TSV630, TSV630A, TSV631, TSV631A

Rail-to-rail input/output 60 µA 880 kHz CMOS operational amplifiers

Datasheet — production data

Features

- Low offset voltage: 500 µV max (A version)
- Low power consumption: 60 µA typ at 5 V
- Low supply voltage: 1.5 V - 5.5 V
- Gain bandwidth product: 880 kHz typ
- Unity gain stability
- Low power shutdown mode: 5 nA typ
- High output current: 63 mA at V_{CC} = 5 V
- Low input bias current: 1 pA typ
- Rail-to-rail input and output
- Extended temperature range: -40°C to +125°C

Applications

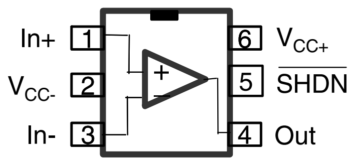
- Battery-powered applications
- Portable devices
- Signal conditioning
- Active filtering
- Medical instrumentation

Description

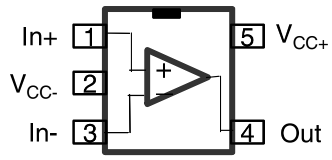
The TSV630 and TSV631 devices are single operational amplifiers offering low voltage, low power operation and rail-to-rail input and output.

With a very low input bias current and low offset voltage (500 µV maximum for the A version), the TSV630 and TSV631 are ideal for applications that require precision. The devices can operate at power supplies ranging from 1.5 to 5.5 V, and are therefore ideal for battery-powered devices, extending battery life.

These products feature an excellent speed/power consumption ratio, offering a 880 kHz gain bandwidth while consuming only 60 µA at a 5-V supply voltage. These op-amps are unity gain stable for capacitive loads up to 100 pF.



TSV630ICT/ILT
SC70-6/SOT23-6



TSV631ICT/ILT
SC70-5/SOT23-5

The devices are internally adjusted to provide very narrow dispersion of AC and DC parameters, especially power consumption, product gain bandwidth and slew rate.

The TSV630 provides a shutdown function.

Both the TSV630 and TSV631 have a high tolerance to ESD, sustaining 4 kV for the human body model.

Additionally, they are offered in micropackages, SC70-6 and SOT23-6 for the TSV630 and SC70-5 and SOT23-5 for the TSV631. They are guaranteed for industrial temperature ranges from -40° C to +125° C.

All these features combined make the TSV630 and TSV631 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 (AMR)

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
I_{in}	Input current (4)	10	mA
$\overline{SHDN}$	Shutdown voltage(3)	6	V
T_{stg}	Storage temperature	-65 to +150	°C
R_{thja}	Thermal resistance junction to ambient(5)(6) SC70-5 SOT23-5 SOT23-6 SC70-6	 205 250 240 232	°C/W
T_j	Maximum junction temperature	150	°C
ESD	HBM: human body model(7)	4	kV
	MM: machine model(8)	300	V
	CDM: charged device model(9)	1.5	kV
	Latch-up immunity	200	mA

1. All voltage values, except differential voltages, 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. Input current must be limited by a resistor in series with the inputs.
5. Short-circuits can cause excessive heating and destructive dissipation.
6. R_{th} are typical values.
7. 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.
8. Machine model: a 200 pF capacitor 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.
9. Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to the 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 +125	°C

2 Electrical characteristics

Table 3. Electrical characteristics at V_{CC+} = +1.8 V with V_{CC-} = 0 V, V_{icm} = $V_{CC}/2$, T_{amb} = 25° 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	TSV630-TSV631 TSV630A-TSV631A			3 0.5	mV
		$T_{min} < T_{op} < T_{max}$ TSV630-TSV631 TSV630A-TSV631A			4.5 2	mV
DV_{io}	Input offset voltage drift			2		μV/°C
I_{io}	Input offset current ($V_{out} = V_{CC}/2$)			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
I_{ib}	Input bias current ($V_{out} = V_{CC}/2$)			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
CMR	Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	0 V to 1.8 V, V_{out} = 0.9 V	53	74		dB
		$T_{min} < T_{op} < T_{max}$	51			
A_{vd}	Large signal voltage gain	R_L= 10 kΩ, V_{out} = 0.5 V to 1.3 V	85	95		dB
		$T_{min} < T_{op} < T_{max}$	80			
V_{OH}	High level output voltage	R_L = 10 kΩ	35	5		mV
		$T_{min} < T_{op} < T_{max}$	50			
V_{OL}	Low level output voltage	R_L = 10 kΩ		4	35	mV
		$T_{min} < T_{op} < T_{max}$			50	
I_{out}	I_{sink}	V_o = 1.8 V	6	12		mA
		$T_{min} < T_{op} < T_{max}$	4			
	I_{source}	V_o = 0 V	6	10		mA
		$T_{min} < T_{op} < T_{max}$	4			
I_{CC}	Supply current $\overline{SHDN} = V_{CC+}$	No load, $V_{out} = V_{CC}/2$	40	50	60	μA
		$T_{min} < T_{op} < T_{max}$			62	
AC performance						
GBP	Gain bandwidth product	R_L = 2 kΩ, C_L=100 pF, f= 100 kHz	700	790		kHz
ϕm	Phase margin	R_L = 2 kΩ, C_L = 100 pF		48		Degrees
G_m	Gain margin	R_L = 2 kΩ, C_L = 100 pF		11		dB
SR	Slew rate	R_L = 2 kΩ, C_L = 100 pF, Av = 1	0.2	0.27		V/μs
e_n	Equivalent input noise voltage	f = 1 kHz f = 10 kHz		67 53		$\frac{nV}{\sqrt{Hz}}$

1. Guaranteed by design.

Table 4. Shutdown characteristics V_{CC} = 1.8 V

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
DC performance						
I_{CC}	Supply current in shutdown mode (all operators)	$\overline{SHDN} = V_{CC-}$		2.5	50	nA
		$T_{min} < T_{op} < 85°$ C			200	nA
		$T_{min} < T_{op} < 125°$ C			1.5	µA
t_{on}	Amplifier turn-on time	R_L = 2 k, Vout = V_{CC-} + 0.2 to V_{CC} - 0.2		300		ns
t_{off}	Amplifier turn-off time	R_L = 2 k, Vout = V_{CC-} + 0.2 to V_{CC+} - 0.2		20		ns
V_{IH}	$\overline{SHDN}$ logic high		1.3			V
V_{IL}	$\overline{SHDN}$ logic low				0.5	V
I_{IH}	$\overline{SHDN}$ current high	$\overline{SHDN} = V_{CC+}$		10		pA
I_{IL}	$\overline{SHDN}$ current low	$\overline{SHDN} = V_{CC-}$		10		pA
I_{OLeak}	Output leakage in shutdown mode	$\overline{SHDN} = V_{CC-}$		50		pA
		$T_{min} < T_{op} < 125°$ C		1		nA

Table 5. Electrical characteristics at V_{CC+} = +3.3 V, V_{CC-} = 0 V, V_{icm} = $V_{CC}/2$, T_{amb} = 25° C, R_L connected to $V_{CC}/2$ (unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
DC performance						
V_{io}	Offset voltage	TSV630-TSV631 TSV630A-TSV631A			3 0.5	mV
		$T_{min} < T_{op} < T_{max}$ TSV630-TSV631 TSV630A-TSV631A			4.5 2	mV
DV_{io}	Input offset voltage drift			2		µV/°C
I_{io}	Input offset current			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
I_{ib}	Input bias current			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
CMR	Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	0 V to 3.3 V, V_{out} = 1.75 V	57	79		dB
		$T_{min} < T_{op} < T_{max}$	53			
A_{vd}	Large signal voltage gain	R_L = 10 kΩ, V_{out} = 0.5 V to 2.8 V	88	98		dB
		$T_{min} < T_{op} < T_{max}$	83			
V_{OH}	High level output voltage	R_L = 10 kΩ	35	6		mV
		$T_{min.} < T_{op} < T_{max}$	50			
V_{OL}	Low level output voltage	R_L = 10 kΩ		7	35	mV
		$T_{min} < T_{op} < T_{max}$			50	
I_{out}	I_{sink}	V_o = 3.3 V	30	45		mA
		$T_{min} < T_{op} < T_{max}$	25	42		
	I_{source}	V_o = 0 V	30	38		mA
		$T_{min} < T_{op} < T_{max}$	25			
I_{CC}	Supply current $\overline{SHDN}$ = V_{CC+}	No load, V_{out} = 1.75 V	43	55	64	µA
		$T_{min} < T_{op} < T_{max}$			66	µA
AC performance						
GBP	Gain bandwidth product	R_L = 2 kΩ, C_L = 100 pF, f = 100 kHz	710	860		kHz
ϕm	Phase margin	R_L = 2 kΩ, C_L = 100 pF		50		Degrees
G_m	Gain margin	R_L = 2 kΩ, C_L = 100 pF		11		dB
SR	Slew rate	R_L = 2 kΩ, C_L = 100 pF, Av = 1	0.22	0.29		V/µs
e_n	Equivalent input noise voltage	f = 1 kHz f = 10 kHz		64 51		$\frac{nV}{\sqrt{Hz}}$

1. Guaranteed by design.

Table 6. Electrical characteristics at V_{CC+} = +5 V with V_{CC-} = 0 V, $V_{icm} = V_{CC}/2$, T_{amb} = 25° 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	TSV630-TSV631 TSV630A-TSV631A			3 0.5	mV
		$T_{min} < T_{op} < T_{max}$ TSV630-TSV631 TSV630A-TSV631A			4.5 2	mV
DV_{io}	Input offset voltage drift			2		µV/°C
I_{io}	Input offset current ($V_{out} = V_{CC}/2$)			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
I_{ib}	Input bias current ($V_{out} = V_{CC}/2$)			1	10(1)	pA
		$T_{min} < T_{op} < T_{max}$		1	100	
CMR	Common mode rejection ratio 20 log ($\Delta V_{ic}/\Delta V_{io}$)	0 V to 5 V, V_{out} = 2.5 V	60	80		dB
		$T_{min} < T_{op} < T_{max}$	55			
SVR	Supply voltage rejection ratio 20 log ($\Delta V_{CC}/\Delta V_{io}$)	V_{CC} = 1.8 to 5 V	75	102		dB
		$T_{min} < T_{op} < T_{max}$				
A_{vd}	Large signal voltage gain	R_L= 10 kΩ, V_{out}= 0.5 V to 4.5 V	89	98		dB
		$T_{min} < T_{op} < T_{max}$	84			
V_{OH}	High level output voltage	R_L = 10 kΩ	35	7		mV
		$T_{min} < T_{op} < T_{max}$	50			
V_{OL}	Low level output voltage	R_L = 10 kΩ		6	35	mV
		$T_{min} < T_{op} < T_{max}$			50	
I_{out}	I_{sink}	V_o = 5 V	40	69		mA
		$T_{min} < T_{op} < T_{max}$	35	65		
	I_{source}	V_o = 0 V	40	74		mA
		$T_{min} < T_{op} < T_{max}$	36	68		
I_{CC}	Supply current $\overline{SHDN} = V_{CC+}$	No load, $V_{out}=V_{CC}/2$	50	60	69	µA
		$T_{min} < T_{op} < T_{max}$			72	
AC performance						
GBP	Gain bandwidth product	R_L = 2 kΩ, C_L= 100 pF, f = 100 kHz	730	880		kHz
F_u	Unity gain frequency	R_L = 2 kΩ, C_L = 100 pF,		830		kHz
ϕm	Phase margin	R_L = 2 kΩ, C_L = 100 pF		50		Degrees
G_m	Gain margin	R_L = 2 kΩ, C_L = 100 pF		12		dB
SR	Slew rate	R_L = 2 kΩ, C_L = 100 pF, Av = 1	0.25	0.34		V/µs

Table 6. Electrical characteristics at V_{CC+} = +5 V with V_{CC-} = 0 V, V_{icm} = $V_{CC}/2$, T_{amb} = 25° C and R_L connected to $V_{CC}/2$ (unless otherwise specified) (continued)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
e_n	Equivalent input noise voltage	f = 1 kHz f = 10 kHz		60 47		$\frac{nV}{\sqrt{Hz}}$
THD+e_n	Total harmonic distortion	f = 1 kHz, A_V = 1, R_L = 100 kΩ, V_{icm} = $V_{CC}/2$, Vout = 2 V_{PP}		0.0017		%

1. Guaranteed by design.

Table 7. Shutdown characteristics V_{CC} = 5 V

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
DC performance						
I_{CC}	Supply current in shutdown mode (all operators)	$\overline{SHDN}$ = V_{CC-}		5	50	nA
		$T_{min} < T_{op} < 85°$ C			200	nA
		$T_{min} < T_{op} < 125°$ C			1.5	µA
t_{on}	Amplifier turn-on time	R_L = 2 k, Vout = V_{CC-} + 0.2 to V_{CC+} - 0.2		300		ns
t_{off}	Amplifier turn-off time	R_L = 2 k, Vout = V_{CC-} + 0.2 to V_{CC+} - 0.2		30		ns
V_{IH}	$\overline{SHDN}$ logic high		4.5			V
V_{IL}	$\overline{SHDN}$ logic low				0.5	V
I_{IH}	$\overline{SHDN}$ current high	$\overline{SHDN}$ = V_{CC+}		10		pA
I_{IL}	$\overline{SHDN}$ current low	$\overline{SHDN}$ = V_{CC-}		10		pA
I_{OLeak}	Output leakage in shutdown mode	$\overline{SHDN}$ = V_{CC-}		50		pA
		$T_{min} < T_{op} < 125°$ C		1		nA

Figure 1. Supply current vs. supply voltage at $V_{icm} = V_{CC}/2$

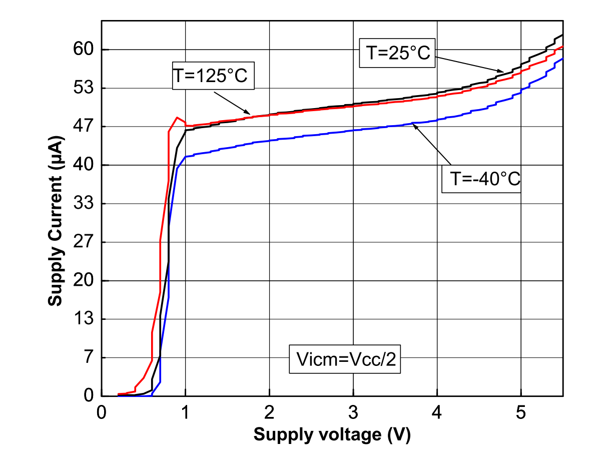


Figure 2. Output current vs. output voltage at $V_{CC} = 1.5$ V

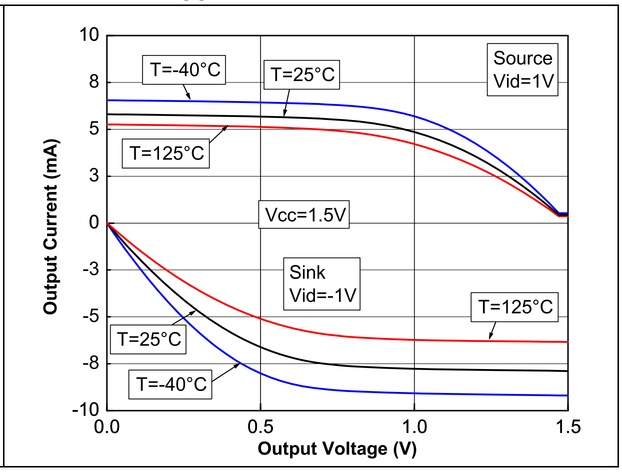


Figure 3. Output current vs. output voltage at $V_{CC} = 5$ V

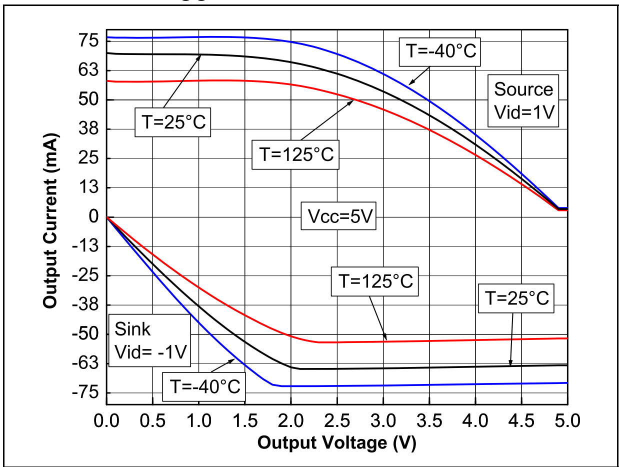


Figure 4. Voltage gain and phase vs. frequency at $V_{CC} = 1.5$ V

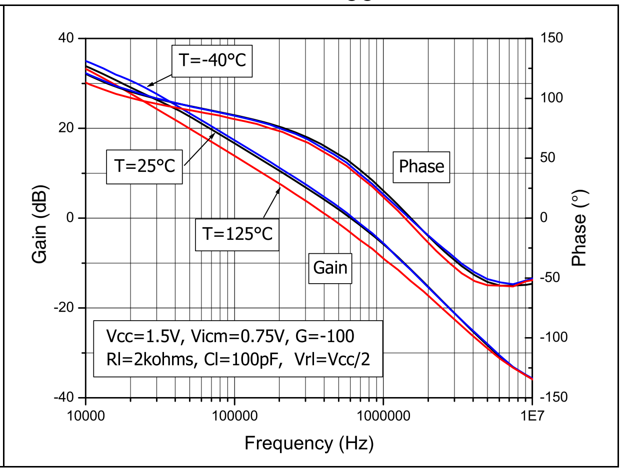


Figure 5. Voltage gain and phase vs. frequency at $V_{CC} = 5$ V

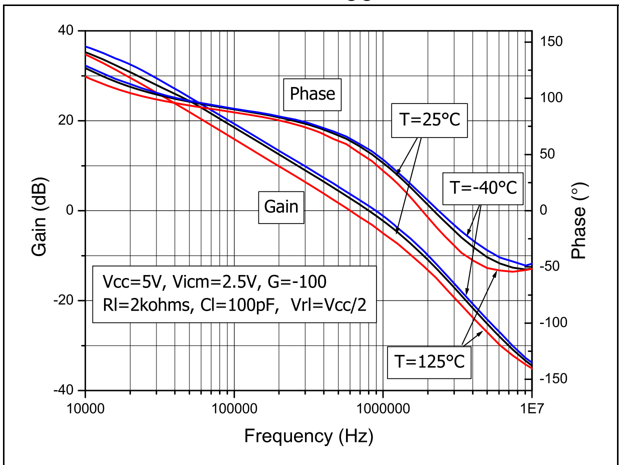


Figure 6. Phase margin vs. output current at $V_{CC} = 5$ V

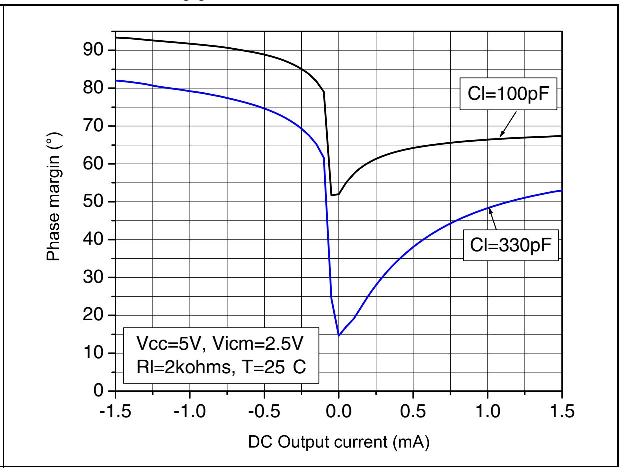


Figure 7. Positive slew rate vs. time

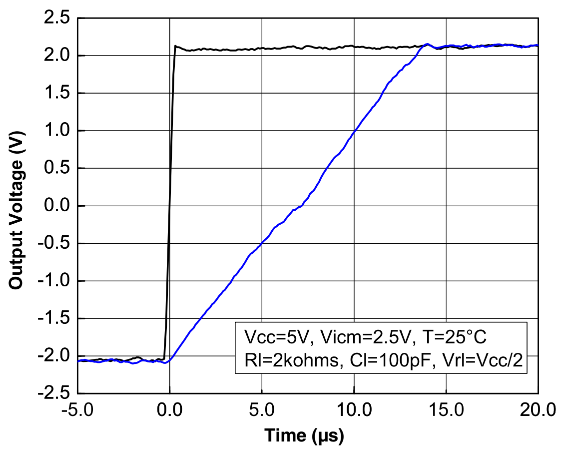


Figure 8. Negative slew rate vs. time

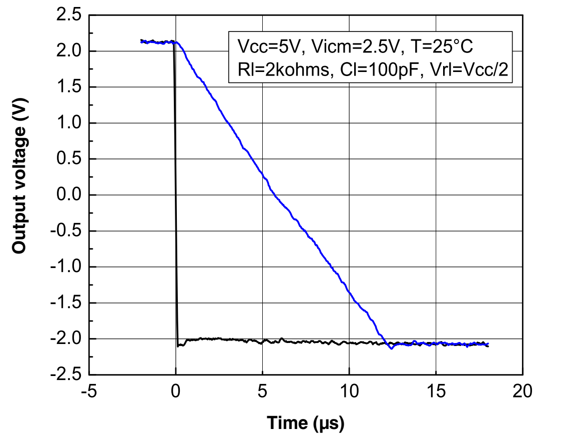


Figure 9. Positive slew rate vs. supply voltage

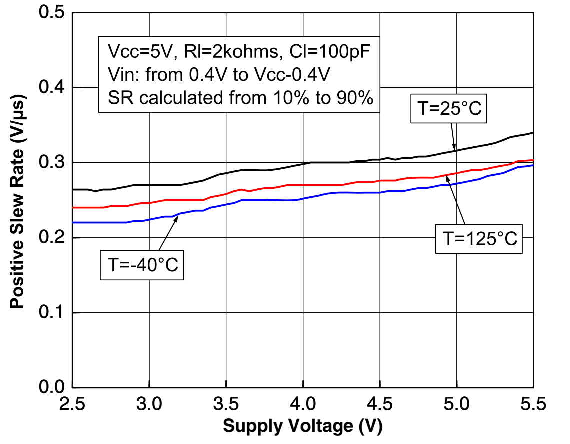


Figure 10. Negative slew rate vs. supply voltage

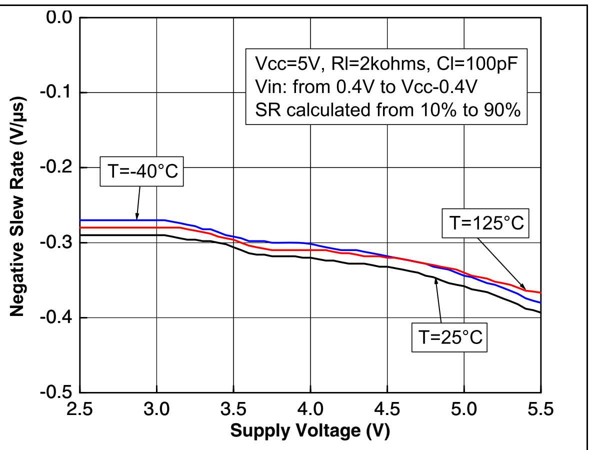


Figure 11. Distortion + noise vs. output voltage (R_L = 2 kΩ)

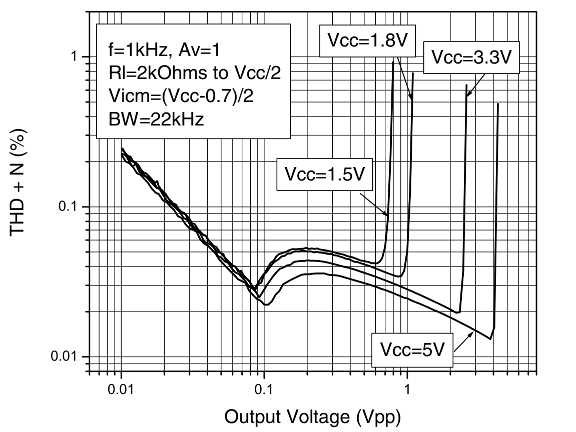


Figure 12. Distortion + noise vs. output voltage (R_L = 100 kΩ)

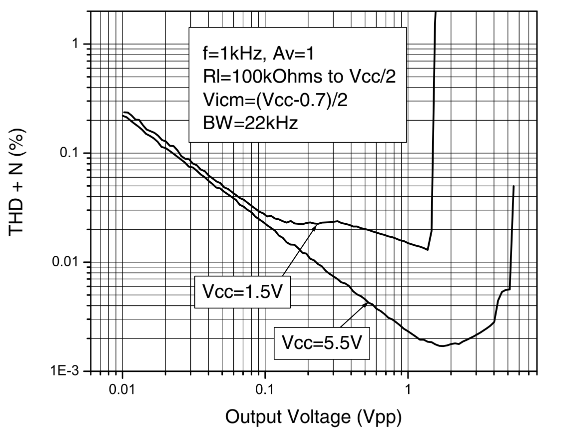


Figure 13. Distortion + noise vs. frequency

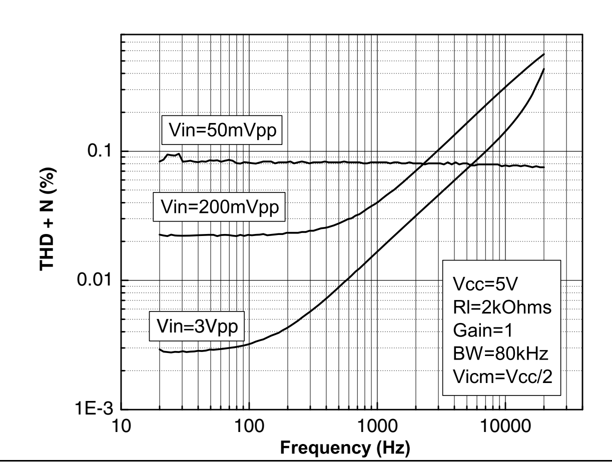


Figure 14. Distortion + noise vs. frequency

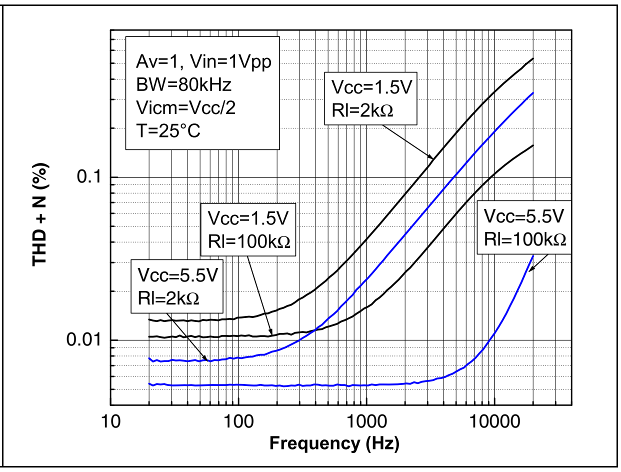
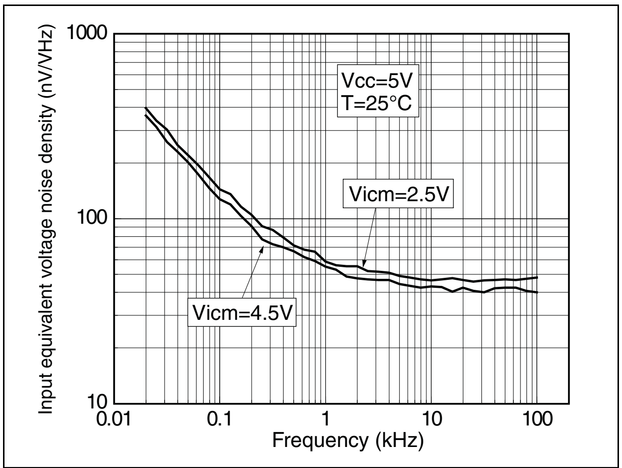


Figure 15. Noise vs. frequency



3 Application information

3.1 Operating voltages

The TSV630 and TSV631 can operate from 1.5 to 5.5 V. Their parameters are fully specified for 1.8-, 3.3- and 5-V power supplies. However, the parameters are very stable in the full V_{CC} range and several characterization curves show the TSV63x characteristics at 1.5 V. Additionally, the main specifications are guaranteed in extended temperature ranges from -40° C to +125° C.

3.2 Rail-to-rail input

The TSV630 and TSV631 are built with two complementary PMOS and NMOS input differential pairs. The devices have a rail-to-rail input, and the input common mode range is extended from V_{CC-} -0.1 V to V_{CC+} +0.1 V. The transition between the two pairs appears at V_{CC+} -0.7 V. In the transition region, the performance of CMRR, PSRR, V_{io} and THD is slightly degraded (as shown in *Figure 16* and *Figure 17* for V_{io} vs. V_{icm}).

Figure 16. Input offset voltage vs input common mode at V_{CC} = 1.5 V

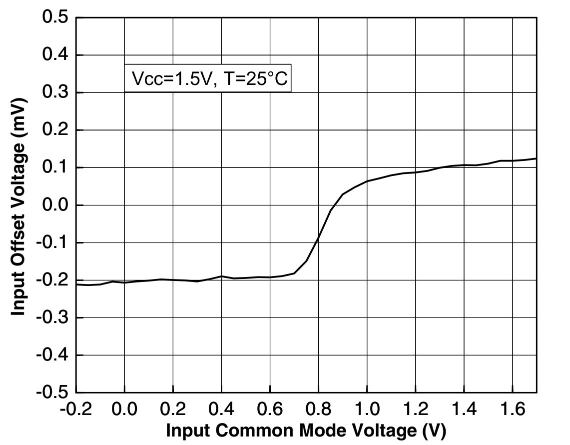
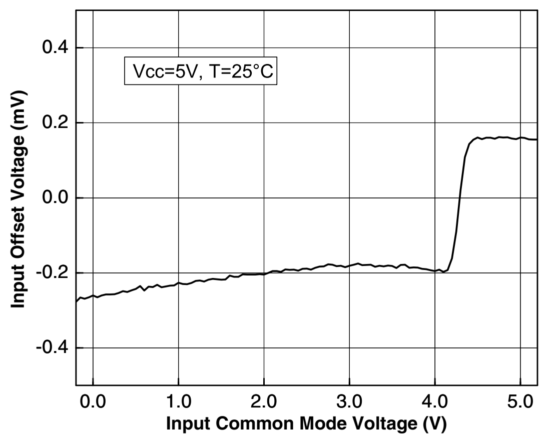


Figure 17. Input offset voltage vs input common mode at V_{CC} = 5 V



The device is guaranteed without phase reversal.

3.3 Rail-to-rail output

The operational amplifiers' output levels can go close to the rails: 35 mV maximum above and below the rail when connected to a 10 kΩ resistive load to $V_{CC}/2$.

3.4 Shutdown function (TSV630)

The operational amplifier is enabled when the $\overline{SHDN}$ pin is pulled high. To disable the amplifier, the $\overline{SHDN}$ must be pulled down to V_{CC-}. When in shutdown mode, the amplifier output is in a high impedance state. The $\overline{SHDN}$ pin must never be left floating, but tied to V_{CC+} or V_{CC-}.

The turn-on and turn-off time are calculated for an output variation of ±200 mV (*Figure 18* and *Figure 19* show the test configurations).

Figure 18. Test configuration for turn-on time (Vout pulled down)

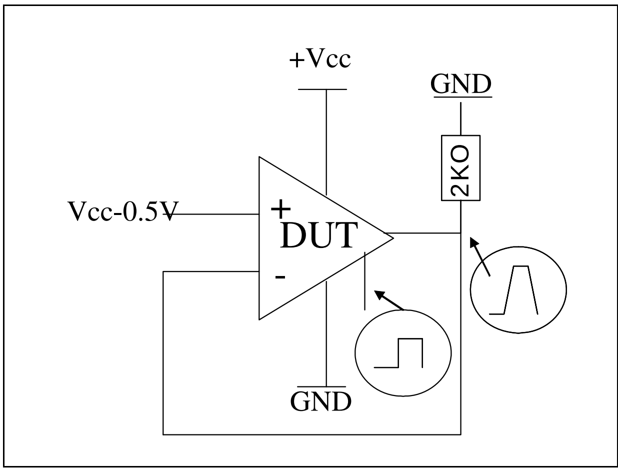


Figure 19. Test configuration for turn-off time (Vout pulled down)

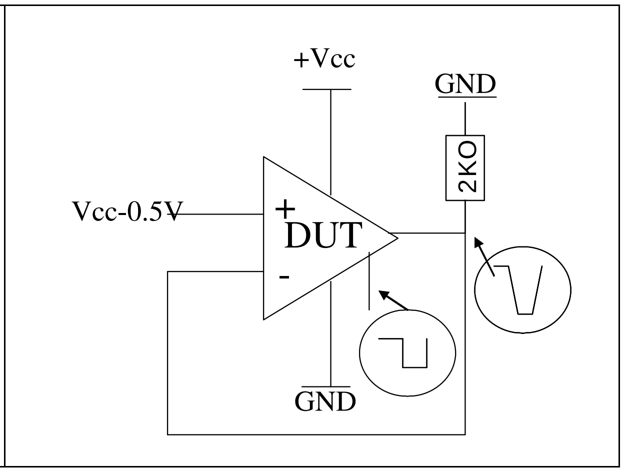


Figure 20. Turn-on time, V_{CC} = 5 V, Vout pulled down, T = 25° C

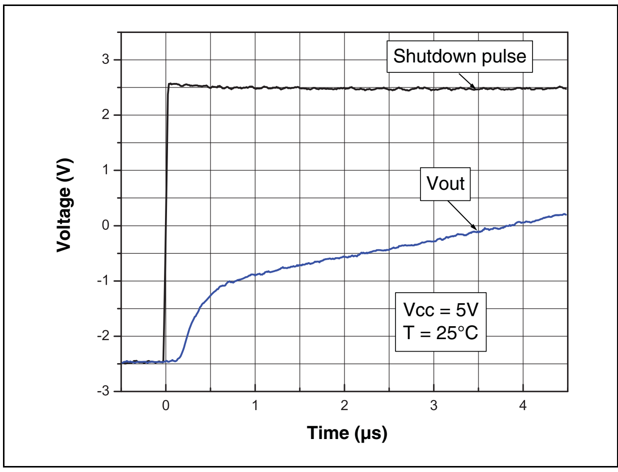
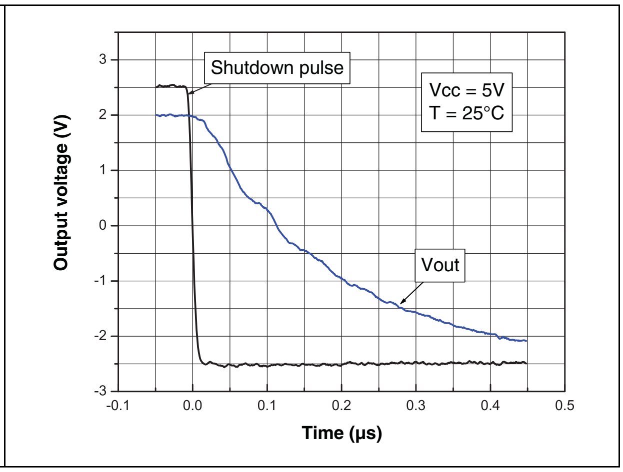


Figure 21. Turn-off time, V_{CC} = 5 V, Vout pulled down, T = 25° C



3.5 Optimization of DC and AC parameters

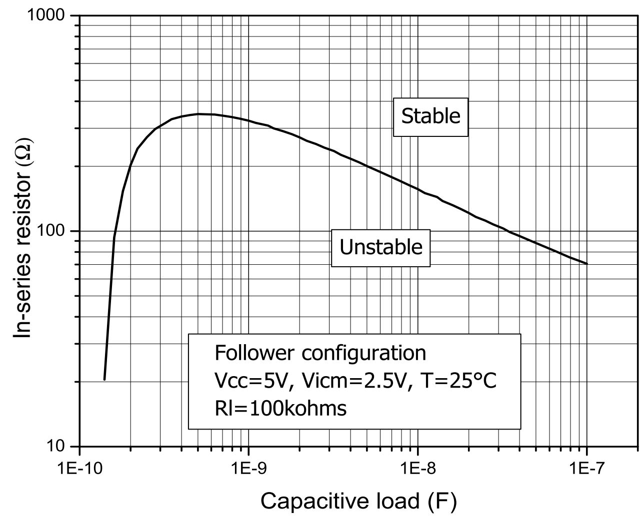
These devices use an innovative approach to reduce the spread of the main DC and AC parameters. An internal adjustment achieves a very narrow spread of the current consumption (60 µA typical, min/max at ±17 %). Parameters linked to the current consumption value, such as GBP, SR and AVd, benefit from this narrow dispersion. All parts present a similar speed and the same behavior in terms of stability. In addition, the minimum values of GBP and SR are guaranteed (GBP = 730 kHz minimum and SR = 0.25 V/µs minimum).

3.6 Driving resistive and capacitive loads

These products are micro-power, low-voltage operational amplifiers optimized to drive rather large resistive loads, above 2 kΩ. For lower resistive loads, the THD level may significantly increase.

In a *follower* configuration, these operational amplifiers can drive capacitive loads up to 100 pF with no oscillations. When driving larger capacitive loads, adding an in-series resistor at the output can improve the stability of the devices (see *Figure 22* for recommended in-series resistor values). Once the in-series resistor value has been selected, the stability of the circuit should be tested on bench and simulated with the simulation model.

Figure 22. In-series resistor vs. capacitive load



3.7 PCB layouts

For correct operation, it is advised to add 10 nF decoupling capacitors as close as possible to the power supply pins.

3.8 Macromodel

An accurate macromodel of the TSV630 and TSV631 is available on STMicroelectronics' web site at www.st.com. This model is a trade-off between accuracy and complexity (that is, time simulation) of the TSV63x operational amplifiers. It emulates the nominal performances of a typical device within the specified operating conditions mentioned in the datasheet. It also helps to validate a design approach and to select the right operational amplifier, *but it does not replace on-board measurements*.

4 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.

4.1 SOT23-5 package mechanical data

Figure 23. SOT23-5L package mechanical drawing

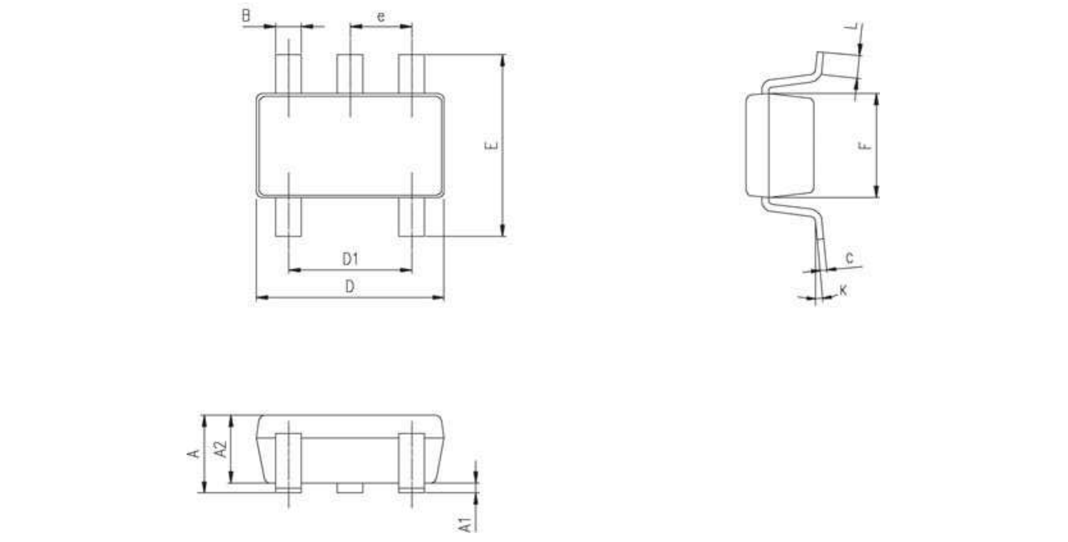


Table 8. SOT23-5L package mechanical data

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			

4.2 SOT23-6 package mechanical data

Figure 24. SOT23-6L package mechanical drawing

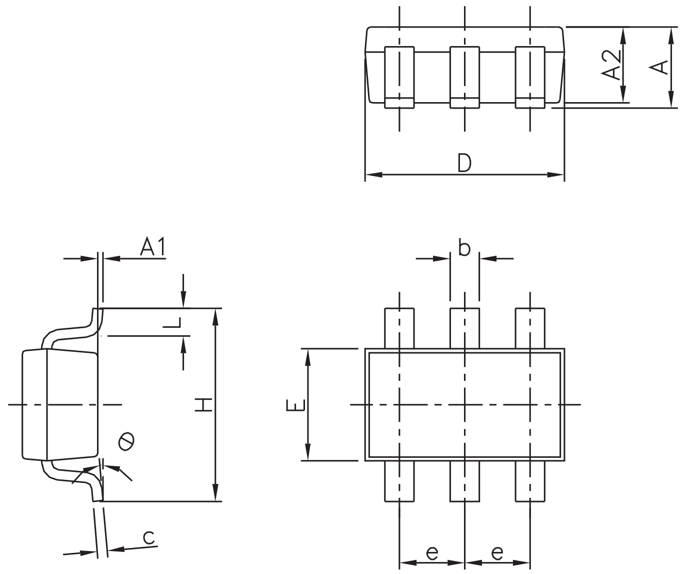


Table 9. SOT23-6L package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90		1.45	0.035		0.057
A1			0.10			0.004
A2	0.90		1.30	0.035		0.051
b	0.35		0.50	0.013		0.019
c	0.09		0.20	0.003		0.008
D	2.80		3.05	0.110		0.120
E	1.50		1.75	0.060		0.069
e		0.95			0.037	
H	2.60		3.00	0.102		0.118
L	0.10		0.60	0.004		0.024
°	0		10°			

4.3 SC70-6 (or SOT323-6) package mechanical data

Figure 25. SC70-6 (or SOT323-6) package mechanical drawing

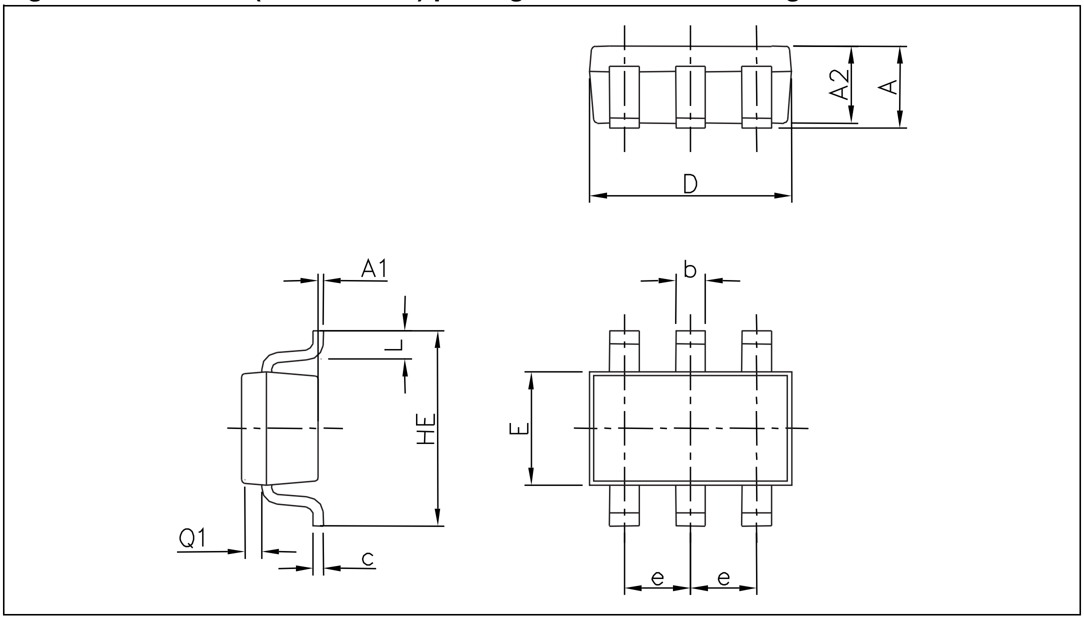
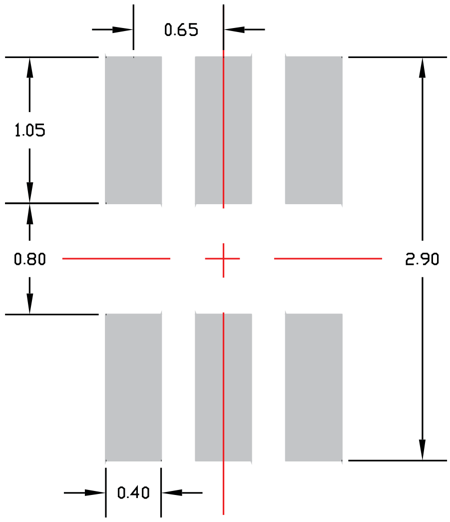


Table 10. SC70-6 (or SOT323-6) package mechanical data

Ref	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80		1.10	0.031		0.043
A1			0.10			0.004
A2	0.80		1.00	0.031		0.039
b	0.15		0.30	0.006		0.012
c	0.10		0.18	0.004		0.007
D	1.80		2.20	0.071		0.086
E	1.15		1.35	0.045		0.053
e		0.65			0.026	
HE	1.80		2.40	0.071		0.094
L	0.10		0.40	0.004		0.016
Q1	0.10		0.40	0.004		0.016

Figure 26. SC70-6 (or SOT323-6) package footprint



4.4 SC70-5 (or SOT323-5) package mechanical data

Figure 27. SC70-5 (or SOT323-5) package mechanical drawing

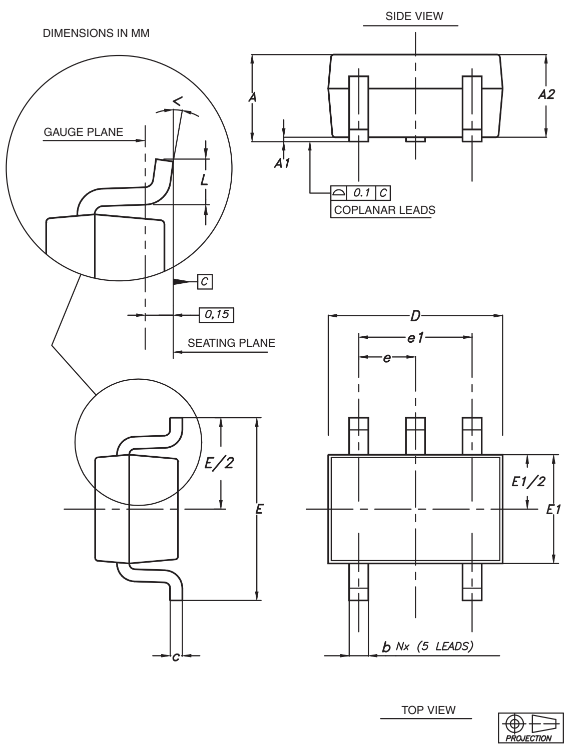


Table 11. SC70-5 (or SOT323-5) package mechanical data

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°			

5 Ordering information

Table 12. Order codes

Part number	Temperature range	Package	Packing	Marking
TSV630ILT	-40°C to +125°C	SOT23-6	Tape & reel	K108
TSV630ICT	-40°C to +125°C	SC70-6	Tape & reel	K18
TSV631ILT	-40°C to +125°C	SOT23-5	Tape & reel	K109
TSV631ICT	-40°C to +125°C	SC70-5	Tape & reel	K19
TSV630AILT	-40°C to +125°C	SOT23-6	Tape & reel	K141
TSV630AICT	-40°C to +125°C	SC70-6	Tape & reel	K41
TSV631AILT	-40°C to +125°C	SOT23-5	Tape & reel	K142
TSV631AICT	-40°C to +125°C	SC70-5	Tape & reel	K42

6 Revision history

Table 13. Document revision history

Date	Revision	Changes
19-Dec-2008	1	Initial release.
17-Aug-2009	2	Added root part numbers TSV630A and TSV631A on cover page.
13-Aug-2012	3	– Corrected the “Equivalent input noise voltage” values in *Table 3*, *5* and *6*. – Updated *Figure 15: Noise vs. frequency*.