



TSV611, TSV612

Rail-to-rail input/output 11 μ A, 120 kHz
CMOS operational amplifiers

Preliminary data

Features

- Rail-to-rail input and output
- Low power consumption: 11 μ A typ at 5 V
- Low supply voltage: 1.5 to 5.5 V
- Gain bandwidth product: 120 kHz typ
- Unity gain stable
- Low input offset voltage: 1 mV max (A version)
- Low input bias current: 1 pA typ
- Temperature range: -40 to +85° C

Applications

- Battery-powered applications
- Portable devices
- Signal conditioning
- Active filtering
- Medical instrumentation

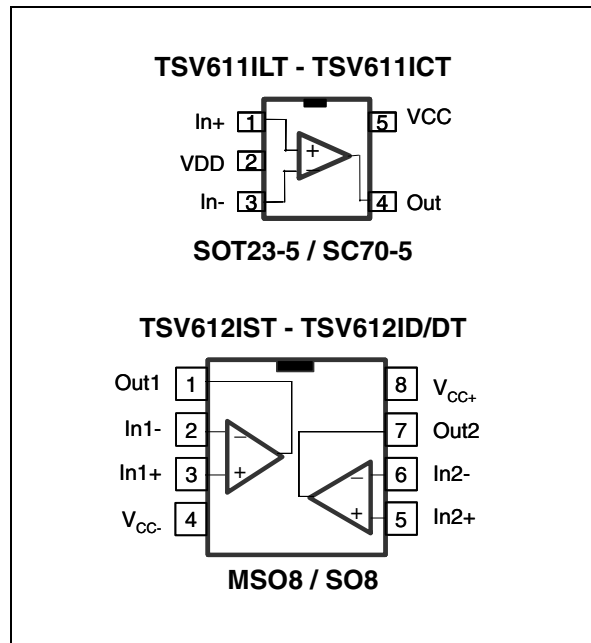
Description

The TSV61x family of single and dual operational amplifiers offers low voltage, low power operation and rail-to-rail input and output.

The devices also feature an ultra-low input bias current as well as a low input offset voltage.

The TSV61x have a gain bandwidth product of 120 kHz while consuming only 11 μ A at 5 V.

These features make the TSV61x family ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering.



1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage ⁽¹⁾	6	V
V_{id}	Differential input voltage ⁽²⁾	$\pm V_{CC}$	V
V_{in}	Input voltage ⁽³⁾	$V_{CC} - 0.2$ to $V_{CC} + 0.2$	V
T_{stg}	Storage temperature	-65 to +150	°C
R_{thja}	Thermal resistance junction to ambient ⁽⁴⁾⁽⁵⁾		°C/W
	SC70-5	205	
	SOT23-5	250	
	MiniSO-8	250	
	SO-8	125	
T_j	Maximum junction temperature	150	°C
ESD	HBM: human body model ⁽⁶⁾	4	kV
	MM: machine model ⁽⁷⁾	300	V
	CDM: charged device model ⁽⁸⁾	1.5	kV
	Latch-up immunity	200	mA

1. All voltage values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. V_{CC} - V_{in} must not exceed 6 V.
4. Short-circuits can cause excessive heating and destructive dissipation.
5. R_{th} are typical values.
6. Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
7. Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.
8. Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to ground.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	1.5 to 5.5	V
V_{icm}	Common mode input voltage range	$V_{CC} - 0.1$ to $V_{CC} + 0.1$	V
T_{oper}	Operating free air temperature range	-40 to +85	°C

2 Electrical characteristics

**Table 3. Electrical characteristics at $V_{CC+} = +1.8\text{ V}$
with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$
(unless otherwise specified)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Offset voltage	TSV61x TSV61xA			5 1	mV
		$T_{min.} < T_{op} < T_{max.}$ TSV61x $T_{min.} < T_{op} < T_{max.}$ TSV61xA			6 2	
DV_{io}	Input offset voltage drift			2		$\mu\text{V}/^\circ\text{C}$
I_{io}	Input offset current ($V_{out} = V_{CC}/2$)			1	10	pA
		$T_{min.} < T_{op} < T_{max.}$		1	100	pA
I_{ib}	Input bias current ($V_{out} = V_{CC}/2$)			1	10	pA
		$T_{min.} < T_{op} < T_{max.}$		1	100	pA
CMR	Common mode rejection ratio $20 \log(\Delta V_{ic}/\Delta V_{io})$	0 V to 1.8 V, $V_{out} = 0.9\text{ V}$	55			dB
		$T_{min.} < T_{op} < T_{max.}$				dB
A_{vd}	Large signal voltage gain	$R_L = 10\text{ k}\Omega$, $V_{out} = 0.5\text{ V}$ to 1.3 V	tbd	87		dB
		$T_{min.} < T_{op} < T_{max.}$	tbd			dB
V_{OH}	High level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$	35 50	3		mV
V_{OL}	Low level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$		3	35 50	mV
I_{out}	Isink	$V_o = 1.8\text{ V}$ $T_{min.} < T_{op} < T_{max.}$	5 5	10		mA
	Isource	$V_o = 0\text{ V}$ $T_{min.} < T_{op} < T_{max.}$	5 5	10		
I_{CC}	Supply current (per operator)	No load, $V_{out} = V_{CC}/2$		8	12	μA
		$T_{min.} < T_{op} < T_{max.}$			12	μA
AC performance						
GBP	Gain bandwidth product	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $f = 100\text{ kHz}$, $A_v = 1$		105		kHz
F_u	Unity gain frequency	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		100		kHz
ϕ_m	Phase margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		45		Degrees
G_m	Gain margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		tbd		dB

**Table 3. Electrical characteristics at $V_{CC+} = +1.8\text{ V}$
with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$
(unless otherwise specified) (continued)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
SR	Slew rate	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$ $A_v = 1$, TSV61x		0.03		V/ μs
e_n	Equivalent input noise voltage	$f = 1\text{ kHz}$		156		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
THD+ e_n	Total harmonic distortion	tbd		tbd		%

Table 4. $V_{CC+} = +3.3\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$,
 R_L connected to $V_{CC}/2$ (unless otherwise specified)

Symbol	Parameter		Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Offset voltage	TSV61x			5	mV
		TSV61xA			1	
		$T_{min} < T_{op} < T_{max}$ TSV61x			6	
		$T_{min} < T_{op} < T_{max}$ TSV61xA			2	
DV_{io}	Input offset voltage drift			2		$\mu\text{V}/^\circ\text{C}$
I_{io}	Input offset current			1	10	μA
		$T_{min.} < T_{op} < T_{max.}$		1	100	μA
I_{ib}	Input bias current			1	10	μA
		$T_{min.} < T_{op} < T_{max.}$		1	100	μA
CMR	Common mode rejection ratio $20 \log (\Delta V_{ic}/\Delta V_{io})$	0 V to 3.3 V, $V_{out} = 1.75\text{ V}$	60			dB
A_{vd}	Large signal voltage gain	$R_L = 10\text{ k}\Omega$, $V_{out} = 0.5\text{ V}$ to 2.8 V	tbd	93		dB
V_{OH}	High level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$	35 50	3		mV
V_{OL}	Low level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$		3	35 50	mV
I_{out}	Isink	$V_o = 5\text{ V}$ $T_{min.} < T_{op} < T_{max.}$	15	20		mA
	Isource	$V_o = 0\text{ V}$ $T_{min.} < T_{op} < T_{max.}$	15	20		
I_{CC}	Supply current (per operator)	No load, $V_{out} = 2.5\text{ V}$		10	14	μA
		$T_{min.} < T_{op} < T_{max.}$			14	μA
AC performance						
GBP	Gain bandwidth product	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $f = 100\text{ kHz}$, $A_v = 1$		110		kHz
F_u	Unity gain frequency	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		100		kHz
ϕ_m	Phase margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		tbd		Degrees
G_m	Gain margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		tbd		dB
SR	Slew rate	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		0.032		$\text{V}/\mu\text{s}$

Table 4. $V_{CC+} = +3.3\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$,
 R_L connected to $V_{CC}/2$ (unless otherwise specified) (continued)

Symbol	Parameter		Min.	Typ.	Max.	Unit
e_n	Equivalent input noise voltage	$f = 1\text{ kHz}$		156		$\frac{nV}{\sqrt{Hz}}$
THD	Total harmonic distortion	tbd		tbd		%

Table 5. $V_{CC+} = +5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, R_L connected to $V_{CC}/2$ (unless otherwise specified)

Symbol	Parameter		Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Offset voltage	TSV61x			5	mV
		TSV61xA			1	
		$T_{min} < T_{op} < T_{max}$ TSV61x			6	
		$T_{min} < T_{op} < T_{max}$ TSV61xA			2	
DV_{io}	Input offset voltage drift			2		$\mu\text{V}/^\circ\text{C}$
I_{io}	Input offset current			1	10	pA
		$T_{min.} < T_{op} < T_{max.}$		1	100	pA
I_{ib}	Input bias current			1	10	pA
		$T_{min.} < T_{op} < T_{max.}$		1	100	pA
CMR	Common mode rejection ratio $20 \log (\Delta V_{ic}/\Delta V_{io})$	0 V to 5 V, $V_{out} = 2.5\text{ V}$	60			dB
SVR	Supply voltage rejection ratio $20 \log (\Delta V_{cc}/\Delta V_{io})$	$V_{cc} = 1.8\text{ to }5\text{ V}$	75	96		dB
A_{vd}	Large signal voltage gain	$R_L = 10\text{ k}\Omega$, $V_{out} = 0.5\text{ V to }4.5\text{ V}$	tbd	96		dB
V_{OH}	High level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$	35 50	3		mV
V_{OL}	Low level output voltage	$R_L = 10\text{ k}\Omega$ $T_{min.} < T_{op} < T_{max.}$		3	35 50	mV
I_{out}	Isink	$V_o = 5\text{ V}$	tbd	20		mA
	Isource	$V_o = 0\text{ V}$	tbd	20		
I_{CC}	Supply current (per operator)	No load, $V_{out} = 2.5\text{ V}$		11	14	μA
		$T_{min.} < T_{op} < T_{max.}$			tbd	μA
AC performance						
GBP	Gain bandwidth product	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $f = 100\text{ kHz}$, $A_v = 1$		120		kHz
F_u	Unity gain frequency	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		109		kHz
ϕ_m	Phase margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		53		Degrees
G_m	Gain margin	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		14		dB
SR	Slew rate	$R_L = 10\text{ k}\Omega$, $C_L = 20\text{ pF}$, $A_v = 1$		0.034		$\text{V}/\mu\text{s}$

Table 5. $V_{CC+} = +5\text{ V}$, $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, R_L connected to $V_{CC}/2$
(unless otherwise specified) (continued)

Symbol	Parameter		Min.	Typ.	Max.	Unit
e_n	Equivalent input noise voltage	$f = 1\text{ kHz}$		156		$\frac{nV}{\sqrt{Hz}}$
THD	Total harmonic distortion	$f_{in} = 1\text{ kHz}$, $A_v = 1$, $V_{out} = 2\text{ V}_{pp}$		0.1		%

3 Package information

In order 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.

3.1 SOT23-5 package information

Figure 1. SOT23-5L package mechanical drawing

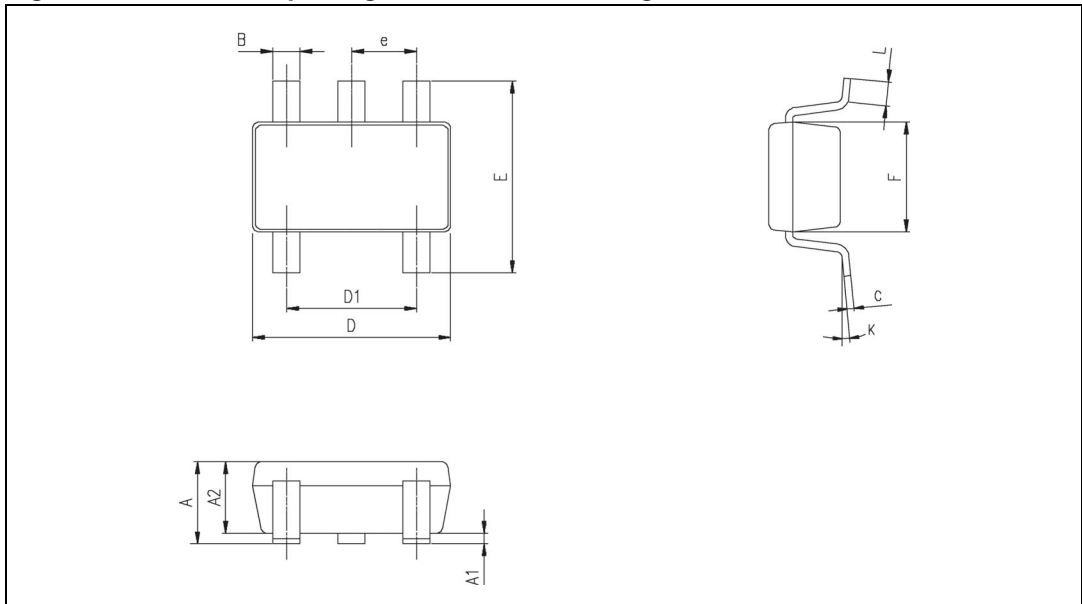


Table 6. SOT23-5L package mechanical data

Ref.	Dimensions					
	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	0.013	0.015	0.019
C	0.09	0.15	0.20	0.003	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	0.013	0.023
K	0 degrees		10 degrees			

3.2 SC70-5 (or SOT323-5) package information

Figure 2. SC70-5 (or SOT323-5) package mechanical drawing

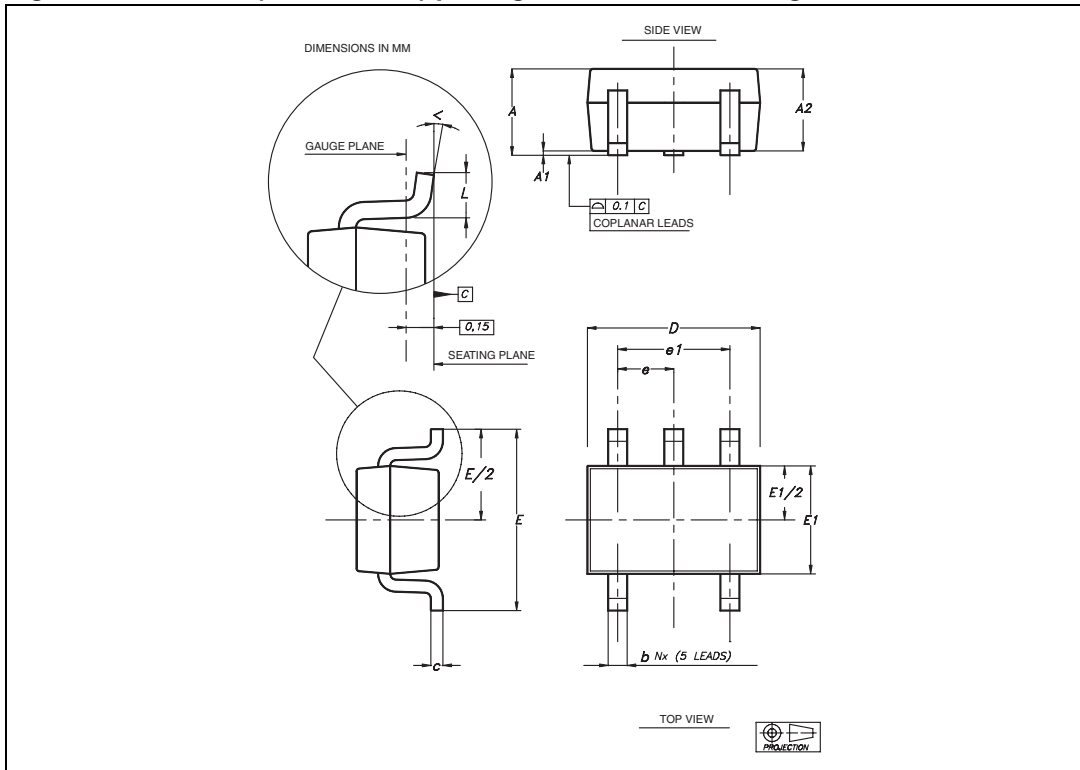


Table 7. SC70-5 (or SOT323-5) package mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min	Typ	Max	Min	Typ	Max
A	0.80		1.10	0.315		0.043
A1			0.10			0.004
A2	0.80	0.90	1.00	0.315	0.035	0.039
b	0.15		0.30	0.006		0.012
c	0.10		0.22	0.004		0.009
D	1.80	2.00	2.20	0.071	0.079	0.087
E	1.80	2.10	2.40	0.071	0.083	0.094
E1	1.15	1.25	1.35	0.045	0.049	0.053
e		0.65			0.025	
e1		1.30			0.051	
L	0.26	0.36	0.46	0.010	0.014	0.018
<	0°		8°			

3.3 SO-8 package information

Figure 3. SO-8 package mechanical drawing

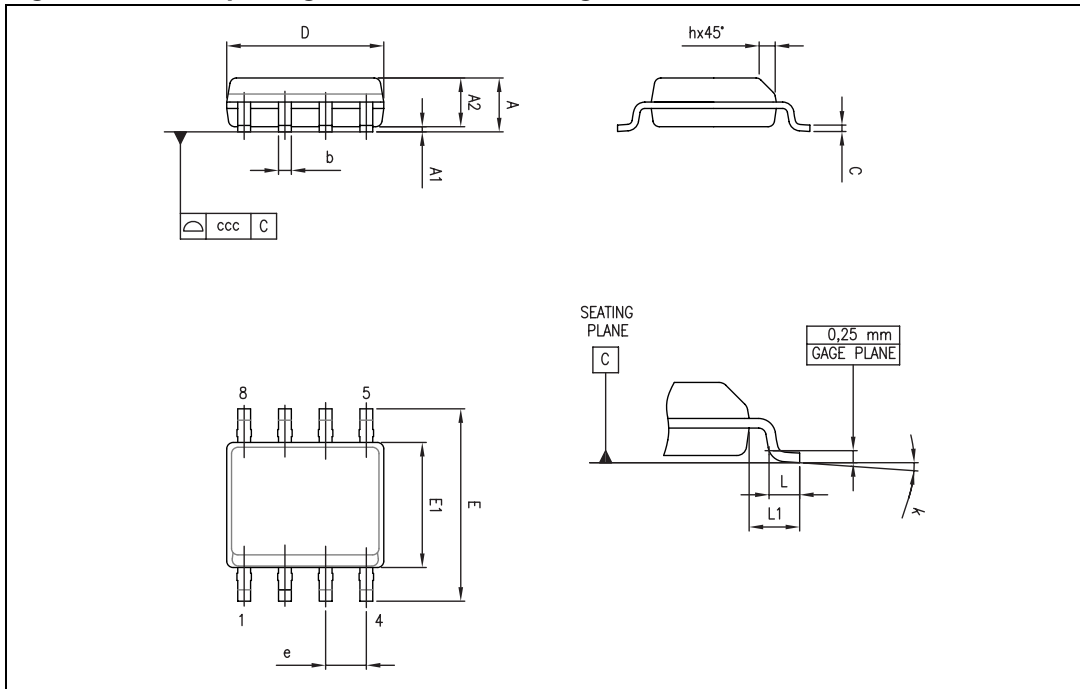


Table 8. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.040	
k	1°		8°	1°		8°
ccc			0.10			0.004

3.4 MiniSO-8 package information

Figure 4. MiniSO-8 package mechanical drawing

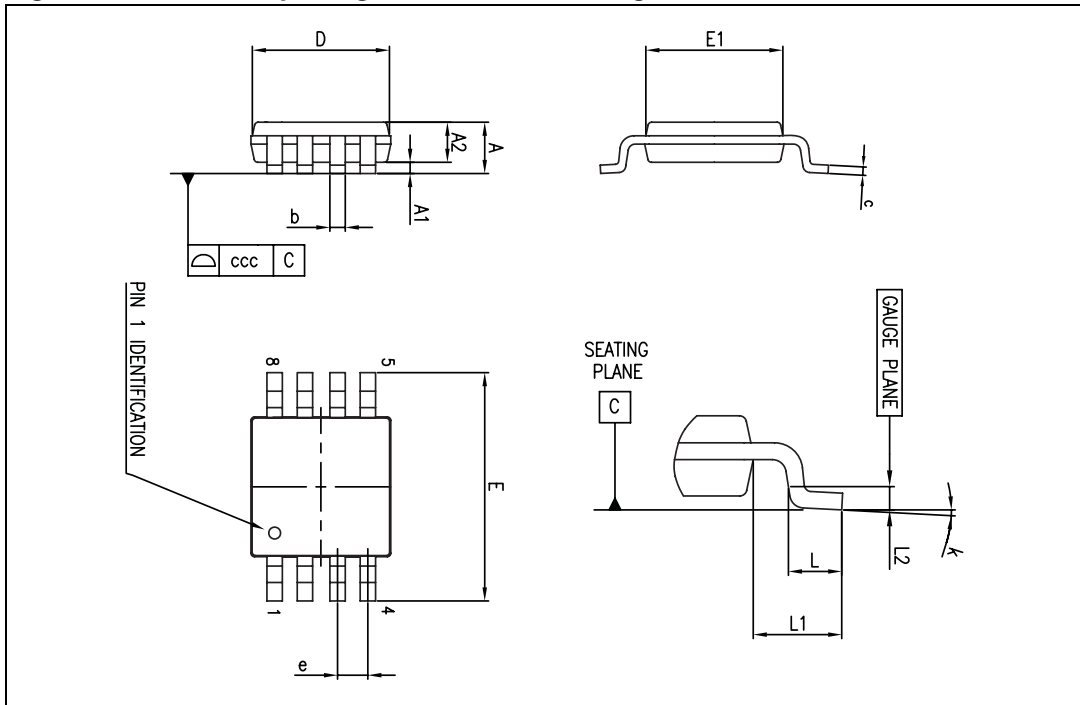


Table 9. MiniSO-8 package mechanical data

Ref.	Dimensions					
	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	0.030	0.033	0.037
b	0.22		0.40	0.009		0.016
c	0.08		0.23	0.003		0.009
D	2.80	3.00	3.20	0.11	0.118	0.126
E	4.65	4.90	5.15	0.183	0.193	0.203
E1	2.80	3.00	3.10	0.11	0.118	0.122
e		0.65			0.026	
L	0.40	0.60	0.80	0.016	0.024	0.031
L1		0.95			0.037	
L2		0.25			0.010	
k	0°		8°	0°		8°
ccc			0.10			0.004

4 Ordering information

Table 10. Order codes

Order code	Temperature range	Package	Packing	Marking
TSV611ILT	-40° C to 85° C	SOT23-5	Tape & reel	K12
TSV611AILT				K11
TSV611ICT		SC70-5		K12
TSV611AICT				K11
TSV612ID/DT		SO-8	Tube & Tape & reel	V612I
TSV612AID/DT				V612AI
TSV612IST		MSO-8	Tape & reel	K113
TSV612AIST				K115

5 Revision history

Table 11. Document revision history

Date	Revision	Changes
28-May-2009	1	Initial release.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2009 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com