AXOP3406x

40V 25MHz RRIO Operational Amplifiers (Dual/Quad)

Datasheet – 14 April 2022

Description

The AXOP34062 (dual), and AXOP34064 (quad) are dual and quad high voltage (3V to 40V) operational amplifiers (opamps) with rail-to-rail input and output swing capabilities. These devices are very suitable for applications where high voltage operation, a small footprint, and high capacitive load drive are required. AXOP34062S and AXOP34064S are with Shutdown function.

Features

- Supply voltages from 3V to 40V
- Excellent THD+N 100dB
- Excellent SNR 110dB
- Rail-to-rail input and output
- Low input offset voltage: ±0.5mV typ
- Unity-gain bandwidth: 25MHz
- Low quiescent current (per opamp): 600μA typ @40V
- Easier to stabilize with higher capacitive load due to resistive open-loop output impedance
- Shutdown function (AXOP34062S and AXOP34064S)

Applications

- Infotainment system
- HVAC: heating, ventilating, and air conditioning
- Industrial control
- Test equipment
- Portable Equipment
- Active filters
- Data acquisition system

Table 1 Device Summary

Order code	Package	Packing
AXOP34062A	TSSOP8	Reel
AXOP34062B	DFN8	Reel
AXOP34062C	SOP8	Reel
AXOP34062D	SOT23-8L	Reel
AXOP34062SA	DFN10	Reel
AXOP34062SB	MSOP10	Reel
AXOP34064A	QFN14	Reel
AXOP34064B	TSSOP14	Reel
AXOP34064S	QFN16	Reel

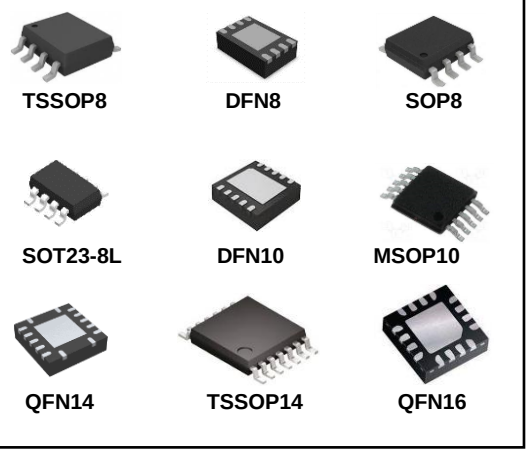

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Figure 1 Block Diagram

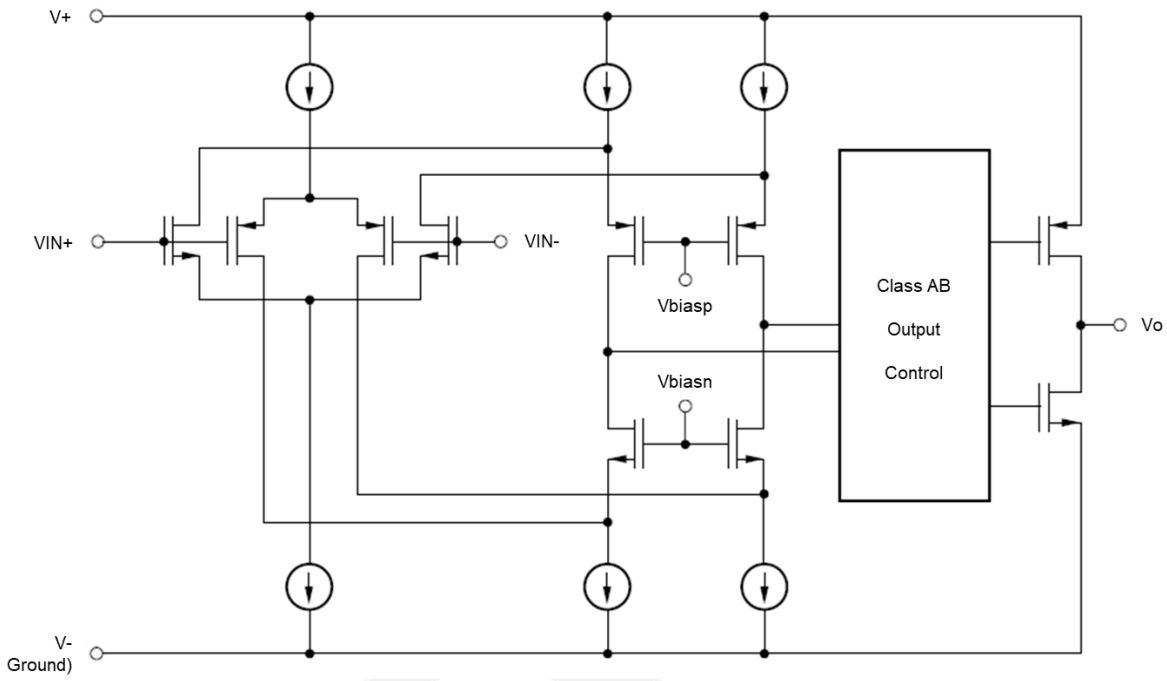
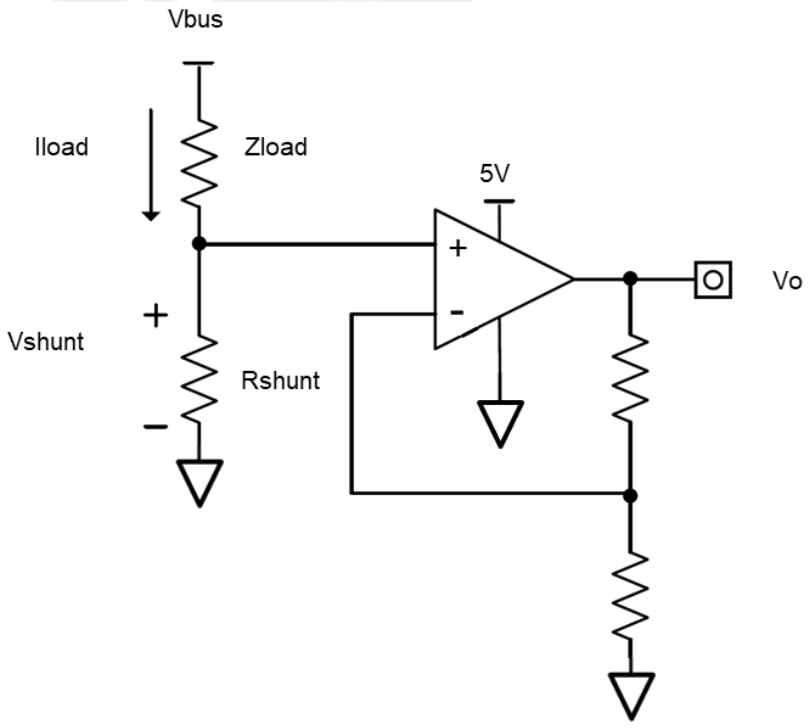


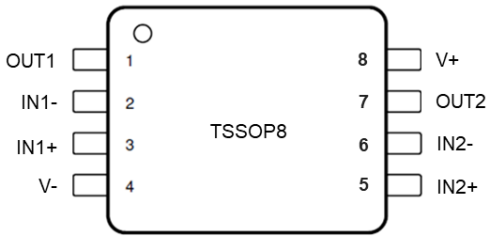
Figure 2 Typical Application Circuit (Low Side Current Sense)



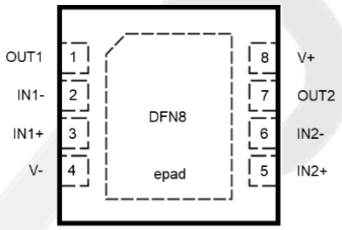
2 Pin Description

2.1 AXOP34062A/B/C/D Pinouts

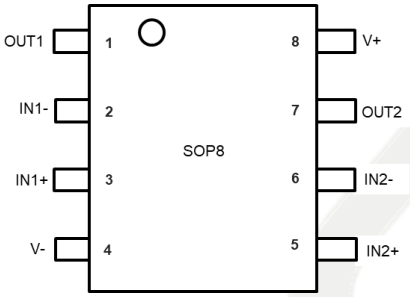
Figure 3 AXOP34062A/B/C/D Pinouts



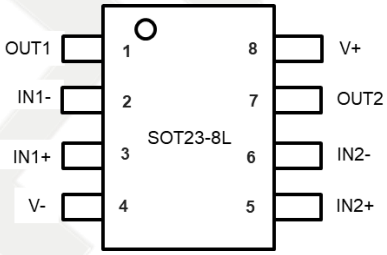
AXOP34062A



AXOP34062B



AXOP34062C

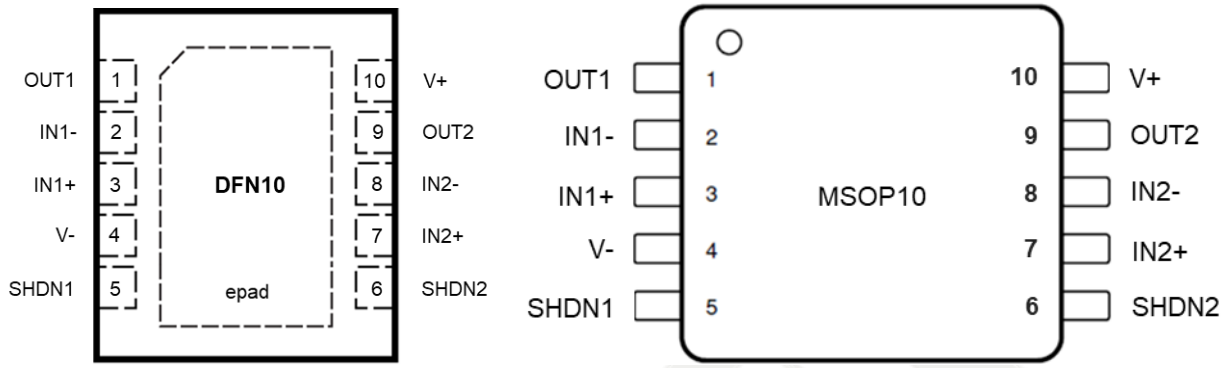


AXOP34062D

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

2.2 AXOP34062SA/B Pinouts

Figure 4 AXOP34062SA/B Pinouts

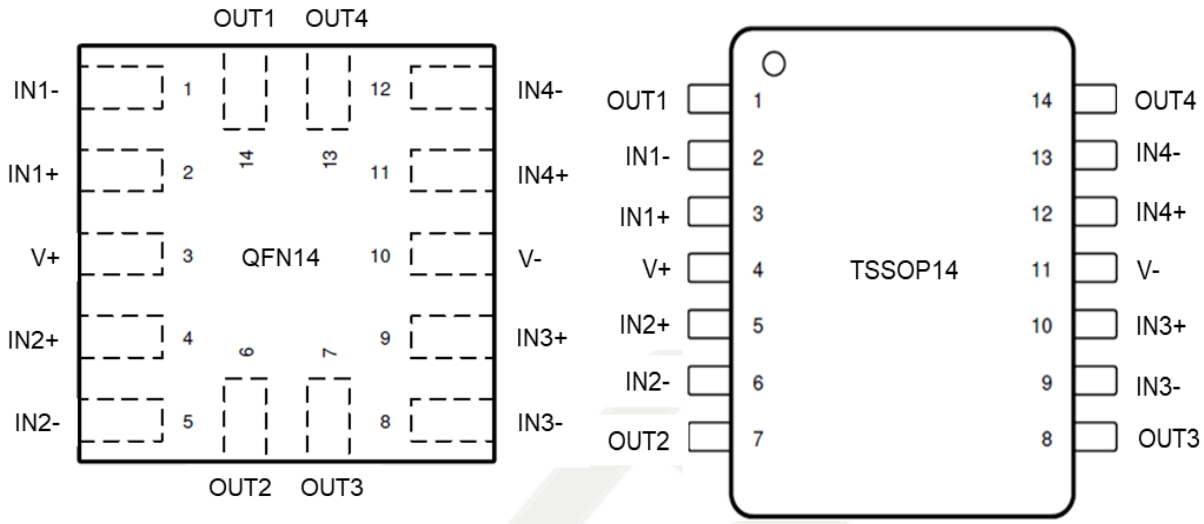


AXOP34062SA AXOP34062SB

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	SHDN1	Shutdown1: “low” = opamp 1 disabled
6	SHDN2	Shutdown2: “low” = opamp 2 disabled
7	IN2+	Non-inverting input 2
8	IN2-	Inverting input 2
9	OUT2	Output 2
10	V+	Positive supply

2.3 AXOP34064A/B Pinouts

Figure 5 AXOP34064A/B Pinouts

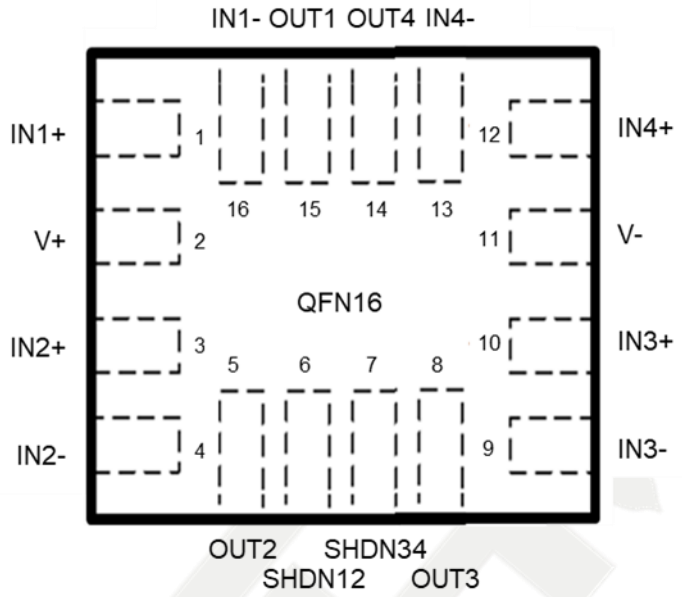


AXOP34064A AXOP34064B

	AXOP34064A			AXOP34064B	
Pin number	**DFN14 Pin name**	**DFN14 Description**		**TSSOP14 Pin name**	**TSSOP14 Description**
1	IN1-	Inverting input 1		OUT1	Output 1
2	IN1+	Non-inverting input 1		IN1-	Inverting input 1
3	V+	Positive supply		IN1+	Non-inverting input 1
4	IN2+	Non-inverting input 2		V+	Positive supply
5	IN2-	Inverting input 2		IN2+	Non-inverting input 2
6	OUT2	Output 2		IN2-	Inverting input 2
7	OUT3	Output 3		OUT2	Output 2
8	IN3-	Inverting input 3		OUT3	Output 3
9	IN3+	Non-inverting input 3		IN3-	Inverting input 3
10	V-	Negative supply or ground		IN3+	Non-inverting input 3
11	IN4+	Non-inverting input 4		V-	Negative supply or ground
12	IN4-	Inverting input 4		IN4+	Non-inverting input 4
13	OUT4	Output 4		IN4-	Inverting input 4
14	OUT1	Output 1		OUT4	Output 4

2.4 AXOP34064S Pinouts

Figure 6 AXOP34064S Pinouts



Pin number	Pin name	Description
1	IN1+	Non-inverting input 1
2	V+	Positive supply
3	IN2+	Non-inverting input 2
4	IN2-	Inverting input 2
5	OUT2	Output 2
6	SHDN12	Shutdown12: “low” = opamp 1&2 disabled
7	SHDN34	Shutdown34: “low” = opamp 3&4 disabled
8	OUT3	Output 3
9	IN3-	Inverting input 3
10	IN3+	Non-inverting input 3
11	V-	Negative supply or ground
12	IN4+	Non-inverting input 4
13	IN4-	Inverting input 4
14	OUT4	Output 4
15	OUT1	Output 1
16	IN1-	Inverting input 1

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 +45	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
DFN8	43	5	°C/W
TSSOP8	206	107	°C/W
DFN10	42	6	°C/W
MSOP10	165	10	°C/W
QFN14	47	4	°C/W
TSSOP14	136	64	°C/W
QFN16	45	5	°C/W

3.3 ESD and Latch Up

Table 4 ESD and Latch up

Symbol	Parameter	Value	Unit
All pins	ESD (HBM) ESD (CDM)	±6,000 ±500	V V
All pins	Latch Up JESD78, Class A	≥ 100	mA

3.4 Electrical Characteristics

For Vs = (V+) - (V-) = 40V at Ta = 25°C, RL = 10kΩ connected to Vs/2, 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-)		3		40	V
Ta	Operating ambient temperature		-40		125	°C
Power Supply						
Iq	Quiescent current per amplifier	Vs=40V, Io=0mA		600	750	μA
		all temp			900	
Offset Voltage						
Vos	Input offset voltage			±0.5	±2.0	mV
		all temp			±3.0	mV
dVos/dT	Drift	all temp		±0.5		μV/°C
PSRR	Power-supply rejection ratio	At DC		100		dB
Csep	Channel separation	At DC		120		dB
Input Voltage Range						
Vcm	Common mode voltage range	Vs=3V to 40V	(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=20Hz to 20kHz		1.5		μV
en	Input voltage noise density	f=10kHz		8		nV/√Hz
		f=1kHz		17		
Input Capacitance						
Cid	Differential			2		pF
Cic	Common mode			4		pF
Open Loop Gain						
Aol	Open loop voltage gain			120		dB
Frequency Response						
GBP	Gain bandwidth product	G=+1, CL=10pF		25		MHz
φ	Phase margin	G=+1, CL=10pF		60		°
Cload	Capacitive load	G=+1			1	nF
SR	Slew rate	G=+1, CL=100pF		8		V/μs

Ts	Settling time	To 0.1%, 2V step, G=+1, CL=100pF		0.4		μs
Tor	Overload recovery time	VIN x gain > Vs, CL=100pF		50		ns
THD+N	Total harmonic distortion + Noise (3rd order filter; BW= 80kHz at -3dB.)	Vs=40V, Vcm=20V, Vo=1Vrms, G=+1, f=1kHz		100		dB
SNR	Signal to Noise Ratio			110		dB
Output						
Vo	Voltage output swing from supply rails	RL=10kΩ		5	10	mV
		RL=2kΩ		15	30	
Isc	Short circuit current			±50		mA
Zo	Open loop output impedance	f=10MHz		100		Ω
Shutdown						
Iqsd	Quiescent current per amplifier	Vs=3V to 40V, all amplifiers disabled, SHDN = Low		0.5	1.5	μA
Vsdh	High level shutdown threshold	Vs=3V to 40V, amplifier enabled	Vs-0.5V			V
Vsdl	Low level shutdown threshold	Vs=3V to 40V, amplifier disabled			0.5	V
ton	Amplifier enable time	Vs=3V to 40V, full shutdown; G=+1, Vo = 0.9×Vs/2, RL connected to V-		10		μs
toff	Amplifier disable time	Vs=3V to 40V, G=+1, Vo=0.1×Vs/2, RL connected to V-		0.6		μs

Disable time (toff) and enable time (ton) are defined as the time interval between the 50% point of the signal applied to the SHDN pin and the point at which the output voltage reaches the 10% (disable) or 90% (enable) level.

3.4 Typical Characteristics

Figure 7 Signal to Noise Performance

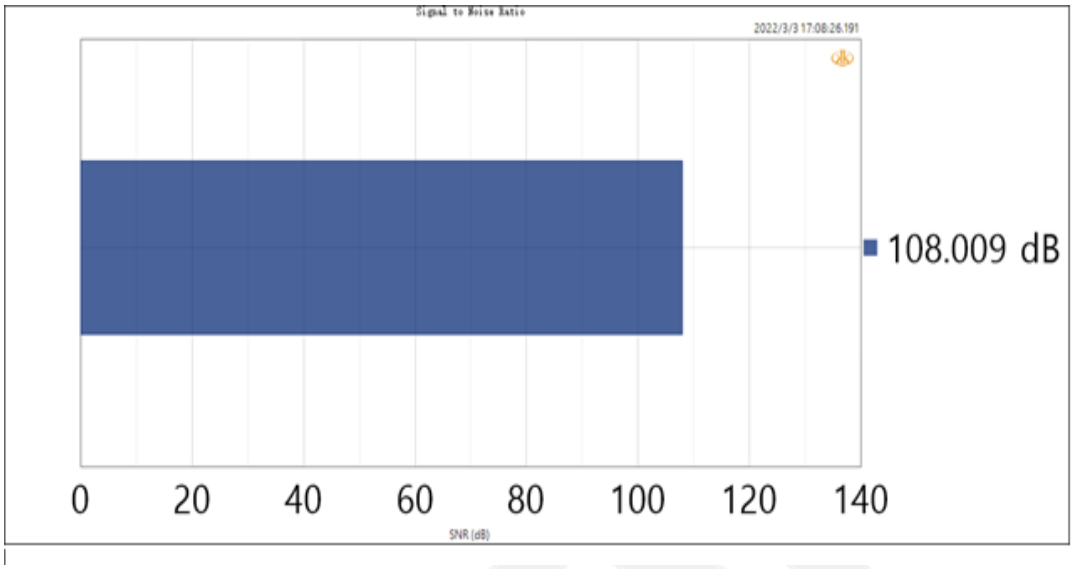
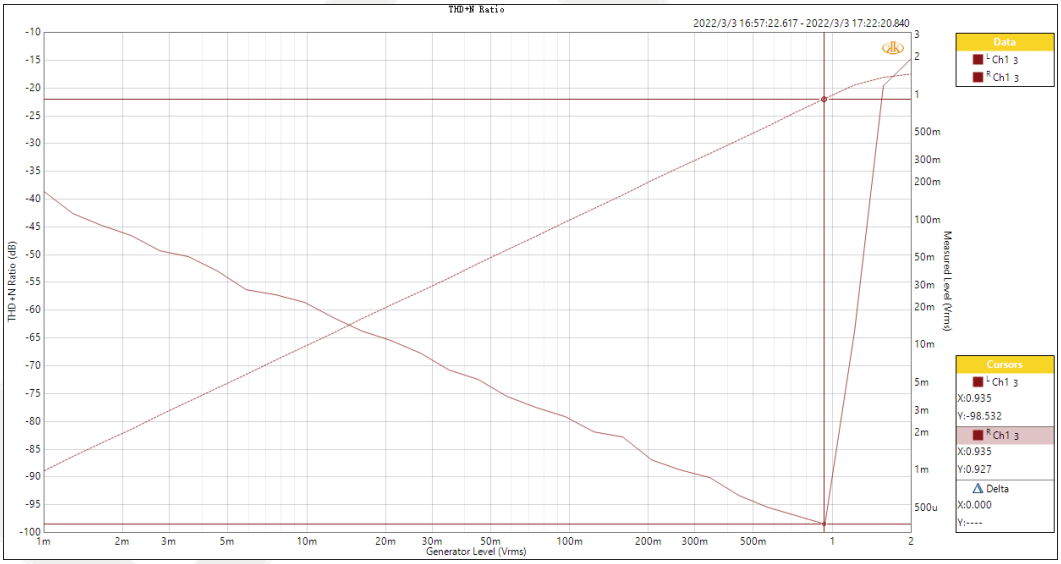


Figure 8 Total Harmonic Distortion + Noise Performance



4 Functional Description

4.1 Overview

The AXOP3406x devices are a family of high voltage, rail-to-rail input and output opamps. These devices operate from 3V to 40V, are unity gain stable, and are 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 AXOP3406x family extends 100mV beyond the supply rails for the full supply voltage range of 3V to 40V. 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 a low power, low voltage operational amplifier, the AXOP3406x series 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 10kΩ, the output swings to within 10mV (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 Overload Recovery

Overload recovery is defined as the time required for the opamp output to recover from a saturated state to a linear state. The output devices of the opamp enter a saturation region when the output voltage exceeds the rated operating voltage, because of the high input voltage or the high gain. After the device enters the saturation region, the charge carriers in the output devices require time to return to the linear state. After the charge carriers return to the linear state, the device begins to slew at the specified slew rate. The overload recovery time for the AXOP3406x family is approximately 300ns.

4.5 EMI Rejection

The AXOP3406x 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.

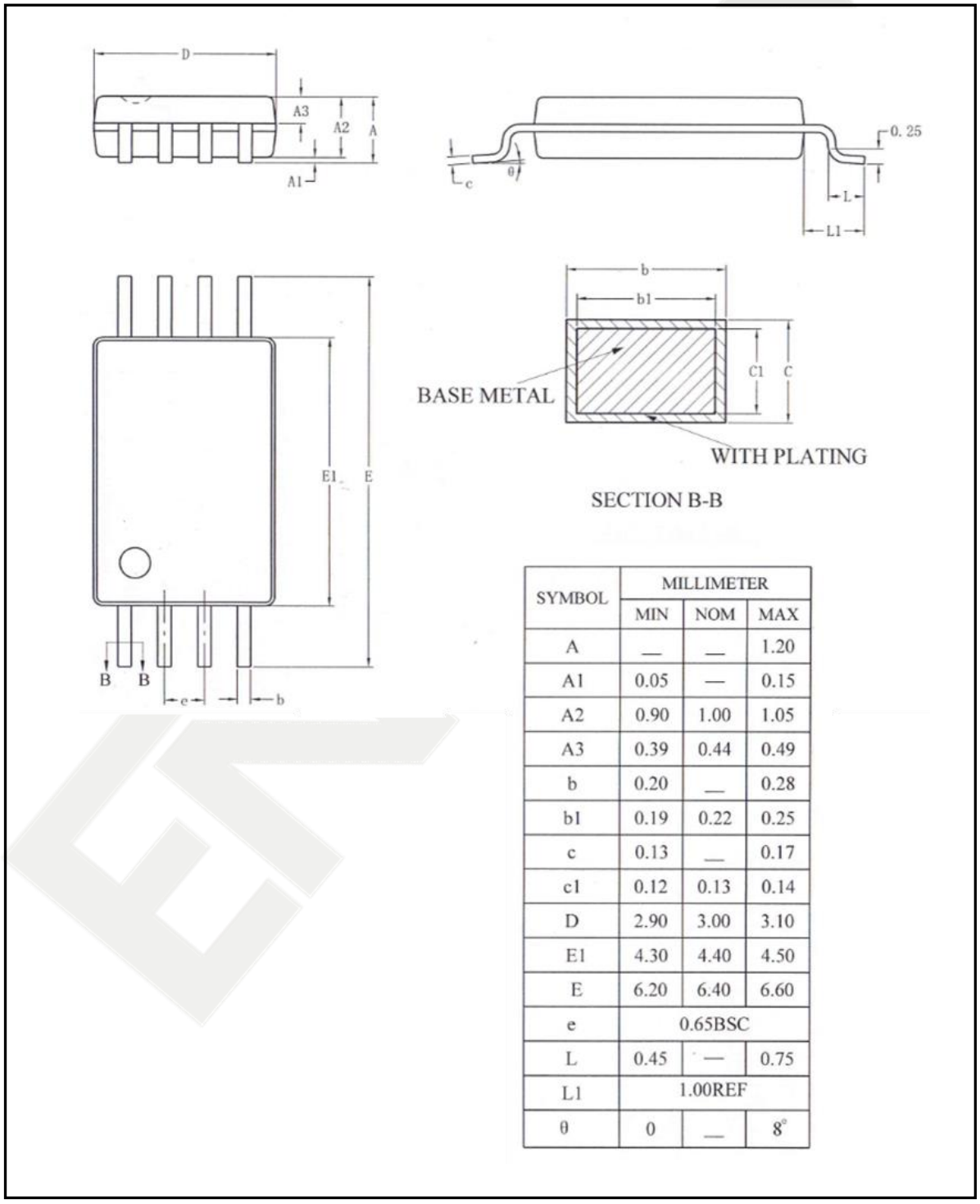
4.6 Shutdown

The AXOP3406xS has shutdown function. The amplifiers can be shut down by enabling the respective shutdown pin.

5 Package Information

5.1 Package Dimensions

Figure 9 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 10 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				

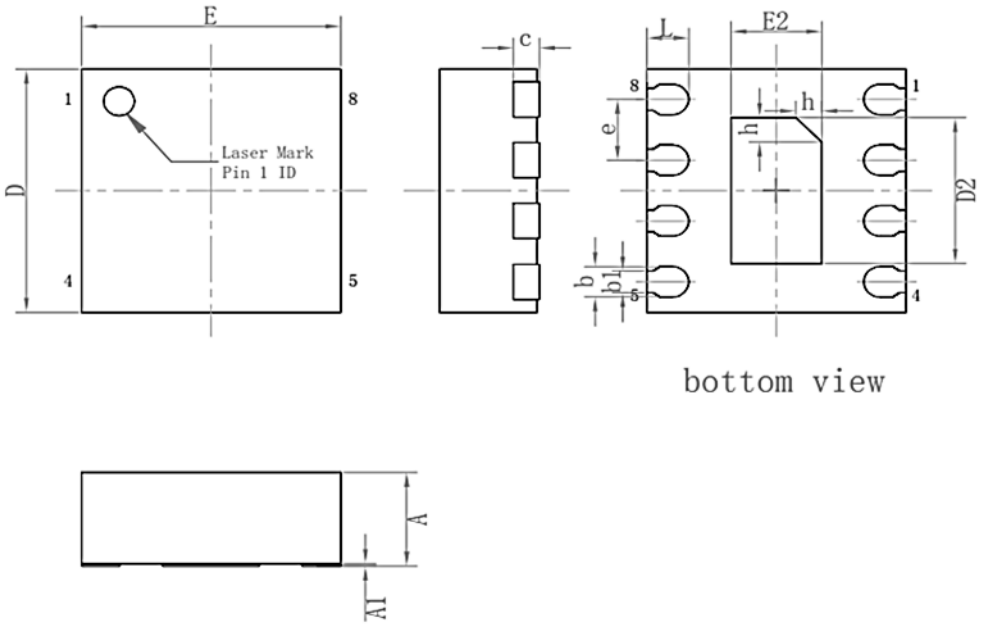
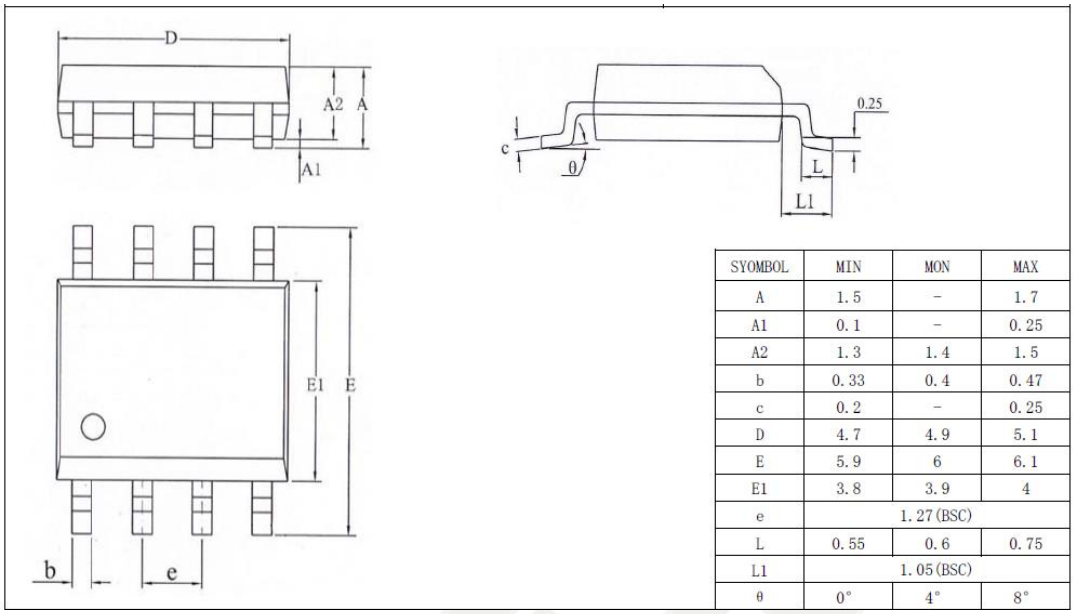
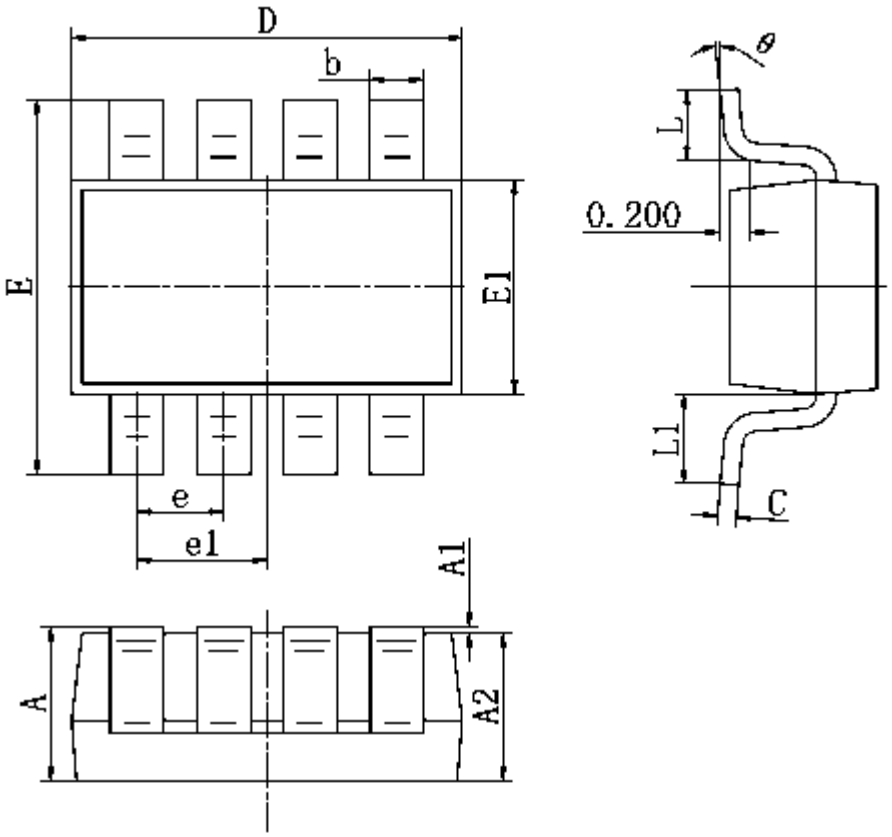


Figure 11 SOP8 Mechanical Data and Package Dimensions



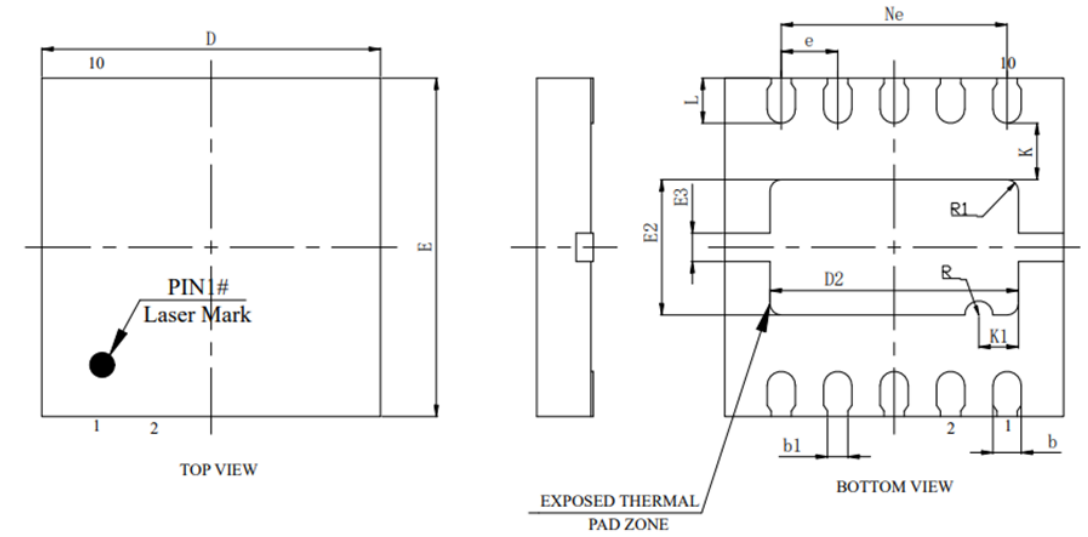
SYOMBOL	MIN	MON	MAX
A	1.5	-	1.7
A1	0.1	-	0.25
A2	1.3	1.4	1.5
b	0.33	0.4	0.47
c	0.2	-	0.25
D	4.7	4.9	5.1
E	5.9	6	6.1
E1	3.8	3.9	4
e	1.27(BSC)		
L	0.55	0.6	0.75
L1	1.05(BSC)		
θ	0°	4°	8°

Figure 12 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°

Figure 13 DFN10 Mechanical Data and Package Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.45	0.50	0.55
A1	0	0.02	0.05
b	0.20	0.25	0.30
b1	0.18REF		
c	0.150REF		
D	2.95	3.00	3.05
D2	2.10	2.20	2.30
e	0.50BSC		
Ne	2.00BSC		
E	2.95	3.00	3.05
E2	1.10	1.20	1.30
E3	0.20	0.25	0.30
L	0.30	0.40	0.50
R	0.125REF		
R1	0.100REF		
K	0.45	0.50	0.55
K1	0.35REF		

Figure 14 MSOP10 Mechanical Data and Package Dimensions

标注 \ 尺寸	最小(mm)	最大(mm)	标注 \ 尺寸	最小(mm)	最大(mm)
A	2.90	3.10	C3	0.152	
A1	0.18	0.25	C4	0.15	0.23
A2	0.50TYP		H	0.00	0.09
A3	0.40TYP		θ	15° TYP4	
B	2.90	3.10	θ1	12° TYP4	
B1	4.70	5.10	θ2	14° TYP	
B2	0.45	0.75	θ3	0° ～ 6°	
C	0.75	0.95	R	0.15TYP	
C1	--	1.10	R1	0.15TYP	
C2	0.328TYP				
* 注EMSOP10产品共用此图所有数据，Die pad exposure大小是根据引线框架设计。					

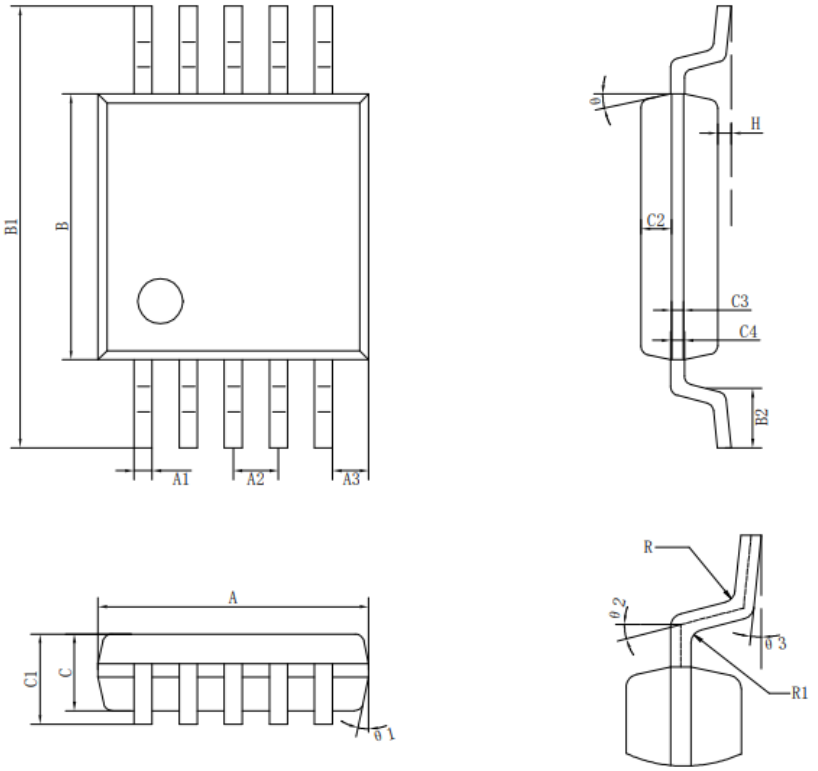
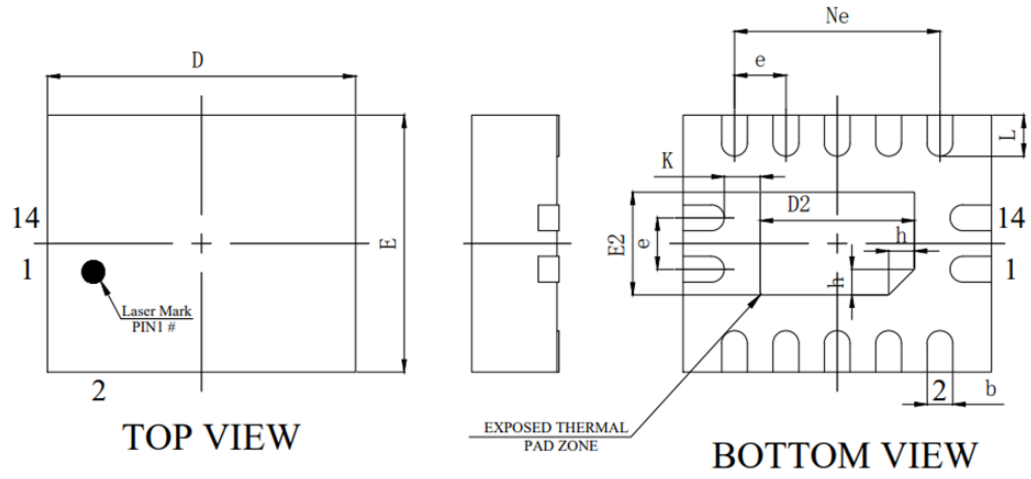
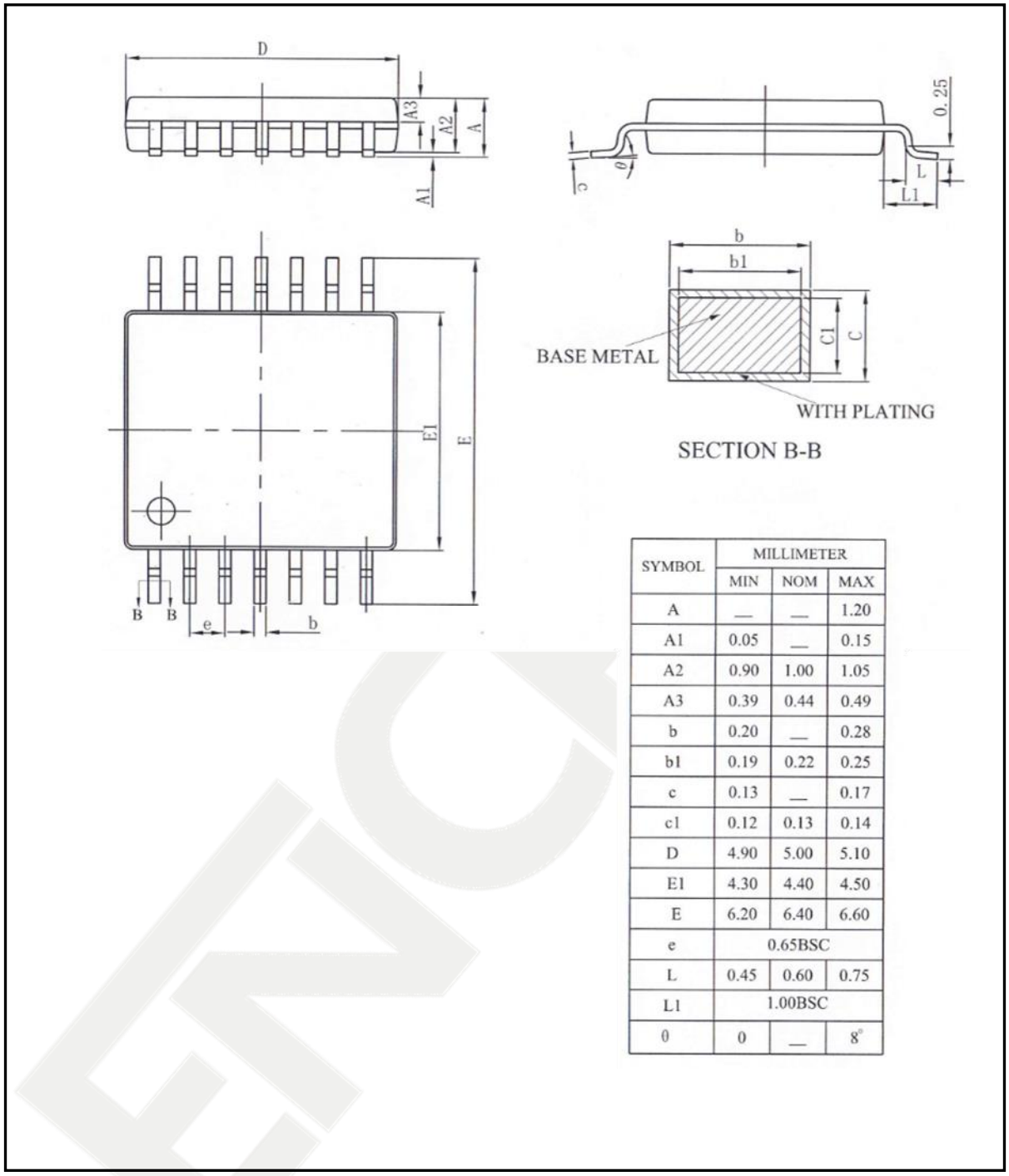


Figure 15 QFN14 Mechanical Data and Package Dimensions



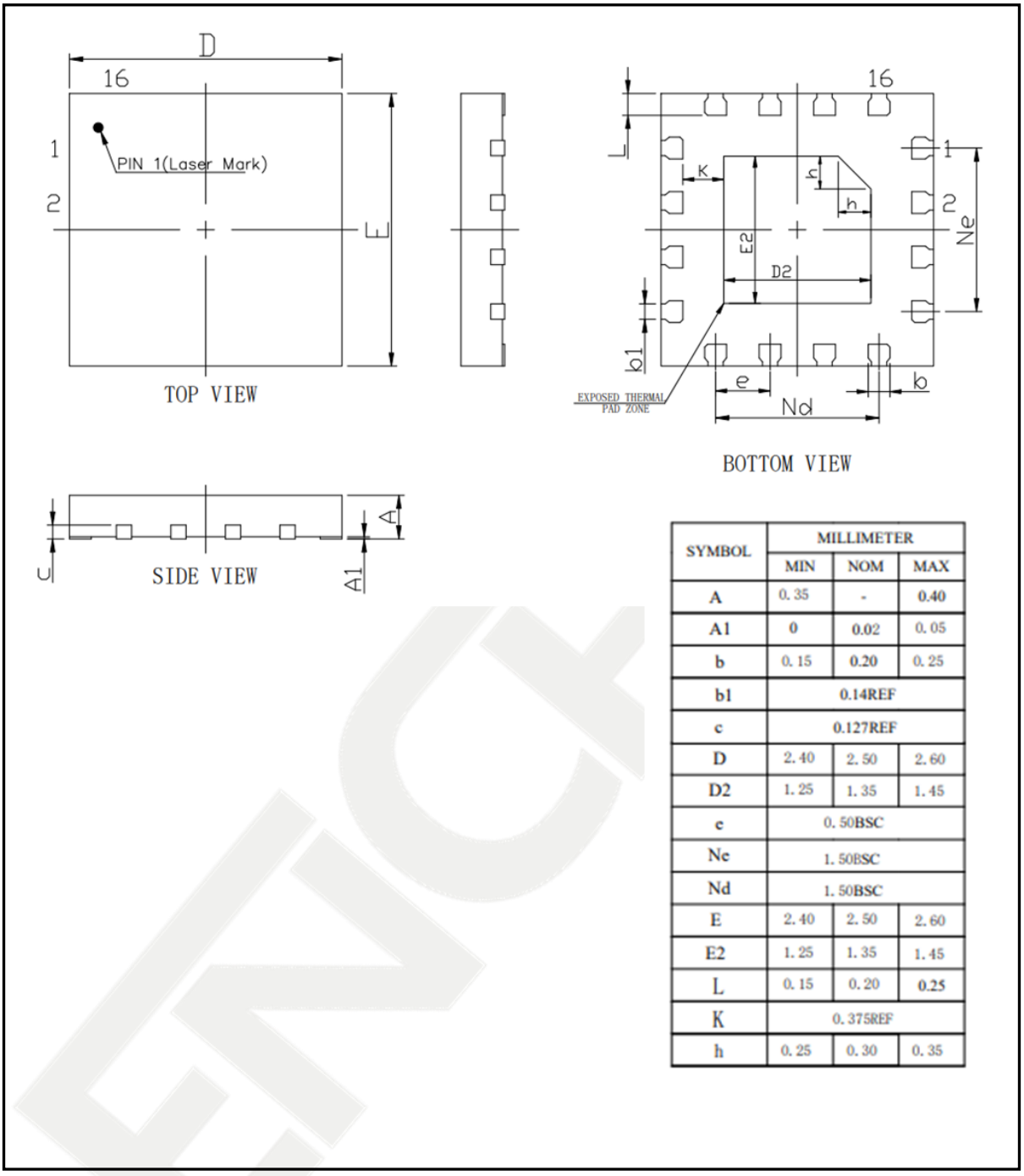
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0	0.02	0.05
b	0.20	0.25	0.30
c	0.20REF		
D	2.90	3.00	3.10
D2	1.40	1.50	1.60
e	0.50BSC		
Ne	2.00BSC		
E	2.40	2.50	2.60
E2	0.90	1.00	1.10
L	0.35	0.40	0.45
h	0.25REF		
K	0.20	–	–

Figure 16 TSSOP14 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	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°

Figure 17 QFN16 Mechanical Data and Package Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.35	-	0.40
A1	0	0.02	0.05
b	0.15	0.20	0.25
b1	0.14REF		
c	0.127REF		
D	2.40	2.50	2.60
D2	1.25	1.35	1.45
e	0.50BSC		
Ne	1.50BSC		
Nd	1.50BSC		
E	2.40	2.50	2.60
E2	1.25	1.35	1.45
L	0.15	0.20	0.25
K	0.375REF		
h	0.25	0.30	0.35

5.2 Marking Information

Figure 18 TSSOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34062A” characters to indicate AXOP34062A

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“C” to indicate the location of assembly

Figure 19 DFN8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “62B” characters to indicate AXOP34062B

Line 2: “y” to indicate year of production

“ww” to indicate week of production

Figure 20 SOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34062C” characters to indicate AXOP34062C

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“F” to indicate the location of assembly

Figure 21 SOT23-8L Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34062D” characters to indicate AXOP34062D

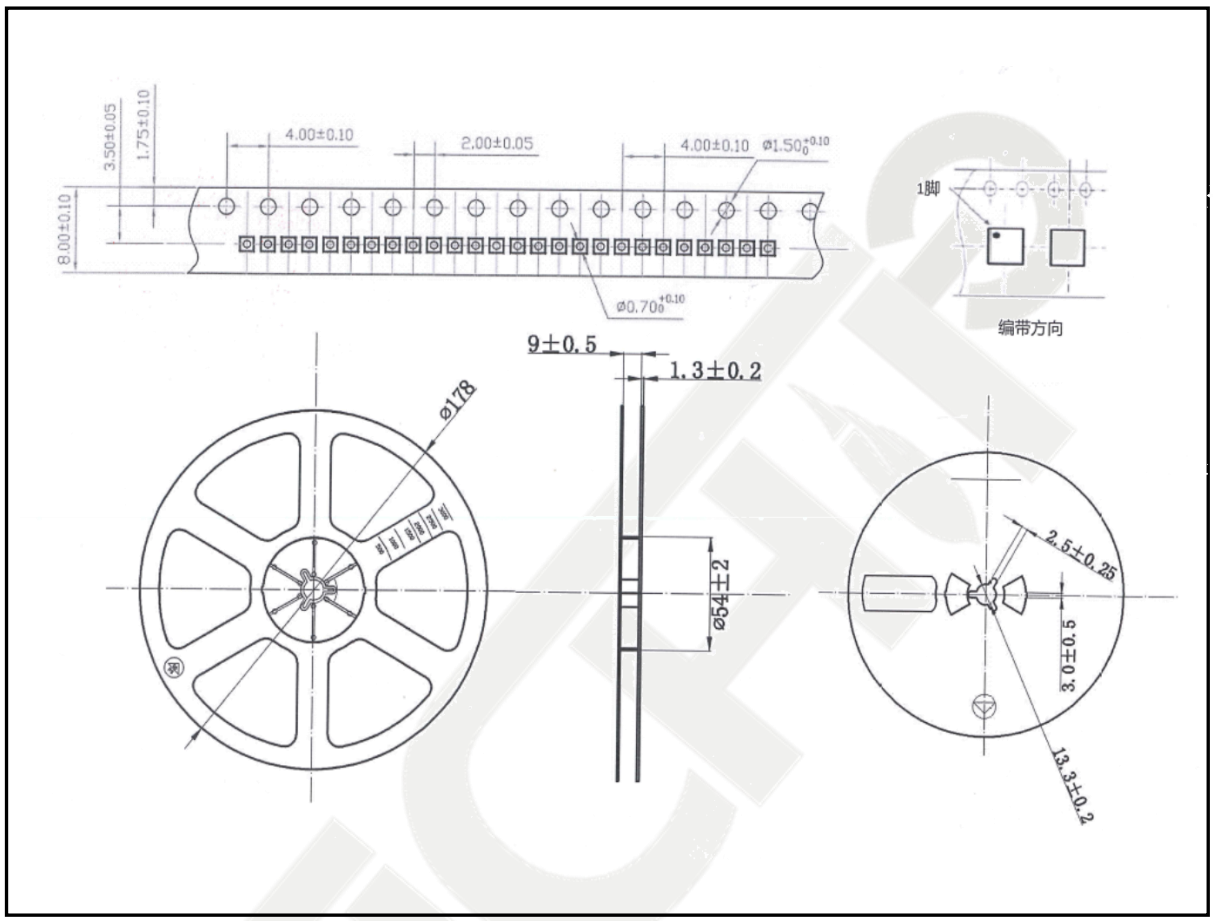
Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“D” to indicate the location of assembly

6 Packing Information

Figure 22 Reel Packing Information



7 Revision History

Table 6 Document Revision History

Date	Version	Description
Apr 2022	1.00	V1.00 version.