PAL DECODER

The TDA3560 is a monolithic integrated colour decoder for the PAL standard. It combines all functions required for the identification and demodulation of PAL signals. Furthermore it contains a luminance amplifier, an RGB-matrix and amplifier. These amplifiers supply output signals up to 5 V peak-to-peak (picture information) enabling direct drive of the output stages. The circuit also contains separate inputs for data insertion, analogue as well as digital, which can be used for Teletext information, channel number display, etc.

QUICK REFERENCE DATA

Supply voltage	V_{1-27}	typ.	12	V
Supply current	I_1	typ.	85	mA
Luminance input signal (peak-to-peak value)	$V_{10-27(p-p)}$	typ.	0,45	V
Chrominance input signal (peak-to-peak value)	$V_{3-27(p-p)}$	55 to	1100	mV
Data input signals (peak-to-peak value)	$V_{13,15,17-27(p-p)}$	typ.	1	V
RGB output signals at nominal contrast and saturation (peak-to-peak value)	$V_{12,14,16-27(p-p)}$	typ.	5	V
Contrast control range		typ.	20	dB
Saturation control range		typ.	50	dB
Input for fast video-data signal switching	V_{9-27}	typ.	1	V
Blanking input voltage	V_{8-27}	typ.	1,5	V
Burst gating and black-level gating input voltage	V_{8-27}	typ.	7	V

PACKAGE OUTLINE

28-lead DIL; plastic (SOT-117).
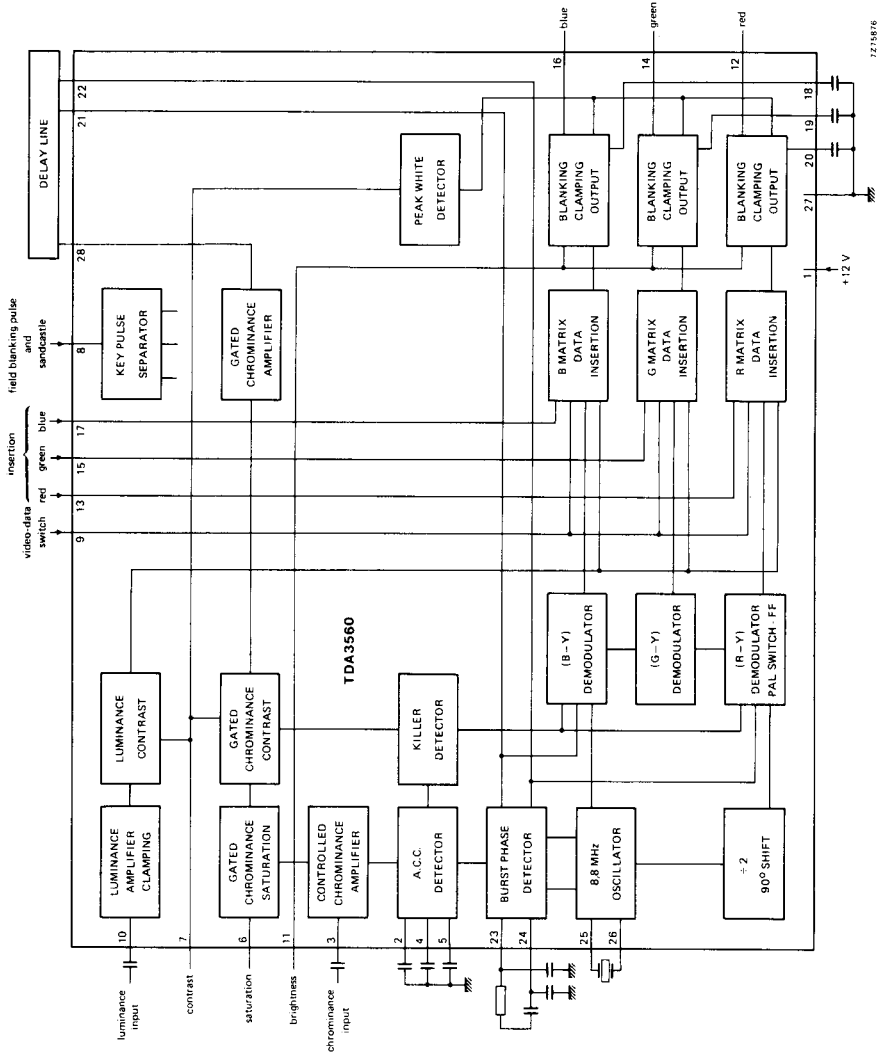
Fig. 1 Block diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

		min.	max.	
Supply voltage	$V_P = V_{1-27}$	–	13,2	V
Input saturation voltage	V_{6-27}	0	V_P	V
Input contrast voltage	V_{7-27}	0	V_P	V
Input blanking pulse and sandcastle	V_{8-27}	0	V_P	V
Input video-data switch voltage	V_{9-27}	0	V_P	V
Input brightness voltage	V_{11-27}	0	V_P	V
Power dissipation	see Fig. 2			
Storage temperature	T_{stg}	–25 to + 150		°C
Operating ambient temperature	T_{amb}	–25 to + 65		°C

CHARACTERISTICS

V_{1-27} = 12 V; $V_{10-27(p-p)}$ = 0,45 V; $V_{3-27(p-p)}$ = 500 mV; T_{amb} = 25 °C; measured in Fig. 6; unless otherwise specified

Supply voltage range	V_P	typ.	12	V
		8 to 13,2		V
Supply current	I_1	typ.	85	mA

Luminance amplifier

Input voltage (peak-to-peak value)	$V_{10-27(p-p)}$	typ.	0,45	V
Input current	I_{10}	<	1	μA
Contrast control range		–17 to + 3		dB
Contrast control voltage range	see Fig. 3			

Chrominance amplifier

Input voltage (peak-to-peak value)	$V_{3-27(p-p)}$	55 to 1100		mV
A.C.C. control range		>	30	dB
Output signal (peak-to-peak value) * burst signal (peak-to-peak value) = 0,5 V	$V_{28-27(p-p)}$	typ.	1,7	V
Saturation control range		>	50	dB
Saturation control voltage range	see Fig. 4			
Phase shift between burst and chrominance *		<	5°	
Tracking between luminance and chrominance with contrast control over a range of 10 dB, starting at maximum contrast		typ.	1	dB

* At nominal contrast and saturation setting. Nominal setting = maximum contrast –3 dB; maximum saturation –6 dB.

CHARACTERISTICS (continued)

Reference oscillator

Phase locked loop:
— catching range (note 1)		>	500 Hz
— phase shift (note 2)		<	5°

Oscillator:
— input resistance	R_{26-27}	typ.	300 Ω
— input capacitance	C_{26-27}	<	10 pF
— output resistance	R_{25-27}	typ.	200 Ω

A.C.C. generation:
— reference voltage	V_{4-27}	typ.	4,6 V
— control voltage at nominal input signal	V_{2-27}	typ.	4,7 V
— control voltage without burst	V_{2-27}	typ.	2,4 V

Demodulator circuit

Input burst signal amplitude (peak-to-peak value)	$V_{21,22-27(p-p)}$	typ.	60 mV

Ratio of demodulated signals without luminance input signal
(B-Y)/(R-Y)	$\dfrac{V_{16-27}}{V_{12-27}}$	typ.	1,78
(G-Y)/(R-Y)	$\dfrac{V_{14-27}}{V_{12-27}}$	typ.	−0,51
(G-Y)/(B-Y)	$\dfrac{V_{14-27}}{V_{16-27}}$	typ.	−0,19

RGB matrix and amplifiers

Output voltage (peak-to-peak value) (note 3)	$V_{12,14,16-27(p-p)}$	typ.	5 V
Maximum white level		typ.	9,3 V
Birghtness control voltage range	see Fig. 5		
Relative spread between R, G and B output signals		<	10 %
Variation of black level with contrast control	ΔV	<	200 mV
Relative black-level variation between the three stages during variation of contrast saturation, brightness and supply voltage		<	20 mV
Differential black-level drift over a temperature range of 40 °C		<	20 mV
Blanking level at RGB outputs		typ.	2,1 V
Signal-to-noise ratio of output signals (note 4)	S/N	>	62 dB

Notes
1. Frequency referred to 4,4 MHz carrier frequency.
2. For ± 400 Hz deviation of the oscillator frequency.
3. For nominal setting of the controls.
4. The signal-to-noise ratio is specified as the nominal peak-to-peak output signal with respect to r.m.s. noise.

Residual 8,8 MHz and higher harmonics
on RGB-outputs (peak-to-peak value) $\quad<\quad$ 150 mV

Output impedance RGB outputs $\quad |Z_o| \quad$ typ. $\quad$ 50 Ω

Frequency response of total luminance
and RGB amplifier circuits for f = 0 to 5 MHz $\quad<\quad$ −3 dB

Signal insertion

Input signals for an RGB output voltage
of 5 V (peak-to-peak value) $\quad V_{13,15,17\text{-}27(p\text{-}p)} \quad$ typ. $\quad$ 1 V

Difference between the black levels of the
RGB signals and the inserted signals
at the output $\quad \Delta V \quad<\quad$ 260 mV $\quad\longleftarrow$

Output rise time $\quad t_r \quad$ typ. $\quad$ 50 ns

Differential delay time for the three channels $\quad t_d \quad<\quad$ 40 ns

Video-data switching

Input voltage for switching
from video to inserted signals $\quad V_{9\text{-}27} \quad$ 0,9 to 2 V

Input voltage for no data insertion $\quad V_{9\text{-}27} \quad<\quad$ 0,3 V

Delay between signal switching at the
output and the signal switching input
pulse at pin 9 $\quad t_d \quad<\quad$ 20 ns

Sandcastle and field blanking input (pin 8)

Burst gate and clamping pulse $\quad V_{8\text{-}27} \quad>\quad$ 7,5 V

RGB blanking level
on $\quad V_{8\text{-}27} \quad$ 2 to 6,5 V
off $\quad V_{8\text{-}27} \quad<\quad$ 0,8 V

7Z75874
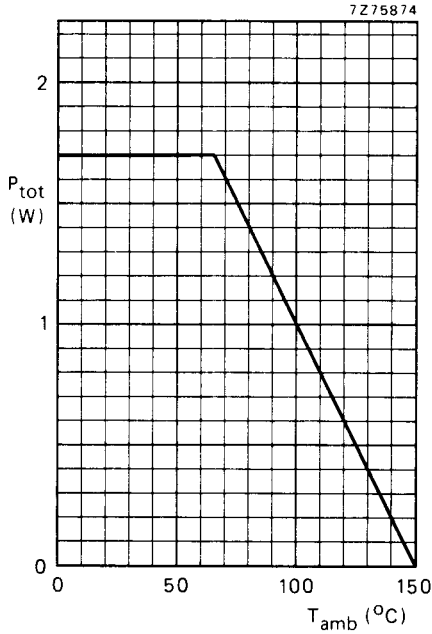
Fig. 2 Power derating curve.

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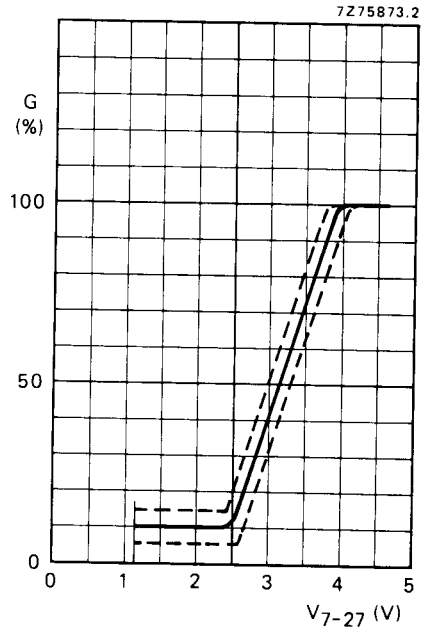
Fig. 3 Contrast control voltage range.

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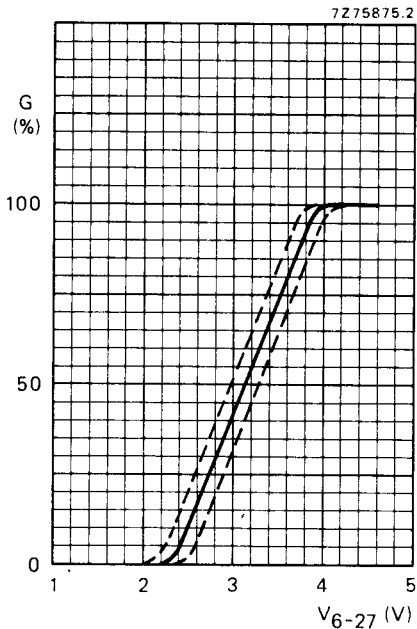
Fig. 4 Saturation control voltage range.

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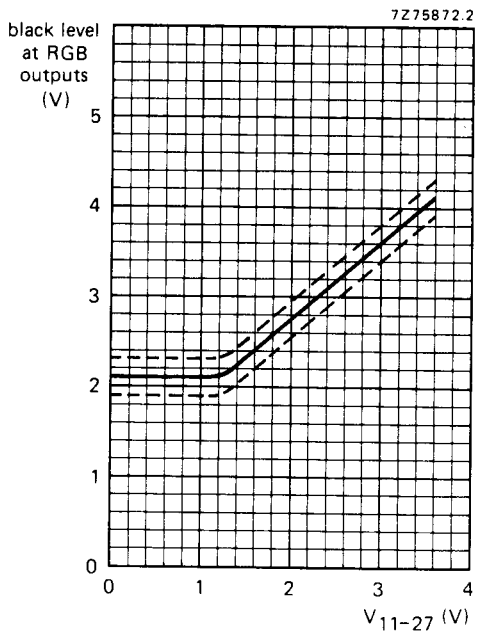
Fig. 5 Brightness control voltage range.

APPLICATION INFORMATION

Fig. 6 Application circuit.
For adjustments see page 10.

APPLICATION INFORMATION

The function is described against the corresponding pin number.

1. + 12 V power supply

The circuit gives good operation in a supply voltage range between 8 and 13,2 V provided that the supply voltage for the controls is equal to the supply voltage for the TDA3560. All signal and control levels have a linear dependency on the supply voltage. The current taken by the device at 12 V is typically 85 mA. It is linearly dependent on the supply voltage.

2. Control voltage for identification

This pin requires a detection capacitor of about 330 nF for correct operation. The voltages available under various signal conditions are given in the specification.

3. Chrominance input

The chroma signal must be a.c.-coupled to the input. Its amplitude must be between 55 mV and 1100 mV peak-to-peak (25 mV to 500 mV peak-to-peak burst signal). All figures for the chroma signals are based on a colour bar signal with 75% saturation, that is the burst-to-chroma ratio of the input signal is 1 : 2,25.

4. Reference voltage A.C.C. detector

This pin must be decoupled by a capacitor of about 330 nF. The voltage at this pin is 4,6 V.

5. Control voltage A.C.C.

The A.C.C. is obtained by synchronous detection of the burst signal followed by a peak detector. A good noise immunity is obtained in this way and an increase of the colour for weak input signals is prevented. The recommended capacitor value at this pin is 2,2 μF.

6. Saturation control

The saturation control range is in excess of 50 dB. The control voltage range is 2 to 4 V. Saturation control is a linear function of the control voltage.

When the colour killer is active, the saturation control voltage is reduced to a low level if the resistance of the external saturation control network is sufficiently high. Then the chroma amplifier supplies no signal to the demodulator. Colour switch-on can be delayed by proper choice of the time constant for the saturation control setting circuit.

When the saturation control pin is connected to the power supply the colour killer circuit is overruled so that the colour signal is visible on the screen. In this way it is possible to adjust the oscillator frequency without using a frequency counter (see also pins 25 and 26).

7. Contrast control

The contrast control range is 20 dB for a control voltage change from + 2 to + 4 V. Contrast control is a linear function of the control voltage. The output signal is suppressed when the control voltage is 1 V or less. If one or more output signals surpasses the level of 9 V the peak white limiter circuit becomes active and reduces the output signals via the contrast control by discharging C2 via an internal current sink.

8. Sandcastle and field blanking input

The output signals are blanked if the amplitude of the input pulse is between 2 and 6,5 V. The burst gate and clamping circuits are activated if the input pulse exceeds a level of 7,5 V.
The higher part of the sandcastle pulse should start just after the sync pulse to prevent clamping of video signal on the sync pulse. The width should be about 4 μs for proper A.C.C. operation.

9. Video-data switching

The insertion circuit is activated by means of this input by an input pulse between 1 V and 2 V. In that condition, the internal RGB signals are switched off and the inserted signals are supplied to the output amplifiers. If only normal operation is wanted this pin should be connected to the negative supply. The switching times are very short ($<$ 20 ns) to avoid coloured edges of the inserted signals on the screen.

10. Luminance signal input

The input signal should have a peak-to-peak amplitude of 0,45 V (peak white to sync) to obtain a black-white output signal of 5 V at nominal contrast. It must be a.c.-coupled to the input by a capacitor of about 22 nF. The signal is clamped at the input to an internal reference voltage.
A 1 kΩ luminance delay line can be applied because the luminance input impedance is made very high. Consequently the charging and discharging currents of the coupling capacitor are very small and do not influence the signal level at the input noticeably. Additionally the coupling capacitor value may be small.

11. Brightness control

The black level of the RGB outputs can be set by the voltage on this pin (see Fig. 5). The minimum black level is identical to the blanking level. The black level can be set higher than 4 V however the available output signal amplitude is reduced (see pin 7). Brightness control also operates on the black level of the inserted signals.

12, 14, 16. RGB outputs

The output circuits for red, green and blue are identical. Output signals are 5 V (black-white) for nominal input signals and control settings. The black levels of the three outputs have the same value. The blanking level at the outputs is 2 V. The peak white level is limited to 9 V. When this level is exceeded the output signal amplitude is reduced via the contrast control (see pin 7).

13, 15, 17. Inputs for external RGB signals

The external signals must be a.c.-coupled to the inputs via a coupling capacitor of about 100 nF. Source impedance should not exceed 150 Ω. The input signal required for a 5 V peak-to-peak output signal is 1 V peak -to-peak. At the RGB outputs the black level of the inserted signal is identical to that of normal RGB signals. When these inputs are not used the coupling capacitors have to be connected to the negative supply.

18, 19, 20. Black level clamp capacitors

The black level clamp capacitors for the three channels are connected to these pins. The value of each capacitor should be about 100 nF.

21, 22. Inputs (B-Y) and (R-Y) demodulators

The input signal is automatically fixed to the required level by means of the burst phase detector and A.C.C. generator which are connected to this pin and pin 22. As the burst (applied differentially to those pins) is kept constant by the A.C.C., the colour difference signals automatically have the correct value.

APPLICATION INFORMATION (continued)

23, 24. Burst phase detector outputs

At these pins the output of the burst phase detector is filtered and controls the reference oscillator. An adequate catching range is obtained with the time constants given in the application circuit (see Fig. 6).

25, 26. Reference oscillator

The frequency of the oscillator is adjusted by the variable capacitor C1. For frequency adjustment interconnect pin 23 and pin 24. The frequency can be measured by connecting a suitable frequency counter to pin 25.

28. Output of the chroma amplifier

Both burst and chroma signals are available at the output. The burst-to-chroma ratio at the output is identical to that at the input for nominal control settings. The burst signal is not affected by the controls. The amplitude of the input signal to the demodulator is kept constant by the A.C.C. Therefore the output signal at pin 28 will depend on the signal loss in the delay line.

Adjustments (see Fig. 6)

C1	8,8 MHz oscillator	
L1	phase delay line	$= 10,7\ \mu H$
L2	nominal value	$= 10,7\ \mu H$
L3	4,4 MHz chrominance input filter	$= 10,7\ \mu H = L1$
L4	4,4 MHz trap in luminance signal line	$= 5,6\ \mu H$
L5	delay equalization	$= 66,1\ \mu H$
P1	amplitude of direct chroma signal	

$\left. \begin{array}{l} R1 \\ R2 \end{array} \right\}$ field blanking $\dfrac{R1}{R1 + R2}$ x field blanking amplitude 2,0 V to 6,5 V.

For a video input voltage of 1 V peak-to-peak: R4 = 1 kΩ; R3, R5 and R6 can be omitted.