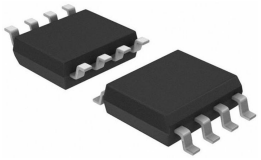
Low Dissipation Operational Amplifier

PRODUCT DESCRIPTION

The MS321, MS358, MS324 are signal channel, dual channel, four channel amplifiers respectively. It has high unit gain bandwidth and the slew rate could be up to 0.4V/us on specific condition. Each amplifier only has 430uA quiescent current at 5V. The input common-mode range could be grounded. In addition, the device supports single or dual power operation, and easily drive large capacitance load.

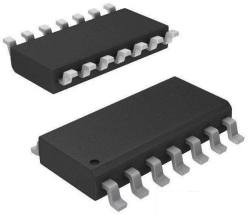
The MS321, MS358, MS324 have lead SOT23-5, SOP8, SOP14/TSSOP14 and QFN16 packages respectively. The device is featured by low dissipation, wide power supply range and economical price, allowing it to be applied widely.

SOT23-5

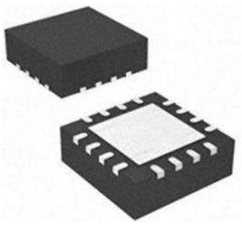


SOP8

TSSOP14



SOP14



QFN16

FEATURES

- Gain BandWidth : 1MHz@25°C
- Low Power Supply Current : 430uA
- Low Input Bias Current : 30nA
- Power Supply Range : 2.5V to 36V
- Maintain Stable in Large Capacitance Load

APPLICATIONS

- Charger
- Power Supply
- Industrial Control Tools
- Desktop Computer
- Communication

PRODUCT SPECIFICATION

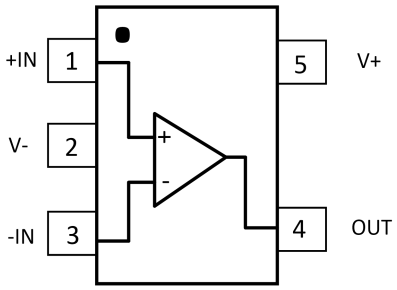
Part Number	Package	Marking
MS321	SOT23-5	321
MS358	SOP8	MS358
MS324	SOP14	MS324
MS324T	TSSOP14	MS324T
MS324N	QFN16	MS324N

PRODUCT CLASSIFICATION

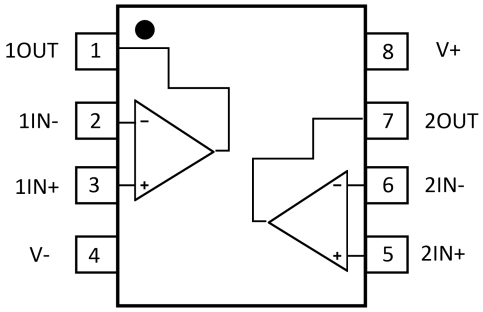
Classification	Normal Temperature Offset Voltage	Full Temperature Offset Voltage	Condition
A	0mv - 3mV	0mv - 5mV	Power Supply@5V
B	3mv - 7mV	3mv - 9mV	Power Supply@5V

PIN CONFIGURATION

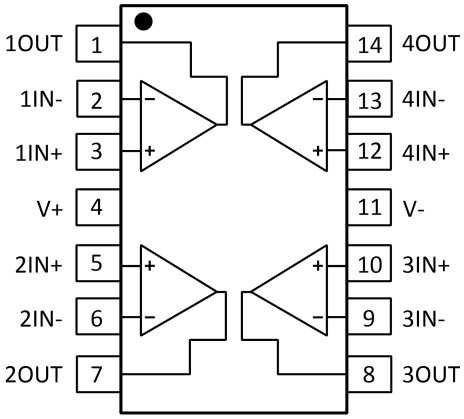
MS321

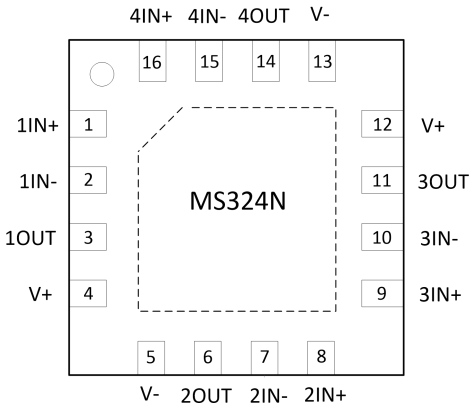


MS358



MS324/MS324T





PIN DESCRIPTION

Pin	Name	Type	Description
MS321			
1	+IN	I	Positive Input
2	V-	POWER	Negative Power Supply
3	-IN	I	Negative Input
4	OUT	O	Channel Output
5	V+	POWER	Positive Power Supply
MS358			
1	1OUT	O	Channel 1 Output
2	1IN-	I	Negative Input (Channel 1)
3	1IN+	I	Positive Input (Channel 1)
4	V-	POWER	Negative Power Supply
5	2IN+	I	Positive Input (Channel 2)
6	2IN-	I	Negative Input (Channel 2)
7	2OUT	O	Channel 2 Output
8	V+	POWER	Positive Power Supply
MS324/MS324T			
1	1OUT	O	Channel 1 Output
2	1IN-	I	Negative Input (Channel 1)
3	1IN+	I	Positive Input (Channel 1)
4	V+	POWER	Positive Power Supply
5	2IN+	I	Positive Input (Channel 2)
6	2IN-	I	Negative Input (Channel 2)
7	2OUT	O	Channel 2 Output
8	3OUT	O	Channel 3 Output
9	3IN-	I	Negative Input (Channel 3)
10	3IN+	I	Positive Input (Channel 3)
11	V-	POWER	Negative Power Supply
12	4IN+	I	Positive Input (Channel 4)
13	4IN-	I	Negative Input (Channel 4)
14	4OUT	O	Channel 4 Output

Pin	Name	Type	Description
MS324N			
1	1IN+	I	Positive Input (Channel 1)
2	1IN-	I	Negative Input (Channel 1)
3	1OUT	O	Channel 1 Output
4	V+	POWER	Positive Power Supply
5	V-	POWER	Negative Power Supply
6	2OUT	O	Channel 2 Output
7	2IN-	I	Negative Input (Channel 2)
8	2IN+	I	Positive Input (Channel 2)
9	3IN+	I	Positive Input (Channel 3)
10	3IN-	I	Negative Input (Channel 3)
11	3OUT	O	Channel 3 Output
12	V+	POWER	Positive Power Supply
13	V-	POWER	Negative Power Supply
14	4OUT	O	Channel 4 Output
15	4IN-	I	Negative Input (Channel 4)
16	4IN+	I	Positive Input (Channel 4)

ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Ratings	Unit
Differential Input Voltage	± Power Supply	
Input Current (VIN < -0.3V)	50	mA
Power Supply (V+ - V-)	40	V
Input Voltage	-0.3 ~ 40	V
Junction Temperature	150	°C
Operating Temperature	-40 ~ 125	°C
Soldering Temperature (10s)	260	°C
Storage Temperature,Tstg	-65 ~ 150	°C

ELECTRICAL CHARACTERISTICS

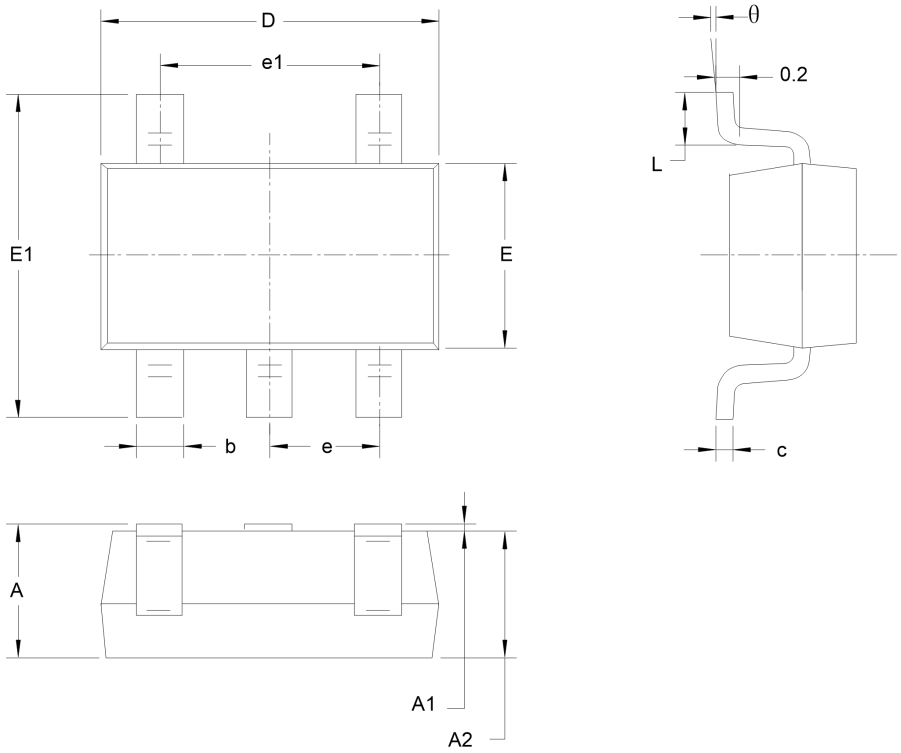
Unless otherwise noted, TA=25°C, V+=5V, V-=0V, VO=1.4V.

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Input Characteristics							
Input Offset Voltage	Vos	A	TA=25°C		2	3	mV
			–40°C ≤ TA ≤125°C			5	
		B	TA=25°C		3	7	mV
			–40°C ≤ TA ≤125°C			9	
Input Bias Current	IB				30	250	nA
		–40°C ≤ TA ≤125°C				500	
Input Offset Current	IOS				5	50	nA
		–40°C ≤ TA ≤ 125°C				150	
Input Common-mode Voltage	VCM	V+=30V, CMRR>=50dB		0		(V+)-1.5	V
		V+=30V, CMRR>=50dB				(V+)- 2	
Common-mode Rejection Ratio	CMRR	RS≤10kΩ		65	85		dB
Large Signal Gain	Avo	V+=15V,RL=2kΩ, VO=1.4V~11.4V		88	100		dB
		V+=15V,RL=2kΩ, VO=1.4V ~11.4V –40°C ≤ TJ ≤ 125°C		83			
Output Characteristics							
Output Voltage	VOH	V+=30V,RL=2kΩ, –40°C ≤ TJ ≤ 125°C		26			V
		V+=30V,RL=10kΩ –40°C ≤ TJ ≤ 125°C		27	28		
	VOL	V+=5V,RL=10kΩ –40°C ≤ TJ ≤ 125°C			5	20	mV
Output Current Source	Isource	VID=+1V,V+=15V,VO=2V		20	30		mA
		VID=+1V,V+=15V,VO=2V –40°C ≤ TJ ≤ 125°C		10	20		
Output Current Sink	Isink	VID=-1V,V+=15V,VO=2V		5	8		mA
		VID=-1V,V+=15V,VO=2V –40°C ≤ TJ ≤ 125°C		3	6		
		VID=-1V,V+=15V,VO=0.2V		12	100		uA
Output Short-circuit Current	Io	V+=15V			30	85	mA

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Dissipation						
Power Supply Rejection Ratio	PSRR	RS ≤10kΩ,V+ ≤5V~30V	65	100		dB
Quiescent Current/Amplifier	Iq	V+=5V		0.430	1.15	mA
		V+=5V,–40°C ≤ TJ ≤ 125°C		0.7	1.2	
		V+=30V		0.660	2.85	
		V+=30V,–40°C ≤ TJ ≤ 125°C		1.5	3	
Dynamic Characteristics						
Gain Bandwidth	GBW	TA=25°C, V+=30V, f=100kHz VIN=10mV,RL=2kΩ,CL=100pF		1		MHz
		TA=125°C, V+=30V, f=100kHz VIN=10mV,RL=2kΩ,CL=100pF		0.7		
Slew Rate	SR	V+=15V, RL=2kΩ, VIN=0.5V~3V CL=100pF,Unit Gain		0.4		V/us
Phase Margin	Z			60		Degrees
Others						
Voltage Noise Density	en	f=1kHz, Rs=100Ω, V+=30V		60		$nV/\sqrt{Hz}$
Total Harmonic Distortion	THD	f=1kHz, AV=20dB, RL=2kΩ VO=2VPP, CL=100pF, V+=30V		0.015		%

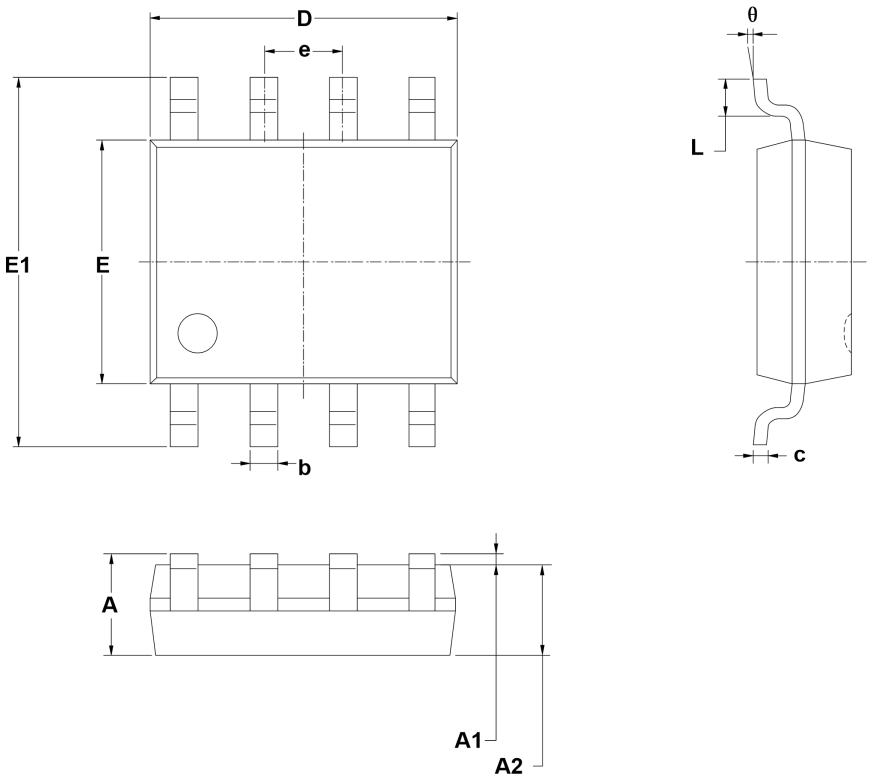
PACKAGE OUTLINE DIMENSIONS

SOT23-5



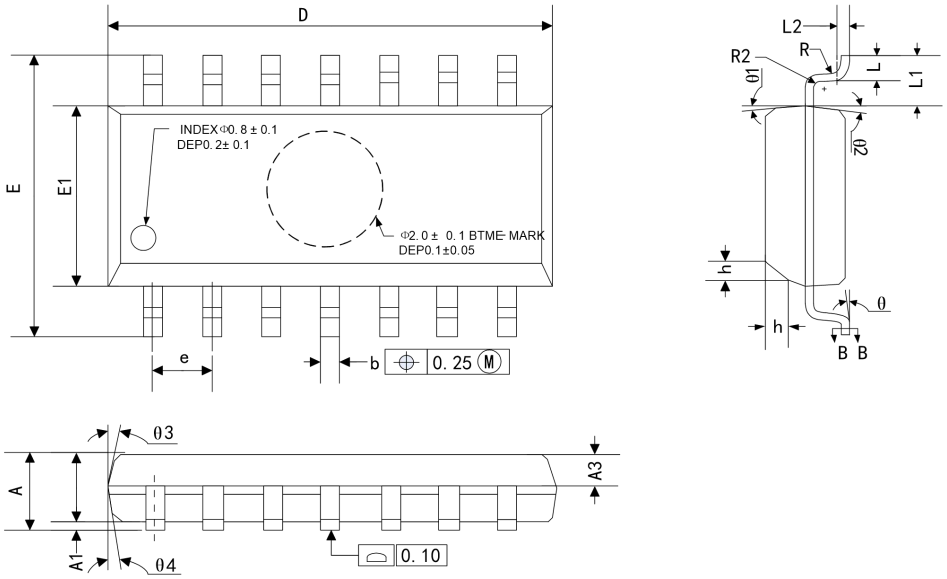
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SOP8



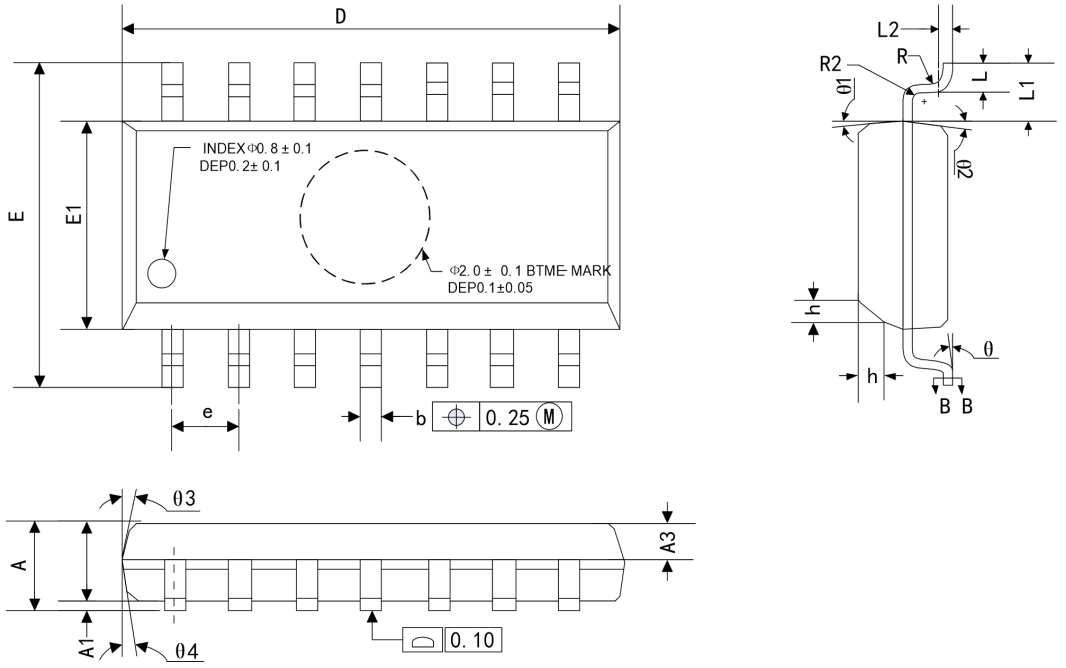
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0 º	8 º	0 º	8 º

SOP14



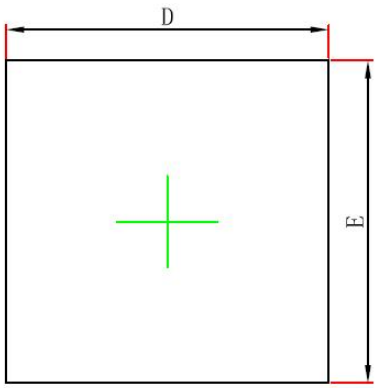
Symbol	Dimensions In Millimeters		
	Min	Typ	Max
A	1.35		1.75
A1	0.10		0.25
A2	1.25		1.65
A3	0.55		0.75
D	8.53		8.73
E	5.80		6.20
E1	3.80		4.00
e	1.27 BSC		
L	0.45		0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30		0.50
θ	0 º		8 º
θ1	6 º	8º	10 º
θ2	6 º	8º	10 º
θ3	5 º	7º	9 º
θ4	5 º	7º	9 º

TSSOP14

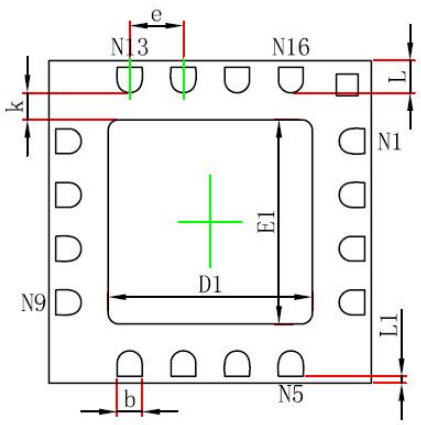


Symbol	Dimensions In Millimeters		
	Min	Typ	Max
A			1.20
A1	0.05		0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20		0.30
b1	0.19	0.22	0.25
c	0.13		0.19
c1	0.12	0.13	0.14
D	4.86	4.96	5.06
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65BSC		
L	0.45		0.75
L1	1.00BSC		
θ	0		8°
L/F Carrier Size(mil)	79×79		90×110
	118×153		

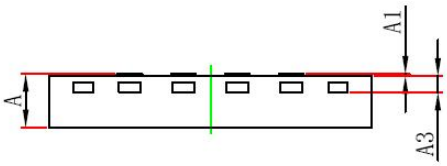
QFN16



Top View



Bottom View



Side View

Symbol	Dimensions In Millimeters	
	Min	Max
A	0.450/0.500/0.550	0.550/0.600/0.650
A1	0.000	0.050
A3	0.152REF.	
D	2.924	3.076
E	2.924	3.076
D1	1.800	2.000
E1	1.800	2.000
k	0.200MIN.	
b	0.230	0.330
e	0.500TYP.	
L	0.250	0.350
L1	0.013	0.113

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description

Product Name : 321, MS358, MS324, MS324T, MS324N

Product Code: XXXX, XXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specifications

Device	Package	Piece/Tray	Tray/Box	Piece /Box	Box/Carton	Piece/Carton
MS321	SOT23-5	3000	10	30000	4	120000
MS358	SOP8	2500	1	2500	8	20000
MS324	SOP14	2500	1	2500	8	20000
MS324T	TSSOP14	3000	1	3000	8	24000
MS324N	QFN16	4000	1	4000	8	32000

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- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.

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