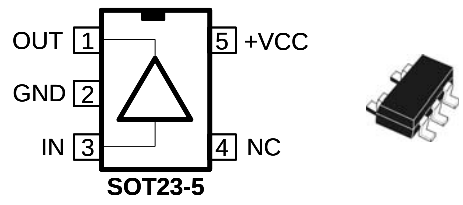
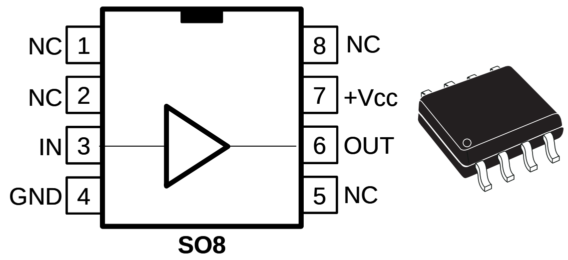
TSH340

320MHz Single Supply Video Buffer with Low In/Out Rail

- **Bandwidth: 320MHz**
- **Single supply operation down to 3V**
- **Low input & output rail**
- **Very low harmonic distortion**
- **Slew rate: 780V/µs**
- **Voltage input noise: 7nV/√Hz**
- **Specified for 150Ω and 100Ω loads**
- **Internal gain of 6dB**
- **Compatible with the PCB layout of a single op-amp**
- **Tested on 5V power supply**
- **Data min. and max. are tested during production**

Pin Connections (top view)





Description

The TSH340 is a single supply video buffer featuring an internal gain of 6dB and a large bandwidth of 320MHz for only 9.8mA of quiescent current.

An **advantage** of this circuit is its input and output negative rail feature, which is very close to GND in single supply. This rail is tested and guaranteed during production at 60mV maximum from GND on a 150Ω load. This allows a good output swing which fits perfectly when driving a video signal on a 75Ω video line. *Chapter 5* of this datasheet gives technical support when using the TSH340 as a driver for video DAC output on a video line. In particular, this chapter focuses on applying a video signal DC shift to avoid any clamping of the synchronization tip.

The TSH340 is available in tiny SOT23-5 and SO8 plastic packages.

Applications

- **High-end video systems**
- **High Definition TV (HDTV)**
- **Broadcast and graphic video**
- **Multimedia products**

Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
TSH340ILT	-40°C to +85°C	SOT23-5	Tape & Reel	K306
TSH340ID		SO-8	Tube	TSH340I
TSH340IDT			Tape & Reel	TSH340I

1 Absolute Maximum Ratings

Table 1. Key parameters and their absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	6	V
V_{in}	Input Voltage Range [2]	-0.2 to +3	V
T_{oper}	Operating Free Air Temperature Range	-40 to +85	°C
T_{std}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thjc}	Thermal Resistance Junction to Case SOT23-5 SO8	 80 75	°C/W
R_{thja}	Thermal Resistance Junction to Ambient Area SOT23-5 SO8	 250 175	°C/W
$P_{max.}$	Maximum Power Dissipation (@Ta=25°C) for Tj=150°C SOT23-5 SO8	 500 715	mW
ESD	CDM: Charged Device Model HBM: Human Body Model MM: Machine Model	2 1.5 200	kV kV V

1) All voltage values, except differential voltage, are with respect to network terminal.

2) The magnitude of input and output voltage must never exceed V_{CC} +0.3V.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Power Supply Voltage	3 to 5.5[1]	V
Vicm	Common Mode Input Voltage	-0.4 to 3	V

1) Tested in full production at 0V/5V single power supply

2 Electrical Characteristics

Table 3. V_{CC} = +5V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
DC Performance						
V_{OS}	Output Offset Voltage[1]	no Load, T_{amb}	-30	-5	+30	mV
		-40°C < T_{amb} < +85°C		-6.8		
I_{ib}	Input Bias Current	T_{amb}, V_{icm}=0.6V		6	16	µA
		-40°C < T_{amb} < +85°C		7.2		
PSR	Power Supply Rejection Ratio 20 log ($\Delta V_{cc}/\Delta V_{out}$)	ΔV_{cc}=200mVp-p, F=1MHz		-90		dB
ICC	Total Supply Current	no Load, V_{in}=100mV		9.8	12.8	mA
G	DC Voltage Gain	RL = 150Ω	1.95	2	2.05	V/V
Rin	Input Resistance	T_{amb}		8		MΩ
Cin	Input Capacitance	T_{amb}		3.2		pF
Dynamic Performance and Output Characteristics						
Bw	-3dB Bandwidth	Small Signal Vout=20mVp V_{icm}=0.6V, RL = 150Ω	190	320		MHz
	Gain Flatness @ 0.1dB	Small Signal Vout=20mVp V_{icm}=0.6V, RL = 150Ω		63		
FPBW	Full Power Bandwidth	V_{icm}=0.6V, V_{OUT} = 2Vp-p, R_L = 150Ω	130	200		MHz
SR	Slew Rate	Vicm=0.6V, V_{OUT} = 2Vp-p, R_L = 150Ω		780		V/µs
V_{OH}	High Level Output Voltage	R_L = 150Ω	3.7	3.9		V
V_{OL}	Low Level Output Voltage	R_L = 150Ω		40	60	mV
I_{OUT}	Output Short Circuit Current (Isource)	T_{amb}		100		mA
		-40°C < T_{amb} < +85°C		90		
	Output Current	Vout=2Vp, T_{amb}	45	87		mA
Noise and Distortion						
eN	Equivalent Input Noise Voltage	F = 100kHz		7		nV/√Hz
iN	Equivalent Input Noise Current	F = 100kHz		1.5		pA/√Hz
HD2	2nd Harmonic Distortion	V_{OUT} = 2Vp-p, R_L = 150Ω F= 10MHz,		-85		dBc
HD3	3rd Harmonic Distortion	V_{OUT} = 1Vp-p, R_L = 150Ω F= 10MHz,		-75		dBc

1) Output Offset Voltage is determined from the following expression: $V_{OUT} = G.V_{IN} + V_{OS}$

Figure 1. Frequency response

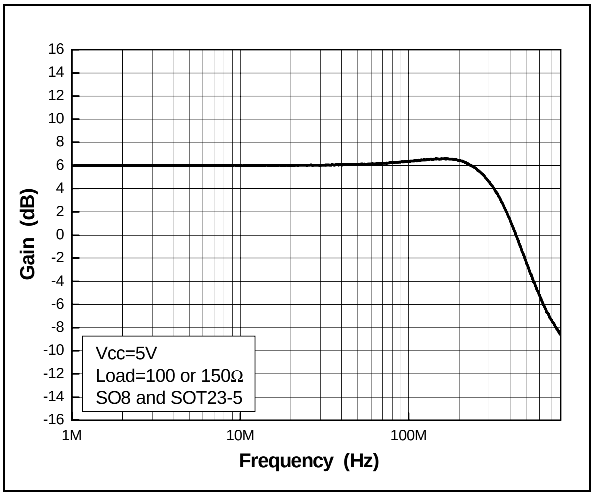


Figure 4. Frequency response on capa-load

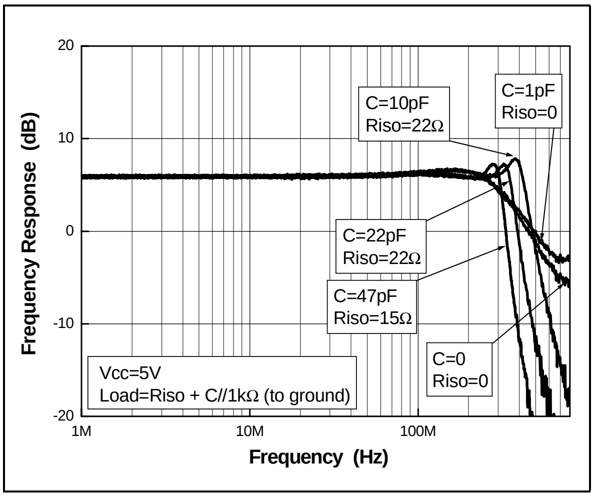


Figure 2. Gain flatness - SOT23-5

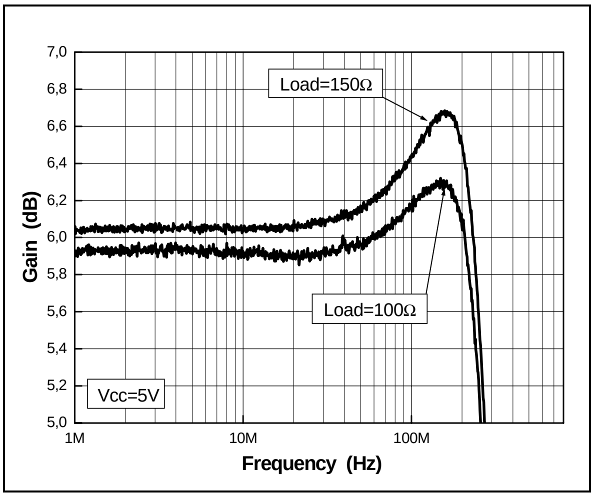


Figure 5. Gain flatness - SO8

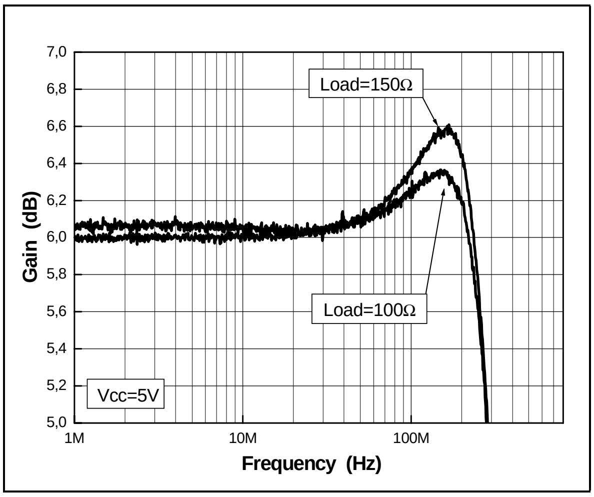


Figure 3. Total input noise vs. frequency

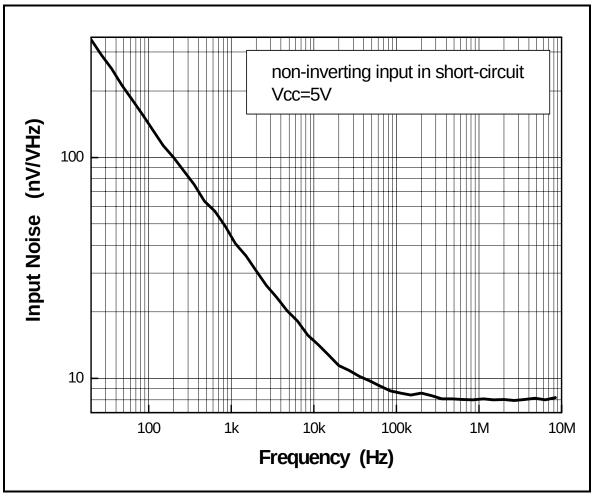


Figure 6. Positive and negative slew rate

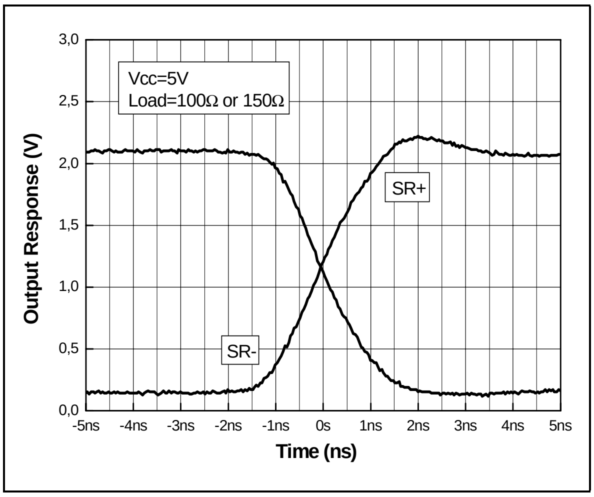


Figure 7. Distortion on 100Ω load

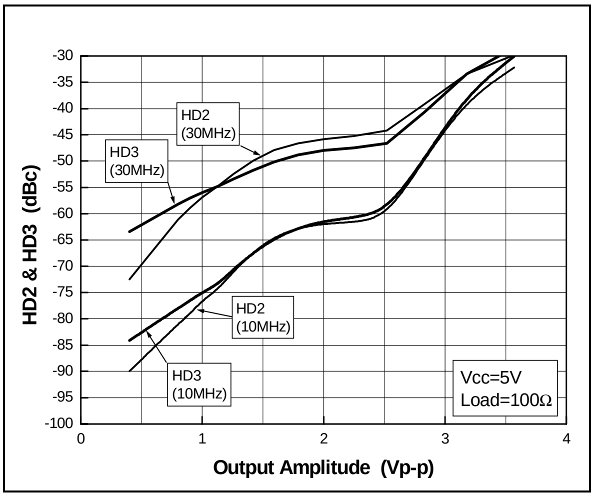


Figure 8. Output lower rail vs. frequency

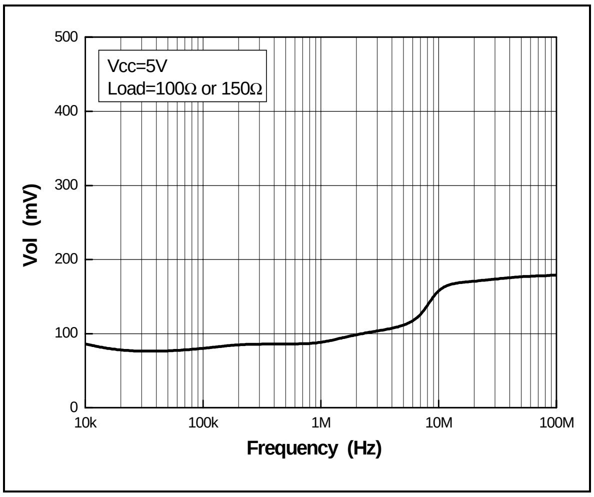


Figure 9. Output voltage swing vs. frequency

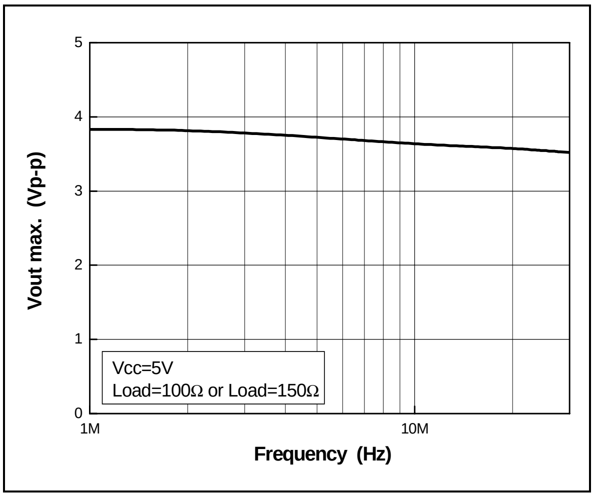


Figure 10. Distortion on 150Ω load

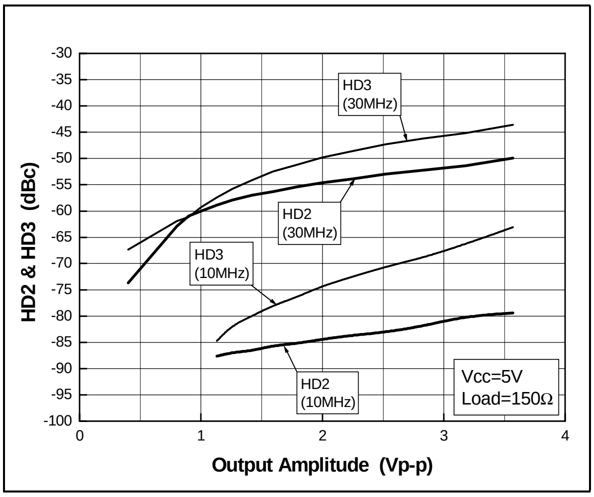


Figure 11. Output voltage swing vs. Vcc

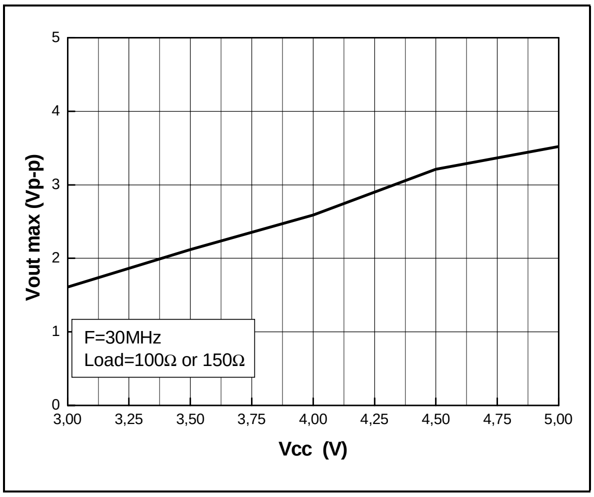


Figure 12. Quiescent current vs. vcc

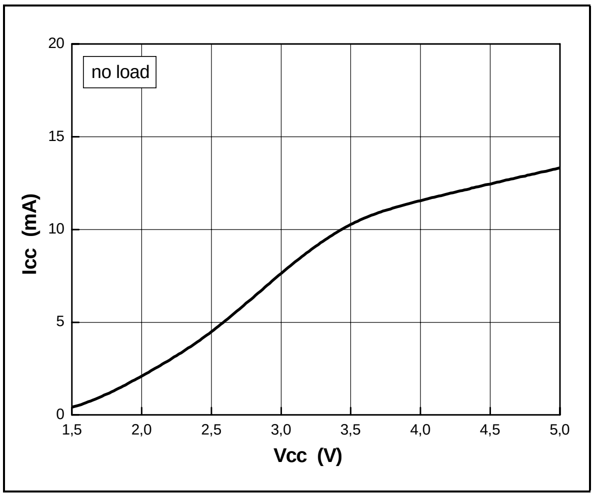


Figure 13. Isource

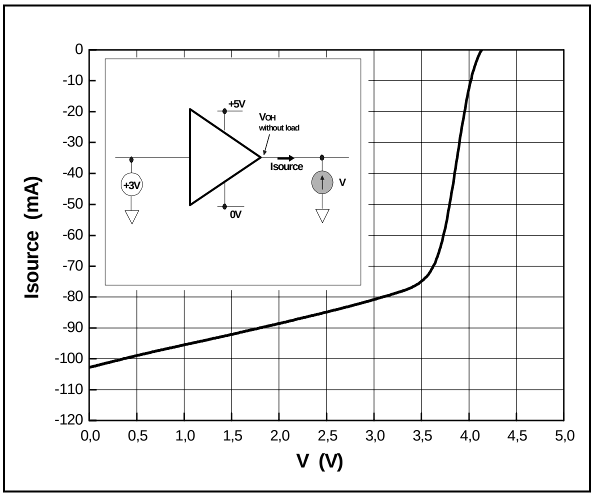


Figure 14. Bandwidth vs. temperature

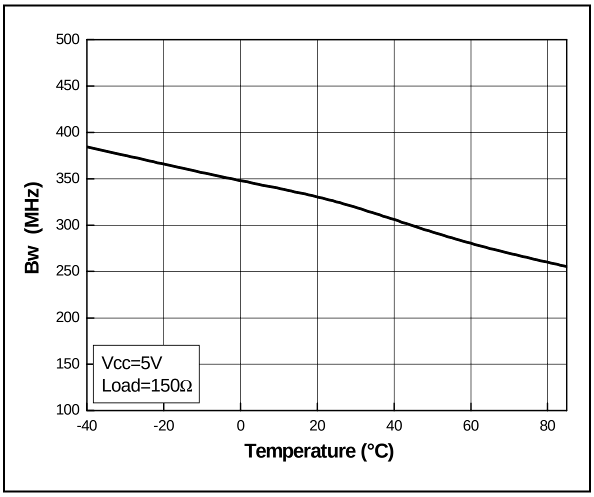


Figure 15. Output offset vs. temperature

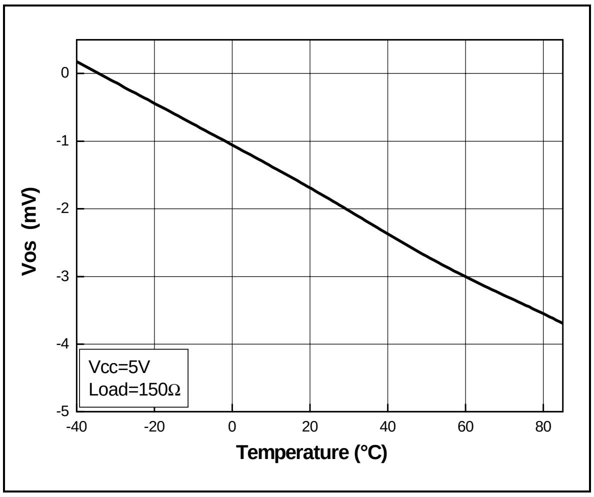


Figure 16. Reverse isolation vs. frequency

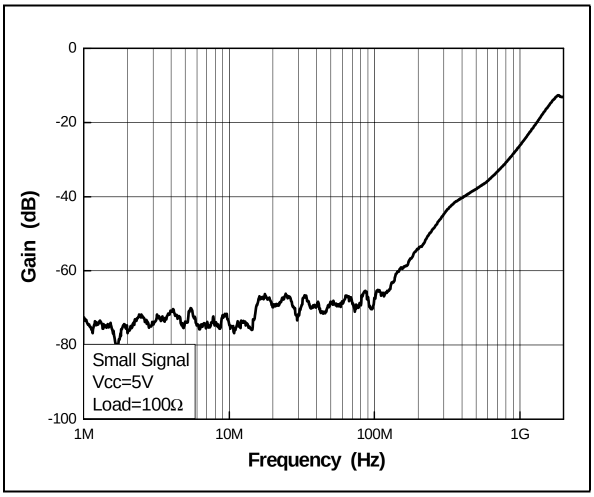


Figure 17. Voltage gain vs. temperature

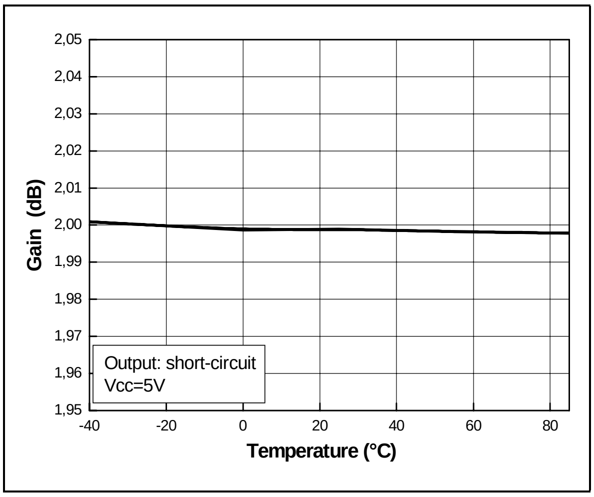


Figure 18. Ibias vs. temperature

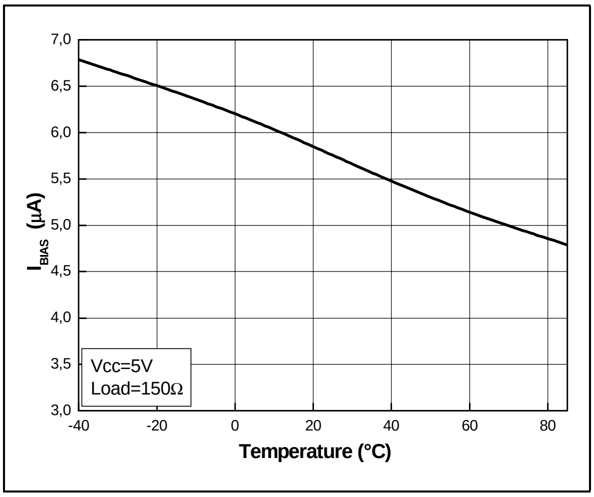


Figure 19. Supply current vs. temperature

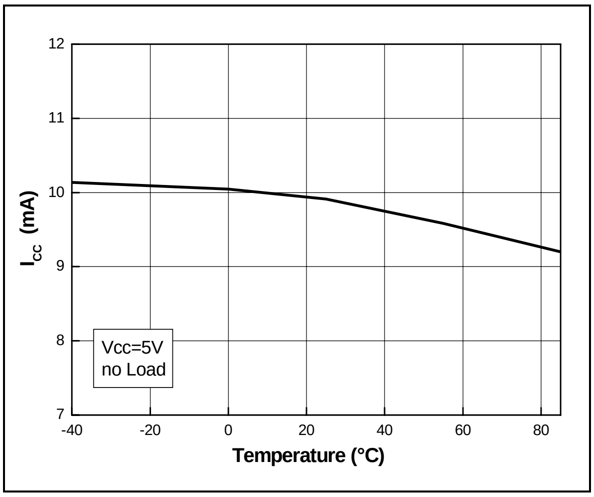


Figure 20. Output lower rail vs. temperature

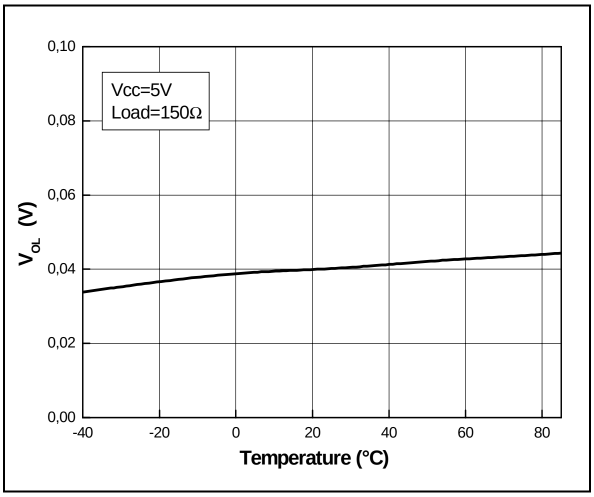
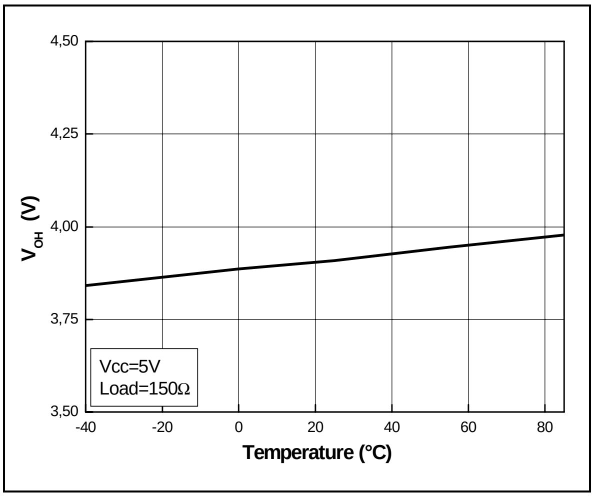


Figure 21. Output higher rail vs. temperature



3 Evaluation Boards

An evaluation board kit optimized for high-speed operational amplifiers is available (order code: KITHSEVAL/STDL). The kit includes the following evaluation boards, as well as a CD-ROM containing datasheets, articles, application notes and a user manual:

- SOT23_SINGLE_HF BOARD: Board for the evaluation of a single high-speed op-amp in SOT23-5 package.
- SO8_SINGLE_HF: Board for the evaluation of a single high-speed op-amp in SO8 package.
- SO8_DUAL_HF: Board for the evaluation of a dual high-speed op-amp in SO8 package.
- SO8_S_MULTI: Board for the evaluation of a single high-speed op-amp in SO8 package in inverting and non-inverting configuration, dual and signle supply.
- SO14_TRIPLE: Board for the evaluation of a triple high-speed op-amp in SO14 package with video application considerations.

Board material:

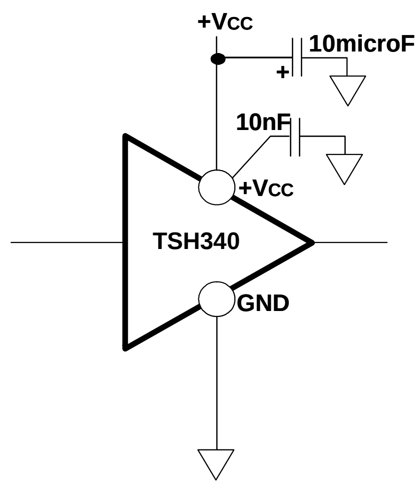
- 2 layers
- FR4 (εr=4.6)
- epoxy 1.6mm
- copper thickness: 35µm

Figure 22: Evaluation kit for high speed op-amps

4 Power Supply Considerations

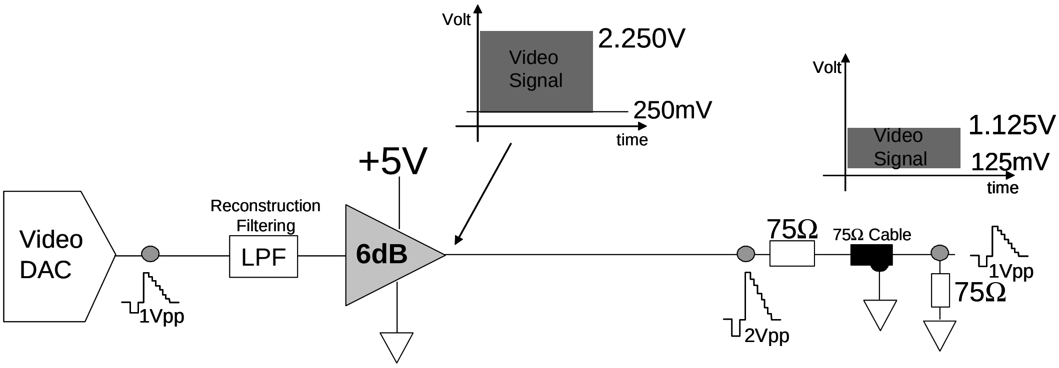
Correct power supply bypassing is very important for optimizing performance in high-frequency ranges. Bypass capacitors should be placed as close as possible to the IC pins to improve high-frequency bypassing. A capacitor greater than 10µF is necessary to minimize the distortion. For better quality bypassing, a capacitor of 10nF is added using the same implementation conditions. Bypass capacitors must be incorporated for both the negative and the positive supply. On the SO8_SINGLE_HF board, these capacitors are C8 and C6.

Figure 23: Circuit for power supply bypassing



5 Using the TSH340 to Drive Video Signals

Figure 24. Implementation of the video driver on output video DACs

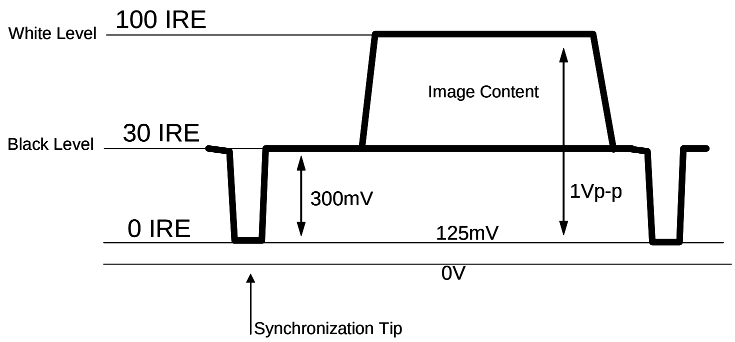


V_{OL}(100MHz) = 180mV (*Figure 8*)

To drive the video signal properly, the output of the driver must be at least equal to 250mV (assuming V_{OS} and V_{OL} variations).

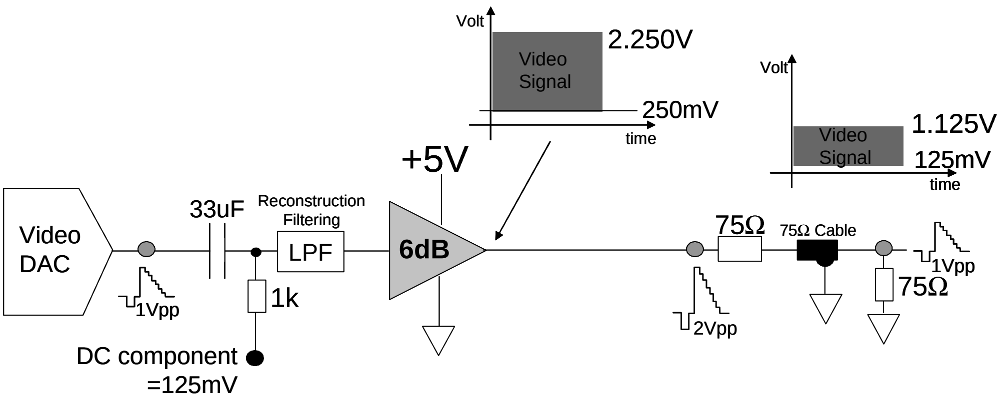
- **1st solution:**

  Set the video DAC 0-IRE output level to 125mV.



- **2nd solution:**

  Implementation of a DC component in the input of the driver.

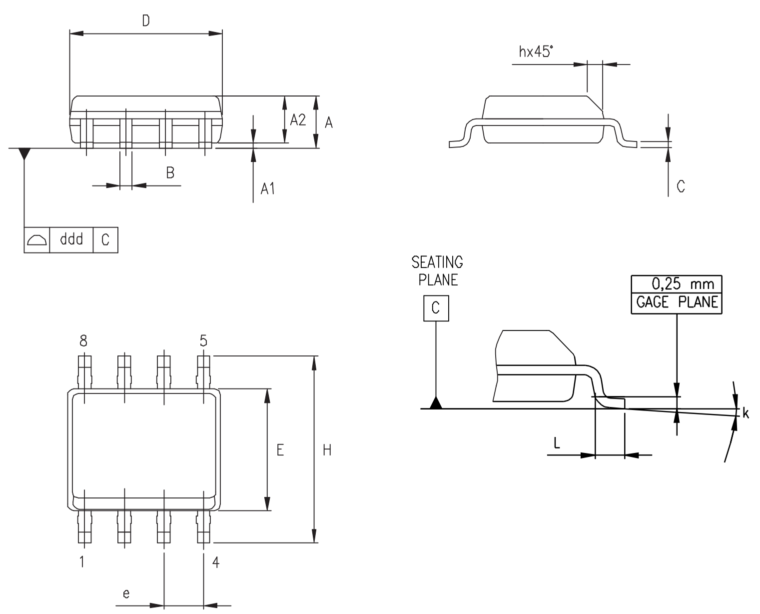


6 Package Mechanical Data

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

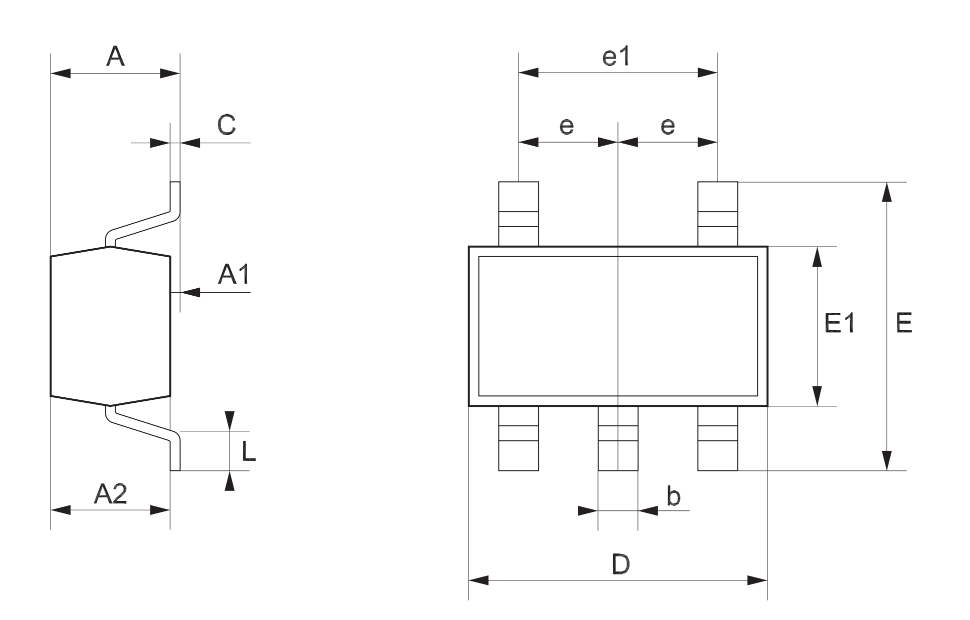


0016023/C

6.2 SOT23-5L (5-pin) package

SOT23-5L MECHANICAL DATA

DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.90		1.45	35.4		57.1
A1	0.00		0.15	0.0		5.9
A2	0.90		1.30	35.4		51.2
b	0.35		0.50	13.7		19.7
C	0.09		0.20	3.5		7.8
D	2.80		3.00	110.2		118.1
E	2.60		3.00	102.3		118.1
E1	1.50		1.75	59.0		68.8
e		0 .95			37.4	
e1		1.9			74.8	
L	0.35		0.55	13.7		21.6



7 Revision History

Date	Revision	Description of Changes
01 Jan. 2005	1	First release corresponding to Preliminary Data version of datasheet.
23 Mar. 2005	2	Datasheet of mature, full-specification product.