PAL DECODER AND RGB MATRIX

GENERAL DESCRIPTION

The TDA8390 is a one-chip PAL colour decoder which is designed to be used in combination with the P²CCD Delay Line (TDA8451) and the Filter Combination (TDA8452). The IC combines the circuits that are required for the identification and demodulation of PAL signals, RGB matrixing and amplification. SECAM signals can be handled when the IC is used in combination with the SECAM decoder TDA8490.
Inductive components are not required due to the integration of the filters and the delay lines. The TDA8390 provides a crystal precise reference signal for the clock generator circuits in TDA8451 and TDA8452. Therefore, no adjustments are required to the filters and delay times. The decoder contains separate inputs for RGB signal insertion (analogue or digital) which can, for example, be used for text display systems (e.g. channel number display, Teletext, Antiope etc.).

Features

- A black-current stabilizer which controls the black currents of the three electron guns
- Contrast and brightness control of inserted RGB signals
- Self aligned oscillator
- Capacitive coupling with black level clamping of the luminance, colour difference and RGB inputs
- Equal black levels for internal TV and external signals
- 12 MHz bandwidth
- Emitter follower outputs for driving the RGB output stages

QUICK REFERENCE DATA

parameter	conditions	symbol	min.	typ.	max.	unit
Supply voltage		V_{23-29}	10.0	12	13.2	V
Supply current		I_{23}	–	90	–	mA
Luminance input voltage (peak-to-peak value)		$V_{25(p-p)}$	–	0.45	–	V
Contrast control range		ΔG	–	20	–	dB
Chrominance input voltage (peak-to-peak value)		$V_{30(p-p)}$	–	465	–	mV
Demodulator output voltages						
R-Y (peak-to-peak value)		$V_{26(p-p)}$	0.50	0.62	0.74	V
B-Y (peak-to-peak value)		$V_{27(p-p)}$	0.64	0.80	0.96	V
Saturation control range		ΔG	50	–	–	dB
Colour difference input signals						
R-Y (peak-to-peak value)		$V_{21(p-p)}$	–	0.62	–	V
B-Y (peak-to-peak value)		$V_{22(p-p)}$	–	0.8	–	V
RGB input signal (peak-to-peak value)		$V_{14, 16, 18(p-p)}$	–	0.7	–	V
Bandwidth of RGB amplifier	−3 dB	B	12	–	–	MHz
Video switching voltage	external RGB	V_9	0.9	–	4.0	V
RGB output voltage (peak-to-peak value)		$V_{13, 15, 17(p-p)}$	–	4.0	–	V
Brigthness control range		V_5	–	2	–	V

PACKAGE OUTLINE

32-lead DIL; plastic with internal heat spreader (SOT201).

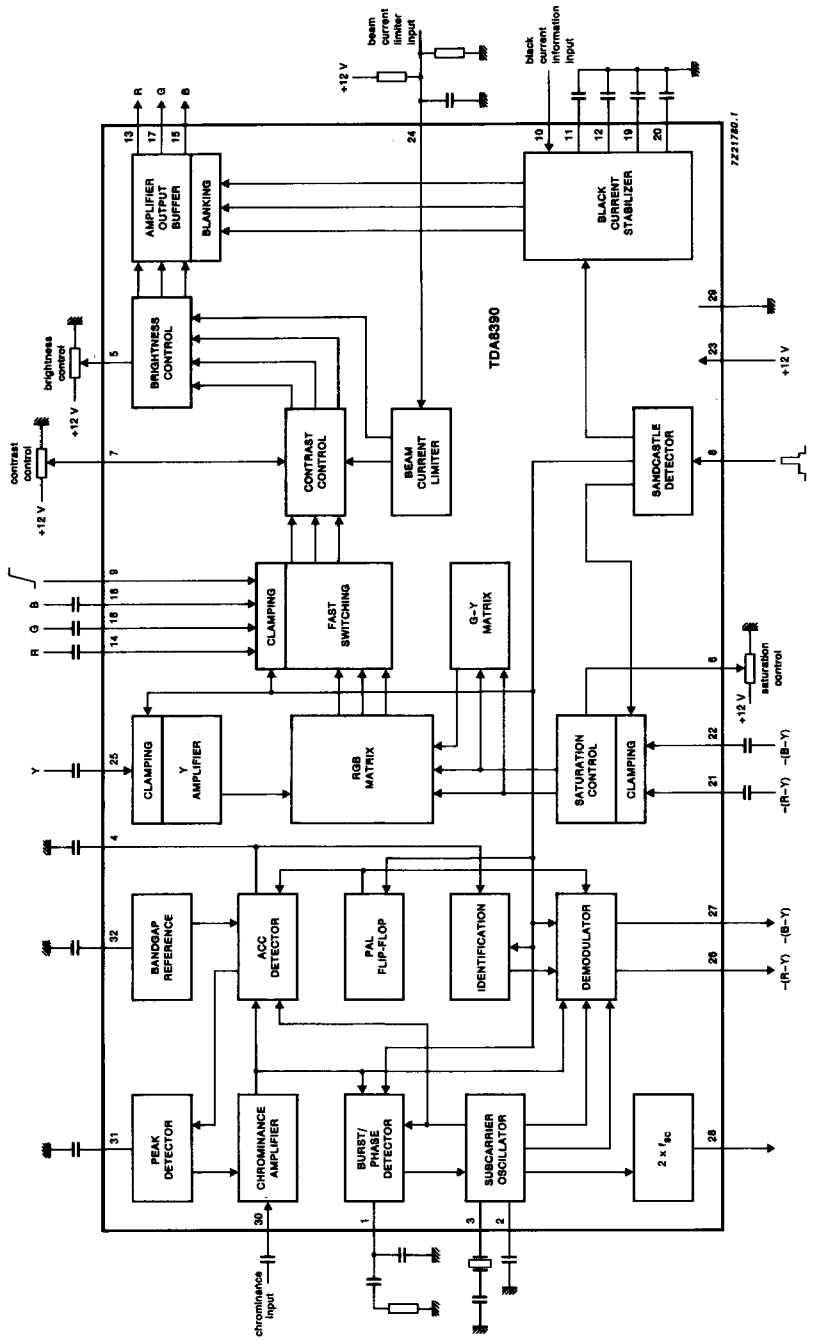


Fig.1 Block diagram.

PINNING

1. Phase detector
2. 90° phase shift DC reference
3. 4.43 MHz PAL reference frequency input
4. Sample and hold (PAL identification)
5. Brightness control
6. Saturation control
7. Contrast control
8. Sandcastle pulse input
9. Video switch input
10. Black current input
11. Black current reference
12. Red clamping circuit
13. Red signal output
14. Red insertion input
15. Blue signal output
16. Blue insertion input
17. Green signal output
18. Green insertion input
19. Blue clamping circuit
20. Green clamping circuit
21. −(R-Y) colour difference input
22. −(B-Y) colour difference input
23. Positive supply voltage
24. Beam current limiter input
25. Luminance input
26. −(R-Y) signal output
27. −(B-Y) signal output
28. Frequency doubler output
29. Ground
30. Chrominance input
31. Automatic colour control
32. ACC reference voltage

DEVELOPMENT DATA

FUNCTIONAL DESCRIPTION

Colour decoder

The input chroma signal is amplified and applied to the burst phase detector (reference signal R-Y phase), the ACC and identification detector (reference signal ± R-Y phase) and the two demodulators. The burst phase detector controls the oscillator which operates at a frequency of 4.43 MHz. By connecting pin 6 to 12 V, the free-running frequency of the oscillator can be adjusted (phase detector and colour killer switched off). The gain control stage of the oscillator is biased in such a way that sinewave signals are generated. The output from the oscillator is fed to a Miller integrator in order to obtain the required 90° phase shift. The reference signals obtained from the oscillator and 90° phase shift network are applied to the various demodulators.

The output signal from the ACC and identification detector is peak detected to generate the ACC voltage and detected in a sample and hold circuit to obtain the identification and killer information. Because the P^2CCD delay line (TDA8451) and the P^2CCD filter combination (TDA8452) both require a reference signal ($2 \times f_{SC}$) the oscillator frequency is doubled, internally, and is made available at pin 28. The demodulated signals, with the correct amplitude ratio, are applied to the TDA8451.

The TDA8390 can be combined with the SECAM decoder TDA8490 (Fig.3) by direct connection of their outputs. The output DC levels have been chosen so that the PAL decoder has priority (output level during PAL is higher than output level during SECAM).

Control circuit

The luminance and colour difference signals together with the RGB inputs and fast switching pulse form the inputs to the control circuit. The required luminance input signal (from TDA8452) has a peak-to-peak value of 0.45 V (including sync). The colour difference input signals (from TDA8451) have a negative phase with a 0.62 V (R-Y) and 0.8 V (B-Y) peak-to-peak value. After amplification, the luminance signal is applied to the RGB matrix.

The colour difference signals are fed to the saturation control circuit before being applied to the RGB matrix (the G-Y signal is generated after the saturation control circuit).

The normal matrix for PAL is: (G-Y) = −0.51 (R-Y)−0.19 (B-Y).

The signals from the RGB matrix are applied to a fast switching circuit from where external RGB signals can be selected. The fast switching circuit is controlled by the video switching input. After amplification the RGB signals (internal or external video) are controlled on the contrast and brightness before being fed to the outputs. A typical output signal amplitude is 4 V black-to-white (nominal controls).

The black level of the RGB output signals is determined by the black current stabilization circuit. The information regarding the black current level of the picture tube is obtained in the same manner as the TDA3562A. The beam current limiter input is used to reduce the output signal amplitude via the contrast and brightness control circuits.

A block diagram is given in Fig.1. Figure 2 illustrates the PAL decoder configuration and Figure 3 the PAL-SECAM configuration. Figures 4, 5 and 6 illustrate the Saturation, Contrast and Brightness control curves respectively.

RATINGS

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

parameter	conditions	symbol	min.	max.	unit
Supply voltage (pin 23)		V_P	–	13.2	V
Total power dissipation		P_{tot}	–	1.5	W
Operating ambient temperature range		T_{amb}	−25	+70	°C
Storage temperature range		T_{stg}	−25	+150	°C

THERMAL RESISTANCE

From junction to ambient (in free air) $R_{th\ j\text{-}a}$ 40 K/W

DEVELOPMENT DATA

CHARACTERISTICS

V_P = 12 V; T_{amb} = 25 °C; all voltages are referenced to ground (pin 29) unless otherwise specified

parameter	conditions	symbol	min.	typ.	max.	unit
Supply voltage (pin 23)		V_P	10.0	12.0	13.2	V
Supply current (pin 23)		I_P	–	90	–	mA
Total power dissipation		P_{tot}	–	1	1.5	W
DEMODULATOR PART						
Chrominance amplifier (pin 30)						
Input signal amplitude (peak-to-peak value)	note 1	$V_{30(p-p)}$	–	465	–	mV
Input signal amplitude before clipping occurs in the input stage (peak-to-peak value)		$V_{30(p-p)}$	–	–	1100	mV
Minimum burst signal amplitude within the ACC control range (–1 dB) (peak-to-peak value)		$V_{30(p-p)}$	30	–	–	mV
Input resistance		R_{30}	–	12	–	kΩ
Input capacitance		C_{30}	–	–	4	pF
ACC control range			30	–	–	dB
Change in amplitude of the output signals (pins 26 and 27) over the ACC range		ΔV_o	–	± 1	–	dB
REFERENCE PART						
Phase locked loop						
Catching range	note 2	Δf	± 500	–	–	Hz
Phase shift for ± 400 Hz deviation of the oscillator frequency	note 2	$\Delta\varphi$	–	–	5	deg
Oscillator						
Temperature coefficient of the oscillator frequency		TC_{osc}	–	–2	–	Hz/K
Frequency deviation for a supply voltage change from 10 V to 13.2 V	note 2	Δf	–	40	–	Hz
Input resistance (pin 3)		R_3	–	650	–	Ω
Input capacitance (pin 3)		C_3	–	–	6	pF

DEVELOPMENT DATA

parameter	conditions	symbol	min.	typ.	max.	unit
ACC and identification detectors (pins 4 and 31)						
Voltage at the PAL identification output (pin 4)						
nominal input signal for PAL		V_4	–	5.0	–	V
without burst input		V_4	–	3.1	–	V
Colour-OFF voltage		V_4	–	3.3	–	V
Colour-ON voltage		V_4	–	3.5	–	V
Voltage at peak detector output (pin 31)						
voltage at nominal input signal		V_{31}	–	5.8	–	V
voltage without input signal		V_{31}	–	2.7	–	V
Demodulators						
Output signal amplitude						
R-Y output (peak-to-peak value) (pin 26)		$V_{26(p-p)}$	0.50	0.62	0.74	V
B-Y output (peak-to-peak value) (pin 27)		$V_{27(p-p)}$	0.64	0.80	0.96	V
Ratio of amplification of both demodulators G(B-Y)/G(R-Y)		V_{26-27}	1.6	1.78	1.96	
Frequency response between 0 and 1 MHz		f	–	–3	–	dB
Output resistance R-Y/B-Y output		R_{26-27}	–	100	–	Ω
Output DC level when a PAL signal is identified		V_{26-27}	–	8.3	–	V
Output level during killing		V_{26-27}	–	1.3	–	V
Unwanted signals at R-Y and B-Y outputs	note 3		–	–	*	dB
4.4 MHz residual carrier at R-Y and B-Y outputs (peak-to-peak value)		$V_{26-27(p-p)}$	–	–	10	mV
8.8 MHz + harmonics residual carrier at R-Y and B-Y outputs (peak-to-peak value)		$V_{26-27(p-p)}$	–	–	20	mV
H/2 ripple at R-Y output without input signal (peak-to-peak value)		$V_{26(p-p)}$	–	–	50	mV
Change in amplitude (R-Y/B-Y) with temperature		$\Delta V/\Delta T$	–	–0.1	–	%/K
Change in amplitude with supply voltage		$\Delta V/\Delta V$	–	–	± 0.1	dB

* Value to be fixed.

CHARACTERISTICS (continued)

parameter	conditions	symbol	min.	typ.	max.	unit
Frequency doubler output (pin 28)						
Output signal amplitude (peak-to-peak value)		$V_{28(p-p)}$	–	350	–	mV
Output resistance		R_{28}	–	50	–	Ω
DC output level		V_{28}	–	4.9	–	V
Bandgap reference decoupling (pin 32)						
DC level		V_{32}	–	7.3	–	V
Luminance input (pin 25)						
Input voltage (peak-to-peak value)	note 4	$V_{25(p-p)}$	–	0.45	–	V
Input voltage before clipping occurs (peak-to-peak value)		$V_{25(p-p)}$	–	–	0.9	V
Input current		I_{25}	–	0.1	1.0	μA
Frequency response of total luminance and amplifier circuits; 0 to 12 MHz			–	–3	–	dB
Colour difference input signals						
Input signal amplitude (R-Y) (peak-to-peak value) (pin 21)		$V_{21(p-p)}$	–	0.62	–	V
Input signal amplitude (B-Y) (peak-to-peak value) (pin 22)		$V_{22(p-p)}$	–	0.8	–	V
Input current (pins 21 and 22)		$I_{21, 22}$	–	0.1	1.0	μA
RGB inputs (pins 14, 16 and 18)						
Input signal amplitude (peak-to-peak value)	note 5	$V_{14, 16, 18(p-p)}$	–	0.7	–	V
Δ Black level	note 6	$\Delta V_{13, 15, 17}$	–	–	*	mV
Frequency response of RGB amplifier between 0 and 12 MHz		f	–	–2	–	dB
Delay difference for the three channels		t_d	–	0	–	ns
Input current		$I_{14, 16, 18}$	–	–	10	μA
Video switching (pin 9)						
Input voltage	no signal insertion	V_9	–	–	0.3	V
Input voltage	signal insertion	V_9	0.9	–	4.0	V
Delay of switching		t_d	–	–	50	ns
Input resistance		R_9	–	10	–	kΩ

* Value to be fixed.

DEVELOPMENT DATA

parameter	conditions	symbol	min.	typ.	max.	unit
Ratio of unwanted internal RGB signals with reference to 4 V at the RGB outputs (peak-to-peak value)	note 8; $V_9 > 0.9$ V 0 - 5 MHz		–46	–	–	dB
Ratio of unwanted external RGB signals with reference to 4 V at the RGB outputs (peak-to-peak value)	note 8; $V_9 < 0.3$ V 0 - 5 MHz		–35	–	–	dB
Sandcastle input (pin 8)						
Detection level for:						
vertical blanking		V_8	1.0	1.5	2.0	V
horizontal blanking		V_8	3.0	3.5	4.0	V
upper part of pulse		V_8	6.5	7.0	7.5	V
Input current						
V_I = 0 to 1.5 V		I_8	–	–	–0.5	mA
V_I = 1.5 to 3.5 V		I_8	–	–	–15	μA
V_I = 3.5 to 7.0 V		I_8	–	–	–7	μA
V_I = 7.0 to 12 V		I_8	–	–	–1	μA
Internal delay between black level clamping and burst gating pulse (leading edge)		t_d	1.5	2.0	2.5	μs
Saturation control input (pin 6)						
Saturation control range		G	50	–	–	dB
Saturation control curve			see Fig.4			
Input current saturation control for $V_6 < 4.5$ V		I_6	–	–	10	μA
Input resistance for V_6 between 4.5 V and 8 V		R_6	–	2	–	kΩ
Input resistance for V_6 between 8 V and 12 V		R_6	–	1	–	kΩ
Contrast control input (pin 7)						
Contrast control range	note 7	G	–	20	–	dB
Tracking of contrast control between the three channels over a control range of 10 dB			–	–	0.5	dB
Contrast control curve			see Fig.5			
Input current contrast control for $V_7 < 6$ V		I_7	–	–	10	μA
Input resistance for $V_7 > 6$ V		R_7	–	2	–	kΩ

* Value to be fixed.

CHARACTERISTICS (continued)

parameter	conditions	symbol	min.	typ.	max.	unit
Brightness control input (pin 5)						
Brightness control voltage range	note 11	V_5	–	2.0	–	V
Brightness control curve				see Fig.6		
Input current brightness control		I_5	–	–	–50	μA
Colour difference matrices						
G-Y/R-Y			–	–0.51	–	
G-Y/B-Y			–	–0.19	–	
RGB amplifiers (pins 13, 15, 17)						
Output signal amplitude (peak-to-peak value)	notes 7 and 8	$V_{13, 15, 17(p-p)}$	3.5	4.0	4.5	V
Output signal amplitude for the blue channel (peak-to-peak value)	note 9	$V_{15(p-p)}$	4.3	5.4	6.5	V
Maximum peak white level		V_{max}	–	10.5	–	V
Available output current		$I_{13, 15, 17}$	10	–	–	mA
Difference in black level between the three outputs at nominal brightness	note 10	$\Delta V_{13, 15, 17}$	–	–	100	mV
Control range of black current stabilization at V black = 3 V and nominal brightness control			–	–	± 2	V
Black level shift with picture content		ΔV	–	–	40	mV
Output voltage during the 4L pulse after switch-ON		$V_{13, 15, 17}$	7.5	–	–	V
Variation of black level with temperature		$\Delta V/\Delta T$	–	0	–	mV/K
Variation of black level over contrast control at nominal satuarion	note 11 +3 to −17 dB	ΔV	–	–	*	mV
Relative spread between the three output signals			–	–	10	%

* Value to be fixed.

DEVELOPMENT DATA

parameter	conditions	symbol	min.	typ.	max.	unit
Relative variation in black level between the three channels during variations of the following conditions:						
supply voltage (± 10%) at nominal controls	note 11	ΔV	–	–	*	mV
contrast (20 dB) at nominal saturation		ΔV	–	–	*	mV
saturation (50 dB) at nominal contrast		ΔV	–	–	*	mV
brightness (± 1 V) at nominal controls		ΔV	–	–	*	mV
Differential drift of the black level over a temperature range of 40 K	note 11	$\Delta V/\Delta T$	–	–	70	mV
Blanking level at the RGB outputs		V_{bl}	–	1	–	V
Difference in blanking level of the three channels		ΔV_{bl}	–	0	10	mV
Differential drift of the blanking levels over a temperature range of 40 K		$\Delta V/\Delta T$	–	0	10	mV
Tracking of the output black levels with supply voltage		$\frac{\Delta V_{bl}}{V_{bl}} \times \frac{V_P}{\Delta V_P}$	0.9	1.0	1.1	
Signal-to-noise ratio of output signals	note 3	S/N	–	–	*	dB
Output resistance		$R_{13, 15, 17}$	–	50	–	Ω
Current source at output stage		I_O	–	2.5	–	mA
Black current stabilization (pin 10)						
DC bias voltage		V_{10}	3.5	5.0	7.0	V
Difference between input voltage for black current and leakage current		ΔV	0.35	0.5	0.65	V
Input current during black current		I_{10}	–	–	1	μA
Input current during scan		I_{10}	–	–	10	mA
Internal limiting level		V_{10}	8.5	9.0	9.5	V
Switching threshold for black current control ON		V_{10}	7.6	8.0	8.4	V
Input resistance during scan		R_{10}	1.0	1.5	2.0	kΩ
DC input current during scan at pins 12, 19 and 20		$I_{12, 19, 20}$	–	–	50	nA
Maximum charge/discharge current during measuring time of clamping pulse at pins 12, 19 and 20		$I_{12, 19, 20}$	0.5	–	–	mA

* Value to be fixed.

CHARACTERISTICS (continued)

parameter	conditions	symbol	min.	typ.	max.	unit
Beam current limiter (pin 24)						
Voltage when beam current limiter function is not active	note 12	V_{14}	5	–	–	V
Trigger level for beam current limiter function		V_{24}	–	4.2	–	V

Notes to the characteristics

1. Indicated as a signal for a colour bar with 75% saturation (chrominance/burst ratio = 2.2 : 1).
2. All frequency variations are referred to 4.43 MHz carrier frequency.
3. The ratio between wanted and unwanted signals (e.g. crosstalk, phase errors and noise) is specified as the output signal amplitude (peak-to-peak value at nominal conditions) with respect to the RMS value of the unwanted signal.
4. Signal with negative going sync. Amplitude includes sync pulse amplitude.
5. For a resultant black-to-white output signal of 4 V at nominal contrast.
6. Difference in black level between RGB signals and inserted signals.
7. Nominal contrast is specified as maximum contrast –3 dB. Nominal saturation as maximum saturation –6 dB; nominal white point adjustment is maximum –3 dB.
8. Nominal luminance input signal and nominal contrast.
9. Nominal contrast, nominal saturation no (R-Y) and no luminance signal.
10. With respect to the measuring pulse. At nominal brightness the black level of one output is identical to the measuring level.
11. With respect to the measuring pulse.
12. Pin 28 should be connected externally to a high-resistance voltage divider. Pins 14, 16 and 18 when unused, should be connected to ground via a 100 nF capacitor.

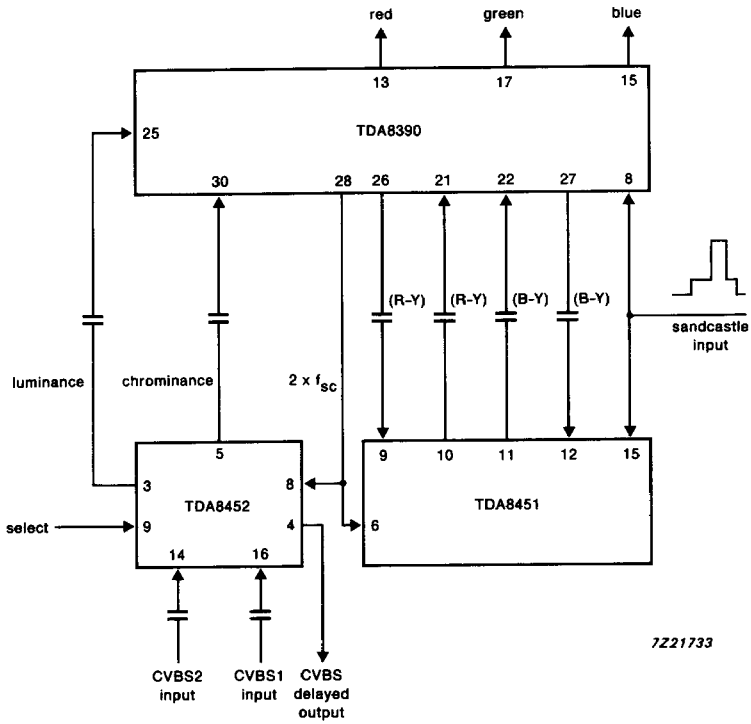


Fig. 2 PAL decoder configuration.

DEVELOPMENT DATA

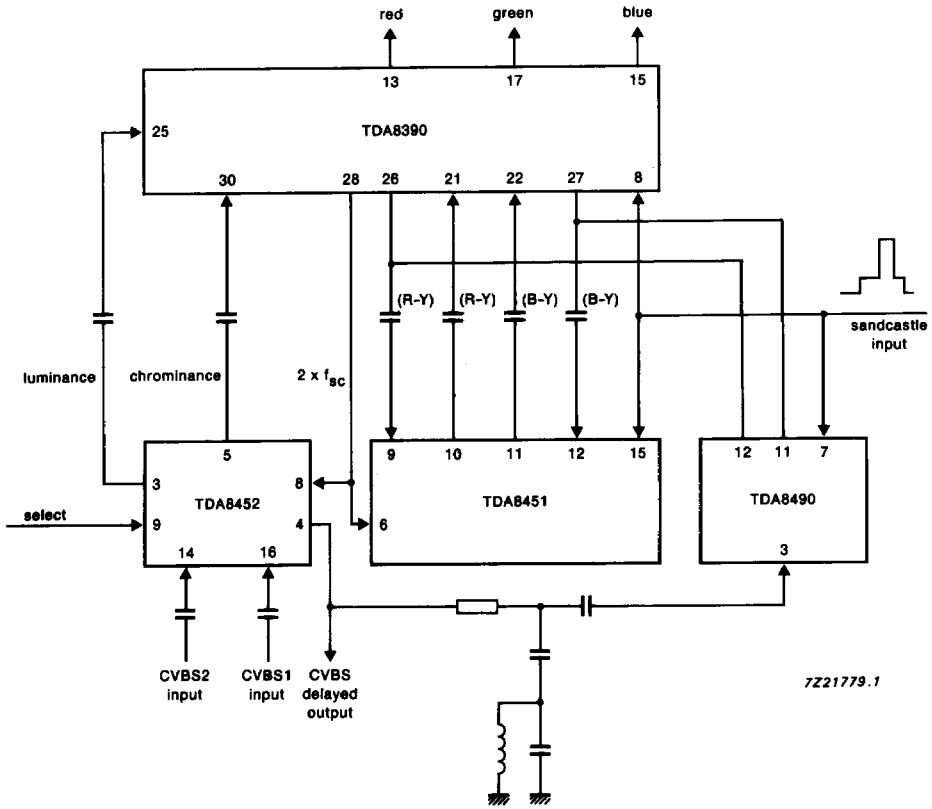


Fig. 3 PAL-SECAM decoder configuration.

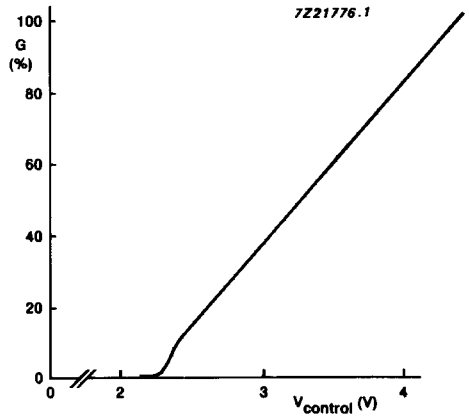


Fig.4 Saturation control curve.

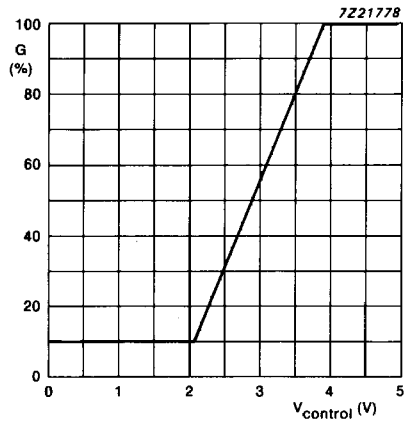
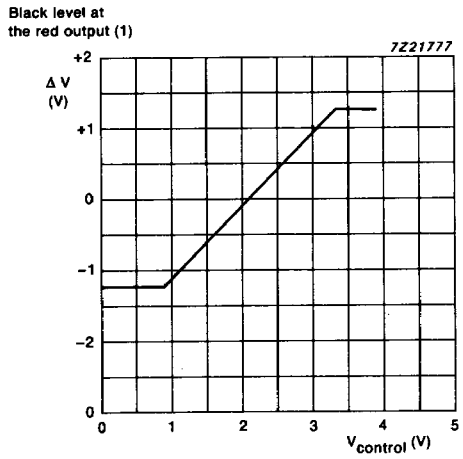


Fig.5 Contrast control curve.



(1) with respect to the measuring pulse

Fig.6 Brightness control curve.

DEVELOPMENT DATA

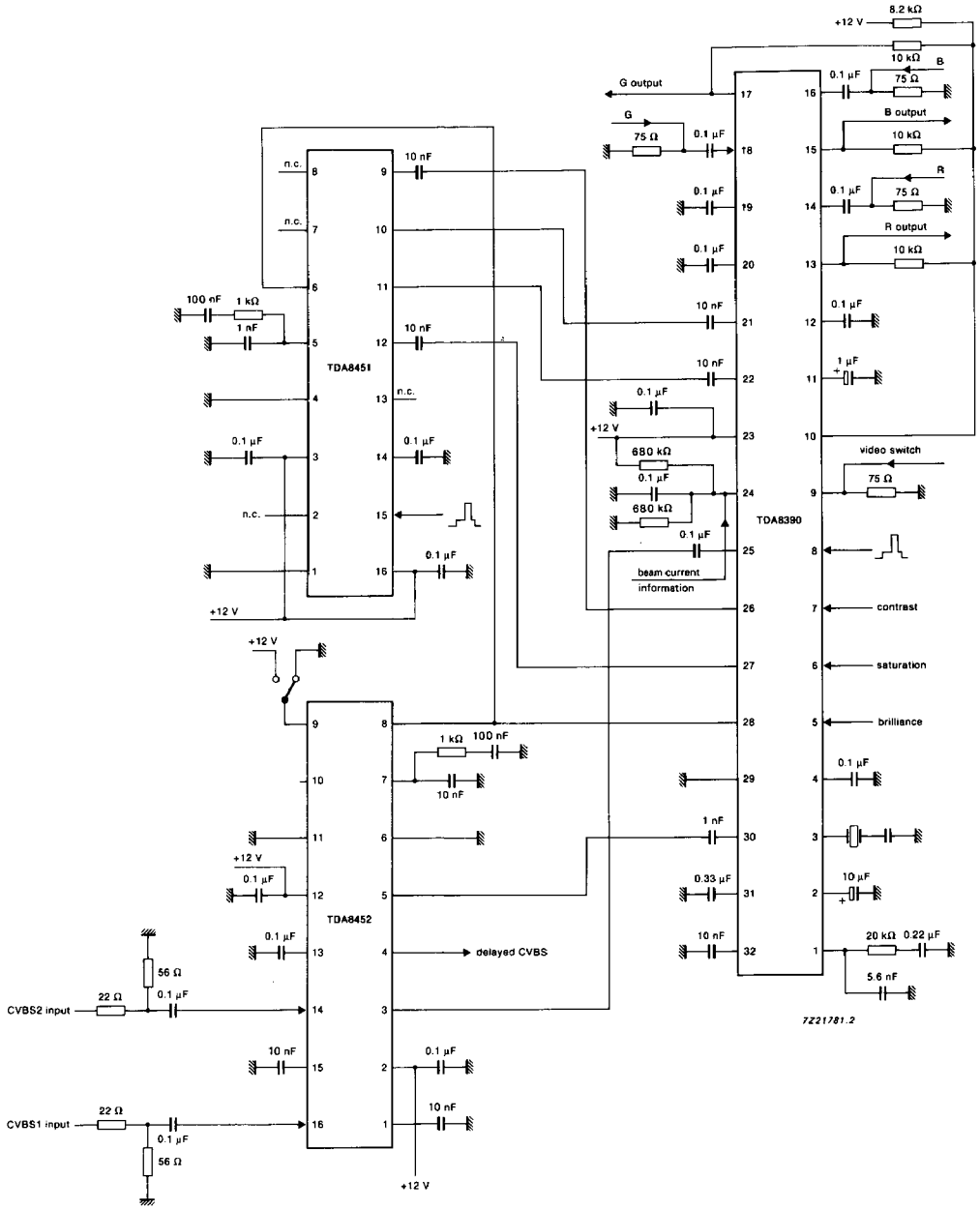


Fig.7 Application diagram.