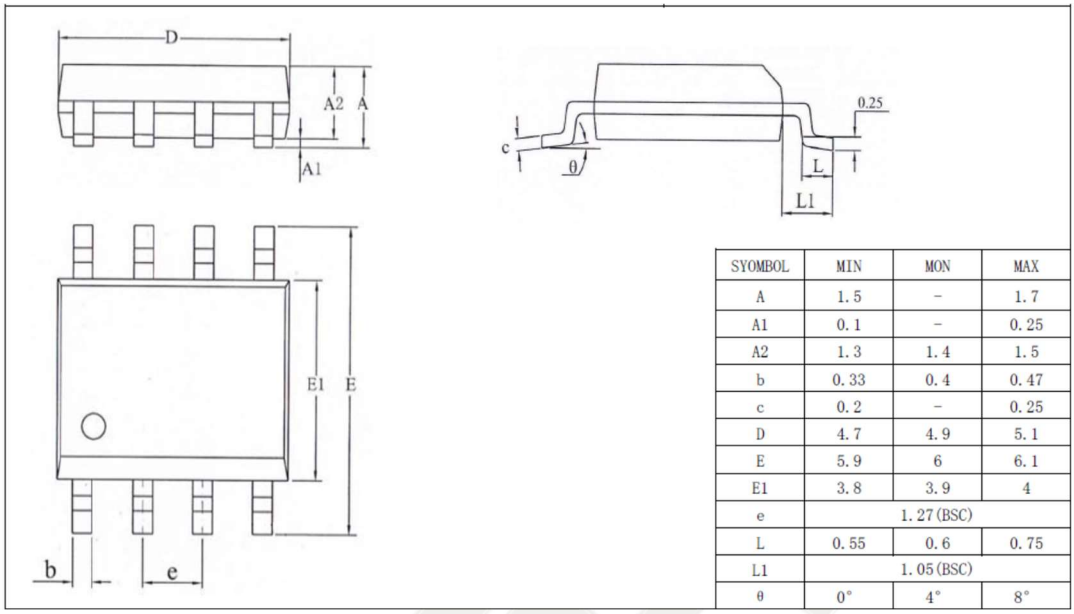
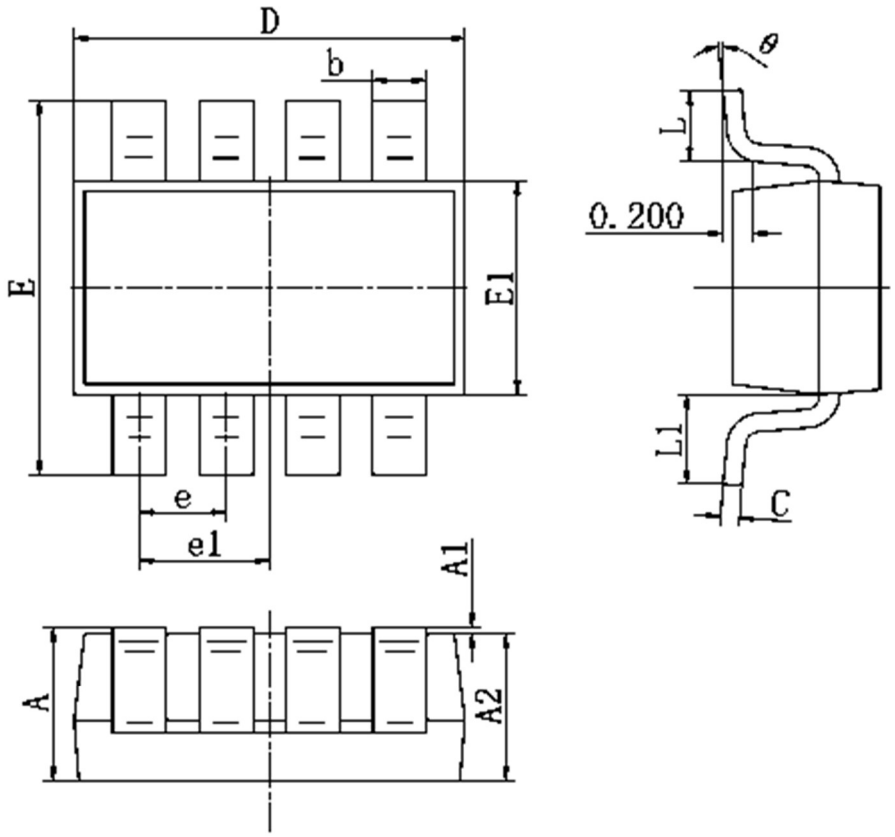


Figure 12 SOP8 Mechanical Data and Package Dimensions



SYOMBOL	MIN	MON	MAX
A	1.5	-	1.7
A1	0.1	-	0.25
A2	1.3	1.4	1.5
b	0.33	0.4	0.47
c	0.2	-	0.25
D	4.7	4.9	5.1
E	5.9	6	6.1
E1	3.8	3.9	4
e	1.27(BSC)		
L	0.55	0.6	0.75
L1	1.05(BSC)		
θ	0°	4°	8°

Figure 13 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 14 TSSOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “38802A” characters to indicate AXOP38802A

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“C” to indicate the location of assembly

Figure 15 DFN8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “38B” characters to indicate AXOP38802B

Line 2: “y” to indicate year of production

“ww” to indicate week of production

Figure 16 SOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “38802C” characters to indicate AXOP38802C

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“F” to indicate the location of assembly

Figure 17 SOT23-8L Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “38802D” characters to indicate AXOP38802D

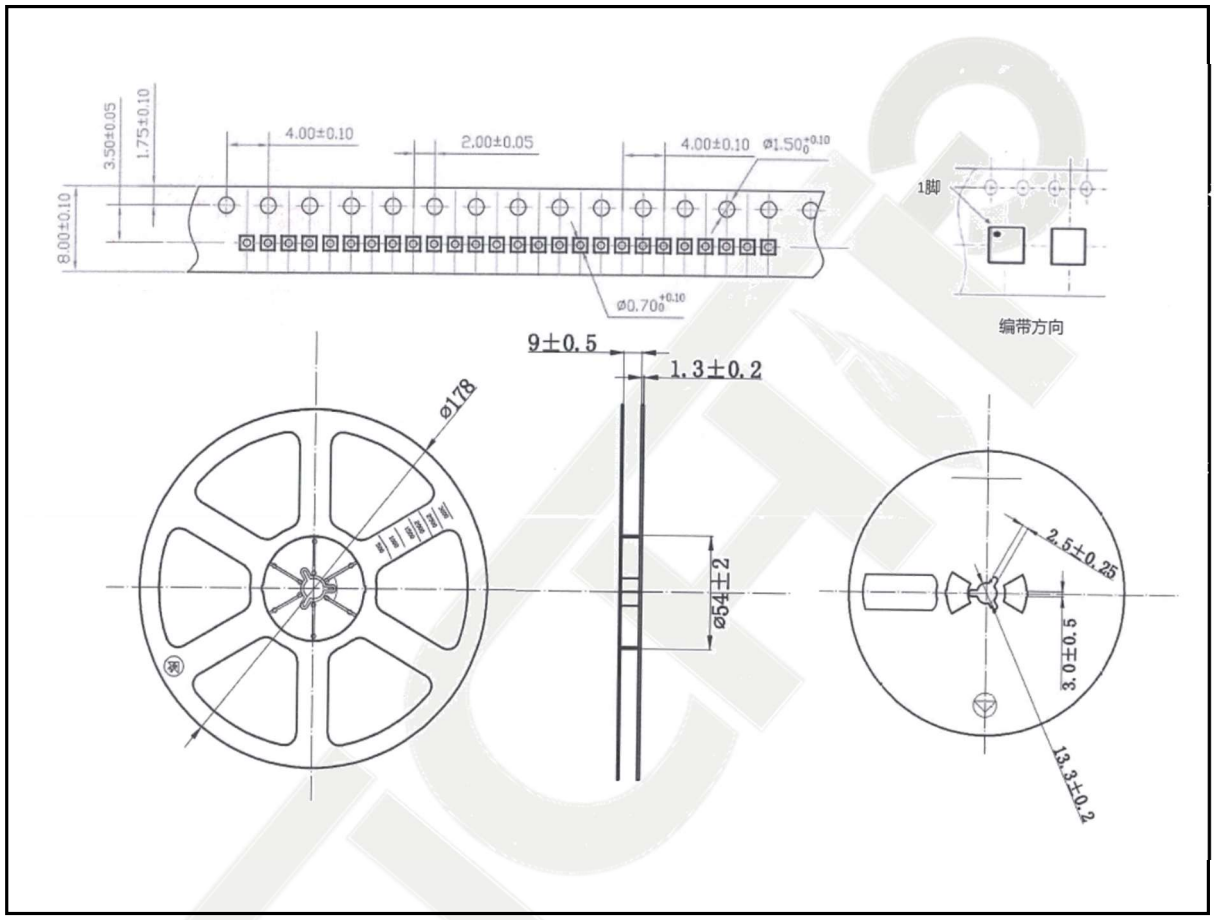
Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“D” to indicate the location of assembly

6 Packing Information

Figure 18 Reel Packing Information



7 Revision History

Table 6 Document Revision History

Date	Version	Description
Jan 2023	1.00	V1.00 version.