AXOP34032/4/S

40V 40μA RRIO Operational Amplifiers (Dual/Quad)

Datasheet – Nov 2022

Description

The AXOP34032 (dual), and AXOP34034 (quad) are dual and quad high voltage (2.5V 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. AXOP34032S and AXOP34034S are with Shutdown function.

Features

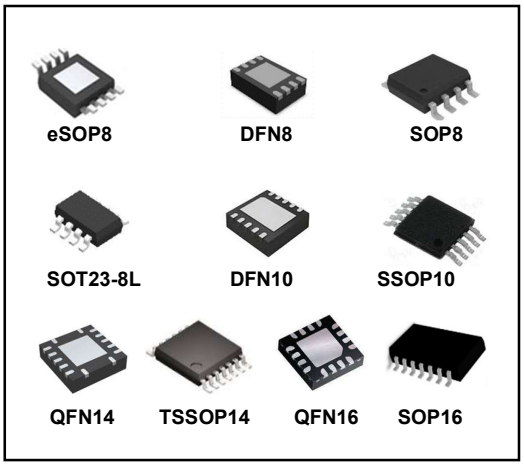
- Supply voltages from 2.5V to 40V
- Excellent THD+N 100dB
- Excellent SNR 100dB
- Rail-to-rail input and output
- Low input offset voltage: ±1mV typ
- Unity-gain bandwidth: 1.2MHz
- Low quiescent current (per opamp): 40μA typ @40V
- Easier to stabilize with higher capacitive load due to resistive open-loop output impedance
- Shutdown function (AXOP34032S and AXOP34034S)

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
AXOP34032A	eSOP8	Reel
AXOP34032B	DFN8	Reel
AXOP34032C	SOP8	Reel
AXOP34032D	SOT23-8L	Reel
AXOP34032SA	DFN10	Reel
AXOP34032SB	SSOP10	Reel
AXOP34034A	QFN14	Reel
AXOP34034B	TSSOP14	Reel
AXOP34034SA	QFN16	Reel
AXOP34034SB	SOP16	Reel



Contents

List of Figures

List of Tables

1 Block Diagram and Application Circuit

Figure 1 Block Diagram

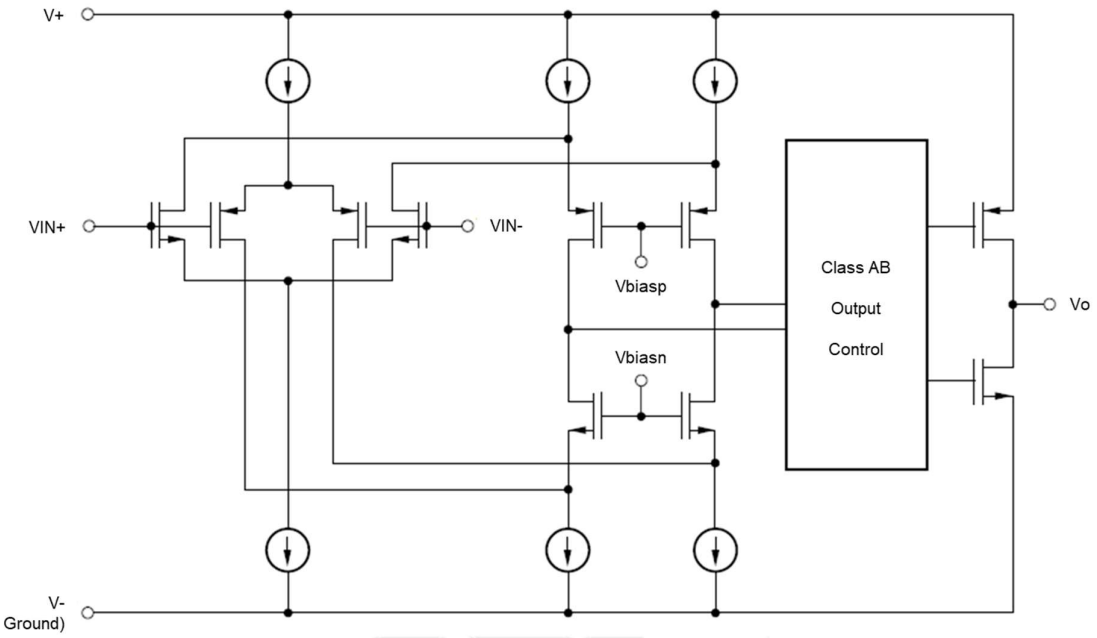
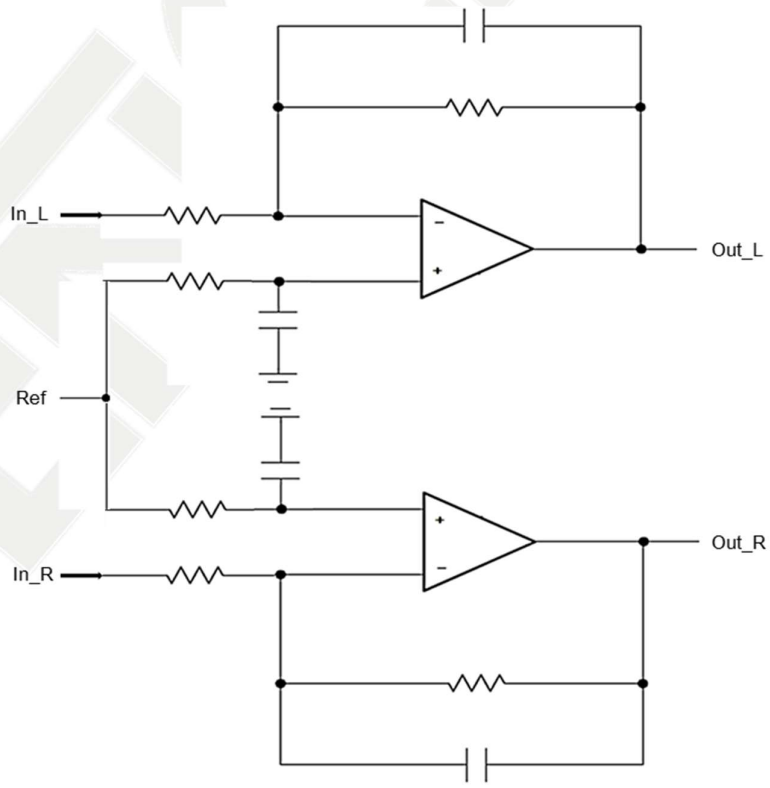


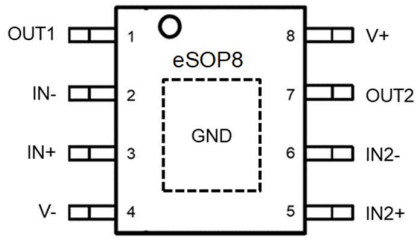
Figure 2 Typical Application Circuit (Stereo Sound Input Amplifier)



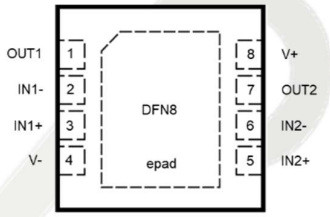
2 Pin Description

2.1 AXOP34032A/B/C/D Pinouts

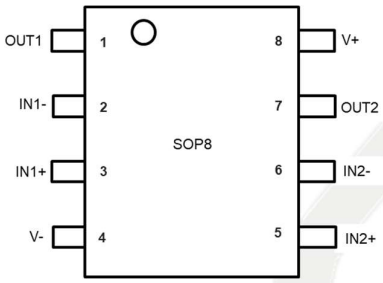
Figure 3 AXOP34032A/B/C/D Pinouts



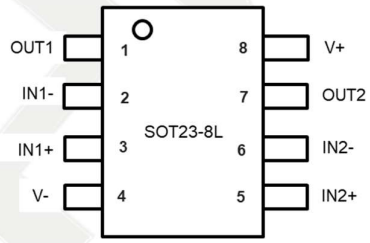
AXOP34032A



AXOP34032B



AXOP34032C

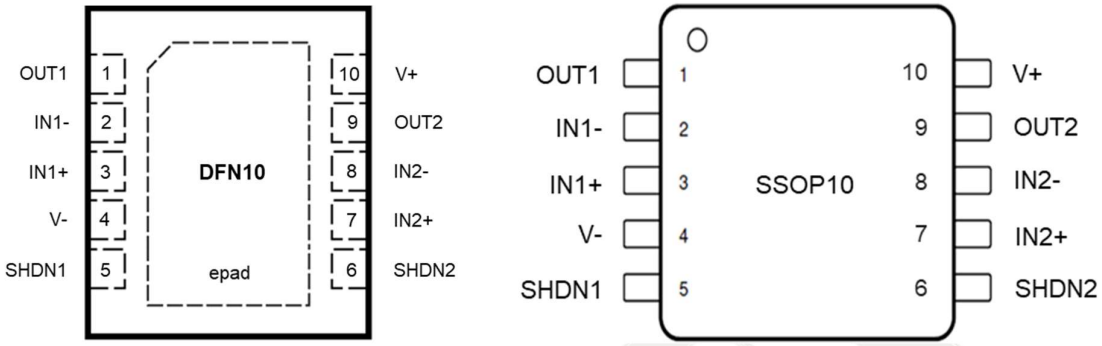


AXOP34032D

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 AXOP34032SA/B Pinouts

Figure 4 AXOP34032SA/B Pinouts

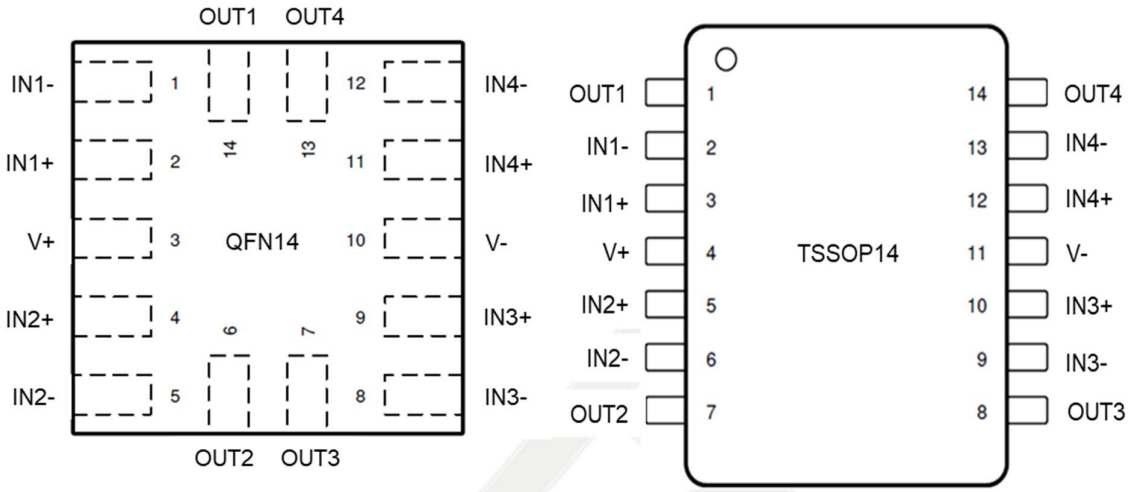


AXOP34032SA AXOP34032SB

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

2.3 AXOP34034A/B Pinouts

Figure 5 AXOP34034A/B Pinouts

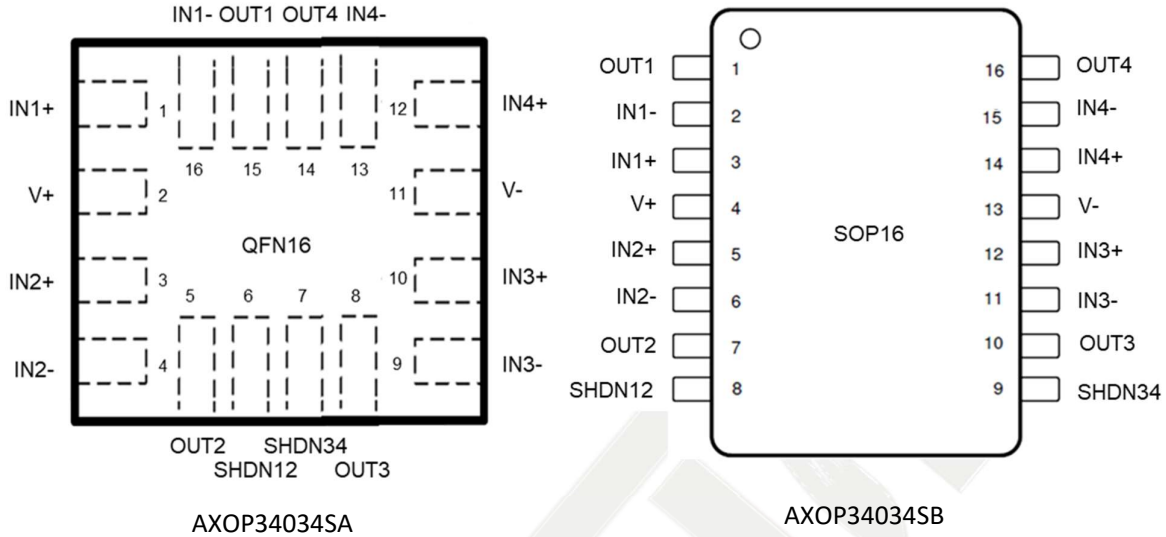


AXOP34034A AXOP34034B

	AXOP34034A			AXOP34034B	
Pin number	**QFN14 Pin name**	**QFN14 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 AXOP34034SA/B Pinouts

Figure 6 AXOP34034SA/B Pinouts



AXOP34034SA AXOP34034SB

	AXOP34034SA			AXOP34034SB	
Pin number	**QFN16 Pin name**	**QFN16 Description**		**SOP16 Pin name**	**SOP16 Description**
1	IN1+	Non-inverting input 1		OUT1	Output 1
2	V+	Positive supply		IN1-	Inverting input 1
3	IN2+	Non-inverting input 2		IN1+	Non-inverting input 1
4	IN2-	Inverting input 2		V+	Positive supply
5	OUT2	Output 2		IN2+	Non-inverting input 2
6	SHDN12	Shutdown12: “High” = opamp 1&2 disabled		IN2-	Inverting input 2
7	SHDN34	Shutdown34: “High” = opamp 3&4 disabled		SHDN12	Shutdown12: “High” = opamp 1&2 disabled
8	OUT3	Output 3		SHDN34	Shutdown34: “High” = opamp 3&4 disabled
9	IN3-	Inverting input 3		IN3-	Inverting input 3
10	IN3+	Non-inverting input 3		OUT3	Output 3
11	V-	Negative supply or ground		IN3-	Inverting input 3
12	IN4+	Non-inverting input 4		IN3+	Non-inverting input 3
13	IN4-	Inverting input 4		V-	Negative supply or ground
14	OUT4	Output 4		IN4+	Non-inverting input 4
15	OUT1	Output 1		IN4-	Inverting input 4
16	IN1-	Inverting input 1		OUT4	Output 4

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
eSOP8	60	10	°C/W
DFN8	43	5	°C/W
SOP8	136	77	°C/W
SOT23-8L	184	100	°C/W
DFN10	42	6	°C/W
SSOP10	160	45	°C/W
QFN14	47	4	°C/W
TSSOP14	113	62	°C/W
QFN16	45	5	°C/W
SOP16	80	30	°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-) = 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-)		2.5		40	V
		AXOP34032A only	3		40	V
Ta	Operating ambient temperature		-40		125	°C
Power Supply						
Iq	Quiescent current per amplifier	Vs=40V, Io=0mA		40	60	μA
		all temp			80	
Offset Voltage						
Vos	Input offset voltage			±1	±3	mV
		all temp			±5	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		6		μV
en	Input voltage noise density	f=10kHz		30		$nV/\sqrt{Hz}$
		f=1kHz		45		
Input Capacitance						
Cid	Differential			2		pF
Cic	Common mode			4		pF
Open Loop Gain						
Aol	Open loop voltage gain			130		dB
Frequency Response						
GBP	Gain bandwidth product	G=+1, CL=10pF		1.2		MHz
φ	Phase margin	G=+1, CL=10pF		60		°
SR	Slew rate	G=+1, CL=100pF		0.7		V/μs

Ts	Settling time	To 0.1%, 2V step, G=+1, CL=100pF		4		μs
Tor	Overload recovery time	VIN x gain > Vs, CL=100pF		200		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			100		dB
Output						
Vo	Voltage output swing from supply rails	RL=10kΩ		5	10	mV
		RL=2kΩ		15	30	
Io,max	Maximum output current drive			±15		mA
		AXOP34032A only eSOP8 package		±100		mA
Zo	Open loop output impedance	f=10MHz		100		Ω
Shutdown (AXOP34032S and AXOP34034S only)						
Iqsd	Quiescent current per amplifier	Vs=3V to 40V, amplifier disabled, SHDN = “High”		80	120	μA
Vsd	Shutdown threshold	V Vs=3V to 40V, amplifier disabled, SHDN = “High”	4			V
Vsdl	Low level shutdown threshold	Vs=3V to 40V, amplifier enabled, SHDN = “Float” or SHDN = “Low”			1	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-		1		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.

3.5 Typical Electrical Characteristics

Figure 7 Vos Distribution

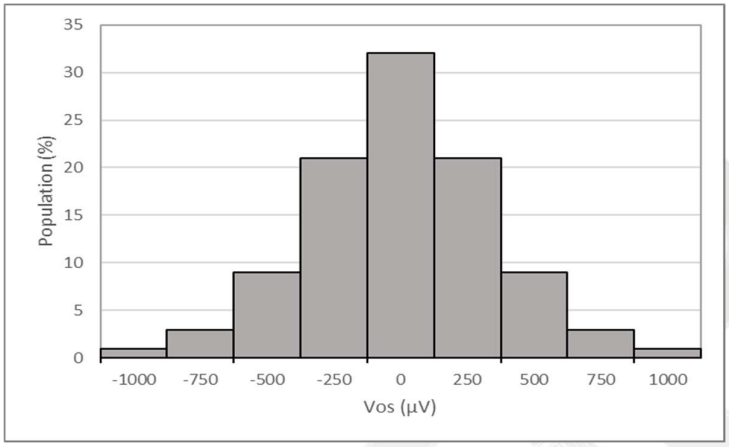


Figure 8 Vos vs Input Common Mode Voltage

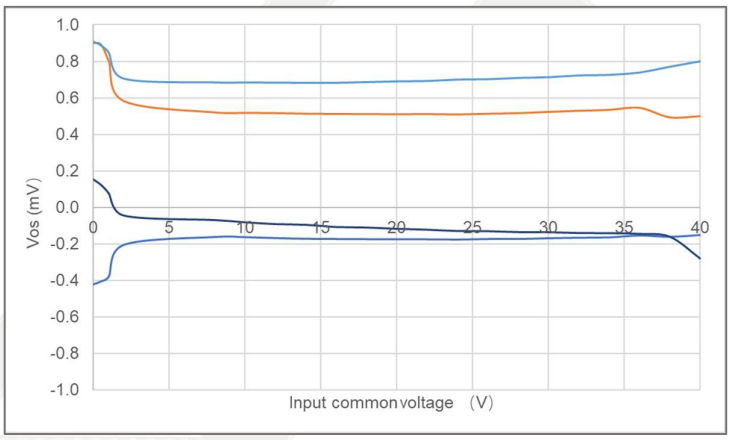


Figure 9 Vos vs Vs

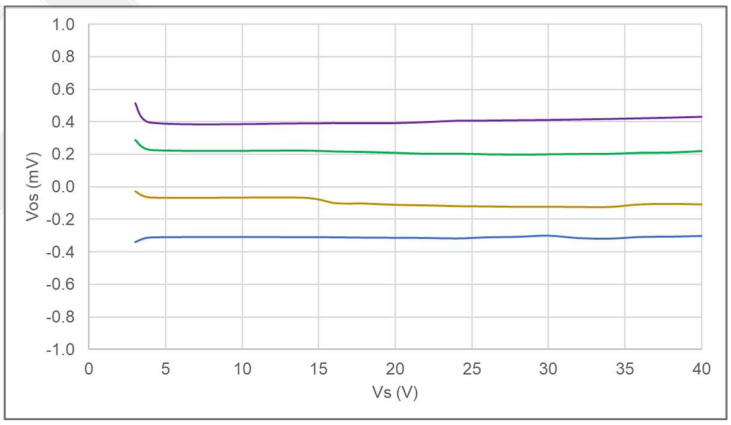


Figure 10 Iq (per opamp) vs Vs

4 Functional Description

4.1 Overview

The AXOP3403x devices are a family of high voltage, rail-to-rail input and output opamps. These devices operate from 2.5V 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 AXOP3403x family extends 100mV beyond the supply rails for the full supply voltage range of 2.5V 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 high voltage operational amplifier, the AXOP3403x 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 AXOP3403x family is approximately 200ns.

4.5 EMI Rejection

The AXOP3403x 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 AXOP3403xS has shutdown function. The amplifiers can be shut down by enabling the respective shutdown pin.

5 Package Information

5.1 Package Dimensions

Figure 11 eSOP8 Mechanical Data and Package Dimensions

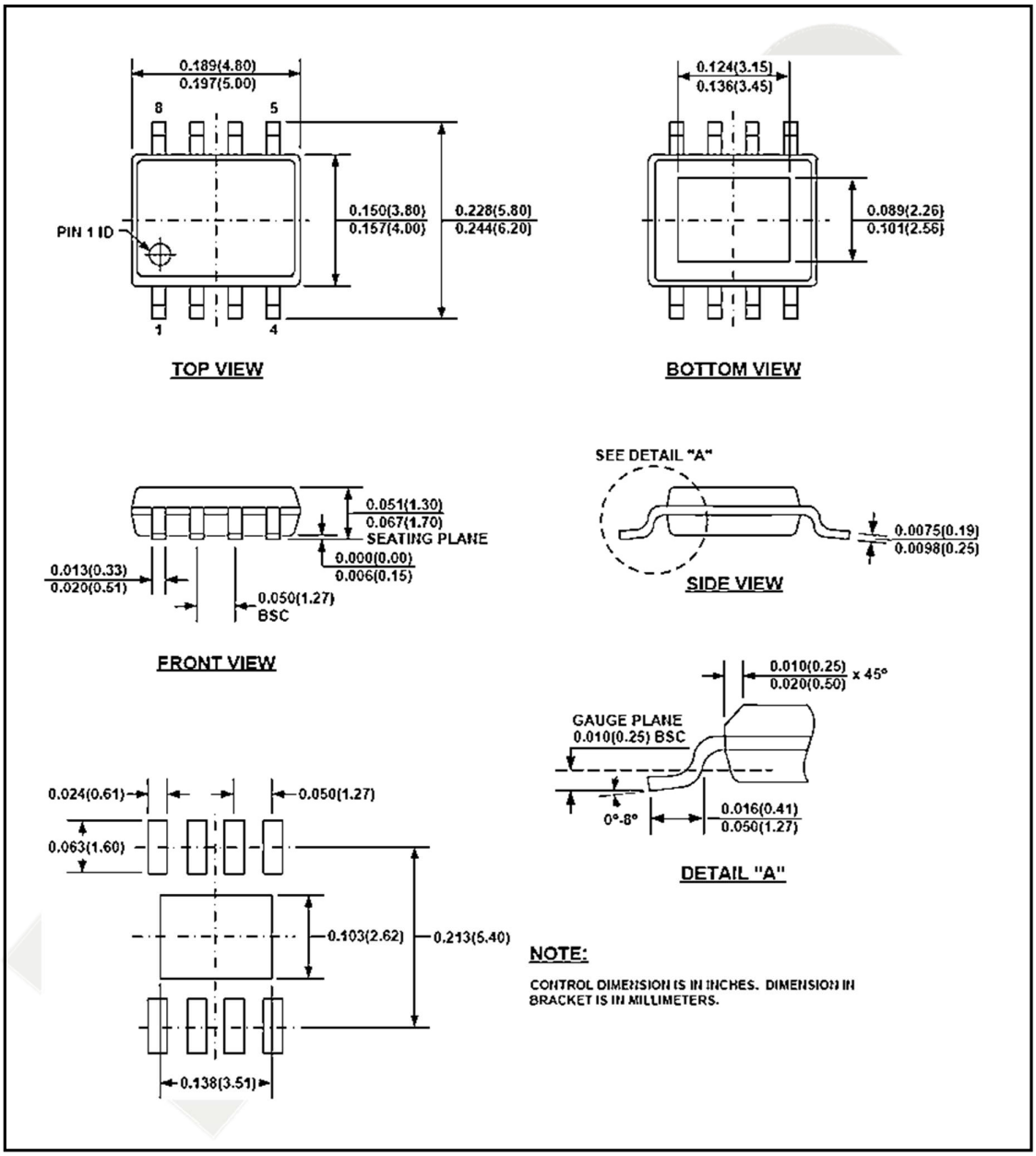


Figure 12 DFN8 Mechanical Data and Package Dimensions

	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				

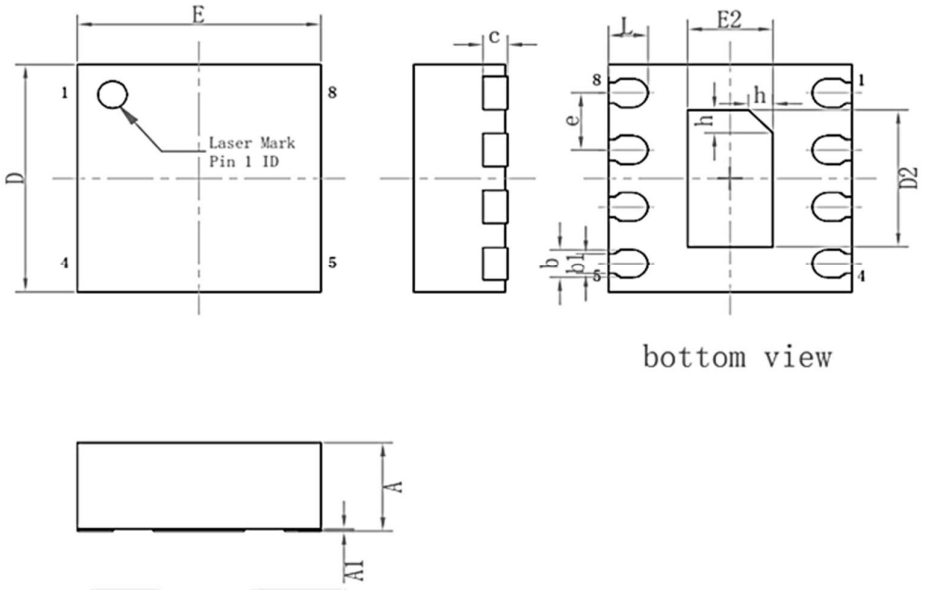
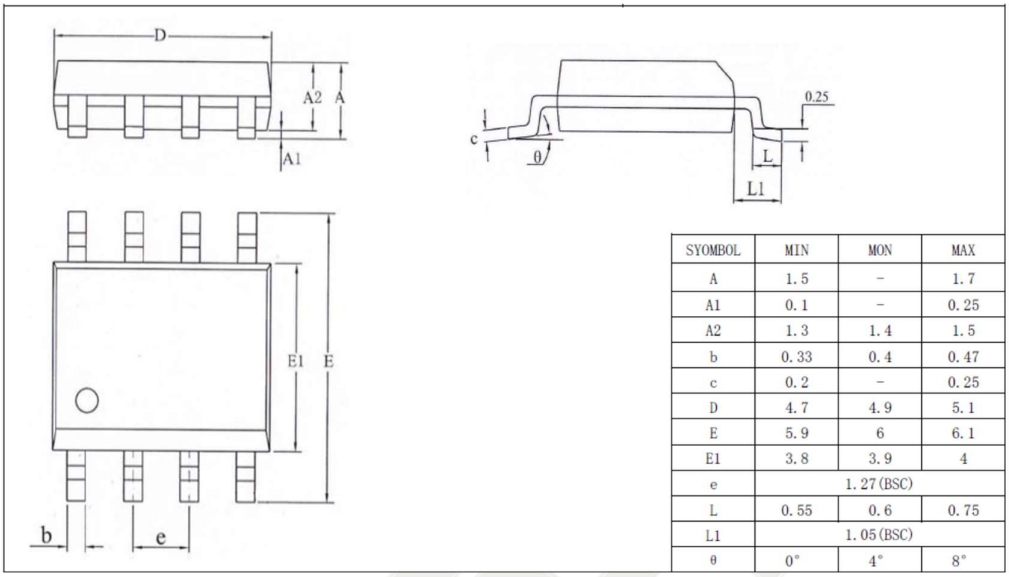
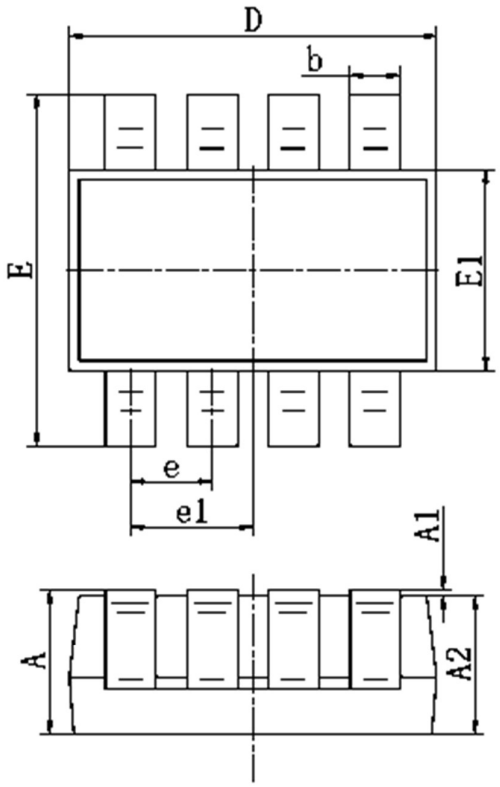


Figure 13 SOP8 Mechanical Data and Package Dimensions



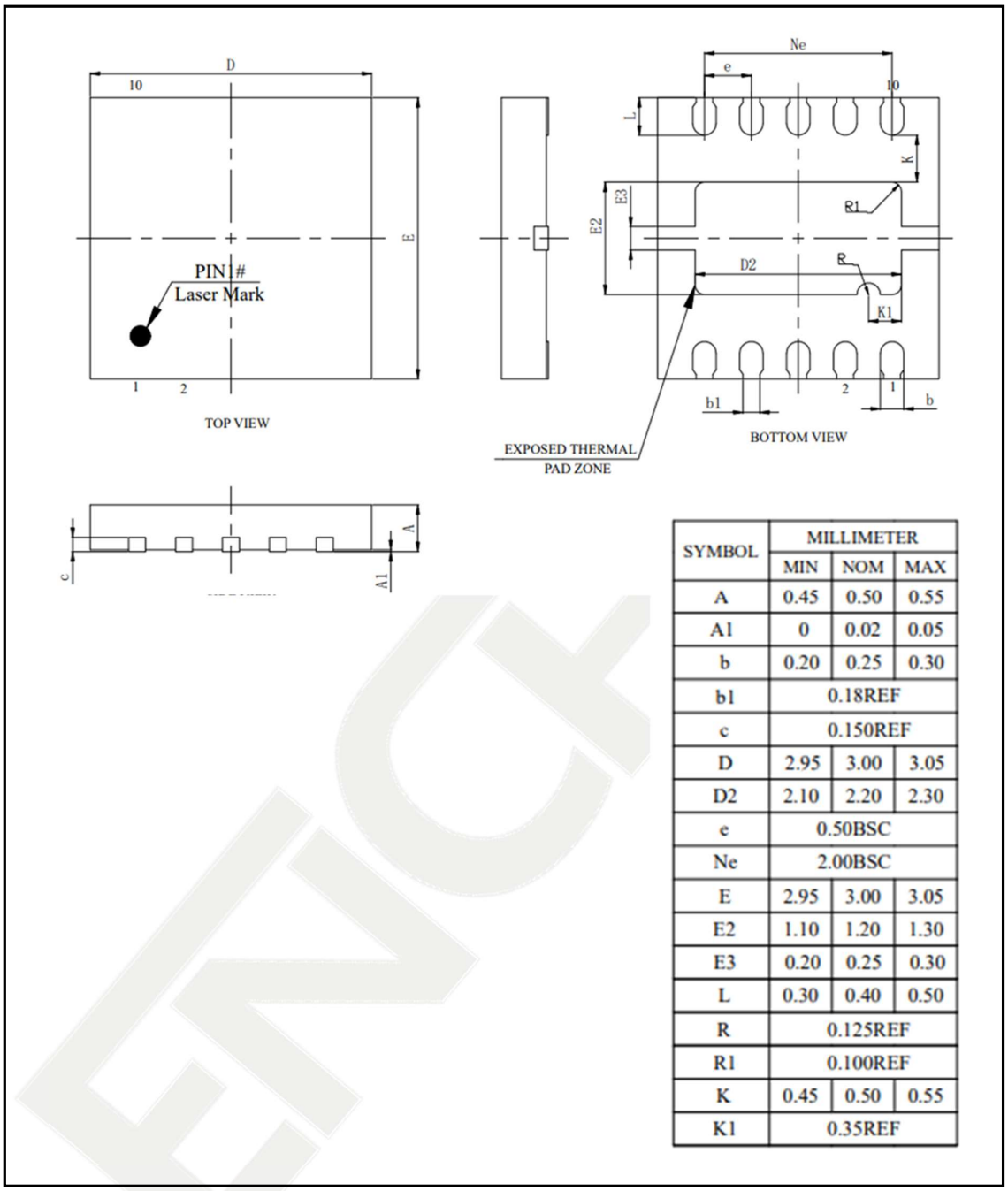
SYOMBOL	MIN	MON	MAX
A	1.5	-	1.7
A1	0.1	-	0.25
A2	1.3	1.4	1.5
b	0.33	0.4	0.47
c	0.2	-	0.25
D	4.7	4.9	5.1
E	5.9	6	6.1
E1	3.8	3.9	4
e	1.27(BSC)		
L	0.55	0.6	0.75
L1	1.05(BSC)		
θ	0°	4°	8°

Figure 14 SOT23-8L Mechanical Data and Package Dimensions



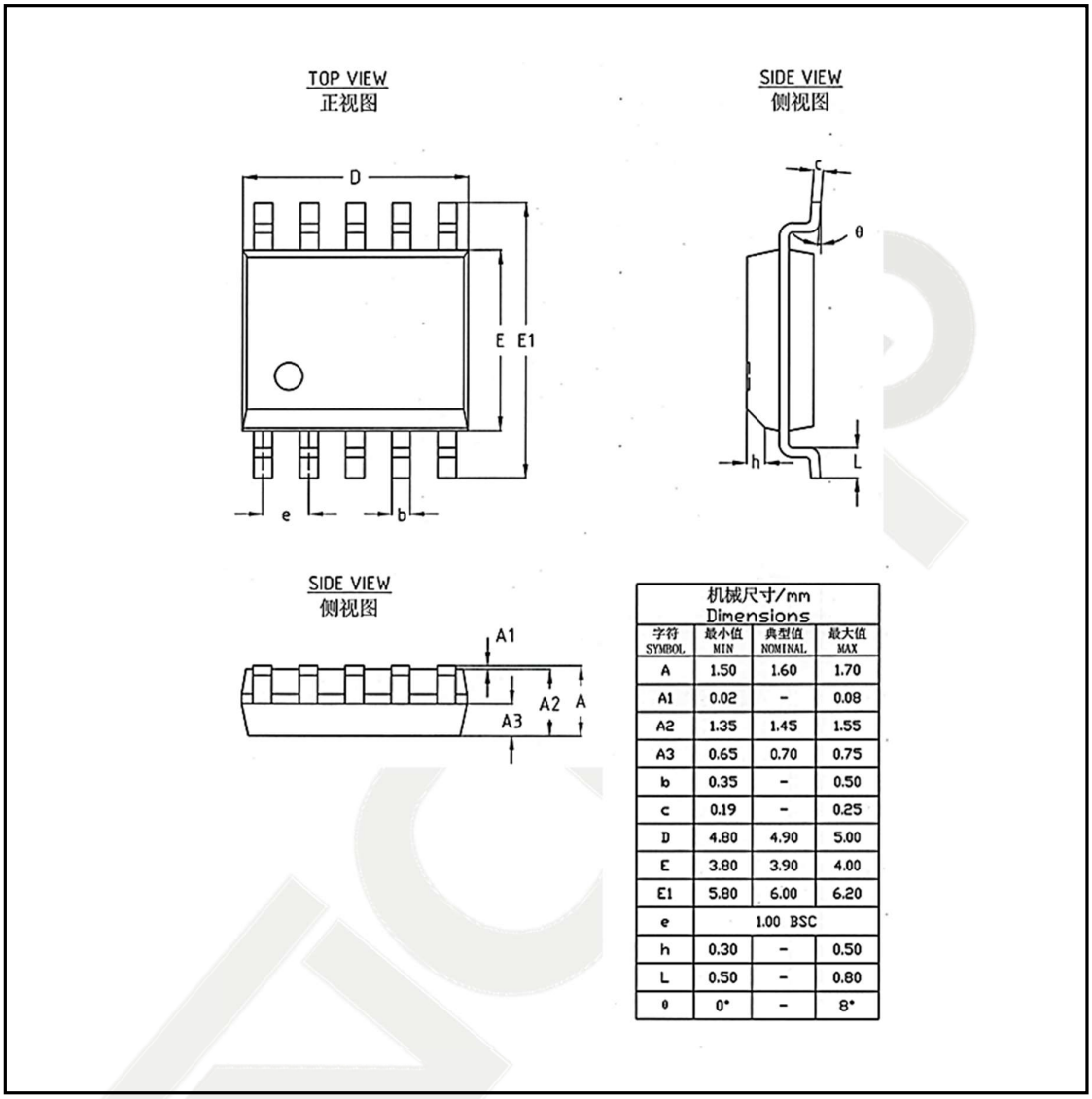
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E1	1.500	1.700	0.059	0.067
E	2.650	2.950	0.104	0.116
e	0.650BSC.		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 15 DFN10 Mechanical Data and Package Dimensions



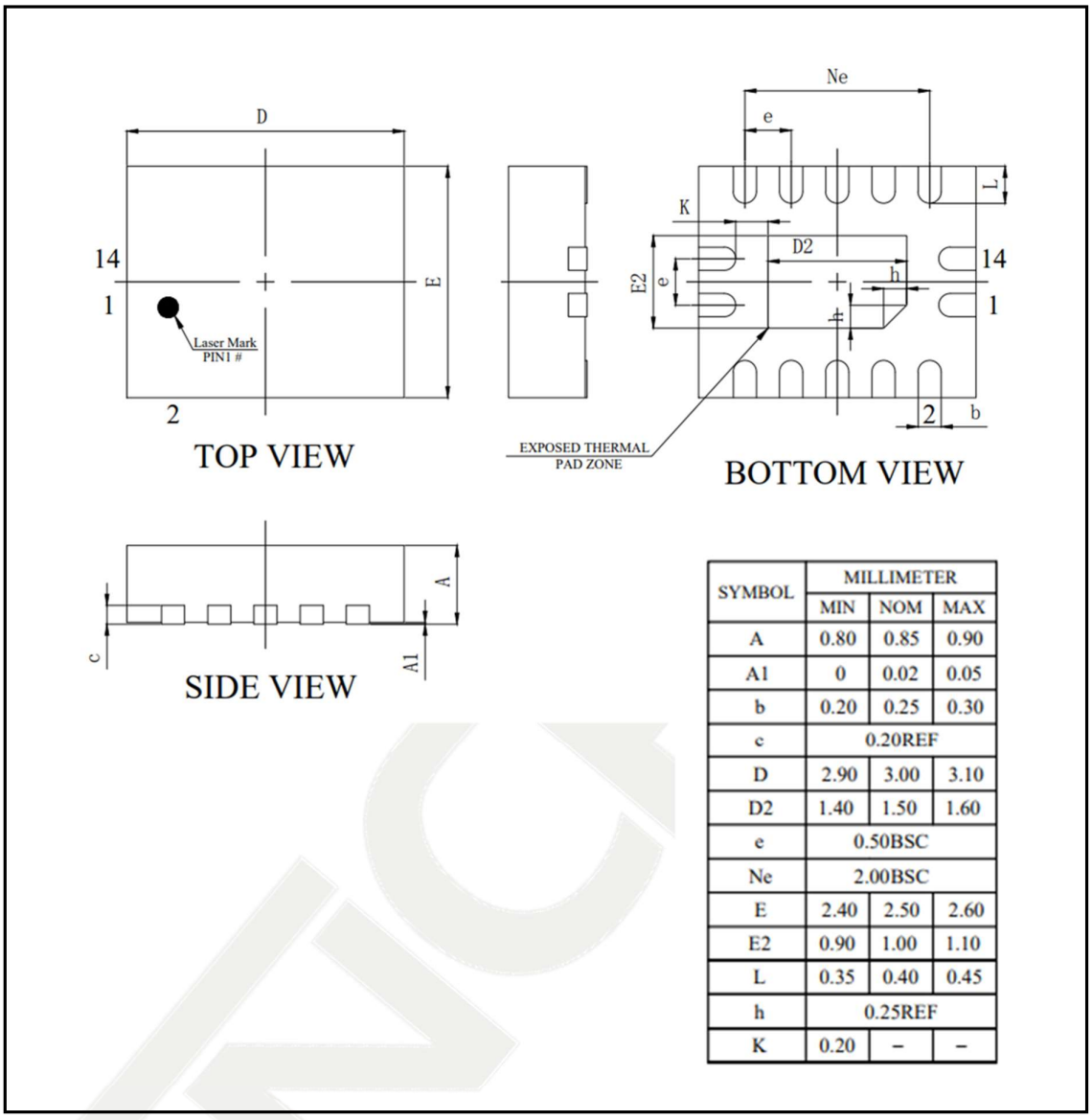
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.45	0.50	0.55
A1	0	0.02	0.05
b	0.20	0.25	0.30
b1	0.18REF		
c	0.150REF		
D	2.95	3.00	3.05
D2	2.10	2.20	2.30
e	0.50BSC		
Ne	2.00BSC		
E	2.95	3.00	3.05
E2	1.10	1.20	1.30
E3	0.20	0.25	0.30
L	0.30	0.40	0.50
R	0.125REF		
R1	0.100REF		
K	0.45	0.50	0.55
K1	0.35REF		

Figure 16 SSOP10 Mechanical Data and Package Dimensions



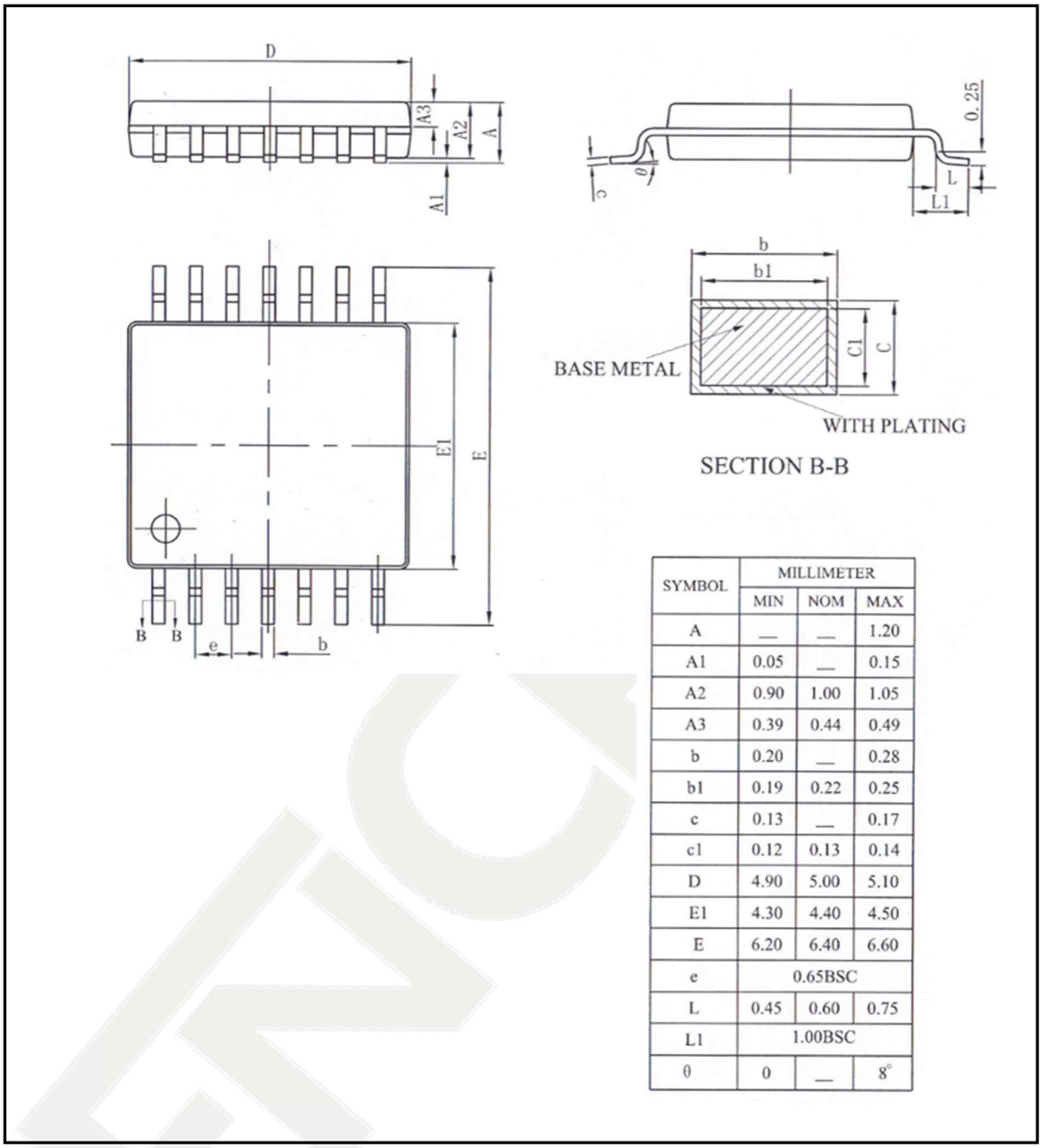
机械尺寸/mm Dimensions			
字符 SYMBOL	最小值 MIN	典型值 NOMINAL	最大值 MAX
A	1.50	1.60	1.70
A1	0.02	-	0.08
A2	1.35	1.45	1.55
A3	0.65	0.70	0.75
b	0.35	-	0.50
c	0.19	-	0.25
D	4.80	4.90	5.00
E	3.80	3.90	4.00
E1	5.80	6.00	6.20
e	1.00 BSC		
h	0.30	-	0.50
L	0.50	-	0.80
θ	0°	-	8°

Figure 17 QFN14 Mechanical Data and Package Dimensions



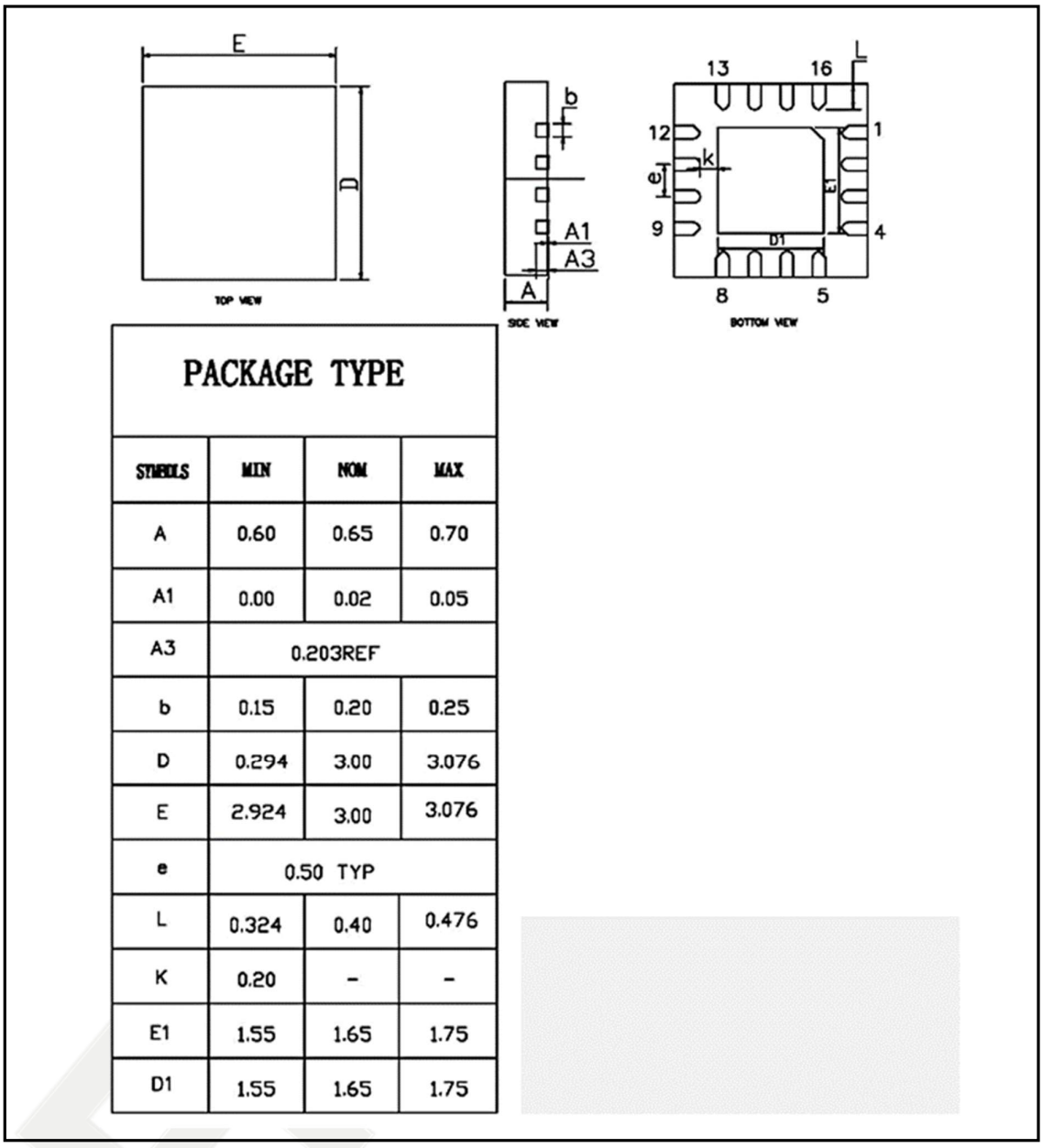
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0	0.02	0.05
b	0.20	0.25	0.30
c	0.20REF		
D	2.90	3.00	3.10
D2	1.40	1.50	1.60
e	0.50BSC		
Ne	2.00BSC		
E	2.40	2.50	2.60
E2	0.90	1.00	1.10
L	0.35	0.40	0.45
h	0.25REF		
K	0.20	–	–

Figure 18 TSSOP14 Mechanical Data and Package Dimensions



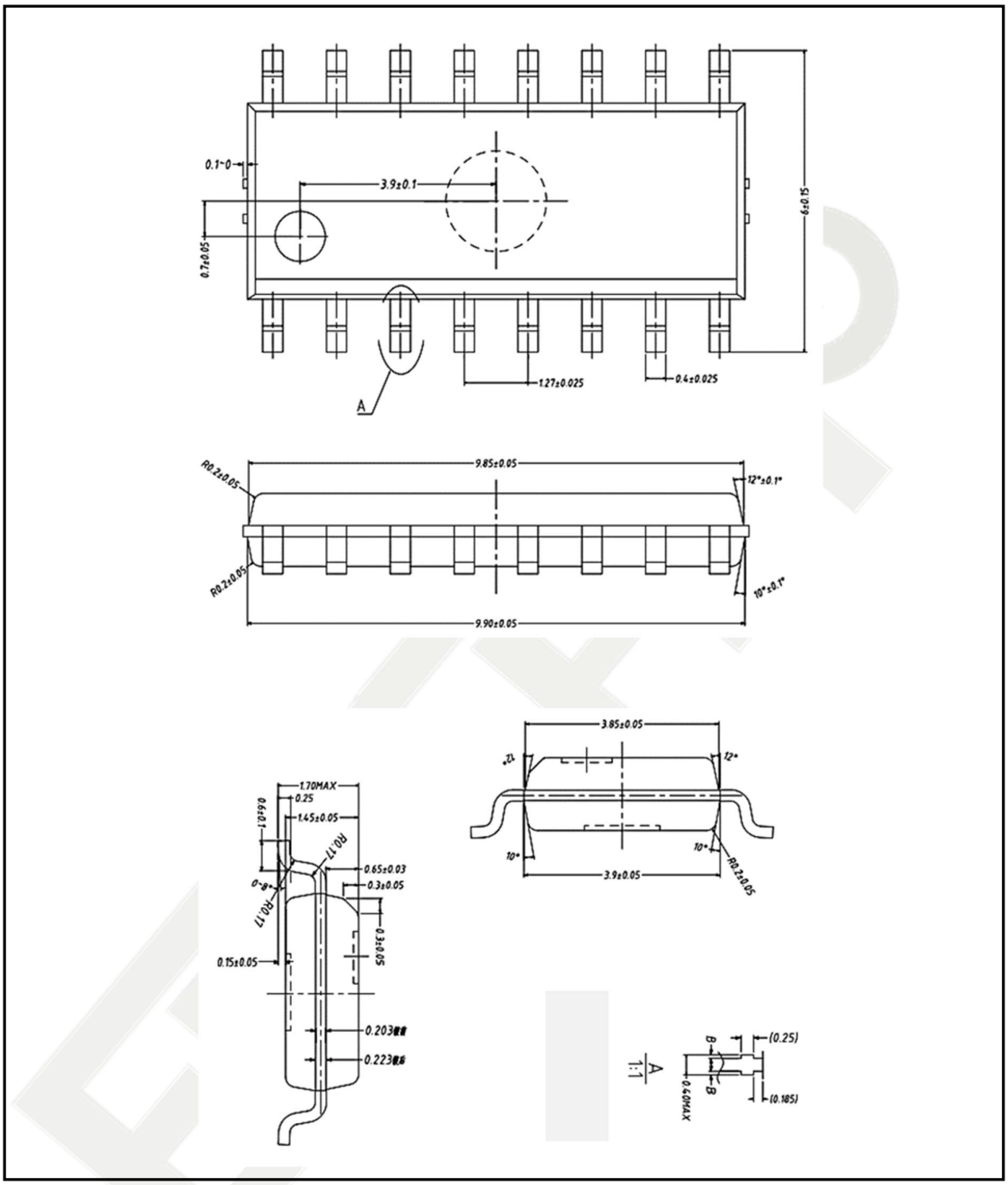
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°

Figure 19 QFN16 Mechanical Data and Package Dimensions



PACKAGE TYPE			
SYMBOLS	MIN	NOM	MAX
A	0.60	0.65	0.70
A1	0.00	0.02	0.05
A3	0.203REF		
b	0.15	0.20	0.25
D	0.294	3.00	3.076
E	2.924	3.00	3.076
e	0.50 TYP		
L	0.324	0.40	0.476
K	0.20	-	-
E1	1.55	1.65	1.75
D1	1.55	1.65	1.75

Figure 20 SOP16 Mechanical Data and Package Dimensions



5.2 Marking Information

Figure 21 eSOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

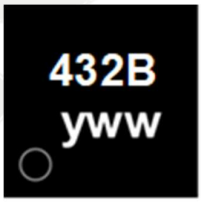
Line 1: “34032A” characters to indicate AXOP34032A

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“C” to indicate the location of assembly

Figure 22 DFN8 Marking Information



Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “432B” characters to indicate AXOP34032B

Line 2: “y” to indicate year of production

“ww” to indicate week of production

Figure 23 SOP8 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34032C” characters to indicate AXOP34032C

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“F” to indicate the location of assembly

Figure 24 SOT23-8L Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34032D” characters to indicate AXOP34032D

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“D” to indicate the location of assembly

Figure 25 DFN10 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34032SA” characters to indicate AXOP34032SA

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“F” to indicate the location of assembly

Figure 26 SSOP10 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: “34032SB” characters to indicate AXOP34032SB

Line 2: “yy” to indicate year of production

“ww” to indicate week of production

“F” to indicate the location of assembly

Figure 27 QFN16 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: "34034SA" characters to indicate AXOP34034SA

Line 2: "yy" to indicate year of production

"ww" to indicate week of production

"F" to indicate the location of assembly

Figure 28 SOP16 Marking Information

Laser mark circle to indicate pin 1

2 lines of alphanumeric coding:

Line 1: "AXOP34034SB" characters to indicate AXOP34034SB

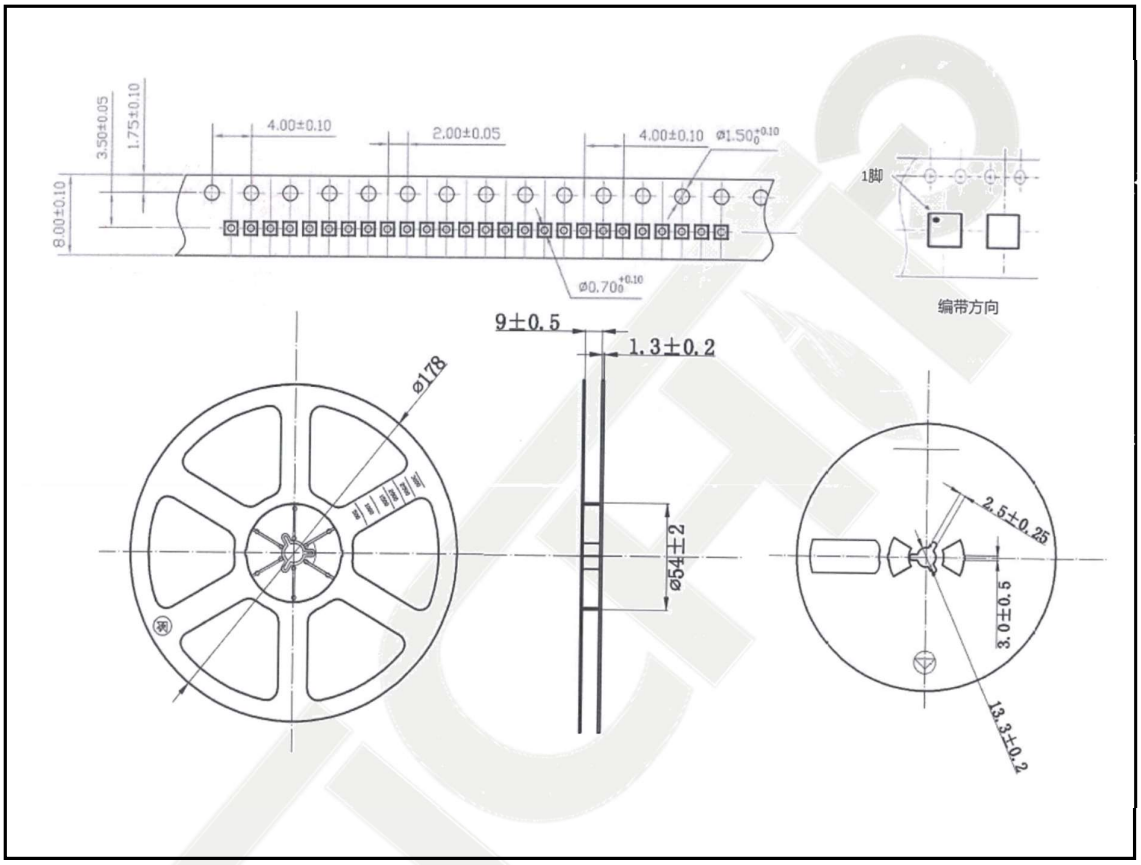
Line 2: "yy" to indicate year of production

"ww" to indicate week of production

"F" to indicate the location of assembly

6 Packing Information

Figure 29 Reel Packing Information



7 Revision History

Table 6 Document Revision History

Date	Version	Description
Nov 2022	1.00	V1.00 version.