TSH345

Triple video buffer with selectable filter for HD and SD video applications

Preliminary Data

Features

- Selectable 6th order filtering of 36 MHz, 18 MHz and 9 MHz
- 5 V single-supply operation
- Internal input DC level shifter
- No input capacitor required
- 3 matched 6 dB amplifiers
- AC or DC output-coupled
- Very low harmonic distortion
- Specified for 150 Ω loads
- Data min. and max. are tested during production

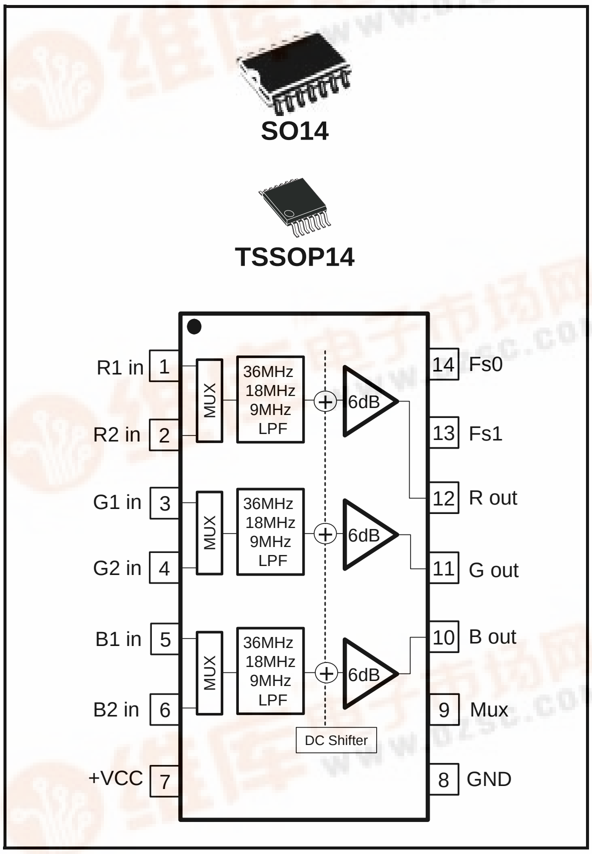
Applications

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

Description

The TSH345 is a triple single-supply video buffer featuring an internal gain of 6 dB and selectable filtering for HD and SD video outputs on 75 Ω video lines. The TSH345 is ideal to drive either Y-C, CVBS, Y-U-V, Y-Pb-Pr or R-G-B signals from video DAC outputs.

The main advantage of this circuit is its input DC level shifter. It allows you to drive video signals on 75 Ω video lines without damage to the synchronization tip, and without either input or output capacitor while using a single 5 V power supply. The DC level shifter is internally fixed and optimized to keep the output video signals between low and high output rails in the best position for the greatest linearity.



The TSH345 is available in the SO14 plastic package for optimum space-saving.

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_{in}	Input voltage range [(2)]	TBD	V
T_{oper}	Operating free air temperature range	-40 to +85	°C
T_{stg}	Storage temperature	-65 to +150	°C
T_j	Maximum junction temperature	150	°C
R_{thjc}	Thermal resistance junction to case SO14 TSSOP14	 22 32	°C/W
R_{thja}	Thermal resistance junction to ambient area SO14 TSSOP14	 125 110	°C/W
P_{max}	Maximum power dissipation (@T_{amb} = 25°C) for T_j = 150° C SO14 TSSOP14	 1 1.1	W
ESD	CDM: charged device model HBM: human body model MM: machine model	200 2 200	V 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} +0.3 V.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Power supply voltage	4.5 to 5.5[(1)]	V

1. Tested in full production with +5 V single power supply.

2 Electrical characteristics

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

Symbol	Test conditions	Min.	Typ.	Max.	Unit
DC performance					
V_{DC}	Output DC shift R_L = 150 Ω, T_{amb} -40° C < T_{amb} < +85° C	197	329 405	389	mV
I_{ib}	Input bias current T_{amb} , input to GND -40° C < T_{amb} < +85° C	0.85	1.5 2.38	2.9	µA
R_{in}	Input resistance, T_{amb}		12.6		GΩ
C_{in}	Input capacitance, T_{amb}		0.1		pF
I_{CC}	Total supply current No load, input to GND -40°C < T_{amb} < +85°C		50.7 TBD	65	mA
PSRR	Power supply rejection ratio 20 log ($\Delta V_{out}/\Delta V_{CC}$) Input to GND, R_L = 150 Ω ΔV_{CC} : 100 mVp/F = 1 MHz, C_{LF} = 470 nF, C_{HF} = 100 µF		-70		dB
G	DC voltage gain R_L = 150Ω, V_{in} = 0.5V -40°C < T_{amb} < +85°C	1.94	1.99 2	2.02	V/V
DG	Variation of the DC voltage gain between inputs of 0.3 V and 1 V Input step from 0.3 V to 1 V		0.2	0.5	%
MG_1	Gain matching between 3 channels, input = 1 V		0.5	1	%
$MG_{0.3}$	Gain matching between 3 channels, input = 0.3 V		0.5	1	%
Output characteristics					
V_{OH}	High level output voltage R_L = 150 Ω -40° C < T_{amb} < +85° C	3.84	3.87 TBD		V
V_{OL}	Low level output voltage(1) R_L = 150 Ω -40° C < T_{amb} < +85° C		33 TBD	40	mV
I_{out}	I_{source} T_{amb} -40° C < T_{amb} < +85° C	46	91 79		mA
	I_{sink} -40° C < T_{amb} < +85° C	TBD	145 102		mA

Table 3. Electrical characteristics at V_{CC} = +5 V single supply, T_{amb} = 25°C (unless otherwise specified) (continued)

Symbol	Test conditions	Min.	Typ.	Max.	Unit
Filtering					
Standard definition	Bandwidth F1 selected, small signal, V_{ICM}= 0.5 V, R_L = 150 Ω 3 dB bandwidth 1 dB bandwidth	 5.12	 9.3 7.3		MHz
	Flatness F1selected/F= 6 MHz, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω		0.5		dB
	Attenuation F1 selected/F=27 MHz, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω	30	47		dB
Standard definition with progressive scanning	Bandwidth F2 selected, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω 3 dB bandwidth 1 dB bandwidth	 10.4	 21.5 18.2		MHz
	Flatness F2 selected/F=12 MHz small signal, V_{ICM} = 0.5 V, R_L = 150 Ω		0.36		dB
	Attenuation F2 selected/F=54 MHz, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω	34	42.7		dB
High definition	Bandwidth F3 selected, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω 3 dB bandwidth 1 dB bandwidth	 22	 35.6 30.8		MHz
	Flatness F3 selected/F=30 MHz, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω		0.46		dB
	Attenuation F3 selected/F=74.25 MHz, small signal, V_{ICM} = 0.5 V, R_L = 150 Ω	TBD	36		dB
D	Delay between each channel		0.5		ns
gd	Group delay variation F1 selected/F=0 to 6 MHz		10.3		ns
Δg	Differential gain F1 selected/F=6 MHz, R_L = 150 Ω		0.5		%
ΔΦ	Differential phase F1 selected/F=6 MHz, R_L = 150 Ω		0.5		°

Table 3. Electrical characteristics at V_{CC} = +5 V single supply, T_{amb} = 25°C (unless otherwise specified) (continued)

Symbol	Test conditions	Min.	Typ.	Max.	Unit
Noise and distortion					
eN	Total input voltage noise in Standard Definition F = 100 kHz, R_{IN} = 50 Ω		70		nV/√Hz
	Total input voltage noise in High Definition F = 100 kHz, R_{IN} = 50 Ω		93		
HD2	2nd harmonic distortion F1 selected/F=1 MHz, V_{out} = 2 Vp-p, R_L = 150 Ω		-44		dBc
HD3	3rd harmonic distortion F1 selected/F=1 MHz, V_{out} = 2 Vp-p, R_L = 150 Ω		-63		dBc
Standby mode					
I_{STBY}	Total current consumption in standby mode Fs1=1, Fs0=1		TBD	570	µA
T_{on}	Time from standby to active mode		5		µs
T_{off}	Time from active to standby mode		5		µs
Fs1, Fs0 and Mux features					
V_{high}	High level	0.9			V
V_{low}	Low level			0.3	V

1. Simulated data.

Table 4. Filter and standby settings, V_{CC} = +5 V single supply, T_{amb} = 25°C

Fs1	Fs0	Settings	
0	0	F3	Filtering for high definition (HD), 36 MHz
0	1	F2	Filtering for progressive video (PV), 18 MHz
1	0	F1	Filtering for standard definition (SD), 9 MHz
1	1	Standby	TSH345 in standby mode
Fs1 and Fs0 floating: forbidden (for proper behavior of the TSH345, the Fs1 and Fs0 pins must never be left floating)			

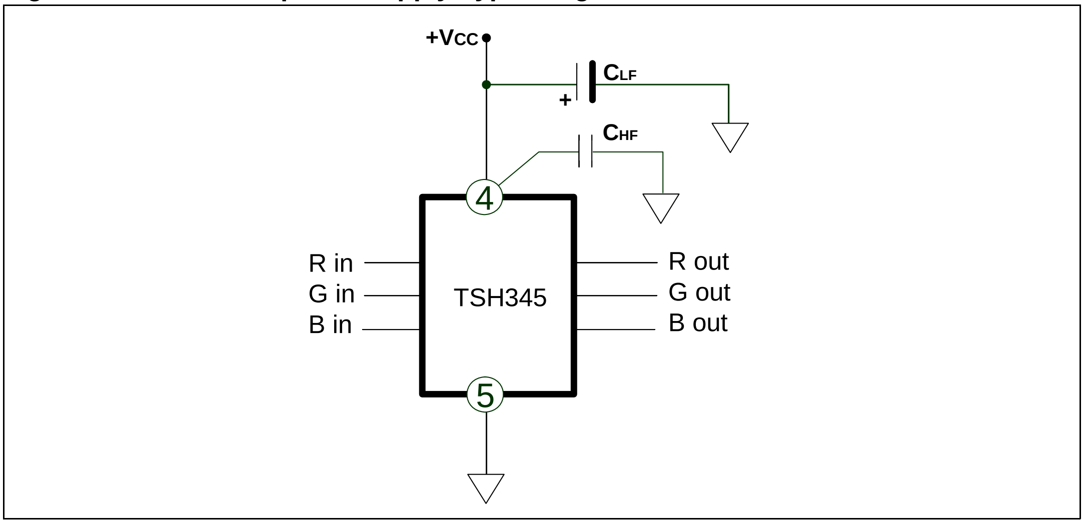
Table 5. Mux settings, V_{CC} = +5 V single supply, T_{amb} = 25°C

Mux	Settings	
0	R1 G1 B1	Video1 selected
1	R2 G2 B2	Video2 selected
Floating	R1 G1 B1	Video1 selected
MUX floating: forbidden (for proper behavior of the TSH345, the MUX pin must never be left floating)		

3 Power supply considerations

Correct power supply bypassing is very important for optimizing performance in low and high-frequency ranges. Bypass capacitors should be placed as close as possible to the IC pin (pin 4) to improve high-frequency bypassing. A capacitor (C_{LF}) greater than 100 µF is necessary to improve the PSRR in low frequencies. For better quality bypassing, you can add a capacitor of 470 nF (C_{HF}), also placed as close as possible to the IC pin, to improve the PSRR in the higher frequencies.

Figure 1. Circuit for power supply bypassing



4 Using the TSH345 to drive Y-C, CVBS, Y-U-V, Y-Pb-Pr and R-G-B video components

Figure 2. Implementation of the video driver on output video DACs

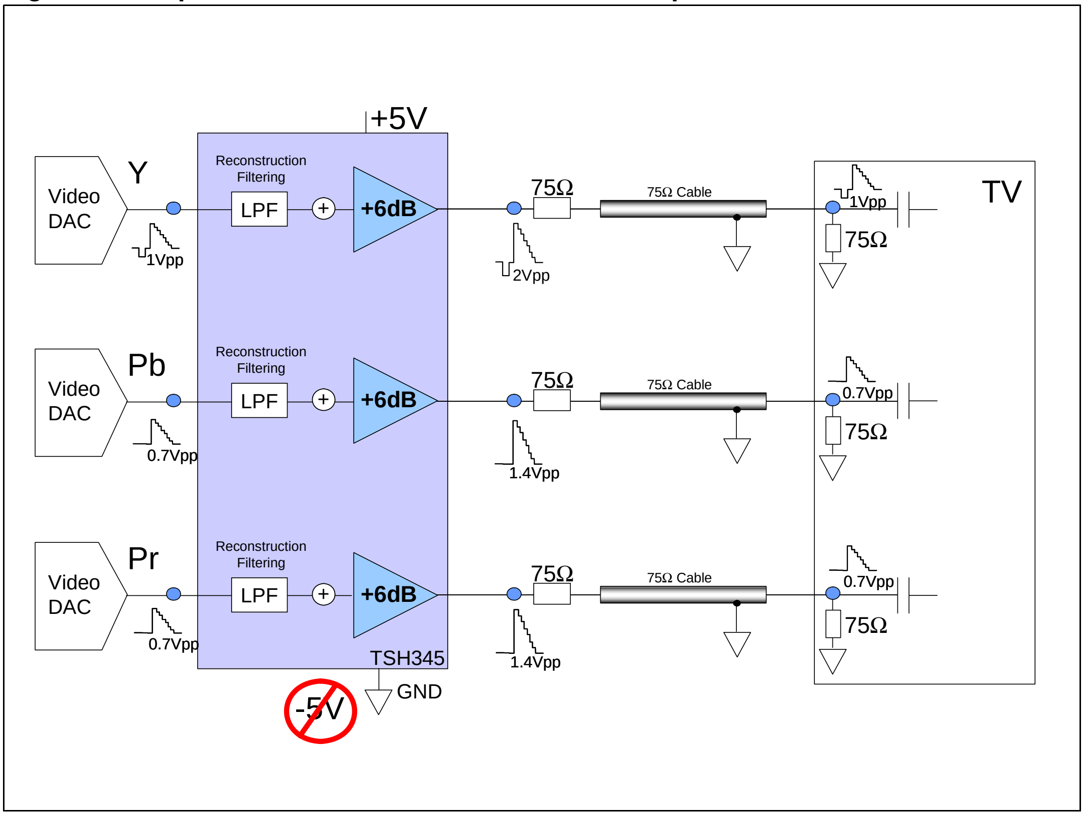


Figure 3. Shapes of video signals coming from DACs (example for a black picture)

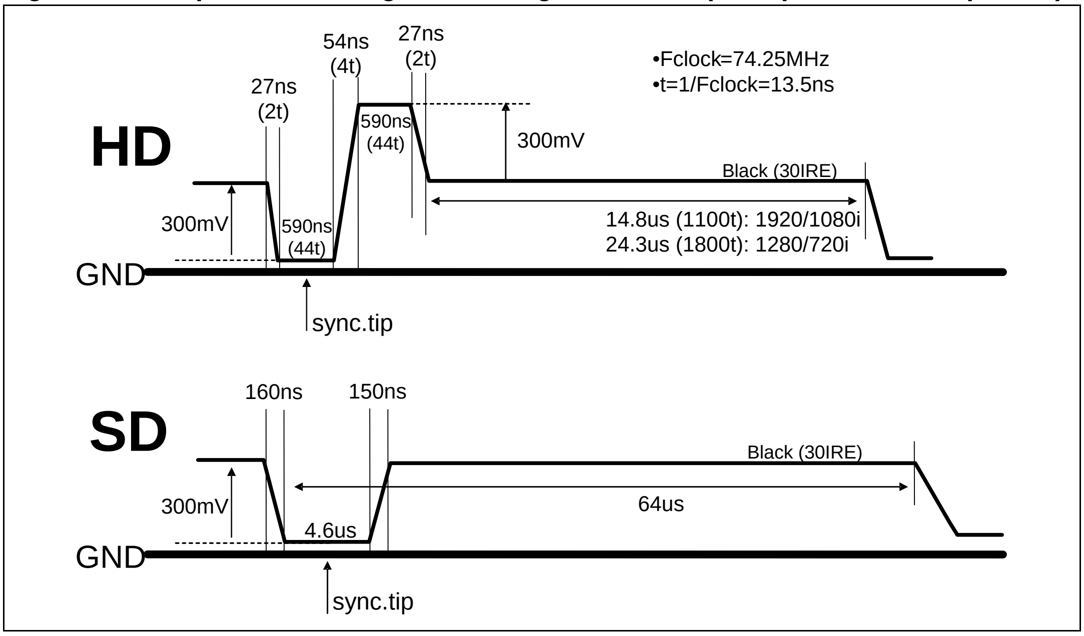
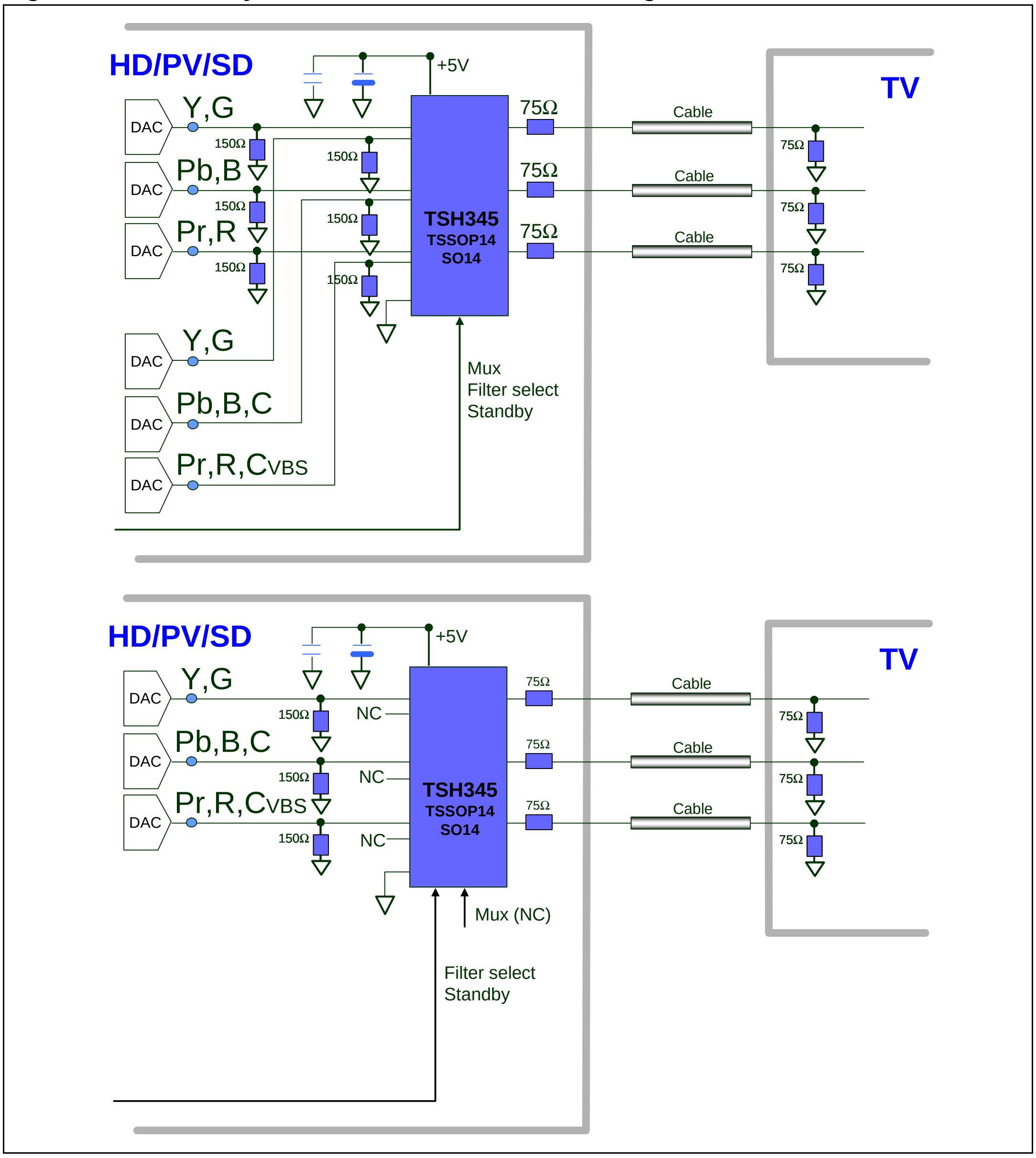


Figure 4. Flexibility of the TSH345 for SD and HD signals



The TSH345 is used to drive either high definition video signals up to 30 MHz, or progessive and interlaced standard definition video signals on 75-ohm video lines. It can drive a large panel of signals like Y-C and CVBS, Y-U-V, Y-Pb-Pr and R-G-B where the bottom of the signal (the synchronization tip in the case of Y and CVBS signals) is close to zero volts. An internal input DC value is added to the video signal in order to shift the bottom from GND.

The shift is not based on the average of the signal, but is an analog summation of a DC component to the video signal. Therefore, no input capacitors are required, which provides a real advantage in terms of cost and board space.

Under these conditions, it is possible to drive the signal in single supply without any saturation of the driver against the lower rail.

Because half of the signal is lost through output impedance matching, in order to properly drive the video line, the shifted signal is multiplied by a gain of 2 or +6 dB.

4.1 Output capacitor

The output can be either DC-coupled or AC-coupled. The output can be connected to the line via a 75-ohm resistor directly (see *Figure 5*). Or, an output capacitor can be used to remove any DC components in the load. Assuming the load is 150-ohm, a coupling capacitor of 220 µF can be used to provide a very low cut-off frequency close to 5 Hz (see *Figure 6*).

Figure 5. DC output coupling (1 of 3 channels)

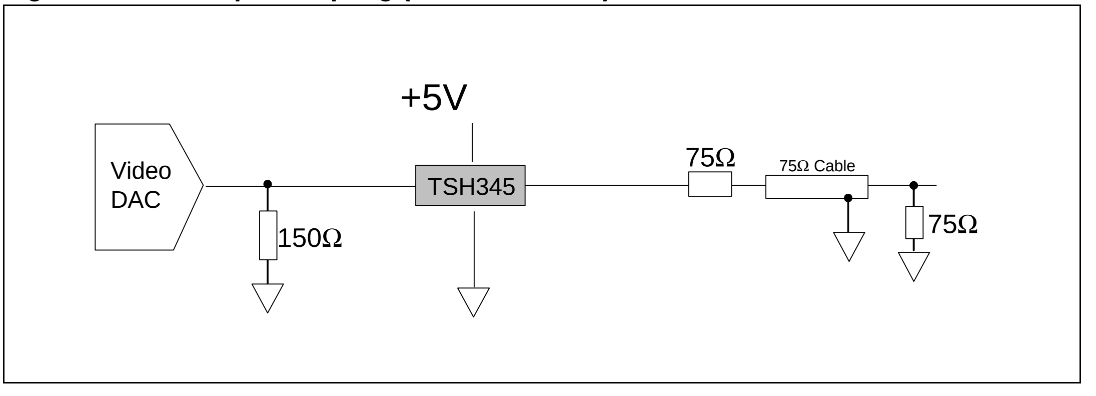
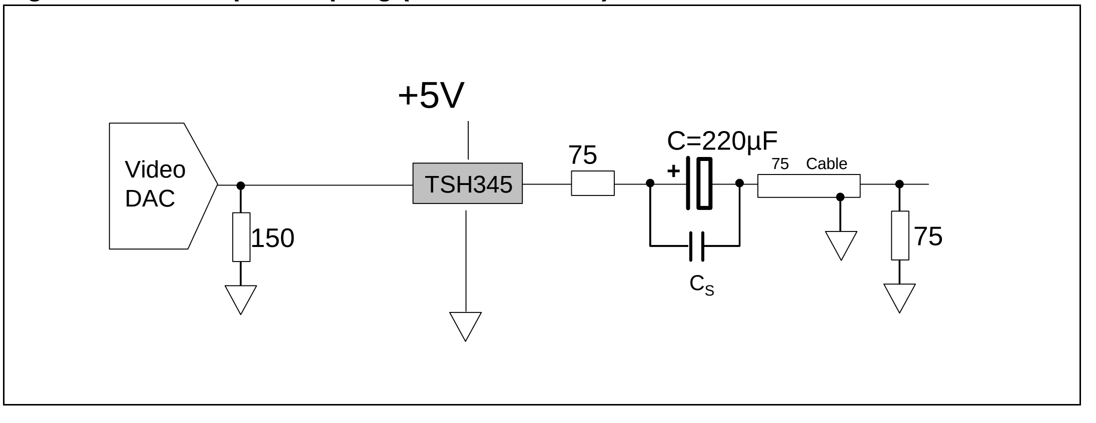


Figure 6. AC output coupling (1 of 3 channels)



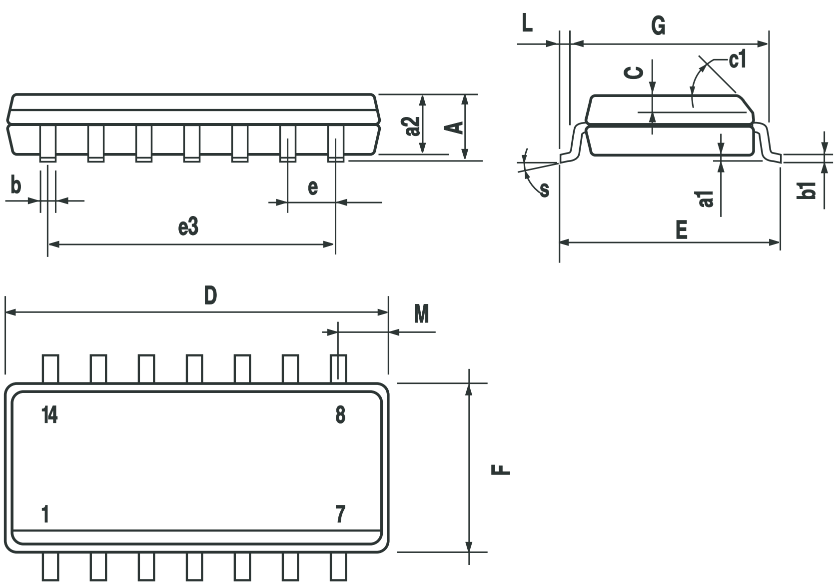
1. C_S is a 100nF used to decrease the parasitic components of C in high frequencies.
2. The 75-ohm resistor must be as close as possible to the output of the driver to minimize the effect of parasitic capacitance.

5 Package information

In order to meet environmental requirements, STMicroelectronics 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 STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

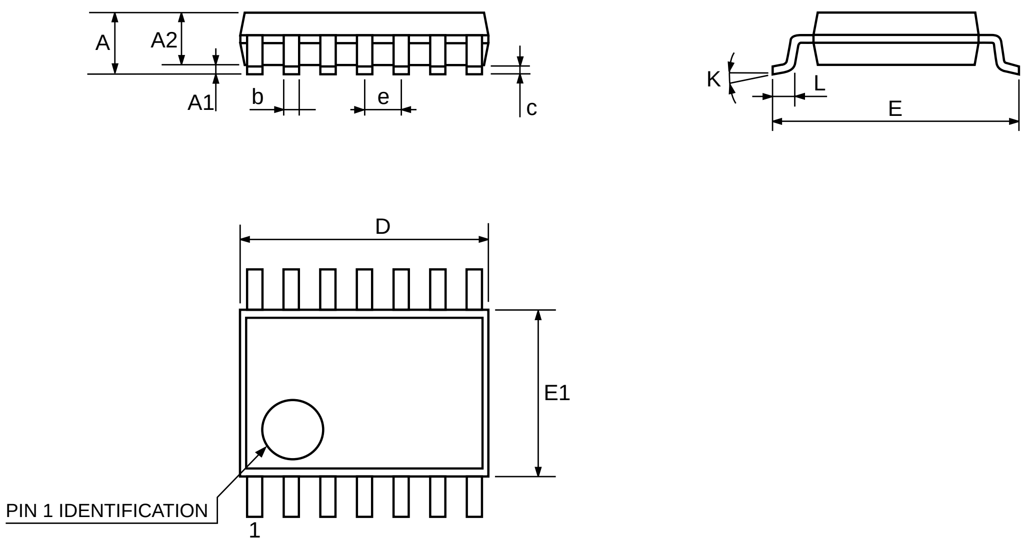
5.1 SO-14 package

Ref.	Dimensions					
	Millimeters			Inches		
	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.)					



5.2 TSSOP14 package

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			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
c	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
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L1	0.45	0.60	0.75	0.018	0.024	0.030



6 Ordering infomation

Table 6. Order codes

Part number	Temperature range	Package	Packing	Marking
TSH345ID	-40°C to +85°C	SO14	Tube	TSH345I
TSH345IDT			Tape & reel	TSH345I
TSH345IPT		TSSOP14	Tape & reel	TSH345I

7 Revision history

Date	Revision	Changes
29-May-07	1	Preliminary data, initial release.