



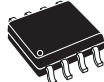
High bandwidth 50 MHz, rail-to-rail, 5 V cost-effective op amp



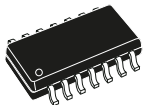
TSL6401
SOT23-5



TSL6402
MiniSO8



TSL6402
SO8



TSL6404
SO14



TSL6404
TSSOP14

Features

- Gain bandwidth product 50 MHz, unity gain stable
- Rail-to-rail input and output
- Wide supply voltage range: 2.2 V to 5.5 V
- Input offset voltage: 4.5 mV
- Low input bias current: 1 pA typ.
- Extended temperature range: -40 °C to +125 °C
 - Available also for Automotive grade

Applications

- Cost-sensitive applications
- Battery-powered products

Description

The [TSL6401](#), [TSL6402](#) and [TSL6404](#) are single, dual and quad, 50 MHz-bandwidth unity-gain-stable amplifier. The rail-to-rail input stage and the wide supply range from 2.2 V to 5.5 V make the [TSL6404](#) ideal for low-voltage, high bandwidth signal conditioning.

Maturity status link

TSL6401	SOT23-5
TSL6402	MiniSO8
	SO8
TSL6404	SO14
	TSSOP14

Related products

TSL680x	Nanopower 600 nA
TSL600x	Low-power 1 MHz
TSL620x	High bandwidth 8 MHz

1 Pin description

1.1 TSL6401 single operational amplifier

Figure 1. Pin connections (top view)

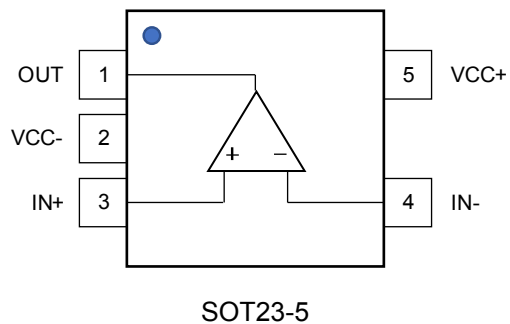


Table 1. Pin description

Pin n°	Pin name	Description
1	OUT	Output channel
2	VCC-	Negative supply voltage
3	IN+	Non-inverting input channel
4	IN-	Inverting input channel
5	VCC+	Positive supply voltage

1.2 TSL6402 dual operational amplifier

Figure 2. MiniSO8 and SO8 pin connection (top view)

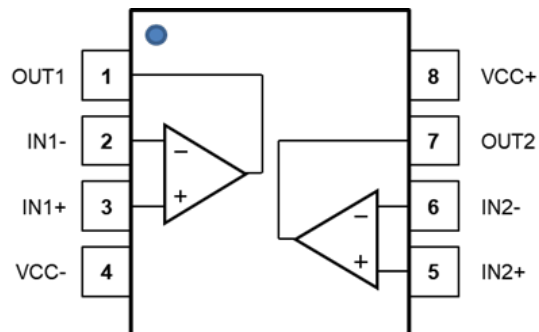


Table 2. MiniSO8 and SO8 pin description

Pin	Pin name	Description
1	OUT1	Output channel 1
2	IN1-	Inverting input channel 1
3	IN1+	Non-inverting input channel 1
4	VCC-	Negative supply voltage
5	IN2+	Non-inverting input channel 2
6	IN2-	Inverting input channel 2
7	OUT2	Output channel 2
8	VCC+	Positive supply voltage

1.3 TSL6404 quad operational amplifier

Figure 3. TSSOP-14 and SO14 pin connections (top view)

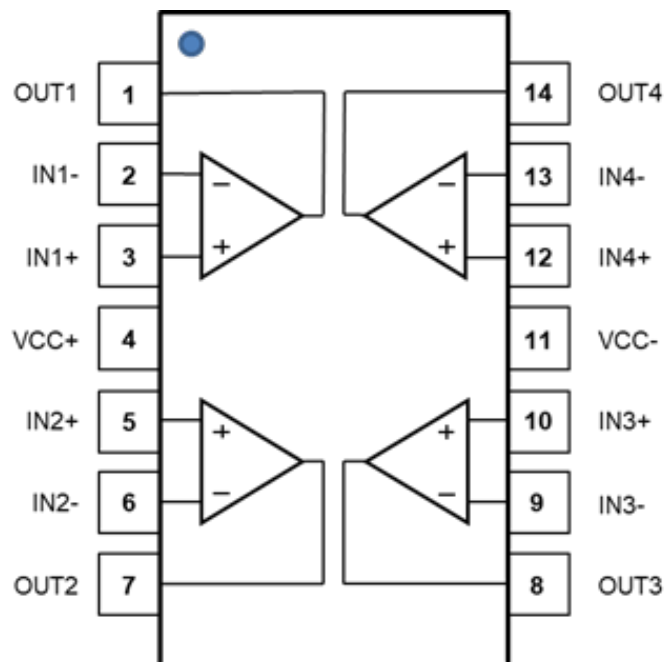


Table 3. TSSOP-14 and SO14 pin description

Pin	Pin name	Description
1	OUT1	Output channel 1
2	IN1-	Inverting input channel 1
3	IN1+	Non-inverting input channel 1
4	VCC+	Positive supply voltage
5	IN2+	Non-inverting input channel 2
6	IN2-	Inverting input channel 2
7	OUT2	Output channel 2
8	OUT3	Output channel 3
9	IN3-	Inverting input channel 3
10	IN3+	Non-inverting input channel 3
11	VCC-	Negative supply voltage
12	IN4+	Non-inverting input channel 4
13	IN4-	Inverting input channel 4
14	OUT4	Output channel 4

2 Absolute maximum ratings and operating conditions

Table 4. Absolute maximum ratings

Symbol	Parameter ⁽¹⁾	Value	Unit
V_{CC}	Supply voltage	6	V
V_{id}	Input voltage differential ($V_{IN+} - V_{IN-}$)	$\pm V_{CC}$	V
$V_{in}^{(2)}$	Input voltage	$(V_{CC-}) - 0.2$ to $(V_{CC+}) + 0.2$	V
I_{in}	Input current	± 10	mA
T_{stg}	Storage temperature	-65 to +150	°C
$R_{th-j\alpha}^{(3)}$	Thermal resistance junction-to-ambient		°C / W
	SOT23-5	250	
	MiniSO8	127	
	SO8	125	
	SO14	105	
	TSSOP-14	100	
T_j	Maximum junction temperature	150	°C
ESD	HBM: human body model ⁽⁴⁾	2	kV
	CDM: charged device model ⁽⁵⁾	1	kV

1. All voltage values are with respect to the V_{CC-} pin, unless otherwise specified.
2. The maximum input voltage differential value may be extended to the condition that the input current is limited to ± 10 mA.
3. $R_{th-j\alpha}$ is a typical value.
4. Human body model: HBM test according to the standard ESDA/JEDEC JS-001-2017.
5. Charged device model: the test CDM is done according to the standard ESDA/JEDEC JS-002-2018.

Table 5. Operating conditions

Symbol	Parameter	Value
V_{CC}	Supply voltage	2.2 V to 5.5 V
V_{icm}	Common-mode input voltage range (CMR)	$V_{CC-} - 0.1$ V to $V_{CC+} + 0.1$ V
T_{oper}	Operating free air temperature range	-40 °C to +125 °C

3 Electrical characteristics

Table 6. Electrical characteristics at $V_{CC} = 2.5\text{ V}$ to 5 V , $V_{ICM} = V_{OUT} = V_{CC} / 2$, $T = 25\text{ °C}$ and OUT connected to $V_{CC} / 2$ through $R_L = 10\text{ k}\Omega$ (unless otherwise specified).

Production screening at $V_{CC} = 5\text{ V}$, operation on the full supply range ensured by design and characterization.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
DC performance						
V_{IO}	Input offset voltage			0.75	4.5	mV
		$-40\text{ °C} \leq T \leq 125\text{ °C}$			5	
$\Delta V_{IO}/\Delta T$	Input offset voltage temperature drift	$-40\text{ °C} \leq T \leq 125\text{ °C}$		2		$\mu\text{V}/\text{°C}$
I_{IB}	Input bias current			1		pA
I_{IO}	Input offset current			1		pA
A_{VD}	Open loop gain	$V_{CC-} + 500\text{ mV} \leq V_{OUT} \leq V_{CC+} - 500\text{ mV}$	80	95		dB
CMR	Common-mode rejection ratio $20.\log(\Delta V_{IO}/\Delta V_{ICM})$	$V_{CC-} \leq V_{ICM} \leq V_{CC+}$	54	90		dB
SVR	Supply-voltage rejection ratio $20.\log(\Delta V_{IO}/\Delta V_{CC})$	$2.5\text{ V} \leq V_{CC} \leq 5\text{ V}$		100		dB
V_{OH}	High level output voltage drop ($V_{OH} = V_{CC+} - V_{OUT}$)				35	mV
V_{OL}	Low level output voltage drop ($V_{OL} = V_{OUT}$)				35	mV
I_{OUT}	Short-circuit current			± 60		mA
I_{CC}	Supply current (by operational amplifier)	No load, $-40\text{ °C} \leq T \leq 125\text{ °C}$		5.5	7.2	mA
AC performance						
GBP	Gain bandwidth product			50		MHz
SR	Slew rate	$A_V = 1\text{ V/V}$, 10% to 90%		30		V/ μs
Φ_m	Phase margin	$C_L = 60\text{ pF}$		50		Degrees
en	Input voltage noise density	$f = 10\text{ kHz}$		15		nV/ $\sqrt{\text{Hz}}$

4 Package information

To meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 SOT23-5 package information

Figure 4. SOT23-5 package outline

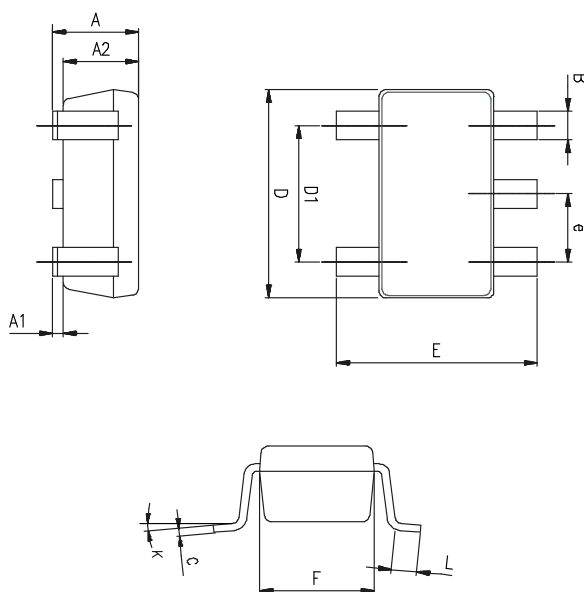


Table 7. SOT23-5 mechanical data

Dimensions						
Symbol	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1			0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.10	0.35	0.60	0.004	0.014	0.024
K	0°		0°	0°		0°

4.2 MiniSO8 package information

Figure 5. MiniSO8 package outline

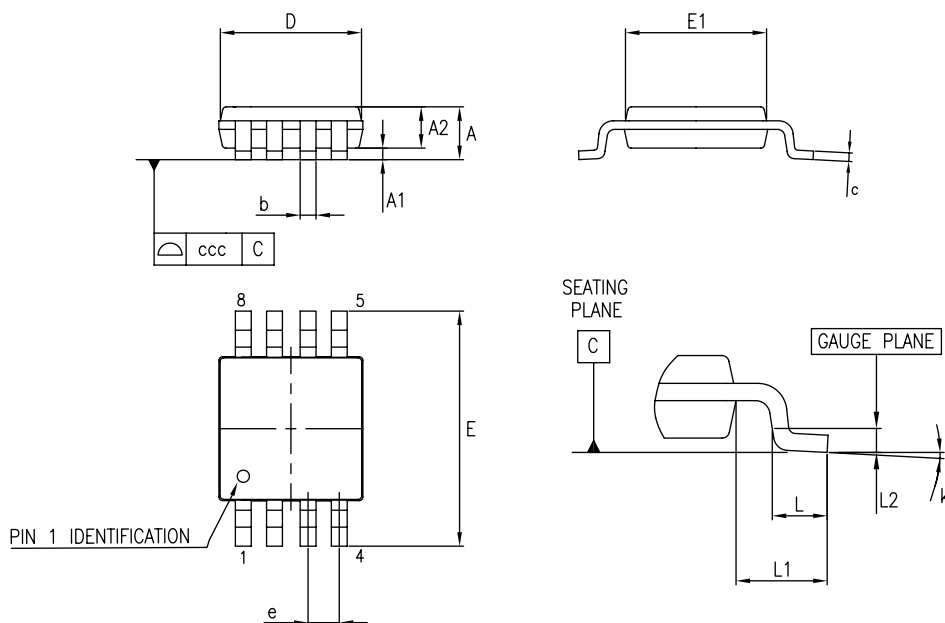


Table 8. MiniSO8 mechanical data

Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.1			0.043
A1	0		0.15	0		0.006
A2	0.75	0.85	0.95	0.03	0.033	0.037
b	0.22		0.4	0.009		0.016
c	0.08		0.23	0.003		0.009
D	2.8	3	3.2	0.11	0.118	0.126
E	4.65	4.9	5.15	0.183	0.193	0.203
E1	2.8	3	3.1	0.11	0.118	0.122
e		0.65			0.026	
L	0.4	0.6	0.8	0.016	0.024	0.031
L1		0.95			0.037	
L2		0.25			0.01	
k	0°		8°	0°		8°
ccc			0.1			0.004

4.3 SO8 package information

Figure 6. SO8 package outline

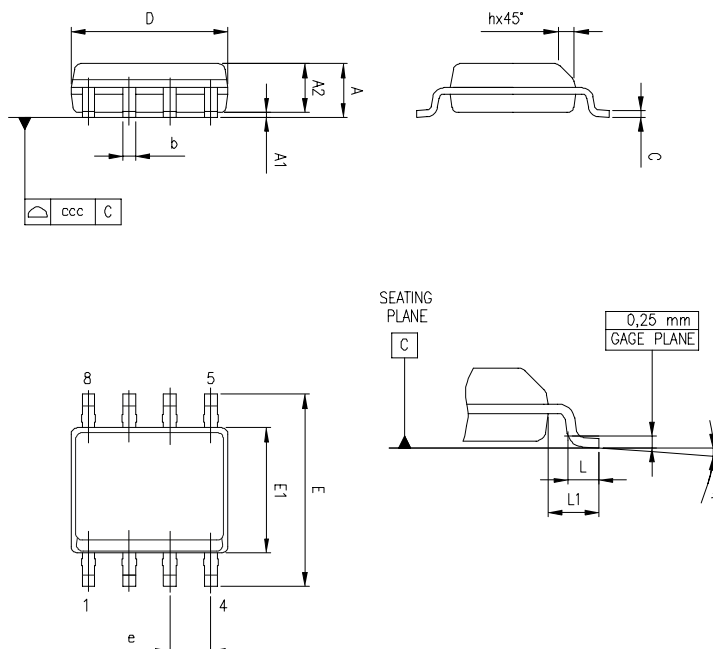


Table 9. SO-8 mechanical data

Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.1		0.25	0.004		0.01
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.01
D	4.8	4.9	5	0.189	0.193	0.197
E	5.8	6	6.2	0.228	0.236	0.244
E1	3.8	3.9	4	0.15	0.154	0.157
e		1.27			0.05	
h	0.25		0.5	0.01		0.02
L	0.4		1.27	0.016		0.05
L1		1.04			0.04	
k	0		8 °	1 °		8 °
ccc			0.1			0.004

4.4 SO14 package information

Figure 7. SO14 package outline

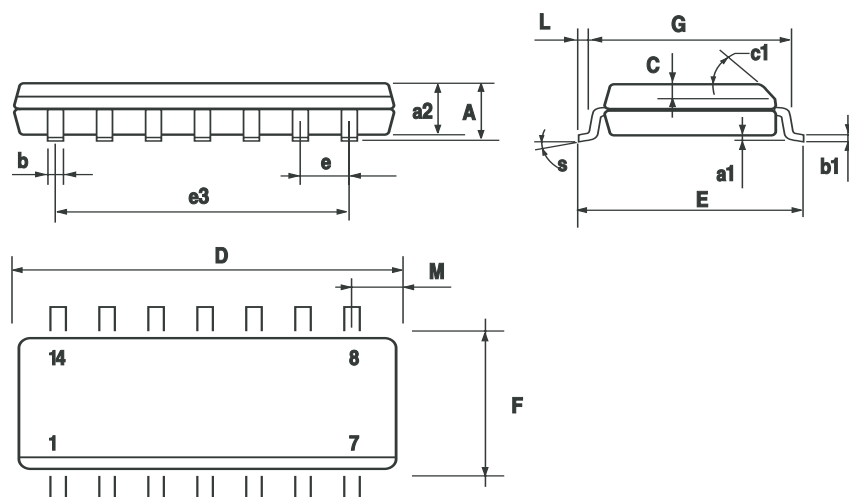


Table 10. SO14 package mechanical data

Symbol	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
S	8° (max.)					

4.5 TSSOP-14 package information

Figure 8. TSSOP-14 package outline

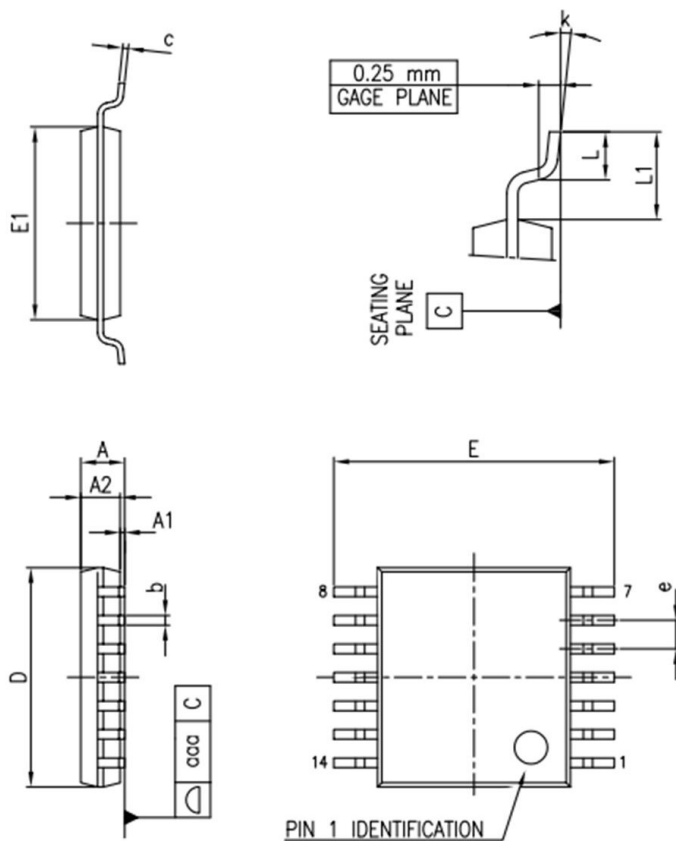


Table 11. TSSOP-14 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.20
A1	0.05		0.15
A2	0.80	1.00	1.05
b	0.19		0.30
c	0.09		0.20
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1		1.00	
k	0		8
aaa			0.10

5 Ordering information

Table 12. Order code

Order code	Temperature range	Channel	Package	Marking
TSL6401ILT	-40 °C to 125 °C	1	SOT23-5	K242
TSL6401IYLT ⁽¹⁾		1		K253
TSL6402IST		2	MiniSO8	K252
TSL6402IYST ⁽¹⁾		2		K254
TSL6402IDT		2	SO8	K252
TSL6402IYDT ⁽¹⁾		2		K254
TSL6404IDT		4	SO14	K263
TSL6404IYDT ⁽¹⁾		4		K264
TSL6404IPT		4	TSSOP14	K255
TSL6404IYPT ⁽¹⁾		4		K256

1. Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent. For qualification status detail, check the "Quality & Reliability" tab in Product page on www.st.com.

Revision history

Table 13. Document revision history

Date	Revision	Changes
21-Jun-2023	1	Initial release.
11-Jun-2024	2	Added new RPN TSL6402, TSL6404, Section 1.2, Section 1.3, Section 4.2, Section 4.3 and Section 4.4. Updated Section 5.
14-Apr-2025	3	Added new package SO14 and Section 4.4: SO14 package information . Updated title, R_{th-ja} parameter in Table 4 , V_{IO} and SVR conditions in Table 6 and Ordering information .

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