TSH60,61,62,63,64

Wide-Band, Low-Power Operational Amplifiers with Standby

- 5V, ±5V specifications
- Gain-bandwidth product: 60MHz
- Slew-rate: 80V/µs
- Output current: up to 45mA
- Input/output rail-to-rail
- Specified for 150Ω load
- Low distortion, THD: 0.1%
- SO packages

Description

The TSH6x series offers single, dual, triple and quad operational amplifiers featuring high video performances.

The TSH6x op-amps can be used in consumer video applications, such as set-top boxes, DVD players and recorders, or TVs, as either video buffers or video line drivers. Their performances guarantee excellent video quality, enhancing the performance of your video solution.

Running at single supply voltage from 5V to 12V, amplifiers feature large output voltage swing and high output current capability to drive standard 150Ω loads.

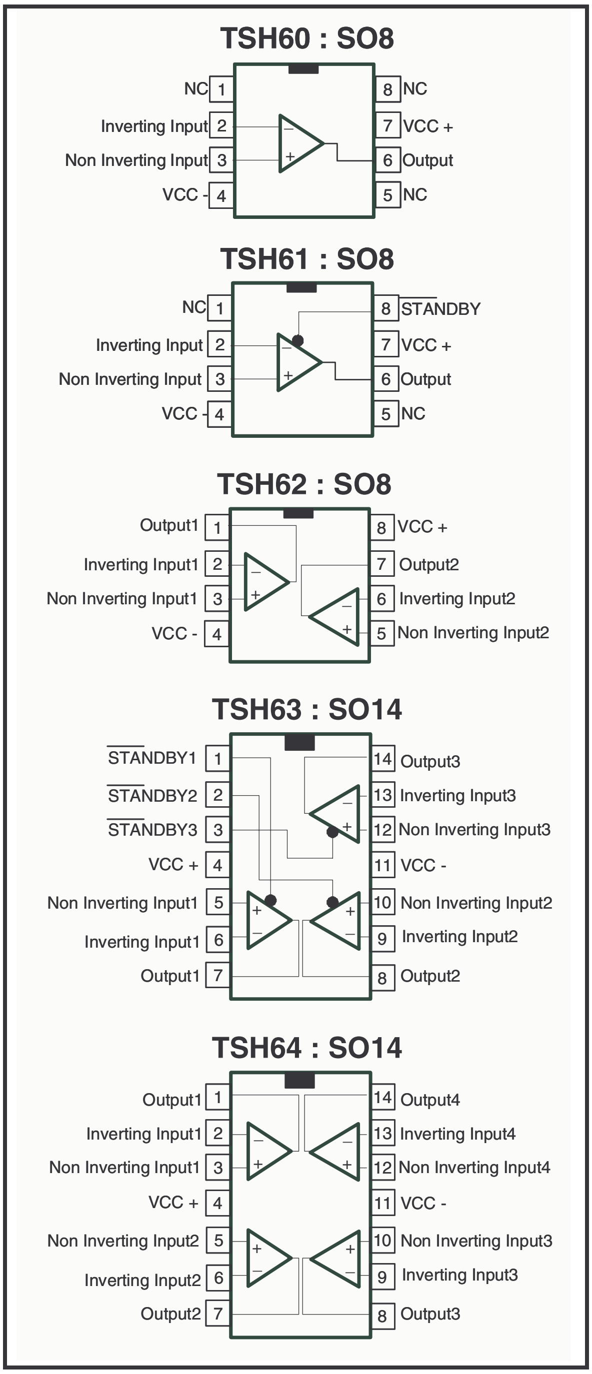
The TSH61 and TSH63 also feature standby inputs, allowing the op amps to be put into a standby mode with low power consumption and high output impedance.

For easy integration into video applications, the TSH6x series is proposed in standard SO8 and SO14 packages.

Applications

- Standard definition video buffers
- Set-top boxes
- DVD players and recorders
- Analog and digital TVs

Pin connections (top view)



1 Order Codes

Type	Temperature Range	Packages	Packing	Marking
TSH60CD/CDT	0°C to 70°C	SO8	Tube or Tape & Reel	TSH60C
TSH61CD/CDT				TSH61C
TSH62CD/CDT				TSH62C
TSH63CD/CDT		SO14		TSH63C
TSH64CD/CDT				TSH64C

2 Absolute Maximum Ratings and Operating Conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage (1)	14	V
V_{id}	Differential Input Voltage (2)	±2	V
V_i	Input Voltage (3)	±6	V
T_{oper}	Operating Free Air Temperature Range	0 to +70	°C
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thjc}	Thermal Resistance Junction to Case (4) SO8 SO14	 28 22	°C/W
R_{thja}	Thermal Resistance Junction to Ambiant Area SO8 SO14	 157 125	°C/W
ESD	HumanBodyModel	2	kV

1. All voltages values, except differential voltage are with respect to network ground terminal
2. Differential voltages are non-inverting input terminal with respect to the inverting terminal
3. The magnitude of input and output must never exceed V_{CC} +0.3V
4. Short-circuits can cause excessive heating

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	4.5 to 12	V
V_{IC}	Common Mode Input Voltage Range	V_{CC}^- to (V_{CC}^+ -1.1)	V

3 Standby Mode

Table 3. V_{CC}^+ (positive supply voltage), V_{CC}^- (negative supply voltage, or ground), T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Vl_{ow}	Standby Low Level		V_{CC}^-		$(V_{CC}^- +0.8)$	V
V_{high}	Standby High Level		$(V_{CC}^- +2)$		(V_{CC}^+)	V
$I_{CC\ STBY}$	Current Consumption per Operator when STANDBY is Active	pin 8 (TSH61) to V_{CC}^- pin 1,2 or 3 (TSH63) to V_{CC}^-		20	55	µA
Z_{out}	Output Impedance (Rout//Cout)	R_{out} C_{out}		10 17		MΩ pF
T_{on}	Time from Standby Mode to Active Mode			2		µs
T_{off}	Time from Active Mode to Standby Mode	Down to $I_{CC\ STBY}$ = 10µA		10		µs

TSH61 Standby Control pin 8 ($\overline{STBY}$)	Operator Status
V_{low}	Standby
V_{high}	Active

TSH63 Standby Control			Operator Status		
pin 1 ($\overline{STBY}$ OP1)	**pin 2** ($\overline{STBY}$ OP2)	**pin 3** ($\overline{STBY}$ OP3)	OP1	OP1	OP3
V_{low}	x	x	Standby	x	x
V_{high}	x	x	Active	x	x
x	V_{low}	x	x	Standby	x
x	V_{high}		x	Active	x
x	x	V_{low}	x	x	Standby
x	x	V_{high}	x	x	Active

4 Electrical Characteristics

Table 4. $V_{CC}^+ = 5V$, $V_{CC}^- = GND$, $V_{ic} = 2.5V$, $T_{amb} = 25°C$ (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$\|V_{io}\|$	Input Offset Voltage	$T_{amb} = 25°C$ $T_{min.} < T_{amb} < T_{max.}$		1.5	10 12	mV
I_{ib}	Input Bias Current			6		µA
C_{in}	Input Capacitance			0.3		pF
I_{CC}	Supply Current per Operator			8.2		mA
CMRR	Common Mode Rejection Ratio (δVic/δVio)	+0.1 < Vic < 3.9V & Vout = 2.5V		85		dB
PSRR	Power Supply Rejection Ratio (δVCC/δVout)	Positive & Negative Rail		70		dB
A_{vd}	Large Signal Voltage Gain	R_L=150Ω to 1.5V V_{out} =1V to 4V		78		dB
I_o	Output Short Circuit Current Source	V_{id} = +1, V_{out} to 1.5V V_{id} = -1, V_{out} to 1.5V |Source| Sink		45 45		mA
V_{oh}	High Level Output Voltage	R_L = 150Ω to GND R_L = 150Ω to 2.5V		4.36 4.66		V
V_{ol}	Low Level Output Voltage	R_L = 150Ω to GND R_L = 150Ω to 2.5V		48 220	100 400	mV
Bw	Bandwidth @-3dB	A_{VCL} = +1 R_L=150Ω to 2.5V		60		MHz
SR	Slew Rate	A_{VCL} = +2 R_L=150Ω to 2.5V		86		V/µs
φm	Phase Margin	R_L=150Ω to 2.5V		40		°
THD	Total Harmonic Distortion	A_{VCL} = +2, F = 4MHz R_L=150Ω to 2.5V V_{out} = 1Vpp V_{out} = 2Vpp		-57 -51		dB
ΔG	Differential gain	A_{VCL}= +2, R_L = 150Ω to 2.5V F = 4.5MHz, V_{out} = 2Vpp		0.5		%
Df	Differential phase	A_{VCL} = +2, R_L=150Ω to 2.5V F = 4.5MHz, V_{out} = 2Vpp		0.5		°
Gf	Gain Flatness	F= DC to 6MHz, A_{VCL}= +2		0.2		dB
Vo1/Vo2	Channel Separation	F=1MHz to 10MHz		65		dB

Table 5. V_{CC}^{+} = 5V, V_{CC}^{-} = -5V, V_{ic} = GND, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$\|V_{io}\|$	Input Offset Voltage	 $T_{min.} < T_{amb} < T_{max.}$		1.2	10 12	mV
I_{ib}	Input Bias Current			6		µA
C_{in}	Input Capacitance			0.7		pF
I_{CC}	Supply Current per Operator			9.8		mA
CMRR	Common Mode Rejection Ratio (δVic/δVio)	-4.9 <Vic < 3.9V & Vout = GND		94		dB
PSRR	Power Supply Rejection Ratio (δVCC/δVout)	Positive & Negative Rail		70		dB
A_{vd}	Large Signal Voltage Gain	R_L=150Ω to GND V_{out} =- 4 to +4		80		dB
I_o	Output Short Circuit Current Source	V_{id} = +1, V_{out} to 1.5V V_{id} =- 1, V_{out} to 1.5V |Source| Sink		 45 45		mA
V_{oh}	High Level Output Voltage	R_L = 150Ω to GND		4.36		V
V_{ol}	Low Level Output Voltage	R_L = 150Ω to GND		-4.63	-4.4	mV
Bw	Bandwidth @-3dB	A_{VCL}= +1 R_L = 150Ω to GND		74		MHz
SR	Slew Rate	A_{VCL}= +2 R_L=150Ω to GND		98		V/µs
φm	Phase Margin	R_L = 150Ω to GND		40		°
THD	Total Harmonic Distortion	A_{VCL} = +2, F = 4MHz R_L=150Ω to GND V_{out} = 1Vpp V_{out} = 2Vpp		 -57 -51		dB
ΔG	Differential gain	A_{VCL}= +2, R_L = 150Ω to GND F = 4.5MHz, V_{out} = 2Vpp		0.5		%
Df	Differential phase	A_{VCL}= +2, R_L=150Ω to GND F = 4.5MHz, V_{out} = 2Vpp		0.5		°
Gf	Gain Flatness	F = DC to 6MHz, A_{VCL}= +2		0.2		dB
Vo1/Vo2	Channel Separation	F = 1MHz to 10MHz		65		dB

Figure 1. Closed loop gain and phase vs. frequency (Gain = +2, V_{CC} = ±2.5V, R_L =150Ω, T_{amb} = 25°C)

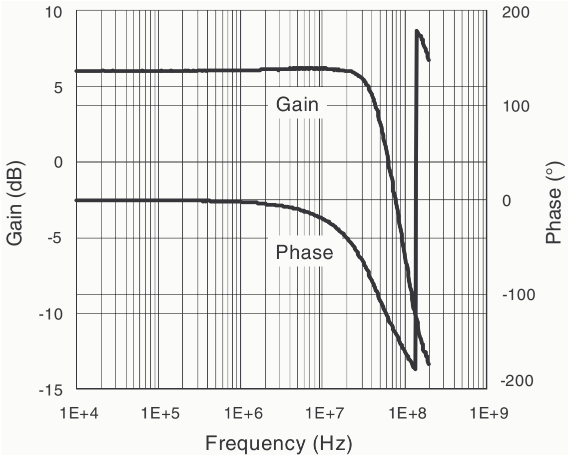


Figure 2. Standby mode - Ton, Toff (V_{CC} = ±2.5V, open loop)

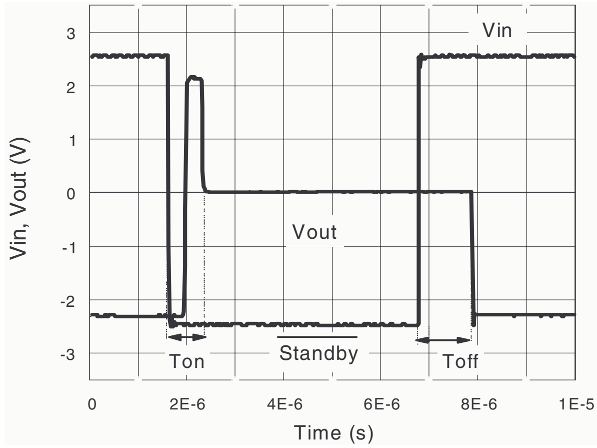


Figure 3. Large signal measurement - positive slew rate (Gain = 2, V_{CC} = ±2.5V, R_L = 150Ω//5.6pF, Vin = 1Vpk)

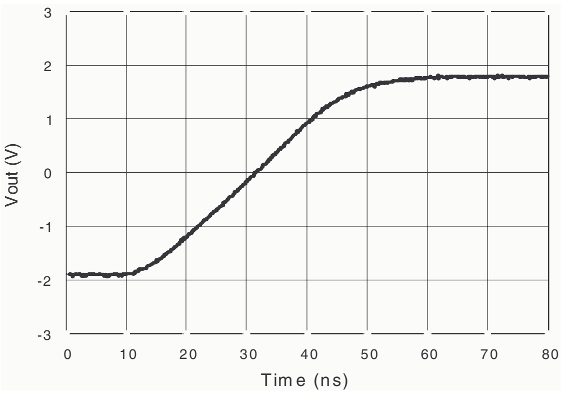


Figure 4. Large signal measurement - negative slew rate (Gain = 2, V_{CC}= ±2.5V, R_L = 150Ω//5.6pF, Vin = 1Vpk)

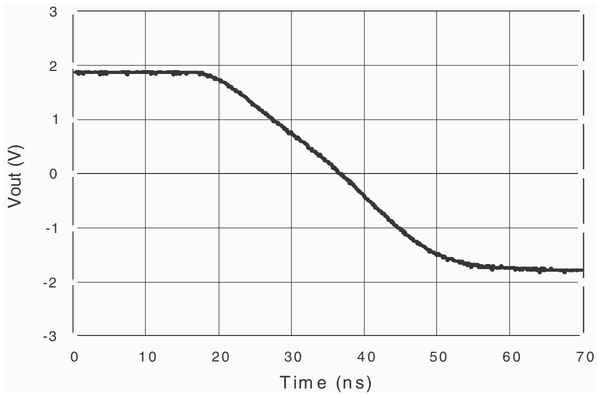


Figure 5. Small signal measurement - rise time (Gain = 2, V_{CC} = ±2.5V, Z_L = 150Ω, Vin = 25mVpk)

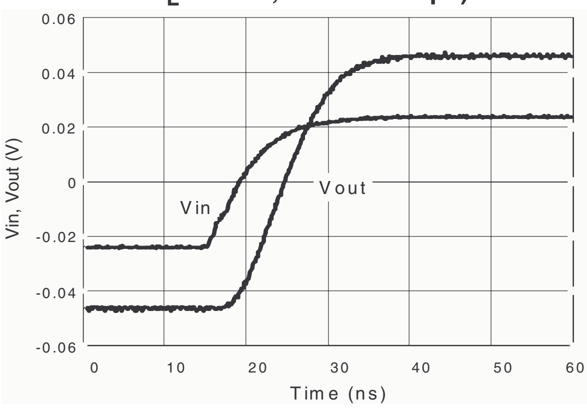


Figure 6. Small signal measurement - fall time (Gain = 2, V_{CC} = ±2.5V, Z_L = 150Ω, Vin = 25mVpk)

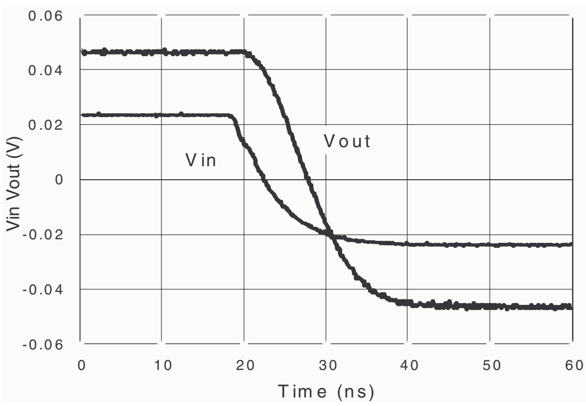


Figure 7. Equivalent noise voltage (Gain = 100, V_{CC} = ±2.5V, no load)

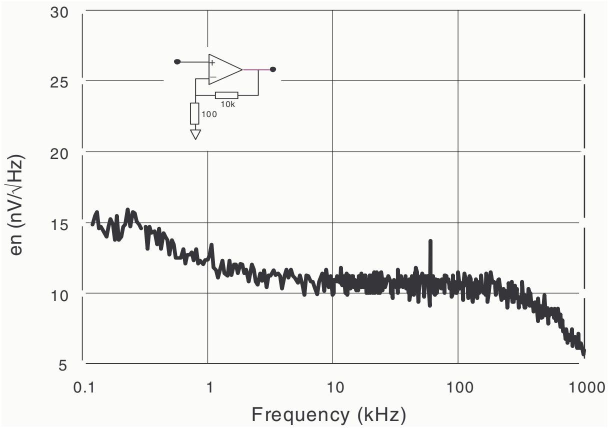
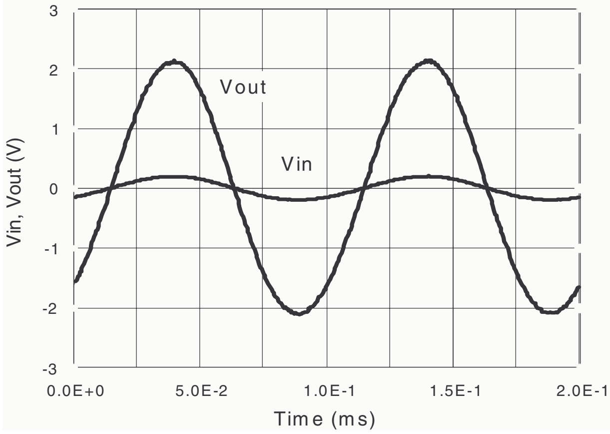


Figure 8. Maximum output swing (Gain = 11, V_{CC}= ±2.5V, R_L = 150Ω)



5 Video Applications

TSH6x operational amplifiers can be used to buffer standard definition video signals on 75-ohm video lines. An example of a video channel is shown below. A typical third-order filter and its response are also shown.

Figure 9. Implementation of a video driver on a video DAC output

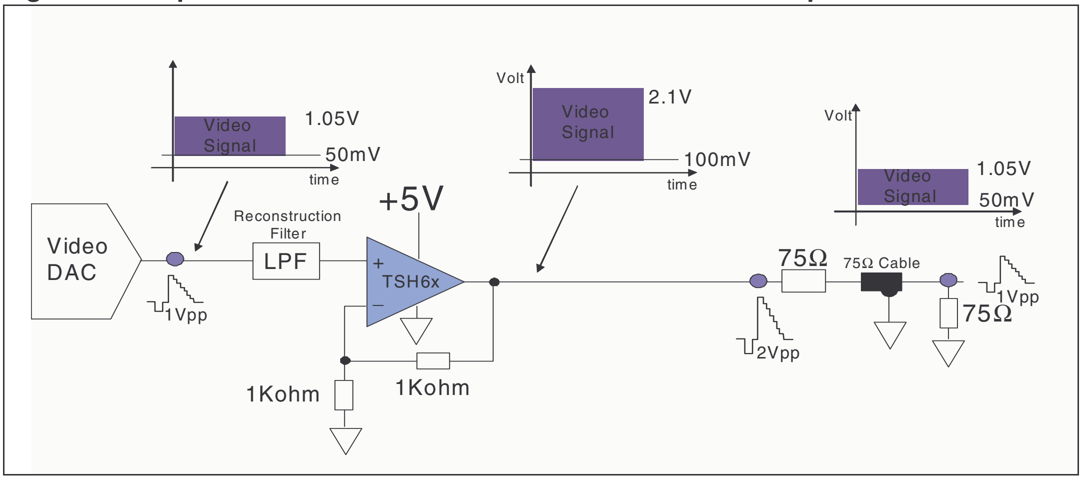
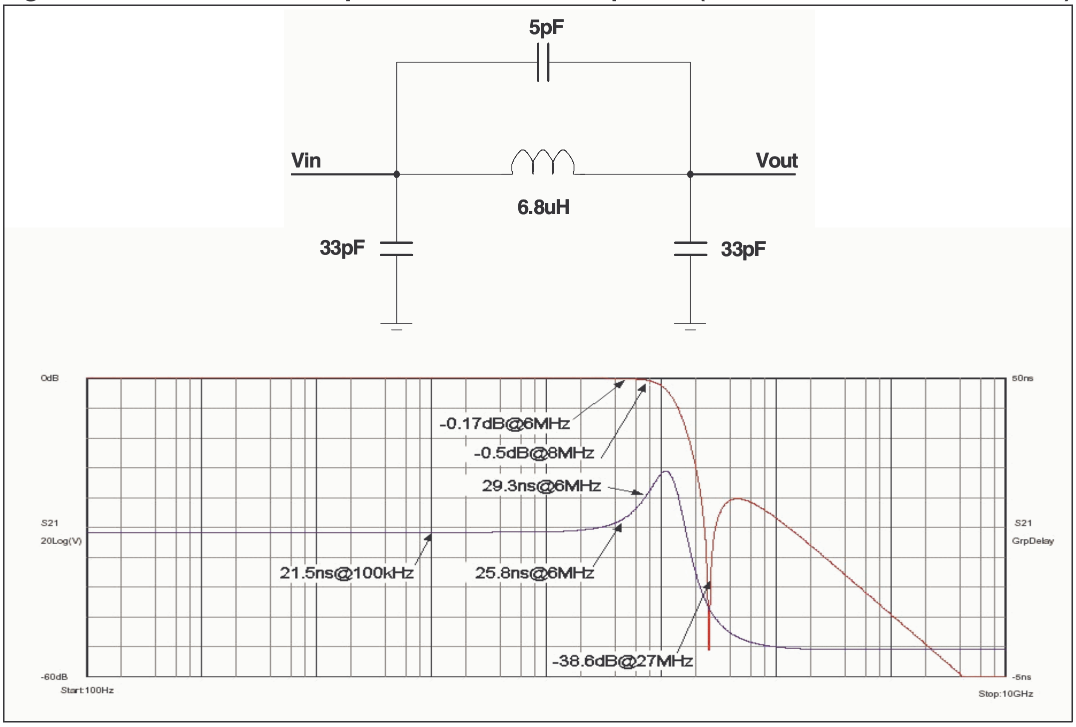


Figure 10. Third order low-pass filter and its response (for standard definition video)



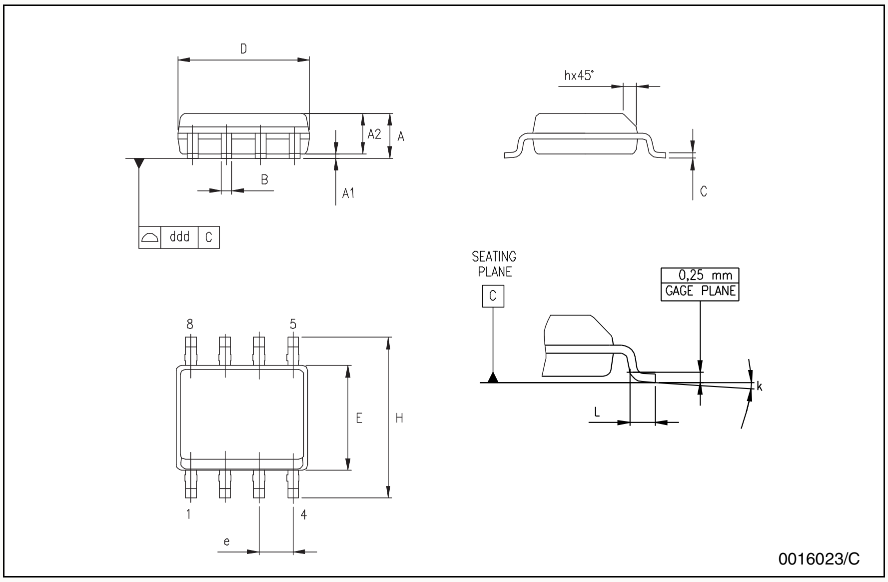
6 Package Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

6.1 SO-8 package

SO-8 MECHANICAL DATA

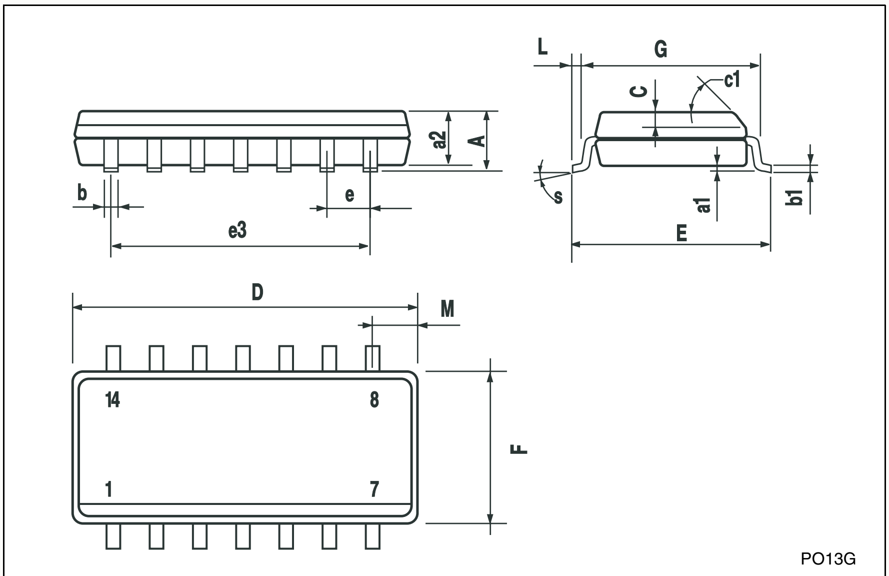
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



6.2 SO-14 package

SO-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
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.)					
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
S	8° (max.)					



7 Revision History

Table 6. Document revision history

Date	Revision	Changes
March 2006	1	First Release.