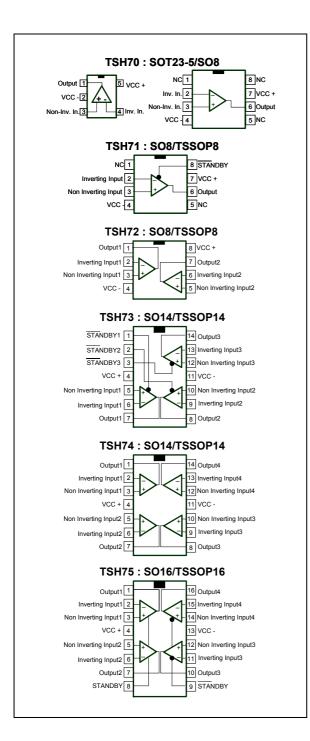


# TSH70, TSH71, TSH72, TSH73, TSH74, TSH75

Rail-to-rail, wide-band, low-power operational amplifiers

Datasheet - production data



#### **Features**

• 3 V, 5 V, ±5 V specifications

• 3 dB bandwidth: 90 MHz

Gain bandwidth product: 70 MHz
 Slew rate: 100 V/µs (typical for 5 V)

• Output current: up to 55 mA

Input single supply voltage

Output rail-to-rail

Specified for 150 Ω loads

Low distortion, THD: 0.1 %

SOT23-5, TSSOP, and SO packages

## **Applications**

Video buffers

ADC driver

· Hi-fi applications

## **Description**

The TSH7x series offers single, dual, triple, and quad operational amplifiers featuring high video performances with large bandwidth, low distortion, and excellent supply voltage rejection. Running with a single supply voltage from 3 V to 12 V, these amplifiers feature a large output voltage swing and high output current capable of driving standard 150  $\Omega$  loads. A low operating voltage makes TSH7x amplifiers ideal for use in portable equipment. The TSH71, TSH73, and TSH75 also feature standby inputs, each of which allows the op-amp to be put into a standby mode with low-power consumption and high-output impedance. This function allows power saving or signal switching/multiplexing for high-speed applications and video applications. To economize both board space and weight, the TSH7x series is proposed in SOT23-5, SO, and TSSOP packages.

Contents TSH7x

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#### Typical application: video driver 1

A typical application for the TSH7x family is that of a video driver for driving STi7xxx DAC outputs on 75-ohm lines.

Figure 1 show the benefits of the TSH7x family as single supply drivers.

Figure 1. Benefits of TSH7x family: +3 V or +5 V single supply solution +5V-Video DAC's outputs: VOH=4.2Vmin. (Tested) Bottom of +3V synchronization tip VOH=2.45Vmin. Vcc=+5V around 50mV (Tested) Vcc=+3V -2.1V [ 50mV VOL=40mVmax. (Tested) VOL=30mVmax. 100mV 100mV 1kΩ -5// **∵**GND 1+5V Reconstruction Filtering Y,G Video 1Vpp LPF TV DAC \_75Ω  $\mathbb{T}_{2\mathsf{Vpp}}^-$ Pb,B Reconstruction Filtering Video LPF  $75\Omega$ DAC \_75Ω Pr,R Reconstruction Filtering Video LPF 75Ω 0.7Vpp \_75Ω TSH73 GND ∜

# 2 Absolute maximum ratings and operating conditions

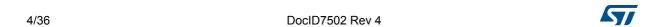
Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage <sup>(1)</sup>	14	
V <sub>id</sub>	Differential Input Voltage (2)	±2	V
V <sub>i</sub>	Input Voltage (3)	±6	
T <sub>oper</sub>	Operating Free Air Temperature Range	0 to +70	
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>j</sub>	Maximum Junction Temperature	150	
R <sub>thjc</sub>	Thermal resistance junction to case <sup>(4)</sup> SOT23-5 SO8 TSSOP08 SO14 TSSOP14 SO16 TSSOP16	80 28 37 22 32 35 35	°C/W
R <sub>thja</sub>	Thermal resistance junction to ambient area SOT23-5 SO8 TSSOPO8 SO14 TSSOP14 SO16 TSSOP16	250 157 130 125 110 110	G/VV
ESD	Human body model	2	kV

<sup>1.</sup> All voltages values, except differential voltage are with respect to the network ground terminal

**Table 2. Operating conditions** 

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply voltage	3 to 12	
V <sub>IC</sub>	Common mode input voltage range	V <sub>CC</sub> <sup>-</sup> to (V <sub>CC</sub> <sup>+</sup> -1.1)	V
Standby		$(V_{CC}^{-})$ to $(V_{CC}^{+})$	



<sup>2.</sup> Differential voltages are the non-inverting input terminal with respect to the inverting terminal

<sup>3.</sup> The magnitude of the input and output must never exceed  $V_{CC}$  +0.3V

<sup>4.</sup> Short-circuits can cause excessive heating

## 3 Electrical characteristics

Table 3.  $V_{CC}^+$  = 3 V,  $V_{CC}^-$  = GND,  $V_{IC}$  = 1.5 V,  $T_{amb}$  = 25 °C (unless otherwise specified)

Symbol	Parameter Test conditions		Min.	Тур.	Max.	Unit
V <sub>io</sub>	Input offset voltage	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		1.2	10 12	mV
$\Delta V_{io}$	Input offset voltage drift vs. temp.	T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		4		μV/°C
I <sub>io</sub>	Input offset current	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		0.1	3.5 5	μΑ
I <sub>ib</sub>	Input bias current	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		6	15 20	μΑ
C <sub>in</sub>	Input capacitance			0.2		pF
I <sub>CC</sub>	Supply current per operator	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		7.2	9.8 11	mA
CMRR	Common mode rejection ratio (δV <sub>IC</sub> /δVio)	+0.1 < V <sub>IC</sub> <+1.9 V and V <sub>out</sub> = 1.5 V T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>	65 64	90		
SVRR	Supply voltage rejection ratio (δVCC/δVio)	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>	66 65	74		dB
PSRR	Power supply rejection ratio (δVCC/δV <sub>out</sub> )	Positive and negative rail		75		QD.
A <sub>vd</sub>	Large signal voltage gain	$R_L$ = 150 Ω to 1.5 V, $V_{out}$ = 1 V to 2 V $T_{amb}$ = 25 °C $T_{min.}$ < $T_{amb}$ < $T_{max.}$	70 65	81		
I <sub>o</sub>	Output short circuit current source	$\begin{split} T_{amb} = & 25  ^{\circ}\text{C}, \\ V_{id} = & +1,  V_{out}  \text{to}  1.5  \text{V}, \\ V_{id} = & -1,  V_{out}  \text{to}  1.5  \text{V} \\  _{Source} \\  _{Sink} \\ T_{min.} < T_{amb} < T_{max.} \\ V_{id} = & +1,  V_{out}  \text{to}  1.5  \text{V} \\ V_{id} = & -1,  V_{out}  \text{to}  1.5  \text{V} \\  _{Source} \\  _{Sink} \end{split}$	30 20 22 19	43 33		mA
V <sub>OH</sub>	High level output voltage	$T_{amb}$ = 25 °C $R_{L}$ = 150 Ω to GND $R_{L}$ = 600 Ω to GND $R_{L}$ = 2 kΩ to GND $R_{L}$ = 10 kΩ to GND $R_{L}$ = 10 kΩ to 1.5 V $R_{L}$ = 600 Ω to 1.5 V $R_{L}$ = 2 kΩ to 1.5 V $R_{L}$ = 10 kΩ to 1.5 V $R_{L}$ = 10 kΩ to 1.5 V $R_{L}$ = 10 kΩ to 1.5 V	2.45 2.65 2.4 2.6	2.60 2.87 2.91 2.93 2.77 2.90 2.92 2.93		V

Table 3.  $V_{CC}^+$  = 3 V,  $V_{CC}^-$  = GND,  $V_{IC}$  = 1.5 V,  $T_{amb}$  = 25 °C (unless otherwise specified) (continued)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>OL</sub>	Low level output voltage	$T_{amb}$ = 25 °C $R_L$ = 150 Ω to GND $R_L$ = 600 Ω to GND $R_L$ = 2 kΩ to GND $R_L$ = 10 kΩ to GND $R_L$ = 150 Ω to 1.5 V $R_I$ = 600 Ω to 1.5 V		10 11 11 11 11 140 90	30	mV
		$R_{L} = 2 \text{ k}\Omega \text{ to } 1.5 \text{ V}$ $R_{L} = 10 \text{ k}\Omega \text{ to } 1.5 \text{ V}$ $T_{\text{min.}} < T_{\text{amb}} < T_{\text{max.}}$ $R_{L} = 150 \Omega \text{ to GND}$ $R_{L} = 150 \Omega \text{ to } 1.5 \text{ V}$		68 57	40 350	
GBP	Gain bandwidth product	$F = 10 \text{ MHz}$ $A_{VCL} = +11$ $A_{VCL} = -10$		65 55		MHz
Bw	Bandwidth @-3dB	A <sub>VCL</sub> =+1, R <sub>L</sub> =150 Ω to 1.5 V		87		
SR	Slew rate	$A_{VCL}$ =+2, $R_{L}$ =150 Ω// $C_{L}$ to 1.5 V $C_{L}$ = 5 pF $C_{L}$ = 30 pF	45	80 85		V/µs
φm	Phase margin	R <sub>L</sub> =150 $\Omega$ // 30 pF to 1.5 V		40		٥
en	Equivalent input noise voltage	F=100 kHz		11		nV/√Hz
THD	Total harmonic distortion	$A_{VCL}$ = +2, F = 4 MHz, $R_L$ =150 $\Omega$ // 30pF to 1.5 V $V_{out}$ = 1 Vpp $V_{out}$ = 2 Vpp		-61 -54		dB
IM2	Second order intermodulation product	$A_{VCL}$ = +2, $V_{out}$ = 2 Vpp $R_L$ = 150 Ω to 1.5 V Fin1 = 180 kHz, Fin2 = 280 kHz spurious measurements @100 kHz		-76		dBc
IM3	Third order inter modulation product	$A_{VCL}$ = +2, $V_{out}$ = 2 Vpp $R_L$ = 150 Ω to 1.5 V Fin1 = 180kHz, Fin2 = 280 kHz spurious measurements @400 kHz		-68		ubc
ΔG	Differential gain	$A_{VCL}$ =+2, $R_{L}$ = 150 $\Omega$ to 1.5 V F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		%
Df	Differential phase	$A_{VCL}$ = +2, $R_{L}$ = 150 $\Omega$ to 1.5 V F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		٥
Gf	Gain flatness	$F = DC$ to 6 MHz, $A_{VCL} = +2$		0.2		dB
Vo1/Vo2	Channel separation	F = 1 MHz to 10 MHz		65		



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

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>io</sub>	Input offset voltage	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		1.1	10 12	mV
$\Delta V_{io}$	Input offset voltage drift vs. temp.	T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		3		μV/°C
I <sub>io</sub>	Input offset current	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		0.1	3.5 5	μΑ
I <sub>ib</sub>	Input bias current	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		6	15 20	μΛ
C <sub>in</sub>	Input capacitance			0.3		pF
I <sub>CC</sub>	Supply current per operator	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		8.2	10.5 11.5	mA
CMRR	Common mode rejection ratio (8V <sub>IC</sub> /8Vio)		72 71	97		
SVRR	Supply voltage rejection ratio (δV <sub>CC</sub> /δVio)	$T_{amb} = 25^{\circ}C$ $T_{min.} < T_{amb} < T_{max.}$	68 67	75		
PSRR	Power supply rejection ratio $(\delta V_{CC}/\delta V_{out})$	Positive and negative rail		75		dB
A <sub>vd</sub>	Large signal voltage gain	$R_{L} = 150 \Omega \text{ to } 1.5 \text{ V},$ $V_{out} = 1 \text{ V to } 4 \text{ V}$ $T_{amb} = 25 \text{ °C}$ $T_{min.} < T_{amb} < T_{max.}$	75 70	84		
I <sub>o</sub>	Output short circuit current source	$\begin{split} T_{amb} &= 25 \text{ °C}, \\ V_{id} &= +1, V_{out} \text{ to } 1.5 \text{ V}, \\ V_{id} &= -1, V_{out} \text{ to } 1.5 \text{ V} \\ &  \text{Source} \\ &  \text{Sink} \\ T_{min.} &< T_{amb} < T_{max.} \\ V_{id} &= +1, V_{out} \text{ to } 1.5 \text{ V} \\ V_{id} &= -1, V_{out} \text{ to } 1.5 \text{ V} \\ &  \text{Source} \\ &  \text{Sink} \end{split}$	35 33 34 32	55 55		mA
V <sub>OH</sub>	High level output voltage	$T_{amb}$ = 25 °C $R_L$ = 150 Ωto GND $R_L$ = 600 Ωto GND $R_L$ = 2 kΩto GND $R_L$ = 10 kΩto GND $R_L$ = 150 Ωto 2.5 V $R_L$ = 600 Ωto 2.5 V $R_L$ = 2 kΩto 2.5 V $R_L$ = 10 kΩto 2.5 V $R_L$ = 10 kΩto 2.5 V $R_L$ = 10 kΩto 2.5 V	4.2 4.5 4.1 4.4	4.36 4.85 4.90 4.93 4.66 4.90 4.92 4.93		V



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

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
		$T_{amb}$ =25 °C $R_{L}$ = 150 Ωto GND $R_{L}$ = 600 Ωto GND $R_{L}$ = 2 kΩto GND $R_{L}$ = 10 kΩto GND		20 23 23 23	40	
V <sub>OL</sub>	Low level output voltage	$R_L$ = 150 $\Omega$ to 2.5 V $R_L$ = 600 $\Omega$ to 2.5 V $R_L$ = 2 k $\Omega$ to 2.5 V $R_L$ = 10 k $\Omega$ to 2.5 V		220 105 76 61	400	mV
		$T_{min.} < T_{amb} < T_{max.}$ $R_L = 150 \Omega to GND$ $R_L = 150 \Omega to 2.5 V$			60 450	
GBP	Gain bandwidth product	$F = 10 \text{ MHz}$ $A_{VCL} = +11$ $A_{VCL} = -10$		65 55		MHz
Bw	Bandwidth @-3 dB	$A_{VCL}$ = +1, $R_{L}$ = 150 $\Omega$ to 2.5 V		87		
SR	Slew rate	$A_{VCL} = +2,$ $R_{L} = 150\Omega // C_{L}$ to 2.5 V $C_{L} = 5 \text{ pF}$ $C_{L} = 30 \text{ pF}$	60	104 105		V/μs
φm	Phase margin	$R_L = 150 \Omega // 30 \text{ pF to } 2.5 \text{ V}$		40		0
en	Equivalent input noise voltage	F = 100 kHz		11		nV/√Hz
THD	Total harmonic distortion	$A_{VCL}$ = +2, F = 4 MHz $R_{L}$ = 150 $\Omega$ // 30 pF to 2.5 V $V_{out}$ = 1 Vpp $V_{out}$ = 2 Vpp		-61 -54		dB
IM2	Second order intermodulation product	$A_{VCL}$ = +2, $V_{out}$ = 2Vpp $R_L$ = 150 $\Omega$ to 2.5 V Fin1 = 180 kHz, Fin2 = 280 kHz spurious measurements @100 kHz		-76		dBc
IM3	Third order inter modulation product	$A_{VCL}$ = +2, $V_{out}$ = 2 Vpp $R_L$ = 150 $\Omega$ to 2.5 V Fin1 = 180 kHz, Fin2 = 280 kHz spurious measurements @400 kHz		-68		ubc .
ΔG	Differential gain	$A_{VCL}$ = +2, $R_{L}$ = 150 $\Omega$ to 2.5 V F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		%
Df	Differential phase	$A_{VCL}$ = +2, $R_{L}$ = 150 $\Omega$ to 2.5 V F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		0
Gf	Gain flatness	$F = DC$ to 6 MHz, $A_{VCL} = +2$		0.2		dB
Vo1/Vo2	Channel separation	F = 1 MHz to 10 MHz		65		



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

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>io</sub>	Input offset voltage	$T_{amb}$ = 25 °C $T_{min.}$ < $T_{amb}$ < $T_{max.}$		8.0	10 12	mV
$\Delta V_{io}$	Input offset voltage drift vs. temp.	T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>		2		μV/°C
I <sub>io</sub>	Input offset current	$T_{amb}$ = 25°C $T_{min.}$ < $T_{amb}$ < $T_{max.}$		0.1	3.5 5	μА
I <sub>ib</sub>	Input bias current	$T_{amb}$ = 25°C $T_{min.}$ < $T_{amb}$ < $T_{max.}$		6	15 20	μιτ
C <sub>in</sub>	Input capacitance			0.7		pF
I <sub>CC</sub>	Supply current per operator	$T_{amb} = 25$ °C $T_{min.} < T_{amb} < T_{max.}$		9.8	12.3 13.4	mA
CMRR	Common mode rejection ratio $(\delta V_{IC}/\delta V_{IO})$	$ \begin{aligned} -4.9 &< V_{IC} < 3.9 \text{ V and } V_{out} = \text{GND} \\ T_{amb} &= 25 \text{ °C} \\ T_{min.} &< T_{amb} < T_{max.} \end{aligned} $	81 80	106		
SVRR	Supply voltage rejection ratio $(\delta V_{CC}/\delta V_{IO})$	T <sub>amb</sub> = 25 °C T <sub>min.</sub> < T <sub>amb</sub> < T <sub>max.</sub>	71 70	77		
PSRR	Power supply rejection ratio $(\delta V_{CC}/\delta V_{out})$	Positive and negative rail		75		dB
A <sub>vd</sub>	Large signal voltage gain	$R_{L} = 150 \Omega \text{ to GND}$ $V_{out} = -4 \text{ to } +4$ $T_{amb} = 25 \text{ °C}$ $T_{min.} < T_{amb} < T_{max.}$	75 70	86		
I <sub>o</sub>	Output short circuit current source	$\begin{split} T_{amb} &= 25  ^{\circ}\text{C} \\ V_{id} &= +1,  V_{out}  \text{to}  1.5  \text{V} \\ V_{id} &= -1,  V_{out}  \text{to}  1.5  \text{V} \\ &   \text{Source} \\   \text{Sink} \\ T_{min.} &< T_{amb} < T_{max.} \\ V_{id} &= +1,  V_{out}  \text{to}  1.5  \text{V} \\ V_{id} &= -1,  V_{out}  \text{to}  1.5  \text{V} \\ &   \text{Source} \\ &   \text{Sink} \end{split}$	35 30 34 29	55 55		mA
V <sub>OH</sub>	High level output voltage	$\begin{split} T_{amb} &= 25 \text{ °C} \\ R_L &= 150 \Omega\text{ to GND} \\ R_L &= 600 \Omega\text{ to GND} \\ R_L &= 2 k\Omega\text{ to GND} \\ R_L &= 10 k\Omega\text{ to GND} \\ T_{min.} &< T_{amb} < T_{max.} \\ R_L &= 150 \Omega\text{ to GND} \end{split}$	4.2	4.36 4.85 4.9 4.93		V
V <sub>OL</sub>	Low level output voltage	$T_{amb} = 25  ^{\circ}\text{C}$ $R_{L} = 150  \Omega  \text{to GND}$ $R_{L} = 600  \Omega  \text{to GND}$ $R_{L} = 2  k\Omega  \text{to GND}$ $R_{L} = 10  k\Omega  \text{to GND}$ $T_{min.} < T_{amb} < T_{max.}$ $R_{L} = 150  \Omega  \text{to GND}$		-4.63 -4.86 -4.9 -4.93	-4.4 -4.3	V

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

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit	
GBP	Gain bandwidth product	$F = 10 \text{ MHz}$ $A_{VCL} = +11$ $A_{VCL} = -10$		65 55		MHz	
Bw	Bandwidth @-3dB	$A_{VCL}$ = +1 $R_L$ = 150 $\Omega$ // 30 pF to GND		100		MHz	
SR	Slew rate	$A_{VCL} = +2,$ $R_{L} = 150 \Omega // C_{L} \text{ to GND}$ $C_{L} = 5 \text{ pF}$ $C_{L} = 30 \text{ pF}$	68	117 118		V/µs	
φm	Phase margin	$R_L = 150 \Omega \text{ to GND}$		40		0	
en	Equivalent input noise voltage	F = 100 kHz		11		nV/√Hz	
THD	Total harmonic distortion	$A_{VCL}$ = +2, F = 4 MHz $R_L$ = 150 $\Omega$ // 30 pF to GND $V_{out}$ = 1 Vpp $V_{out}$ = 2 Vpp		-61 -54		dB	
IM2	Second order intermodulation product	$A_{VCL}$ = +2, $V_{out}$ = 2 Vpp $R_L$ = 150 Ω to GND Fin1 = 180 kHz, Fin2 = 280 kHz spurious measurements @100 kHz		-76		dPo	
IM3	Third order intermodulation product	$A_{VCL}$ = +2, $V_{out}$ = 2 Vpp $R_L$ = 150 Ω to GND Fin1 = 180 kHz, Fin2 = 280 kHz spurious measurements @400 kHz	z -68			- dBc	
ΔG	Differential gain	$A_{VCL}$ = +2, $R_L$ = 150 $\Omega$ to GND F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		%	
Df	Differential phase	$A_{VCL}$ = +2, $R_L$ = 150 $\Omega$ to GND F = 4.5 MHz, $V_{out}$ = 2 Vpp		0.5		٥	
Gf	Gain flatness	F = DC to 6 MHz, A <sub>VCL</sub> = +2		0.2		dB	
Vo1/Vo2	Channel separation	F = 1 MHz to 10 MHz		65		ub	

## 3.1 Standby mode

Table 6.  $V_{CC}^+$ ,  $V_{CC}^-$ ,  $T_{amb}$  = 25 °C (unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>low</sub>	Standby low level		V <sub>CC</sub> -		(V <sub>CC</sub> +0.8)	V
V <sub>high</sub>	Standby high level		(V <sub>CC</sub> <sup>-</sup> +2)		(V <sub>CC</sub> <sup>+</sup> )	
I <sub>CC STBY</sub>	Current consumption per operator when STANDBY is active	Pin 8 (TSH71) to $V_{CC}^-$ Pin 1, 2 or 3 (TSH73) to $V_{CC}^-$ Pin 8 (TSH75) to $V_{CC}^+$ Pin 9 (TSH75) to $V_{CC}^-$		20	55	μΑ
Z <sub>out</sub>	Output impedance (R <sub>out</sub> //C <sub>out</sub> )	R <sub>out</sub> C <sub>out</sub>		10 17		MΩ pF
T <sub>on</sub>	Time from standby mode to active mode			2		116
T <sub>off</sub>	Time from active mode to standby mode	Down to $I_{CC STBY} = 10 \mu A$		10		μS

#### Table 7. TSH71 standby function table

TSH71 standby control pin 8 (STBY)	Operator status
V <sub>low</sub>	Standby
$V_{high}$	Active

#### Table 8. TSH73 standby function table

TS	SH73 standby cont	rol	Operator status			
Pin 1 (STBY OP1)	Pin 2 (STBY OP2)	Pin 3 (STBY OP3)	OP1	OP1	OP3	
V <sub>low</sub>	х	х	Standby	х	х	
$V_{high}$	х	х	Active	х	х	
х	V <sub>low</sub>	х	х	Standby	х	
х	V <sub>high</sub>		х	Active	х	
х	х	V <sub>low</sub>	х	х	Standby	
х	х	$V_{high}$	х	х	Active	

Table 6. Form 6 canday function able								
TSH75 stan	dby control	Operator status						
Pin 8 TBY OP2)	Pin 9 (STBY OP3)	OP1	OP1 OP2 OP3 OP4					
$V_{high}$	$V_{low}$		Standby	Standby				
$V_{high}$	$V_{high}$	Standby —		Active	Active			

Active

Table 9. TSH75 standby function table

Active

#### Characteristic curves for $V_{CC} = 3 \text{ V}$ 3.2

Figure 2. Closed loop gain and phase vs. frequency (gain = +2,  $V_{CC}$  = ±1.5 V,  $R_L$  = 150  $\Omega$ T<sub>amb</sub> = 25 °C)

 $V_{low}$ 

 $V_{high}$ 

Pin 8 (STBY OP2)

 $V_{low}$ 

 $V_{low}$ 

100 Gain -100 -15 -20 -200 1E+9 1E+5 1E+6 1E+7 1E+8 1E+4 Frequency (Hz)

Figure 3. Overshoot function of output capacitance (gain = +2,  $V_{CC}$  = ±1.5 V,  $T_{amb} = 25 \,^{\circ}C$ 

Standby

Active

Active

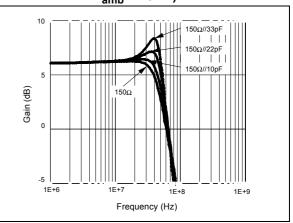
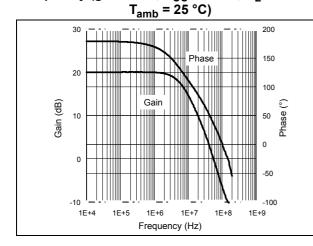
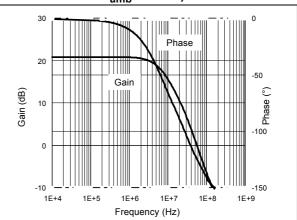


Figure 4. Closed loop gain and phase vs. frequency (gain = -10,  $V_{CC}$  =  $\pm 1.5$  V,  $R_L$  = 150  $\Omega$ 

Figure 5. Closed loop gain and phase vs. frequency (gain = +11,  $V_{CC}$  = ±1.5 V,  $R_L$  = 150  $\Omega$ ,  $T_{amb} = 25 \, ^{\circ}C)$ 

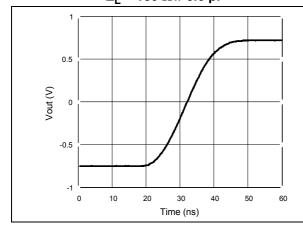




TSH7x Electrical characteristics

Figure 6. Large signal measurement - positive slew rate (gain = 2,  $V_{CC}$  = ±1.5 V,  $Z_L$  = 150  $\Omega$  // 5.6 pF

Figure 7. Large signal measurement - negative slew rate (gain = 2,  $V_{CC}$  = ±1.5 V,  $Z_L$  = 150  $\Omega$  // 5.6 pF)



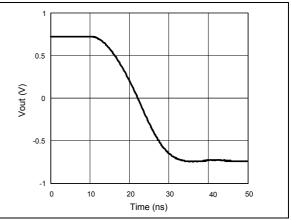
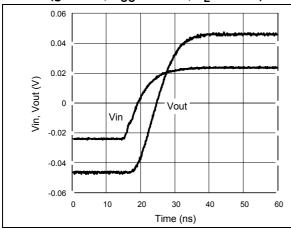


Figure 8. Small signal measurement - rise time (gain = 2,  $V_{CC}$  = ±1.5 V,  $Z_L$  = 150  $\Omega$ )

Figure 9. Small signal measurement - fall time (gain = 2,  $V_{CC}$  = ±1.5 V,  $Z_L$  = 150  $\Omega$ )



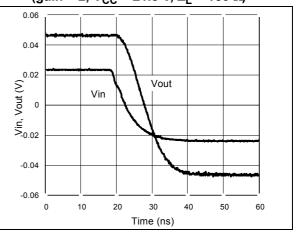
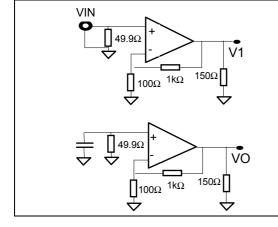


Figure 10. Channel separation (Xtalk) vs. frequency (measurement configuration: Xtalk = 20 log (V0/V1))

Figure 11. Channel separation (Xtalk) vs. frequency (gain = +11,  $V_{CC}$  = 1.5 V,  $Z_L$  = 150  $\Omega$  // 27 pF)



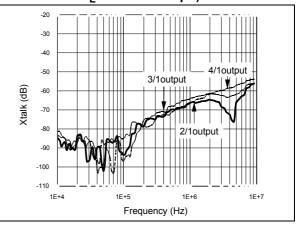


Figure 12. Equivalent noise voltage (gain = 100,  $V_{CC}$  = ±1.5 V, No load)

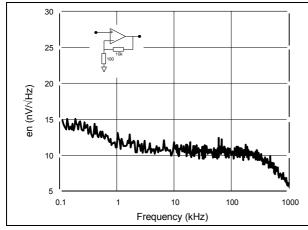


Figure 13. Maximum output swing (gain = 11,  $V_{CC}$  = ±5 V,  $R_L$  = 150  $\Omega$ 

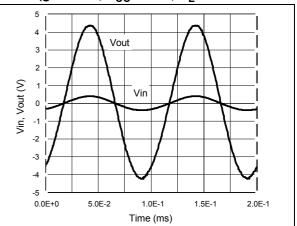


Figure 14. Standby mode -  $T_{on}$ ,  $T_{off}$  ( $V_{CC} = \pm 1.5 \text{ V}$ , open loop)

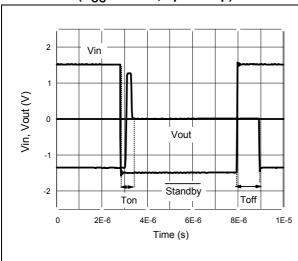


Figure 15. Group delay gain = 2 ( $V_{CC}$  =  $\pm$ 1.5 V,  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C)

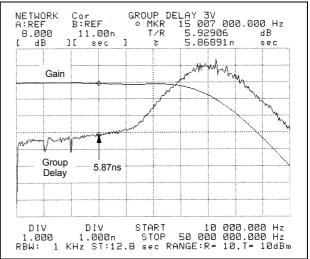
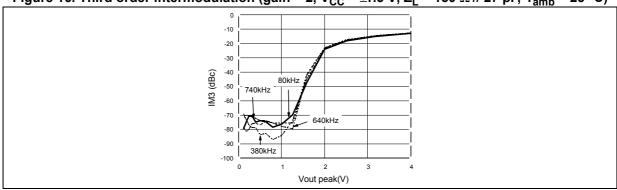


Figure 16. Third order intermodulation (gain = 2,  $V_{CC}$  =  $\pm 1.5$  V,  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C)



1. Note on intermodulation products:

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The IFR2026 synthesizer generates a two tone signal (F1 = 180 kHz, F2 = 280 kHz); each tone has the same amplitude level.

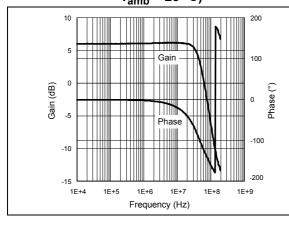
The HP3585 spectrum analyzer measures the intermodulation products function of the output voltage. The generator and the spectrum analyzer are phase locked for precision considerations.

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#### Characteristic curves for $V_{CC} = 5 V$ 3.3

Figure 17. Closed loop gain and phase vs. frequency (gain = +2,  $V_{CC}$  = ±2.5 V,  $R_L$  = 150  $\Omega$ ,  $T_{amb}$  = 25 °C)

Figure 18. Overshoot function of output capacitance (gain = +2,  $V_{CC}$  =  $\pm 2.5 V$ ,  $T_{amb} = 25 °C)$ 



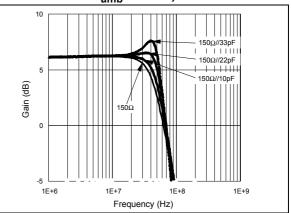
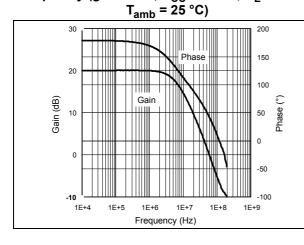
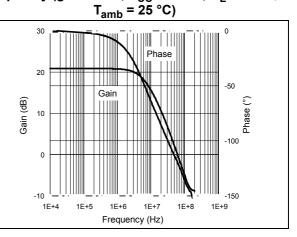


Figure 19. Closed loop gain and phase vs.

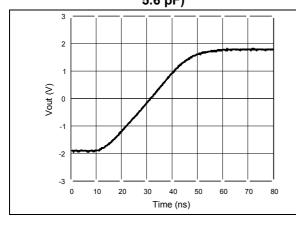
Figure 20. Closed loop gain and phase vs. frequency (gain = -10,  $V_{CC}$  =  $\pm 2.5$  V,  $R_L$  = 150  $\Omega$ , frequency (gain = +11,  $V_{CC}$  =  $\pm 2.5$  V,  $R_L$  = 150  $\Omega$ 





slew rate (gain = 2,  $V_{CC}$  = ±2.5 V,  $Z_L$ = 150  $\Omega$  // 5.6 pF)

Figure 21. Large signal measurement - positive Figure 22. Large signal measurement - negative slew rate (gain = 2,  $V_{CC}$  = ±2.5 V,  $Z_L$  = 150  $\Omega$  // 5.6 pF)



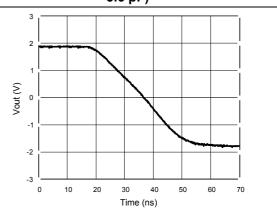


Figure 23. Small signal measurement - rise time (gain = 2,  $V_{CC}$  = ±2.5 V,  $Z_L$  = 150  $\Omega$ ) (gain = 2,  $V_{CC}$  = ±2.5 V,  $Z_L$  = 150  $\Omega$ )

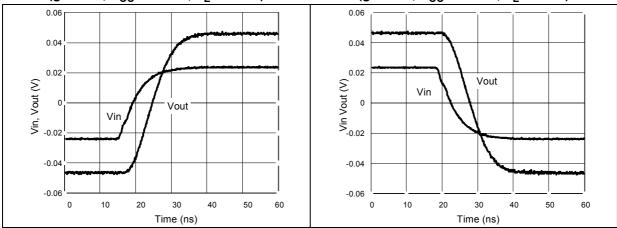


Figure 25. Channel separation (Xtalk) vs. frequency (measurement configuration: Xtalk = 20 log (V0/V1))

Figure 26. Channel separation (Xtalk) vs. frequency (gain = +11,  $V_{CC}$  =  $\pm 2.5$  V,  $Z_L$  = 150  $\Omega$  // 27 pF)

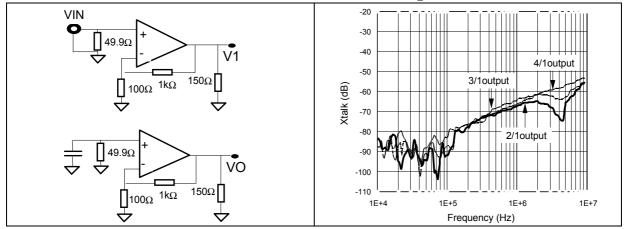
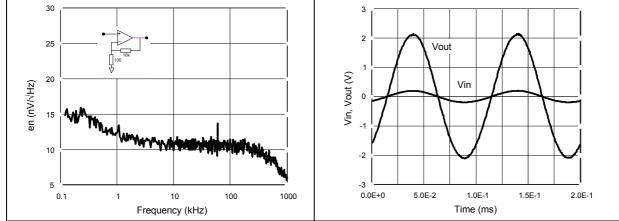


Figure 27. Equivalent noise voltage (gain = 100, V<sub>CC</sub> = ±2.5 V, no load)

Figure 28. Maximum output swing (gain = 11,  $V_{CC}$  = ±2.5 V,  $R_L$  = 150  $\Omega$ )



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Figure 29. Standby mode -  $T_{on}$ ,  $T_{off}$  $(V_{CC} = \pm 2.5 \text{ V, open loop})$ 

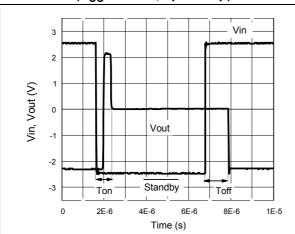


Figure 30. Group delay (gain = 2,  $V_{CC}$  =  $\pm 2.5$  V,  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C)

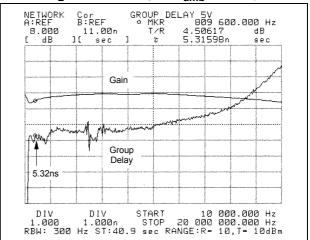
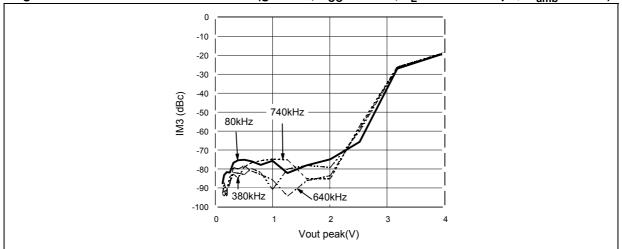


Figure 31. Third order intermodulation (gain = 2,  $V_{CC}$  =  $\pm 2.5 \ V$ ,  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C)



Note on intermodulation products: The IFR2026 synthesizer generates a two tone signal (F1 = 180 kHz, F2 = 280 kHz); each tone has the same amplitude

The HP3585 spectrum analyzer measures the intermodulation products function of the output voltage. The generator and the spectrum analyzer are phase locked for precision considerations.

## 3.4 Characteristic curves for $V_{CC} = 10 \text{ V}$

Figure 32. Closed loop gain and phase vs. frequency (gain = +2,  $V_{CC}$  = ±5 V,  $R_L$  = 150  $\Omega$ ,  $T_{amb}$  = 25 °C)

Figure 33. Overshoot function of output capacitance (gain = +2,  $V_{CC}$  =  $\pm 5$  V,  $T_{amb}$  = 25 °C)

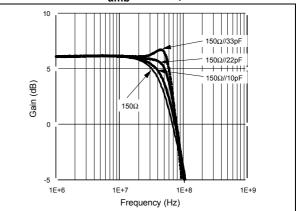
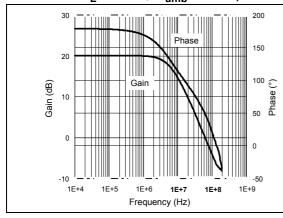


Figure 34. Closed loop gain and phase vs. frequency (gain = -10,  $V_{CC}$  = ±5 V,  $R_L$  = 150  $\Omega$ ,  $T_{amb}$  = 25 °C)

Frequency (Hz)

Figure 35. Closed loop gain and phase vs. frequency (gain = +11,  $V_{CC}$  =  $\pm 5$  V,  $R_L$  = 150  $\Omega$ ,  $T_{amb}$  = 25 °C)



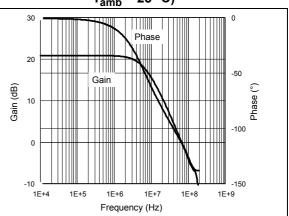
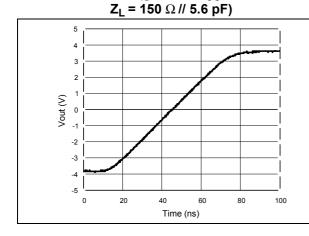
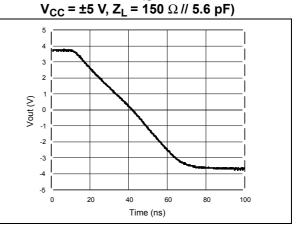


Figure 36. Large signal measurement - positive Figure 37. Large signal measurement - negative slew rate (gain = 2, $V_{CC}$  =  $\pm 5$  V, slew rate (gain = 2





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Figure 38. Small signal measurement - rise time (gain = 2,  $V_{CC}$  = ±5 V,  $Z_L$  = 150  $\Omega$ ) Figure 39. Small signal measurement - fall time (gain = 2,  $V_{CC}$  = ±5 V,  $Z_L$  = 150  $\Omega$ )

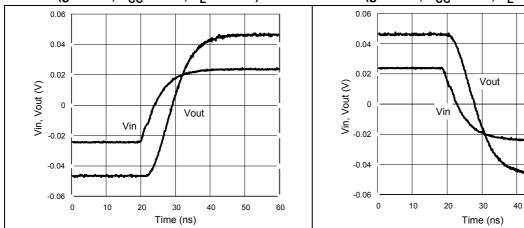


Figure 40. Channel separation (Xtalk) vs. frequency (measurement configuration: Xtalk = 20 log(V0/V1))

Figure 41. Channel separation (Xtalk) vs. frequency (gain = +11,  $V_{CC}$  =  $\pm 5$  V,  $Z_L$  = 150  $\Omega$  // 27 pF)

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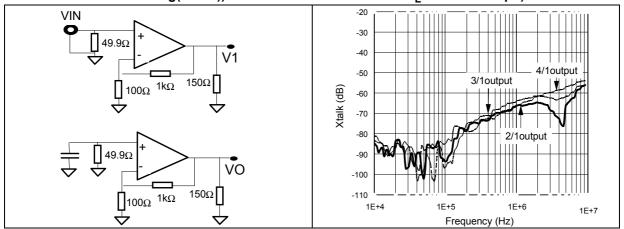


Figure 42. Equivalent noise voltage (gain = 100, V<sub>CC</sub> = ±5 V, no load)

Figure 43. Maximum output swing (gain = 11,  $V_{CC}$  = ±5 V,  $R_L$  = 150  $\Omega$ )

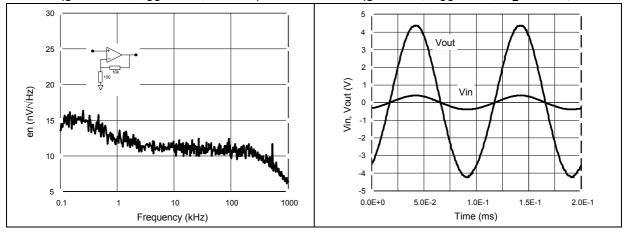
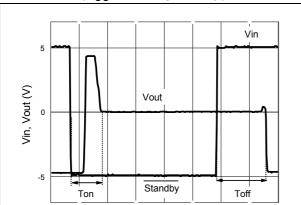


Figure 44. Standby mode -  $T_{on}$ ,  $T_{off}$  ( $V_{CC}$  = ±5 V, open loop)



4E-6

Time (s)

6E-6

0

20/36

2E-6

Figure 45. Group delay (gain = 2,  $V_{CC}$ =  $\pm 5$  V  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C)

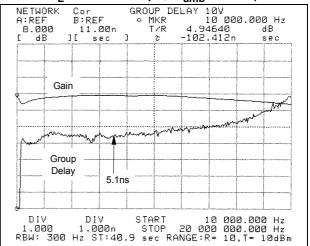
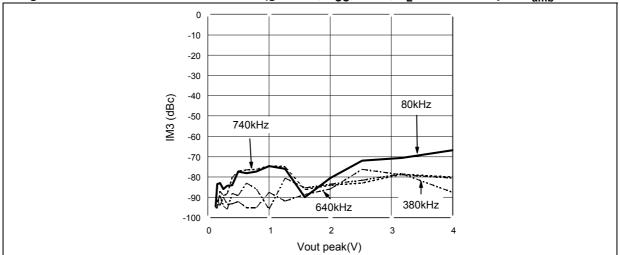


Figure 46. Third order intermodulation (gain = 2,  $V_{CC}$  =  $\pm 5$  V,  $Z_L$  = 150  $\Omega$  // 27 pF,  $T_{amb}$  = 25 °C

8E-6



 Note on intermodulation products: The IFR2026 synthesizer generates a two tone signal (F1 = 180 kHz, F2 = 280 kHz); each tone has the same amplitude level.

The HP3585 spectrum analyzer measures the intermodulation products function of the output voltage. The generator and the spectrum analyzer are phase locked for precision considerations.

TSH7x Testing conditions

## 4 Testing conditions

#### 4.1 Layout precautions

To use the TSH7X circuits in the best manner at high frequencies, some precautions have to be taken for power supplies:

- First of all, the implementation of a proper ground plane on both sides of the PCB is mandatory for high-speed circuit applications to provide low inductance and low resistance common return.
- Power supply bypass capacitors (4.7 µF and ceramic 100 pF) should be placed as close as possible to the IC pins in order to improve high frequency bypassing and reduce harmonic distortion. The power supply capacitors must be incorporated for both the negative and the positive pins.
- Proper termination of all inputs and outputs must be in accordance with output termination resistors. In this way, the amplifier load is resistive only, and the stability of the amplifier is improved.
- All leads must be wide and as short as possible (especially for op-amp inputs and outputs) in order to decrease parasitic capacitance and inductance.
- For lower gain applications, care should be taken to avoid large feedback resistance (> 1  $k\Omega$ ) in order to reduce the time constant of parasitic capacitances.
- Choose component sizes as small as possible (SMD)
- Finally, on output, the load capacitance must be negligible to maintain good stability.
   You can put a serial resistance as close as possible to the output pin to minimize capacitance.

Testing conditions TSH7x

## 4.2 Maximum input level

Figure 47. CCIR330 video line

The input level must not exceed the following values:

- Negative peak: must be greater than -V<sub>CC</sub>+400 mV
- Positive peak value: must be lower than +V<sub>CC</sub>-400 mV

The electrical characteristics show the influence of the load on this parameter.

## 4.3 Video capabilities

To characterize the differential phase and differential gain, a CCIR330 video line is used.

The video line contains five (flat) levels of luma on which is superimposed a chroma signal. The first level contains no luma. The luma gives various amplitudes which define the saturation of the signal. The chrominance gives various phases which define the color of the signal.

Differential phase (respectively differential gain) distortion is present if a signal chrominance phase (gain) is affected by luminance level. They represent the ability to uniformly process the high frequency information at all luminance levels.

When differential gain is present, color saturation is not correctly reproduced.

The input generator is the Rohde and Schwarz CCVS. The output measurement was made by the Rohde and Schwarz VSA.

TSH7x Testing conditions

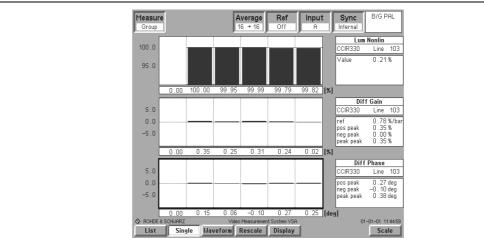


Figure 48. Measurement on Rohde and Schwarz VSA

Table 10. Video results

Parameter	Value V <sub>CC</sub> = ±2.5 V	Value V <sub>CC</sub> = ±5 V	Unit
Lum NL	0.1	0.3	
Lum NL step 1	100	100	
Lum NL step 2	100	99.9	
Lum NL step 3	99.9	99.8	
Lum NL step 4	99.9	99.9	
Lum NL step 5	99.9	99.7	
Diff gain pos	0	0	
Diff gain neg	-0.7	-0.6	70
Diff gain pp	0.7	0.6	
Diff gain step1	-0.5	-0.3	
Diff gain step2	-0.7	-0.6	
Diff gain step3	-0.3	-0.5	
Diff gain step4	-0.1	-0.3	
Diff gain step5	-0.4	-0.5	
Diff phase pos	0	0.1	
Diff phase neg	-0.2	-0.4	
Diff phase pp	0.2	0.5	
Diff phase step1	-0.2	-0.4	dog
Diff phase step2	-0.1	-0.4	deg
Diff phase step3	-0.1	-0.3	
Diff phase step4	0	0.1	
Diff phase step5	-0.2	-0.1	

Testing conditions TSH7x

#### 4.4 Precautions when operating on an asymmetrical supply

The TSH7X can be used with either a dual or a single supply. If a single supply is used, the inputs are biased to the mid-supply voltage ( $+V_{CC}/2$ ). This bias network must be carefully designed, in order to reject any noise present on the supply rail.

As the bias current is 15  $\mu$ A, you must carefully choose the resistance R1 so as not to introduce an offset mismatch at the amplifier inputs.

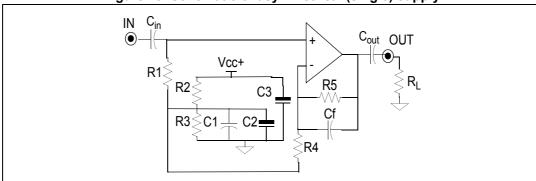


Figure 49. Schematic of asymmetrical (single) supply

R1 = 10 k $\Omega$  is a typical and convenient value. C1, C2, C3 are bypass capacitors that filter perturbations on V<sub>CC</sub>, as well as for the input and output signals. We choose C1 = 100 nF and C2 = C3 = 100  $\mu$ F.

R2, R3 are such that the current through them must be greater than 100 times the bias current. Therefore, we set R2 = R3 =  $4.7 \text{ k}\Omega$ 

 $C_{in}$ , as  $C_{out}$ , is chosen to filter the DC signal by the low-pass filters (R1, $C_{in}$  and  $R_{out}$ ,  $C_{out}$ ). By taking R1 = 10 k $\Omega$ ,  $R_L$  = 150  $\Omega$ , and  $C_{in}$  = 2  $\mu$ F,  $C_{out}$  = 220  $\mu$ F we provide a cut-off frequency below 10 Hz.

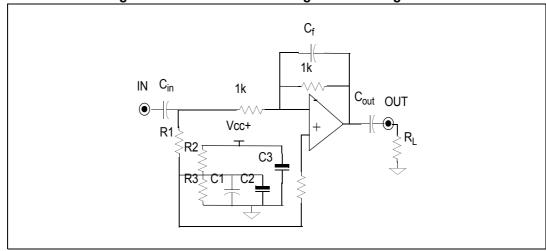


Figure 50. Use of the TSH7x in gain = -1 configuration

Some precautions must be taken, especially for low-power supply applications.

TSH7x Testing conditions

A feedback capacitance,  $C_f$ , should be added for better stability. *Table 11* summarizes the impact of the capacitance  $C_f$  on the phase margin of the circuit.

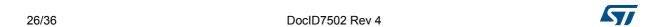
Table 11. Impact capacitance C<sub>f</sub>

Parameter	C <sub>f</sub> (pF)	V <sub>CC</sub> = ±1.5 V	V <sub>CC</sub> = ±2.5 V	V <sub>CC</sub> = ±5 V	Unit
Phase margin	0	28	43	56	deg
f-3 dB		40	39.3	38.3	MHz
Phase margin	5.6	30	43	56	deg
f-3 dB	5.0	40	39.3	38.3	MHz
Phase margin	22	37	52	67	deg
f-3 dB	22	37	34	32	MHz
Phase margin	33	48	65	78	deg
f-3 dB	33	33.7	30.7	27.6	MHz

Package information TSH7x

# 5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: <a href="https://www.st.com">www.st.com</a>. ECOPACK<sup>®</sup> is an ST trademark.



TSH7x Package information

## 5.1 SOT23-5 package information

A1

E1

E1

E

D

Figure 51. SOT23-5 package mechanical drawing

Table 12. SOT23-5 package mechanical data

	Dimensions							
Symbol		Millimeters			Inches			
	Min	Тур	Max	Min	Тур	Max		
Α	0.90		1.45	0.035		0.057		
A1	0.00		0.15	0.000		0.006		
A2	0.90		1.30	0.035		0.051		
b	0.35		0.50	0.014		0.020		
С	0.09		0.20	0.004		0.008		
D	2.80		3.00	0.110		0.118		
E	2.60		3.00	0.102		0.118		
E1	1.50		1.75	0.059		0.069		
е		0.95			0.037			
e1		1.9			0.075			
L	0.35		0.55	0.014		0.022		

Package information TSH7x

## 5.2 SO8 package information

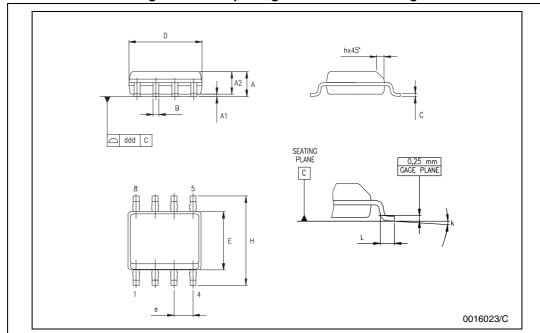


Figure 52. SO8 package mechanical drawing

Table 13. SO8 package mechanical data

		Dimensions							
Symbol		Millimeters			Inches				
	Min	Тур	Max	Min	Тур	Max			
Α	1.35		1.75	0.053		0.069			
A1	0.10		0.25	0.004		0.010			
A2	1.10		1.65	0.043		0.065			
В	0.33		0.51	0.013		0.020			
С	0.19		0.25	0.007		0.010			
D	4.80		5.00	0.189		0.197			
Е	3.80		4.00	0.150		0.157			
е		1.27			0.050				
Н	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°			8°			
ddd			0.1			0.004			

TSH7x Package information

# 5.3 TSSOP8 package information

O.25 mm
O.10 inch
GAGE PLANE

PIN 1 IDENTIFICATION

O079397/D

Figure 53. TSSOP8 package mechanical drawing

Table 14. TSSOP8 package mechanical data

	Dimensions							
Symbol		Millimeters			Inches			
	Min	Тур	Max	Min	Тур	Max		
Α			1.2			0.047		
A1	0.05		0.15	0.002		0.006		
A2	0.80	1.00	1.05	0.031	0.039	0.041		
b	0.19		0.30	0.007		0.012		
С	0.09		0.20	0.004		0.008		
D	2.90	3.00	3.10	0.114	0.118	0.122		
Е	6.20	6.40	6.60	0.244	0.252	0.260		
E1	4.30	4.40	4.50	0.169	0.173	0.177		
е		0.65			0.0256			
K	0°		8°	0 °		8°		
L	0.45	0.60	0.75	0.018	0.024	0.030		
L1		1	_		0.039			

Package information TSH7x

# 5.4 SO14 package information

D M M PO13G

Figure 54. SO14 package mechanical drawing

Table 15. SO14 package mechanical data

	Dimensions						
Symbol		Millimeters			Inches		
	Min	Тур	Max	Min	Тур	Max	
Α			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	
С		0.5			0.019		
c1		45 °			45°		
D	8.55		8.75	0.336		0.344	
E	5.8		6.2	0.228		0.244	
е		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	
М			0.68			0.026	
S			8°			8°	



TSH7x Package information

## 5.5 TSSOP14 package information

A A2 A1 D D E1

PIN 1 IDENTIFICATION 1 0080337D

Figure 55. TSSOP14 package mechanical drawing

Table 16. TSSOP14 package mechanical data

	Dimensions							
Symbol		Millimeters			Inches			
	Min	Тур	Max	Min	Тур	Max		
Α			1.2			0.047		
A1	0.05		0.15	0.002	0.004	0.006		
A2	0.8	1	1.05	0.031	0.039	0.041		
b	0.19		0.30	0.007		0.012		
С	0.09		0.20	0.004		0.0089		
D	4.9	5	5.1	0.193	0.197	0.201		
E	6.2	6.4	6.6	0.244	0.252	0.260		
E1	4.3	4.4	4.48	0.169	0.173	0.176		
е		0.65			0.0256			
K	0°		8°	0°		8°		
L	0.45	0.60	0.75	0.018	0.024	0.030		

Package information TSH7x

## 5.6 SO16 package information

Figure 56. SO16 package mechanical drawing

Table 17. SO16 package mechanical data

	Dimensions						
Symbol		Millimeters			Inches		
	Min	Тур	Max	Min	Тур	Max	
Α			1.75			0.068	
a1	0.1		0.2	0.004		0.008	
a2			1.65			0.064	
b	0.35		0.46	0.013		0.018	
b1	0.19		0.25	0.007		0.010	
С		0.5			0.019		
c1		45°			45 °		
D	9.8			0.385		0.393	
E	5.8		10	0.228		0.244	
е		1.27	6.2		0.050		
e3		8.89			0.350		
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	
М			0.62			0.024	
S			8°			8°	



TSH7x Package information

## 5.7 TSSOP16 package information

A A2 A1 D C K E

PIN 1 IDENTIFICATION 1 0080338D

Figure 57. TSSOP16 package mechanical drawing

Table 18. TSSOP16 package mechanical data

	Dimensions							
Symbol		Millimeters			Inches			
	Min	Тур	Max	Min	Тур	Max		
Α			1.2			0.047		
A1	0.05		0.15	0.002		0.006		
A2	0.8	1	1.05	0.031	0.039	0.041		
b	0.19		0.30	0.007		0.012		
С	0.09		0.20	0.004		0.0079		
D	4.9	5	5.1	0.193	0.197	0.201		
Е	6.2	6.4	6.6	0.244	0.252	0.260		
E1	4.3	4.4	4.48	0.169	0.173	0.176		
е		0.65			0.0256			
K	0 °		8°	0°		8°		
L	0.45	0.60	0.75	0.018	0.024	0.030		

Order information TSH7x

# 6 Order information

Table 19. Order codes

Part number	Temperature range	Package	Packing	Marking
TSH70CLT		SOT23-5	Tape and reel	K301
TSH70CD/CDT		SO8	Tube or tane and real	70C
TSH71CD/CDT		306	Tube or tape and reel	710
TSH71CPT		TSSOP8	Tape and reel	71C
TSH72CD/CDT		SO8	Tube or tape and reel	72C
TSH72CPT	0 °C to 70 °C	TSSOP8	Tape and reel	120
TSH73CD/CDT	0 0 10 70 0	SO14	Tube or tape and reel	73C
TSH73CPT		TSSOP14	Tape and reel	730
TSH74CD/CDT		SO14	Tube or tape and reel	74C
TSH74CPT		TSSOP14	Tape and reel	740
TSH75CD/CDT		SO16	Tube or tape and reel	750
TSH75CPT		TSSOP16	Tape and reel	75C

TSH7x Revision history

# 7 Revision history

Table 20. Document revision history

Date	Revision	Changes
Nov. 2000	1	First Release.
Aug. 2002	2	Limit min. of I <sub>sink</sub> from 24mA to 20mA (only on 3V power supply). Reason: yield improvement.
May 2006	3	Improvement of VOL max. at 3V and 5V power supply on 150-ohm load connected to GND (pages 6 and 8).  Reason: TSH7x can drive video signals from DACs to lines in single supply (3V or 5V) without any DC level change of the video signals.  Grammatical and typographical changes throughout.  Package mechanical data updated.
05-Dec-2013	4	Updated slew rate in <i>Features Table 12: SOT23-5 package mechanical data</i> : added information for inches.

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