Signetics

TDA3564
NTSC Decoder

Product Specification

Linear Products

DESCRIPTION

The TDA3564 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.

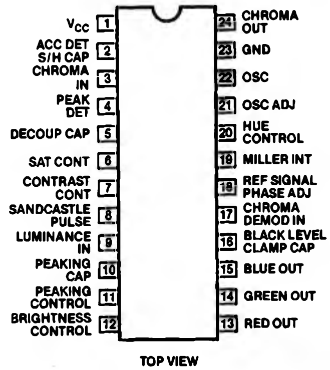
FEATURES

- **Single-chip chroma and luminance processor**
- **ACC with peak detector**
- **DC control settings**
- **High-level RGB outputs**
- **Luminance signal with clamp**
- **Black current stabilizer**
- **On-chip hue control**

APPLICATIONS

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

PIN CONFIGURATION



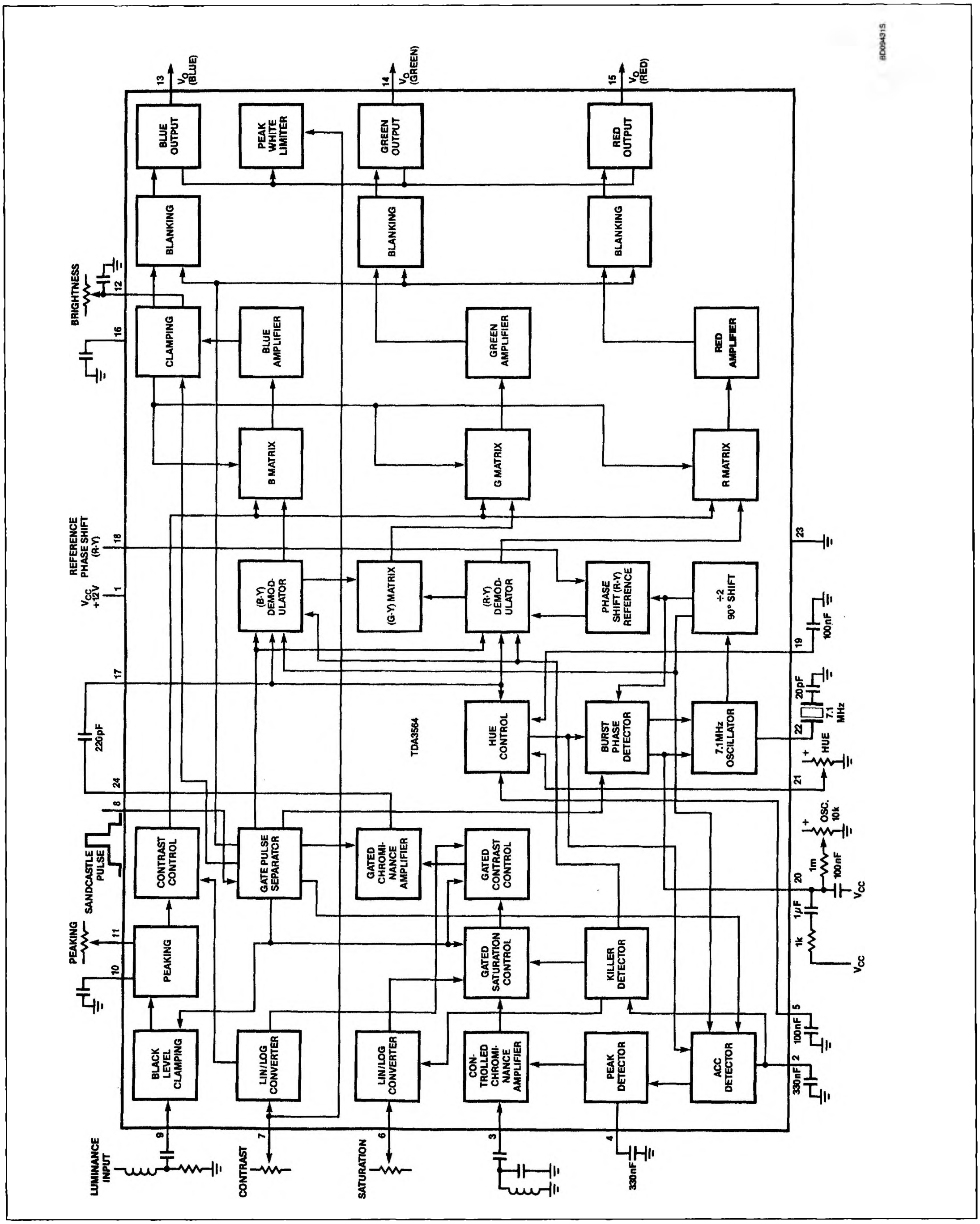
ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE
24-Pin Plastic DIP (SOT-101A)	−25°C to +65°C	TDA3564N

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
$V_{CC} = V_{1-23}$	Supply voltage (Pin 1)	13.2	V
P_{TOT}	Total power dissipation	1.7	W
T_{STG}	Storage temperature range	−65 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

BLOCK DIAGRAM



DC AND AC ELECTRICAL CHARACTERISTICS $V_{CC} = V_{1-23} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	LIMITS			UNIT
		Min	Typ	Max	
Supply (Pin 1)					
$V_{CC} = V_{1-23}$	Supply voltage	8	12	13.2	V
$I_{CC} = I_1$	Supply current		85		mA
P_{TOT}	Total power dissipation		1		W
Luminance amplifier (Pin 9)					
$V_{9-23(P-P)}$	Input voltage[1] (peak-to-peak value)		450		mV
V_{9-23}	Input level before clipping			2	V
I_9	Input current		0.15	1	μA
	Contrast control range (see Figure 1)	−17		+3	dB
	Control voltage for an attenuation of 40dB		1.2		V
I_7	Input current contrast control			15	μA
Peaking of luminance signal					
$\lvert Z_{10-23}\rvert$	Output impedance (Pin 10)		200		Ω
	Ratio of internal/external current when Pin 10 is short-circuited		3		
V_{11-23}	Control voltage for peaking adjustment (Pin 11)		2 - 4		V
$\lvert Z_{11-23}\rvert$	Input impedance (Pin 11)		10		kΩ
Chrominance amplifier (Pin 3)					
$V_{3-23(P-P)}$	Input voltage[2] (peak-to-peak value)	55	550	1100	mV
$\lvert Z_{3-23}\rvert$	Input impedance		8		kΩ
C_{3-23}	Input capacitance		4	6	pF
	ACC control range	30			dB
	Change of the burst signal at the output over the whole control range			1	dB
	Gain at nominal contrast/saturation Pin 3 to Pin 24[3]	13			dB
$V_{24-23(P-P)}$	Output voltage[3] (peak-to-peak value) at a burst signal of $300mV_{P-P}$		240		mV
$V_{24-23(P-P)}$	Maximum output voltage range (Pin 24) (peak-to-peak value)		1 - 7		V
d	Distortion of chrominance amplifier at $V_{24-23(P-P)} = 0.5V$ (output) up to $V_{3-23(P-P)} = 1V$ (input)		3	5	%
α_{24-3}	Frequency response between 0 and 5MHz			−2	dB
	Saturation control range (see Figure 2)	50			dB
I_6	Input current saturation control (Pin 6)			20	μA
	Tracking between luminance and chrominance contrast control			2	dB
	Cross-coupling between luminance and chrominance amplifier[4]			−46	dB
S/N	Signal-to-noise ratio at nominal input signal[5]	56			dB
$\Delta\phi$	Phase shift between burst and chrominance at nominal contrast/saturation			±5	deg
$\lvert Z_{24-23}\rvert$	Output impedance of chrominance amplifier		25		Ω
I_{24}	Output current			10	mA

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{1-23} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	LIMITS			UNIT
		Min	Typ	Max	
Reference part					
	Phase-locked loop				
Δf	Catching range[6]	500	700		Hz
$\Delta\phi$	Phase shift for ±400Hz deviation of f_{OSC}[6]			5	deg
	Oscillator				
TC_{OSC}	Temperature coefficient of oscillator frequency[6]		−1.5		Hz/°C
Δf_{OSC}	Frequency variation when supply voltage increases from 10 to 13.2V[6]		40		Hz
R_{22-23}	Input resistance (Pin 22)		300		Ω
C_{22-23}	Input capacitance (Pin 22)			10	pF
	ACC generation (Pin 2)				
V_{2-23}	Control voltage at nominal input signal		5.3		V
V_{2-23}	Control voltage without chrominance input		2.8		V
V_{2-23}	Color-off voltage		3.4		V
V_{2-23}	Color-on voltage		3.6		V
	Change in burst amplitude with supply voltage	independent			
V_{4-23}	Voltage at Pin 4 at nominal input signal		5.2		V
	Hue control				
	Control range	±50			deg
	Control voltage range	see Figure 4			V
Demodulator part					
$V_{17-23(P-P)}$	Input burst signal amplitude (Pin 17) (peak-to-peak value)		320		mV
$\lvert Z_{17-23} \rvert$	Input impedance (Pin 17)[7]		2		kΩ
$\frac{V_{15-23}}{V_{13-23}}$	Ratio of demodulated signals (B-Y)/(R-Y)		1.1		
$\frac{V_{14-23}}{V_{13-23}}$	(G-Y)/(R-Y); no (B-Y) signal		0.26		
$\frac{V_{14-23}}{V_{15-23}}$	(G-Y)/(B-Y); no (R-Y) signal		0.22		
	Frequency response between 0 and 1MHz			−3	dB
	Cross-talk between color difference signals	40			dB
ϕ	Control range reference signal (R-Y) demodulator (Pin 18)[8]	see Figure 5			deg
RGB matrix and amplifiers					
$V_{13,\ 14,\ 15-23(P-P)}$	Output voltage (peak-to-peak value) at nominal input signal (black-to-white)[3]		5		V
$V_{13-23(P-P)}$	Output voltage at Pin 13 (peak-to-peak value) at nominal contrast/ saturation and no luminance signal to (R-Y)		5.25		V
$V_{13,\ 14,\ 15-23}$	Maximum peak-white level[9]	9	9.3	9.6	V
$I_{13,\ 14,\ 15}$	Maximum output current (Pins 13, 14, 15)			10	mA
$V_{13,\ 14,\ 15-23}$	Output black level voltage for a brightness control voltage at Pin 12 of 2V		2.7		V
	Black level shift with vision contents			40	mV
	Brightness control voltage range	see Figure 3			V

DC AND AC ELECTRICAL CHARACTERISTICS (Continued) $V_{CC} = V_{1-23} = 12V$; $T_A = 25°C$, unless otherwise specified.

SYMBOL	PARAMETER	LIMITS			UNIT
		Min	Typ	Max	
I_{12}	Brightness control input current			5	μA
 $\Delta V/\Delta T$ ΔV	Variation of black level with temperature with contrast		 0.35 10	 1 100	 mV/°C mV
	Relative spread between the R, G, and B output signals			10	%
	Relative black level variation between the three channels during variation of contrast, brightness, and supply voltage		0	20	mV
	Differential black level drift over a temperature range of 40°C		0	20	mV
	Blanking level at the RGB outputs	1.9	2.1	2.3	V
	Difference in blanking level of the three channels		0		mV
	Differential drift of the blanking levels over a temperature range of 40°C		0		mA
$\frac{\Delta V_{B1}}{V_{B1}} \times \frac{V_{CC}}{\Delta V_{CC}}$	Tracking of output black level with supply voltage		1.1		
S/N	Signal-to-noise ratio of output signals[5]	62			dB
	Residual 7.1MHz signal and higher harmonics at the RGB outputs (peak-to-peak value)		75	150	mV
$\lvert Z_{13,\ 14,\ 15-23} \rvert$	Output impedance of RGB outputs		50		Ω
	Frequency response of total luminance and RGB amplifier circuits for f = 0 to 5MHz			−3	dB
Sandcastle input (Pin 8)					
V_{8-23}	Level at which the RGB blanking is activated	1	1.5	2	V
V_{8-23}	Level at which burst gating and clamping pulse are separated	6.5	7	7.5	V
t_D	Delay between black level clamping and burst gating pulse		0.4		μs
 $-I_8$ I_8 I_8	Input current at $V_{8-23} = 0$ to 1V at $V_{8-23} = 1$ to 8.5V at $V_{8-23} = 8.5$ to 12V		 20 	 1 2	 mA μA mA

NOTES:
1. Signal with the negative-going sync; amplitude includes sync amplitude.
2. Indicated is a signal for a color bar with 75% saturation; chrominance-to-burst ratio is 2.2:1.
3. Nominal contrast is specified as the maximum contrast −3dB and nominal saturation as the maximum saturation −6dB.
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 to the nominal output signal at that output.
5. The signal-to-noise ratio is defined as peak-to-peak signal with respect to RMS noise.
6. All frequency variations are referred to 3.58MHz carrier frequency.
7. These signal amplitudes are determined by the ACC circuit of the reference part.
8. When Pin 18 is open circuit, the phase shift between the (R-Y) and (B-Y) reference carrier is 115°. This phase shift can be varied by changing the voltage applied to Pin 18.
9. If the typical voltage for this white level is exceeded, the output voltage is reduced by discharging the capacitor at Pin 7 (contrast control); discharge current is 1.5mA.

FUNCTIONAL DESCRIPTION

Luminance Amplifier

The luminance amplifier is voltage driven and requires an input signal of $450mV_{P-P}$ (positive video). The luminance delay line must be connected between the IF amplifier and the decoder. The input signal is AC-coupled to the input (Pin 9).

The black level at the output of the preamplifier is clamped to a fixed DC level by the black level clamping circuit. The high input impedance of the luminance amplifier minimizes disturbance of the input signal black level by the source impedance (delay line matching resistors).

During clamping, the low-input impedance reduces noise and residual signals. After clamping, the signal is fed to a peaking stage. The overshoot is defined by the capacitor connected to Pin 10 and the peaking is adjusted by the control voltage at Pin 11.

The peaking stage is followed by a contrast control stage. The contrast control voltage range (Pin 7) is nominally −17 to +3dB. The linear relationship between the contrast-control voltage and the gain is shown in Figure 1.

Chrominance Amplifier

The chrominance amplifier has an asymmetrical input. The input signal must be AC-coupled (Pin 3) and have a minimum amplitude of $55mV_{P-P}$. The gain control stage has a control range in excess of 30dB, the maximum input signal must 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 contrast control stages are directly coupled to obtain good tracking. Saturation is linearly controlled via Pin 6 (see Figure 2). The control voltage range is 2V to 4V, the input impedance is High, and the saturation control range is in excess of 50dB. The burst signal is not affected by saturation control. The output signal at Pin 24 is AC coupled to the demodulators via Pin 17.

Oscillator and ACC Detector

The 7.16MHz reference oscillator operates at twice the subcarrier frequency. The reference signals for the (R-Y) and (B-Y) demodulators, burst-phase detector, and ACC detector are obtained via the divide-by-2 circuit, which provides a 90° phase shift. The oscillator is controlled by the burst phase detector, which is gated with the narrow part of the sandcastle pulse (Pin 8). As the burst phase detector has an asymmetrical output, the oscillator can be adjusted by changing the voltage of the output (Pin 21) via a high-ohmic resistor. The capacitor in series with the oscillator crystal must then have a fixed value. When Pin 6 (saturation control) is connected to the positive supply line, the burst signal is suppressed and the color killer is overruled. This position can therefore be used for adjustment of the oscillator. The adjustment is visible on the screen.

The hue control is obtained by changing the phase of the input signal of the burst phase detector with respect to the chrominance signal applied to the demodulators. This phase shift is obtained by generating a 90° shifted sine wave via a Miller integrator (biased via Pin 19) which is mixed with the original burst signal. A control circuit is required in the 90° phase shift circuit to make the chrominance voltage independent of the hue setting. The control circuit is decoupled by a capacitor connected to Pin 5.

As the shifted burst signal is synchronously demodulated in a separate ACC detector to generate the ACC voltage, it is not affected by the hue control. The output pulses of this detector are peak detected (Pin 4) to control the gain of the chrominance amplifier, thus preventing blooming-up of the color during weak signal reception. This ensures reliable operation of the color killer. During color killing, the color channel is blocked by switching off saturation control and the demodulators.

Demodulators

The (R-Y) and (B-Y) demodulators are driven by the chrominance signal (Pin 24) and the reference signals from the 7.16MHz divider circuit. The phase angle between the two reference carriers is 115°. This is achieved by the (R-Y) demodulator receiving an additional phase shift by mixing the two signals from the divider circuit. The phase shift of 115° can be varied between 90° and 140° by changing the bias voltage at Pin 18. The demodulator output signals are fed to R and B matrix circuits and to the (G-Y) matrix to provide the (G-Y) signal which is applied to the G matrix. The demodulator circuits are killed and blanked by bypassing the input signals.

RGB Matrix and Amplifiers

The three matrix and amplifier circuits are identical and only one circuit will be described. The luminance 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 −6dB maximum

The maximum output voltage is approximately $7V_{P-P}$.

The black level of the blue channel is compared to a variable external reference level (Pin 12) which provides brightness control. The brightness control range is 1V to 3.2V (see Figure 3). The control voltage is stored in a capacitor (connected to Pin 16) and controls the black level at the output (Pin 15) between 2V and 4V, via a change of the level of the luminance signal before matrixing.

NOTE:
Black levels of up to approximately 6V are possible, but amplitude of the output signal is reduced to $3V_{P-P}$.

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

The RGB signals can be blanked via the sandcastle input (Pin 8). A slicing level of 1.5V is used for this blanking function, so that the wide part of the sandcastle pulse is separated from the remainder of the pulse. During blanking, a level of +2V is available at the output.

NTSC Decoder TDA3564

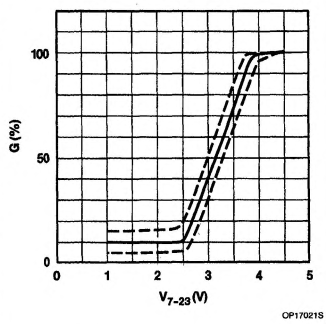


Figure 1. Contrast Control Voltage Range

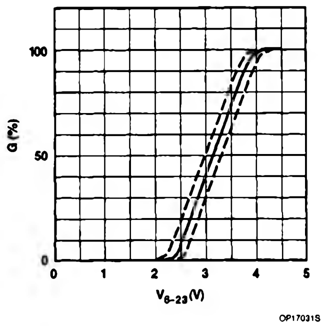


Figure 2. Saturation Control Voltage Range

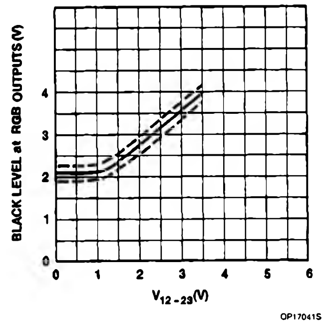


Figure 3. Brightness Control Voltage Range

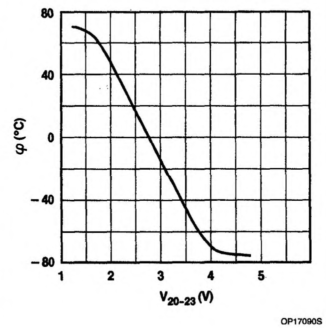


Figure 4. Hue Control Voltage Range

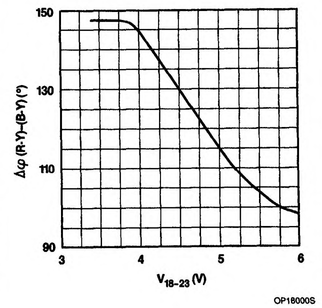
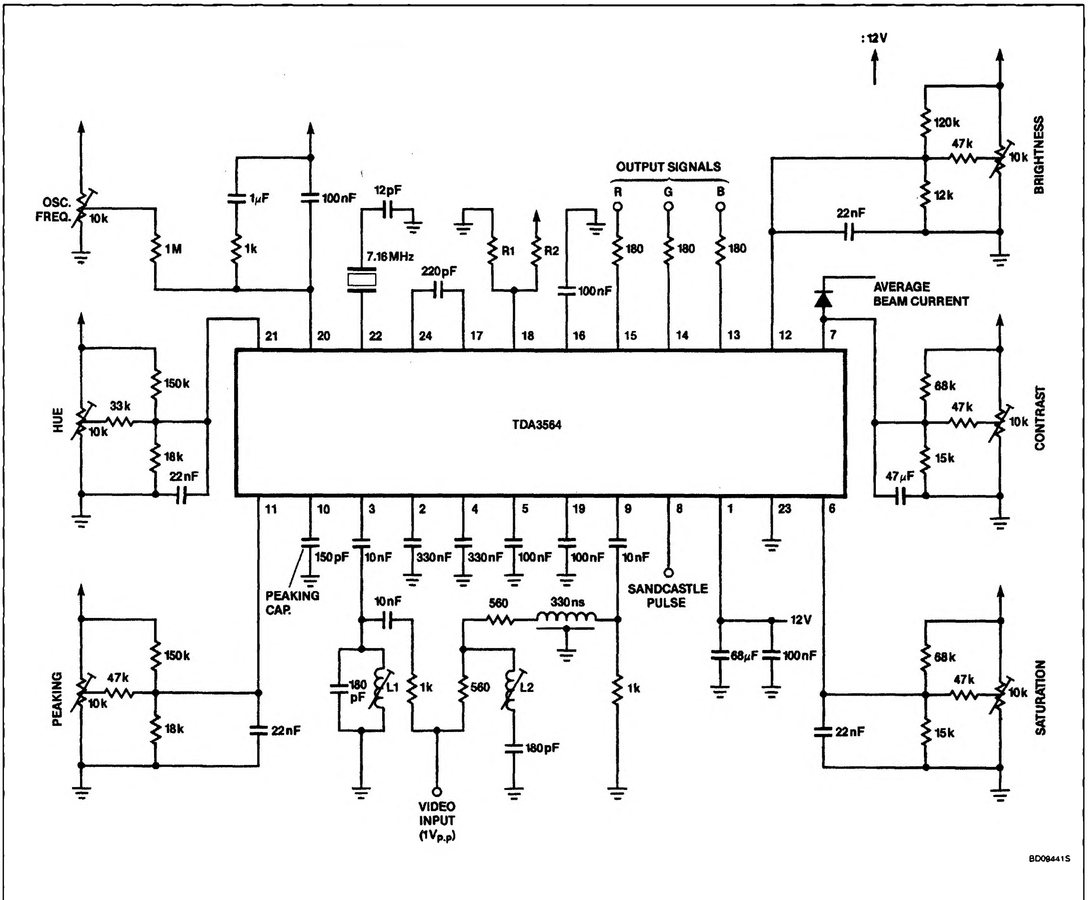
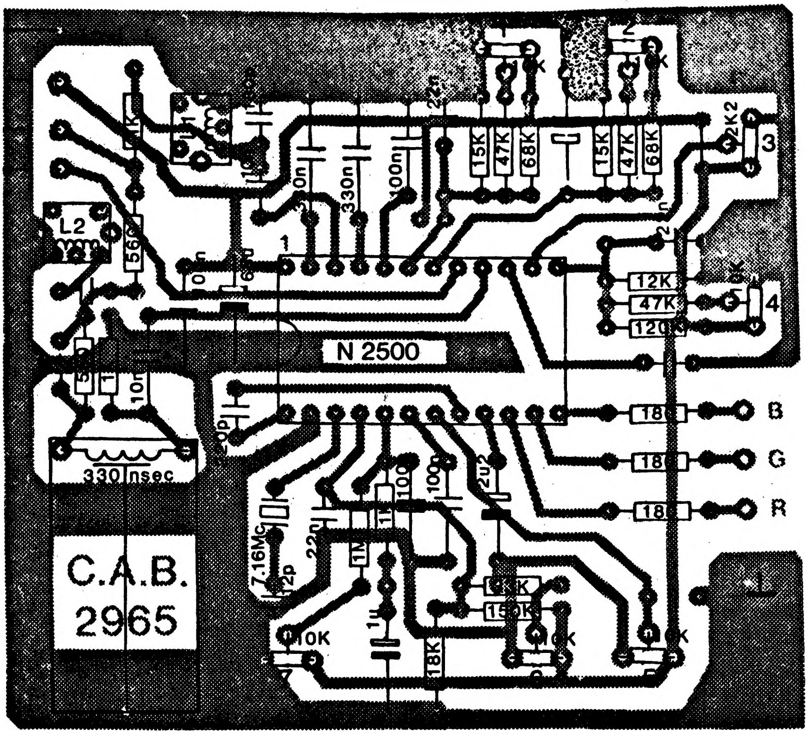


Figure 5. Phase Shift Between (R-Y) and (B-Y) as a Function of V_{18-23}

APPLICATION CIRCUIT FOR TDA3564 NTSC COLOR DECODER



NTSC DECODER N 2500



NOTES:
L1 = L2 μH TOKO 7P mat.

Controls:
1. Saturation
2. Contrast
3. Peaking
4. Brightness
5. ΔQ (R-Y)
6. Hue
7. Osc. freq.