

## Timing Processor (LINE, FRAME, SMPS) for TV Sets

### General Description

This integrated circuit uses I<sup>2</sup>L bipolar technology and combines analog signal processing with digital processing. Timing signals are obtained from a Voltage-Controlled Oscillator (VCO) operating at 500 kHz by means of a cheap ceramic resonator.

A chain of dividers and appropriate logic functions are producing very accurately defined sampling pulses and the necessary timing signals. This avoids the frequency adjustment normally required with line and frame oscillators.

### Features

- 500 kHz VCO and appropriate logic avoids adjustment of timing pulses
- Identical line and Switch Mode Power Supply (SMPS) frequency avoids visible interference on screen
- Multistandard capability by automatic 50/60 Hz identification
- Low power dissipation by controlling a frame thyristor (or class D output transistor stage)
- Video identification circuit
- Super sandcastle

Case: DIP 28

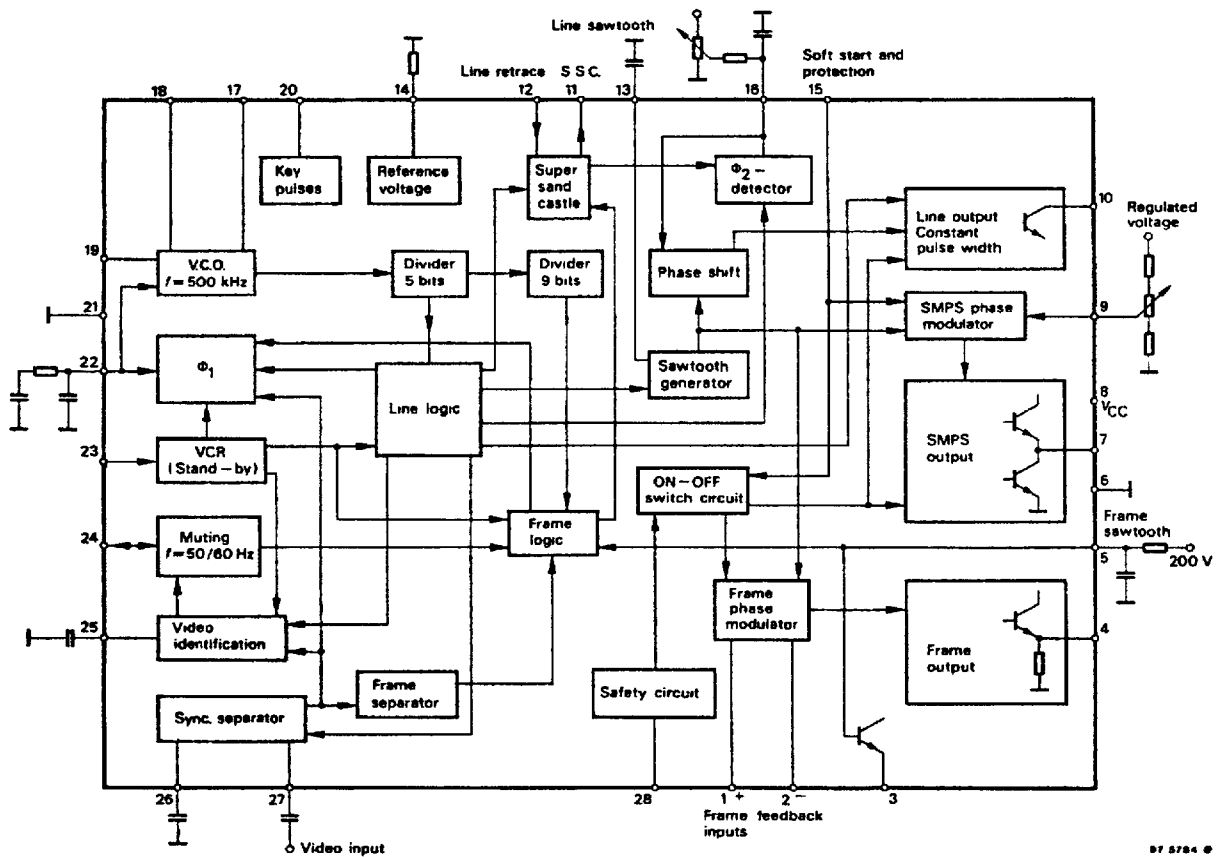


Figure 1. Block diagram

## Absolute Maximum Ratings

$T_{amb} = 25^{\circ}\text{C}$ , unless otherwise specified.

Parameters	Symbol	Value	Unit
Supply voltage Pin 8	$V_S$	14	V
AGC current Pin 20	$I_{20}$	5	mA
Video identification current Pin 24	$I_{24}$	10	mA
Line retrace current Pin 12	$\pm I_{12}$	10	mA
Line output current Pin 10	$+I_{10}$ $-I_{10}$	40 10	
Frame sawtooth generator Pin 3	$I_S$	20	mA
Frame output current Pin 4	$I_4$	100	mA
SMPS output current Pin 7	$\pm I_7$	50	mA
Safety input current Pin 28	$I_{28}$	5	mA
Safety input voltage Pin 28	$V_{28}$	$V_{CC}$	
Ambient temperature range	$T_{amb}$	0 to +70	$^{\circ}\text{C}$
Storage temperature range	$T_{stg}$	-25 to +150	$^{\circ}\text{C}$

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient	$R_{thJA}$	55	K/W

## Electrical Characteristics

$V_S = V_{CC} = 12\text{ V}$ ,  $T_{amb} = 25^{\circ}\text{C}$ , unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Supply current	Frame, line and SMPS output without load Pin 8	$I_S$		60	80	mA
Sync. separator	Pins 26 and 27					
Positive video input signal, ac coupled	Source impedance $\leq 200\ \Omega$ Pin 27	$V_{27}$	0.2	1.8	3	$V_{pp}$
Negative clamping current during sync. pulse		$-I_{27}$	25	40	55	$\mu\text{A}$
Clamping current, continuously		$I_{27}$	3	5	9	$\mu\text{A}$
Slicing level decoupling 50 % of sync. amplitude	Negative current Pin 26	$-I_{26}$		640	1000	$\mu\text{A}$
	Positive current	$I_{26}$	12	25	36	$\mu\text{A}$
Pulse for keyed AGC	Pin 20					
Output current		$I_0$			5	mA
Output separation voltage	$I_0 = 5\text{ mA}$	$V_0$			0.4	V
Delay time from the key pulse leading edge to the middle of the sync. pulse		$t_{d1}$		3.4		$\mu\text{s}$
Delay time from the middle of the sync. pulse to the key pulse trailing		$t_{d2}$		4.8		$\mu\text{s}$

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Voltage control oscillator, VCO</b> Pin 17, 18, 19						
$V_S = V_{CC} = 11 \text{ V to } 13 \text{ V}$ Ceramic resonator type: CSB 503 B						
Operating voltage	Pin 8	$V_S$	5		13.2	V
Frequency control range after H. divider	Low-end	$f_{\text{low}}$		15.3		kHz
	High-end	$f_{\text{high}}$		16.1		
Control current	Pin 22	$\pm I_{22}$			10	$\mu\text{A}$
<b>Phase detector <math>\theta_1</math></b> Pin 22						
Output current	Low loop gain	$\pm I_O$	0.35	0.5	0.65	mA
	High loop gain		1	1.5	2	
Ratio of charging and discharging current		$I_{\text{ch}}/I_{\text{dis}}$		1		
Transfer gain	Low loop gain	$G_{\text{TL}}$		1.2		kHz/ $\mu\text{s}$
	High loop gain	$G_{\text{TH}}$		3.6		
Window pulse width (only in low loop gain, video identif. is "ON")		$t_{\theta 1}$		10		$\mu\text{s}$
Delay time between middle of key pulse and $\theta_1$ comparison edge		$t_d$		0		$\mu\text{s}$
<b>VCR and STAND-BY switching input</b> Pin 23						
Threshold voltage VCR (VCR switch is in ON position below this value)		$V_T$	1.6	2.1	2.6	V
Threshold voltage STAND-BY (STAND-BY switch is in ON position above this level)		$V_T$	3.2	4	4.8	V
Input current		$-I_1$	0.030		1	mA
<b>Video identification, see figure 2</b> Pins 24 and 25						
Input current	Pin 24	$I_I$			10	mA
Output saturation voltage	$I_I = 5 \text{ mA}$ , no video signal	$V_{\text{Osat}}$			0.6	V
Output voltage	$f = 60 \text{ Hz}$ , $I_{i(\text{Video})} = 2.5 \text{ mA}$	Pin 24 $V_0$	5.5	6	7.5	V
Input current	$f = 50 \text{ Hz}$	Pin 24 $I_I$			10	$\mu\text{A}$
Output current, charging the capacitor	Pin 25	$I_{\text{ch}}$	0.5	0.75	1	mA
Ratio between the charging and discharging current	Pin 25	$I_{\text{ch}}/I_{\text{dis}}$	1.7		4.0	
Identification sampling time	Pin 25	$t_{25}$	1.3		2.2	$\mu\text{s}$
Threshold voltage	Pin 25 lower to higher value (low means no video)	$V_T$	4	4.5	5	V
Hysteresis voltage	Pin 25	$V_{\text{hyst}}$		350		mV
<b>H. ramp generator, see figure 3</b> Pin 13						
Saw-tooth amplitude synchronized state	peak to peak	v	3	3.5	4	V
Charge current		$I_{\text{ch}}$	185	200	215	$\mu\text{A}$
Saw-tooth base voltage		$V_{\text{min}}$			0.5	V
Discharging time		$t_{\text{dis}}$			4	$\mu\text{s}$
Delay time between $\theta_2$ comparing edge and leading edge of discharging pulse		$t_d$		1.95		$\mu\text{s}$

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Super sandcastle, SSC</b> Pin 11						
Output current		$I_{11}$	-10		+ 10	mA
Output voltage levels; Burst key pulse	$I_{11} = 5 \text{ mA}$	$V_{\text{Burst}}$	9			V
Horizontal blank pulse		$V_{\text{HB}}$	4	4.5	5	
Frame blank pulse	$I_{11} = 5 \text{ mA}$ frame out of function	$V_{\text{VB}}$	2	2.5	3	V
Delay time between middle of sync. pulse (pin 27) and leading edge of burst key pulse		$t_d$	2.3		3	$\mu\text{s}$
Duration of burst key pulse			3.7	4	5	$\mu\text{s}$
Delay time	between SSC cutting level at pin 12 and line blank pulse	$t_d$			0.5	$\mu\text{s}$
Frame retrace blanking duration				24		lines
<b>Line retrace input</b> Pin 12						
First threshold for blanking		$V_b$	11		12	V
Second threshold for $\theta_2$		$V_{\theta_2}$	-1	1.3	2.3	V
Input currents:	$V_{12} = 12 \text{ V}$ $V_{12} = 5 \text{ V}$ $V_{12} = 0 \text{ V}$ $V_{12} = 1 \text{ V}$	$I_{12}$		550		$\mu\text{A}$
				200		$\mu\text{A}$
				-50		$\mu\text{A}$
				-2	-1	mA
Operating input voltage		$-V_{12}$			1	V
<b>Phase detector <math>\theta_2</math>,</b> Pin 16						
Charging current		$I_{\text{ch}}$	0.4	0.6	0.8	mA
Ratio of charging and discharging current		$I_{\text{ch}}/I_{\text{dis}}$		1		
Delay time between the comparing edges of $\theta_1$ and $\theta_2$ $f_0$ (VCO) = 500 kHz		$t_d$	1.5	2	2.8	$\mu\text{s}$
Input current of internal error amplifier for $\theta_2$ phase shift		$I_{16}$			3	$\mu\text{A}$
Time difference between $\theta_2$ comparing edge and middle of line retrace (without external phase tuning circuit)		$\Delta t$		0		$\mu\text{s}$
<b>Horizontal output (Open collector),</b> Pin 10						
Output saturation voltage	$I_0 = 20 \text{ mA}$	$V_0$			1	V
Output current		$I_0$			40	mA
Output pulse duration	$f_0 = 500 \text{ kHz}$	$t_p$	24	26	28	$\mu\text{s}$
$\theta_2$ phase range	without external phase shift	$t_\theta$	14	16	19	$\mu\text{s}$
<b>Frame logic</b>						
Free running period video identification = 0		N		315		lines
Search window		N	247		361	lines
50 Hz window		N	309		315	lines
60 Hz window		N	247		277	lines
VCR mode window		N	247		361	lines
<b>Frame saw-tooth generator</b> Pin 5						

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Saw-tooth amplitude	peak to peak	v	2	3	4	V
60 Hz internal current generator		$I_0$	12	14	16	$\mu\text{A}$
Discharge time	$C = 0.47 \mu\text{F}, \Delta V_C = 4 \text{ V}$	$t_{\text{dis}}$			70	$\mu\text{s}$
Delay time	between beginning of discharging and leading edge of the first main equalizing pulse which appears during internal sync. pulse	$t_d$		5		$\mu\text{s}$
Saw tooth base voltage	$I_3 = 0. \text{to } 10 \text{ mA}$ Pin 3	$V_{\text{min}}$	1	1.26	1.4	V
<b>Frame feed back inputs</b> Pins 1 and 2						
Input current		$I_{1,2}$			10	$\mu\text{A}$
Common mode range		CMR	2		10	V
<b>Frame output, see figure 4</b> Pin 4						
Operating output current		$-I_0$			80	mA
Limit value		$-I_{0M}$			100	mA
Max. "ON" time		$t_{\text{on}}$		40		$\mu\text{s}$
Output phase range		$t_{\theta}$	0		$t_{\text{onmax}}$	$\mu\text{s}$
Negative over current	limit value	$I_{N0}$		10		mA
Output voltage	$I_4 = -80 \text{ mA}$	$V_O$	10			V
<b>Switch mode power supply, SMPS</b>						
Input current	Pin 9	$I_I$			10	$\mu\text{A}$
Internal reference voltage		$V_{\text{ref}}$	1.2	1.26	1.35	V
<b>SMPS Output, see figure 5</b> Pin 7						
Output current limit value		$I_0$	-50		50	mA
Output voltage	$I_0 = -20 \text{ mA}$ $I_0 = +20 \text{ mA}$	$V_0$	10		2	V
$t_{\text{on}}$ time		$t_{\text{onmax}}$	27	28	29	$\mu\text{s}$
Position of trailing edge of SMPS pulse			3 $\mu\text{s}$ before middle of H sync. pulse			
Negative over current limit value		$I_{N0}$			50	mA
<b>Safety input,</b> Pin 28						
Threshold voltage		$V_T$	1.15	1.26	1.37	V
Input current	$V_T = V_{\text{ref}}$	$I_I$			3	$\mu\text{A}$
Input voltage		$V_{28\text{max}}$			$V_{\text{CC}}$	
<b>Soft starting input and SMPS - <math>T_{\text{ON}}</math> limitation (see figure 6), Pin 15</b>						
Charging current	$t = 4 \mu\text{s}$	$I_{\text{ch}}$	70		130	$\mu\text{A}$
Ratio of charging and discharging current		$I_{\text{ch}} / I_{\text{dis}}$		1		
Charging time		$t_{\text{ch}}$		4		$\mu\text{s}$
Ratio of charging and discharging time		$t_{\text{ch}} / t_{\text{dis}}$		2		

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Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
<b>Switch-ON, Switch-OFF processing</b> Pins 4, 7 and 10						
SMPS	frame and line $V_{CC}$ starting	$V_S$	$5.25 + V_{hyst}$		$6.5 + V_{hyst}$	V
	$V_{CC}$ stopping		5.25		6.25	
Hysteresis between switch on- and off level		$V_{hyst}$		500		mV
Voltage reference	Pin 14	$V_{ref}$	1.2	1.26	1.35	V

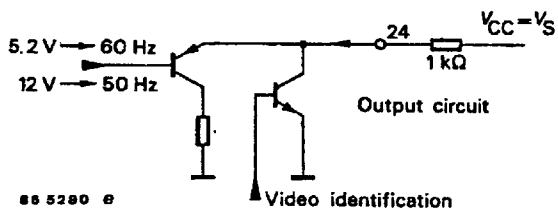


Figure 2.

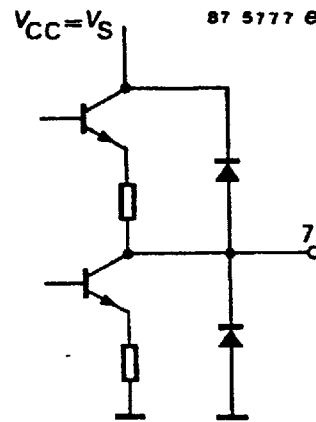


Figure 5.

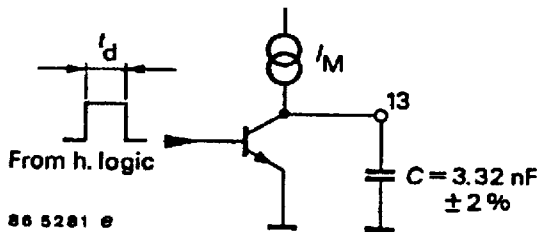


Figure 3.

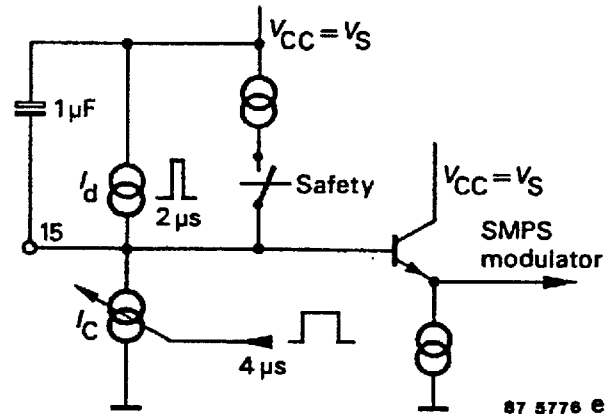


Figure 6.

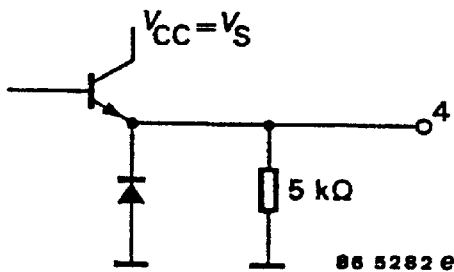


Figure 4.

$I_C$  = charge current ( $I_{ch}$ )  
 $I_d$  = discharge current ( $I_{dis}$ )  
 $t_d$  = discharge time ( $t_{dis}$ )

## Application

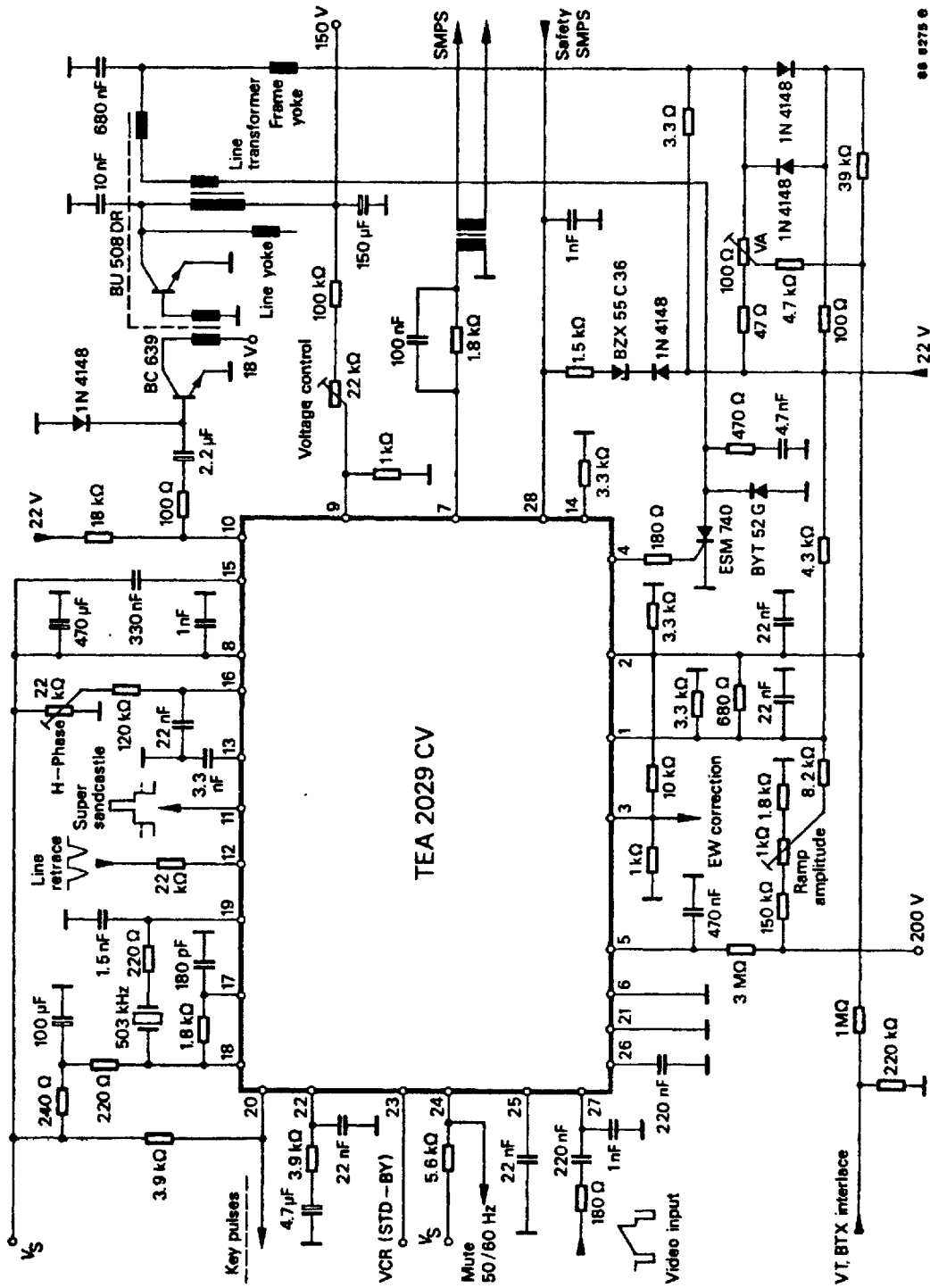


Figure 7.

## TEA2029CV

### Dimension in mm

Package: DIP 28

