Signetics

TDA3567
NTSC Color Decoder

Product Specification

Linear Products

DESCRIPTION

The TDA3567 is a monolithic integrated decoder for the NTSC color television standards. It combines all functions required for the demodulation of NTSC signals. Furthermore, it contains a luminance amplifier, and an RGB-matrix and amplifier. These amplifiers supply output signals up to $5V_{P-P}$ (picture information) enabling direct drive of the discrete output stages.

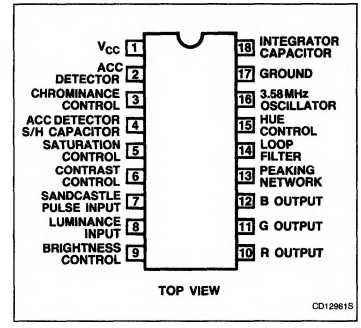
FEATURES

- **Single-chip chroma and luminance processor**
- **ACC with peak detector**
- **DC control settings**
- **High-level RGB outputs**
- **Luminance signal with clamp**
- **Requires few external components**
- **On-chip hue control circuit**

APPLICATIONS

- **Video monitors and displays**
- **TV receivers**
- **Video processing**

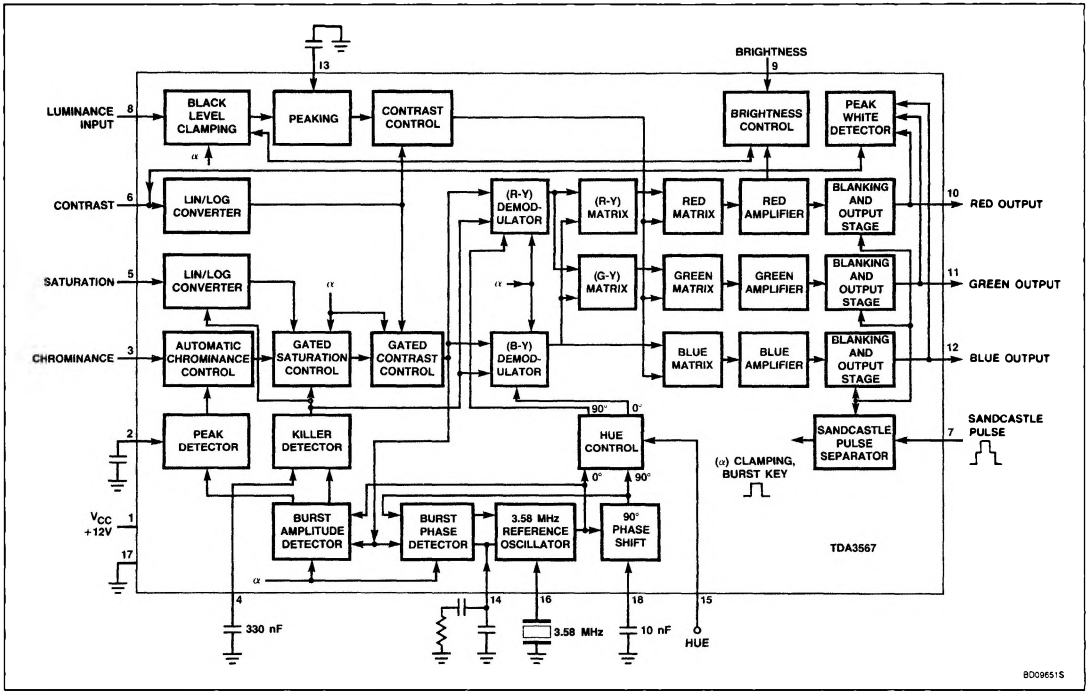
PIN CONFIGURATION



ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
18-Pin Plastic DIP (SOT-102HE)	−25°C to +65°C	TDA3567N

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
$V_{CC} = V_{1-17}$	Supply voltage	13.2	V
P_{TOT}	Total power dissipation	1.7	W
T_{STG}	Storage temperature range	−25 to +150	°C
T_A	Operating ambient temperature range	−25 to +65	°C
θ_{JA}	Thermal resistance from junction to ambient (in free-air)	50	°C/W

DC AND AC ELECTRICAL CHARACTERISTICS $V_{CC} = V_{1-17} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
Supply						
$V_{CC} = V_{1-17}$	Supply voltage		9	12	13.2	V
$I_{CC} = I_1$	Supply current			65		mA
P_{TOT}	Total power dissipation			0.78		W
Luminance input signal						
$V_{8-17(P-P)}$	Input voltage[1] (peak-to-peak value)	Pin 8		450		mV
V_{8-17}	Input voltage level before clipping occurs in the input stage				1	V
I_8	Input current			0.15	1	μA
	Contrast control range	See Figure 1	−17		+3	dB
I_7	Input current contrast control	For $V_{6-17} < 6V$		0.5	15	μA
I_7	Input current when the peak white limiter is active	$V_{6-17} = 2.5V$		5.5		mA
R_{7-17}	Input resistance	$V_{6-17} > 6V$	1.4	2	2.6	kΩ
Peaking of luminance signal						
$\lvert Z_{13-17} \rvert$	Output impedance	Pin 13		200		Ω
	Ratio of internal/external current when Pin 13 is short-circuited			3		
Chrominance amplifier						
$V_{3-17(P-P)}$	Input signal amplitude[2] (peak-to-peak value)	Pin 3		550		mV
$V_{3-17(P-P)}$	Input signal amplitude before clipping occurs in the input stage (peak-to-peak value)				1.1	V
	Minimum burst signal amplitude within the ACC control range (peak-to-peak)		35			mV
	ACC control range		30			dB
ΔV	Change of the burst signal at the output for the complete control range				+1	dB
$\lvert Z_{3-17} \rvert$	Input impedance	Pin 3	6	8	10	kΩ
C_{3-17}	Input capacitance	Pin 3		4	6	pF
	Saturation control range	See Figure 3	50			dB
I_5	Input current saturation control	For $V_{5-17} > 6V$		1	20	μA
$\lvert Z_{5-17} \rvert$	Input impedance	$V_{5-17} = 6V$ to 10V	1.4	2	2.6	kΩ
$\lvert Z_{5-17} \rvert$	Input impedance when the color killer is active		1.4	2	2.6	kΩ
$\lvert Z_{5-17} \rvert$	Input impedance	For $V_{5-17} > 10V$	0.7	1	1.3	kΩ
	Tracking between luminance and chrominance contrast	For 10dB of control		1	2	dB
	Cross-coupling between luminance and chrominance amplifier[4]			−50	−46	dB
Reference part phase-locked loop						
Δf	Catching range		±400	±500		Hz
Δ	Phase shift for 400Hz deviation of the carrier frequency				5	deg

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{1-17} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
Oscillator						
TC_{OSC}	Temperature coefficient of oscillator frequency			1.5	2.5	Hz/°C
Δf_{OSC9}	Frequency deviation	$\Delta V_{CC} = \pm 10\%$		150	250	Hz
R_{16-17}	Input resistance	Pin 16	260	360	460	Ω
C_{22-17}	Input capacitance	Pin 16			10	pF
ACC generation						
V_{4-17}	Voltage at Pin 4 nominal input signal			4		V
V_{4-17}	Voltage at Pin 4 without burst input			1.9		V
V_{4-17}	Color-off voltage			2.5		V
V_{4-17}	Color-on voltage			2.8		V
	Change in burst amplitude with temperature			0.1		%/°C
	Change in burst amplitude with 10% supply voltage change			0		%/V
V_{2-17}	Voltage at Pin 2 at nominal input signal			5		V
Hue control						
	Control voltage range		see Figure 4			
I_{14}	Input current	for $V_{15-17} < 5V$		0.5	20	μA
$\lvert Z_{14-17} \rvert$	Input impedance	for $V_{15-17} > 5V$	1.5	2.5	3.5	kΩ
Demodulation part						
	Ratio of demodulation signals (measured at the various outputs)[7]					
$\frac{V_{10-17}}{V_{12-17}}$	(R-Y)/(B-Y); no (R-Y) signal			−0.42		
$\frac{V_{10-17}}{V_{12-17}}$	(R-Y)/(B-Y); color bar signal			1.4		
$\frac{V_{11-17}}{V_{12-17}}$	(G-Y)/(R-Y); no (B-Y) signal			−0.25		
$\frac{V_{11-17}}{V_{12-17}}$	(G-Y)/(B-Y); no (R-Y) signal			−0.11		
	Frequency response	0 to 0.7MHz			−3	dB
RGB matrix and amplifier						
$V_{10, 11, 12-17(P-P)}$	Output signal amplitude[3]	at nominal luminance input signal and nominal contrast (peak-to-peak value) black-white	4	5	6	V
$V_{12-17(P-P)}$	Output signal amplitude of the "blue" channel	at nominal contrast and saturation control setting and no luminance signal to the input (B-Y) signal (peak-to-peak value)		3.8		V
$V_{10, 11, 12-7}$	Maximum peak-white level[6]		9	9.3	9.6	V

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{1-17} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	LIMITS			UNIT
			Min	Typ	Max	
$I_{10, 11, 12-17}$	Maximum output current				10	mA
	Difference in the black level between the three channels				600	mV
	Black level shift with vision content			10	40	mV
	Brightness control voltage range		see Figure 3			
I_9	Brightness control input current				−50	μA
V/T	Black level variation with temperature			0.15	1	mV/°C
ΔV	Black level variation with contrast control			75	200	mV
	Relative spread between the three output signals				10	%
ΔV	Relative variation in black level between the three channels	during variations of contrast (10dB), brightness (± 1V), and supply voltage (± 10%)		0	20	mV
ΔV	Differential drift of black level over a temperature range of 40°C			0	20	mV
V_{B1}	Blanking level at the RGB outputs		1.95	2.15	2.35	V
$\frac{\Delta V_{B1}}{V_{B1}} \times \frac{V_{CC}}{\Delta V_{CC}}$	Tracking of output black levels with supply voltage		1	1.05	1.1	
S/N	Signal-to-noise ratio of output signals[5]		62			dB
$V_{R(P-P)}$	Residual 3.58MHz in RGB outputs (peak-to-peak value)			50	75	mV
$V_{R(P-P)}$	Residual 7.1MHz and higher harmonics in the RGB outputs (peak-to-peak value)			50	75	mV
$\lvert Z_{10, 11, 12-17} \rvert$	RGB output impedance				50	Ω
	Frequency response of total luminance and RGB amplifier circuits	0 to 5MHz			−3	dB
Sandcastle input						
V_{7-17}	Level at which the RGB blanking is activated		1	1.5	2	V
V_{7-17}	Level at which burst gate clamping pulses are separated		6.5	7	7.5	V
t_D	Delay between black level clamping and burst gating pulse		300	375	450	ns
I_7 I_7 I_7	Input currents	$V_{7-17} = 0$ to 1V $V_{7-17} = 1$ to 8.5V $V_{7-17} = 8.5$ to 12V		−20	−1 −40 2	mA μA mA

NOTES:

1. Signal with negative-going sync; amplitude includes sync pulse amplitude.
2. Indicated is a signal for color bar with 75% saturation, so the chrominance-to-burst ratio is 2.2:1.
3. Nominal contrast is specified as maximum contrast −3dB and nominal saturation as maximum saturation −10dB.
4. Cross-coupling is measured under the following conditions:
   - input signals nominal
   - contrast and saturation such that nominal output signals are obtained
   - the signals at the output at which no signal should be available must be compared with the nominal output signal at that output.
5. The signal-to-noise ratio is specified as peak-to-peak signal with respect to RMS noise.
6. When this level is exceeded, the amplifier of the output signal is reduced via a discharge of the capacitor on Pin 7 (contrast control). Discharge current is 5.5mA.
7. These matrixed values are found by measuring the ratio of the various output signals. The values are derived from the matrix equations given in the section 'FUNCTIONAL DESCRIPTION'.

FUNCTIONAL DESCRIPTION

Luminance Amplifier

The luminance amplifier is voltage driven and requires an input signal of $450mV_{P-P}$ [1]. The luminance delay line must be connected between the IF amplifier and the decoder. The input signal must be AC coupled to the input Pin 8.

The black level clamp circuit of the RGB amplifiers uses the coupling capacitor as a storage capacitor. After clamping, the signal is fed to a peaking stage. The RC network connected to Pin 13 is used to define the amount of overshoot.

The peaking stage is followed by a contrast control stage. The control voltage has to be supplied to Pin 6. The control voltage range is nominally −17 to +3dB. The linear curve of the contrast control voltage is shown in Figure 1.

Chrominance Amplifier

The chrominance amplifier has an asymmetrical input. The input signal at Pin 3 must be AC coupled, and must have an amplitude of $550mV_{P-P}$. The gain control stage has a control range in excess of 30dB, the maximum input signal should not exceed $1.1V_{P-P}$, otherwise clipping of the input signal will occur. From the gain control stage, the chrominance signal is fed to the saturation and contrast control stages. Chrominance and luminance control stages are directly coupled to obtain good tracking. The saturation is linearly controlled via Pin 5. The control voltage range is 2V to 4V. The impedance is high and the saturation control range is in excess of 50dB. The burst signal is not affected by contrast or saturation control. After the amplification and control stages, the chrominance signal is internally fed to the (R-Y) and (B-Y) demodulators, burst phase, and ACC detectors.

Oscillator and ACC Circuit

The 3.58MHz reference oscillator operates at the subcarrier frequency. The crystal must be connected between Pin 16 and ground. The oscillator does not require adjustment due to the small spreads of the IC. The free-running frequency of the oscillator can be checked by connecting the saturation control (Pin 5) to the positive supply line. Then the loop is opened so that the frequency can be measured. The oscillator has an internal gain-limiting stage which controls the gain to unity, so that internal signals are sinusoidal. This prevents the generation of higher harmonics of the subcarrier signals. The burst signal is compared to a 0° reference signal by the burst amplitude detector, and is then amplified and fed to a peak detector for ACC and to a sample-and-hold circuit which drives the color-killer circuit. The reference signal for the burst phase detector is provided by the 90° phase-shifted signal. An RC network is used to obtain the required catching range and noise immunity for the output voltage of the burst phase detector.

The hue control is obtained by mixing oscillator signals with a phase of 0° and 90° before they are fed to the (R-Y) and (B-Y) demodulators. The 90° phase-shifted signal is provided by a Miller integrator (biased by Pin 18). As the hue control is independent of the PLL, the control will react without time delay on the control voltage changes.

Demodulator Circuits

The demodulators are driven by the amplified and controlled chrominance signals; the reference signals are obtained from the hue control circuit. In nominal hue control position, the phase angle of (R-Y) reference signal is 0°; the phase angle of the (B-Y) reference signal is 90°.

For flesh-tone corrections, the demodulated (R-Y) signal is matrixed with the demodulated (B-Y) signal according to the following equations:

$$(R\text{-}Y)\text{matrixed} = 1.61\ (R\text{-}Y)_{IN} - 0.42\ (B\text{-}Y)_{IN}$$

$$(G\text{-}Y)\text{matrixed} = 0.43\ (R\text{-}Y)_{IN} - 0.11\ (B\text{-}Y)_{IN}$$

$$(B\text{-}Y)\text{matrixed} = (B\text{-}Y)_{IN}$$

In these equations $(R\text{-}Y)_{IN}$ and $(B\text{-}Y)_{IN}$ indicate the color difference signal amplitudes when the chrominance signal is demodulated with a phase difference between the R-Y and B-Y demodulator of 90° and a gain ratio B-Y/R-Y = 1.78.

RGB Matrix Circuit and Amplifiers

The three matrix and amplifier circuits are identical. The luminance signal and the color difference signals are added in the matrix circuit to obtain the color signal.

Output signals are $5V_{P-P}$ (black-white) for the following nominal input signals and control settings:

- Luminance $450mV_{P-P}$
- Chrominance $550mV_{P-P}$ (burst-to-chrominance ratio of the input 1:2.2)
- Contrast −3dB (maximum)
- Saturation −10dB (maximum)

The maximum available output voltage is approximately $7V_{P-P}$. The black level of the red channel is compared to a variable external reference level (Pin 9), which provides the brightness control. The control loop is closed via the luminance input.

The luminance input is varied to control the black level control; therefore, the green and blue outputs will follow any variation of the red output. The output of the black control can be varied between 2V to 4V. The corresponding brightness control voltage is shown in Figure 3.

If the output signal surpasses the level of 9V, the peak white limiter circuit becomes active and reduces the output signal via the contrast control.

Blanking of RGB Signals

A slicing level of about 1.5V is used for this blanking function, so that the wide part of the sandcastle pulse is separated from the rest of the pulse. During blanking, a level of +2V is available at the output.

NOTE:

1. Signal with negative-going sync; amplitude includes sync pulse amplitude.

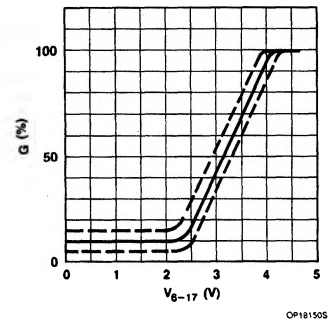


Figure. 1. Contrast Control Voltage Range

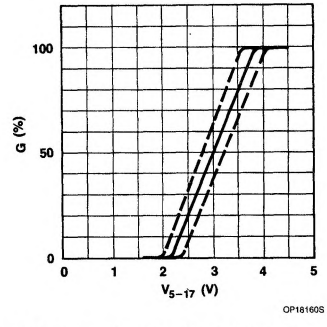


Figure 2. Saturation Control Voltage Range

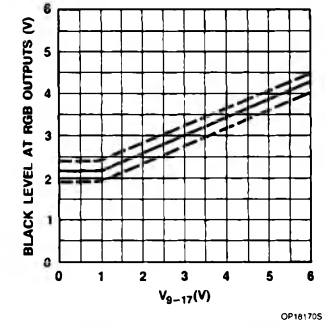


Figure 3. Brightness Control Voltage Range

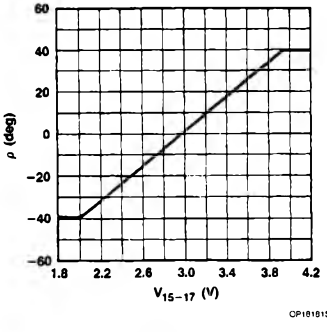


Figure 4. Hue Control Voltage Range

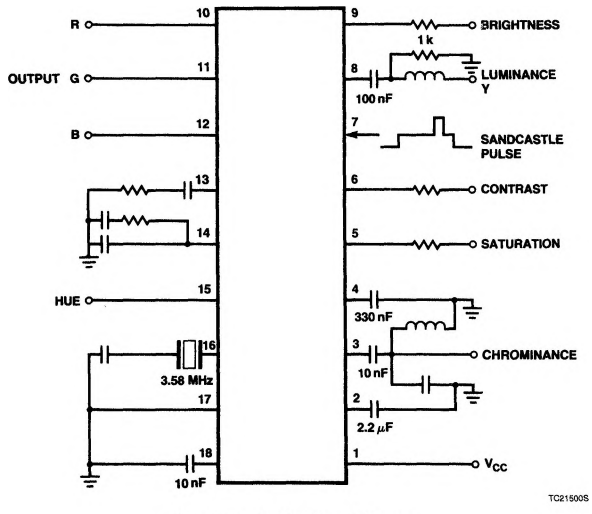


Figure 5. Application Diagram