M52390FP

NTSC/PAL Encoder

REJ03F0080-0100Z
Rev.1.0
Sep.22.2003

Description

The M52390FP is a semiconductor integrated circuit that has a function for converting R, G and B signals into NTSC/PAL composite video signals, as well as a superimpose function, on a single chip.

Features

- RGB encoder-related
  - Built-in LPF for color discrimination. An external resistor enables cutoff frequency control.
  - An internal VCA circuit enables gain control of the chroma unit.
  - A high-precision modulation circuit and clamping circuit realize low carrier leaks.
  - Burst and synch signals are generated in the IC.
- Superimpose-related
  - Y_S IN (control input) enables switching between two input signals, VIDEO IN and RGB IN.
  - An internal high-speed analog switch makes it possible to insert fine text.
  - An internal APC circuit automatically adjusts the color phases of new screen (VIDEO IN) and RGB encoder signals.
- Overall
  - The VIDEO OUT signal is output at 2 V_{P-P}, making it possible to configure a 75 Ω drive circuit with a single transistor.
  - Both NTSC and PAL are supported.

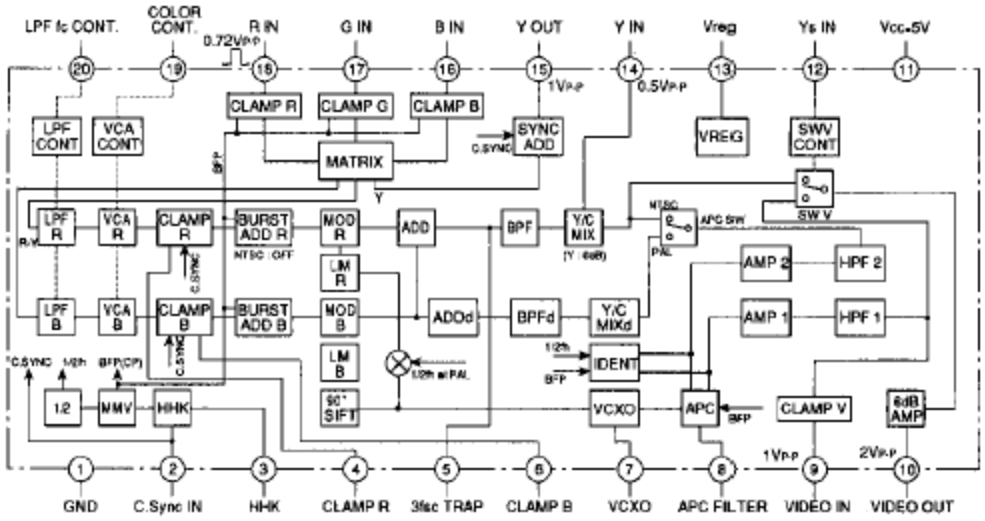
Application

- TVs, VCRs, monitors and other audio/video devices

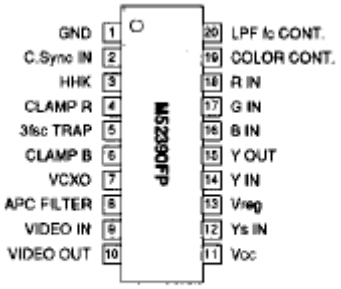
Recommended Operating Conditions

- Power supply voltage range: 4.7 to 5.3 V
- Recommended power supply voltage: 5.0 V

Block Diagram

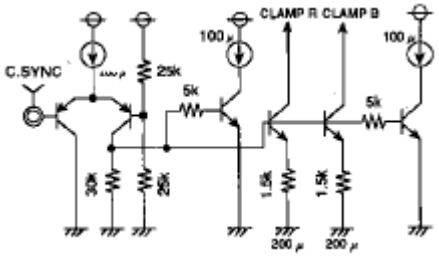
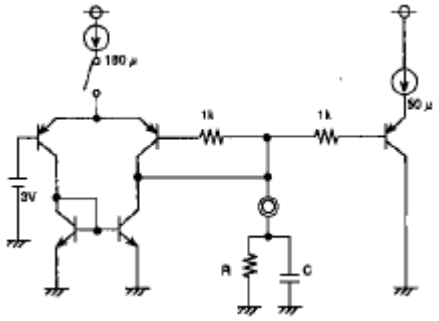
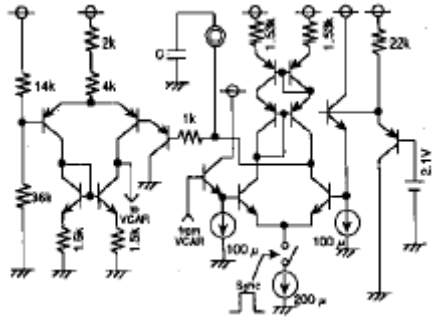
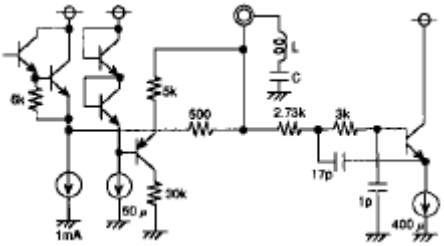


Pin Configuration

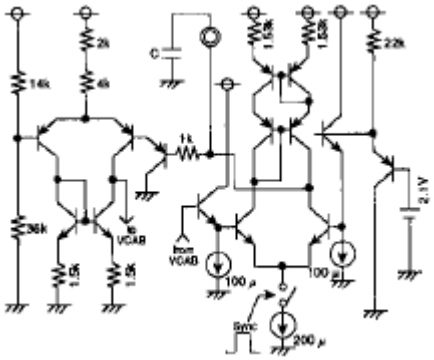
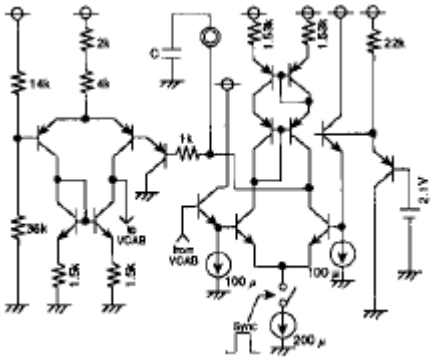
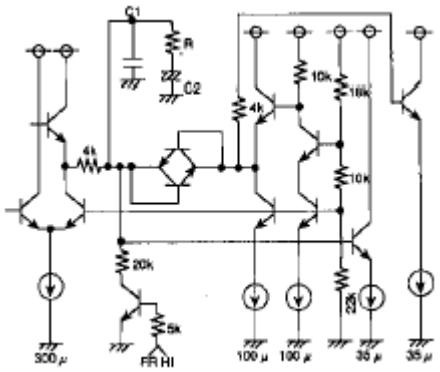
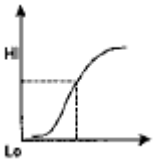
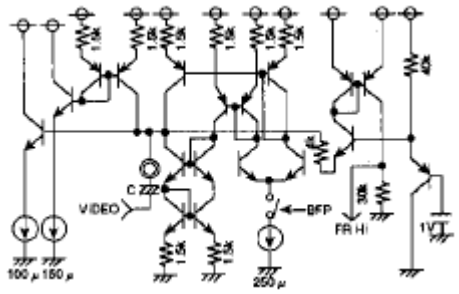


Package: 20P2N-A
(lead pitch: 1.27 mm)

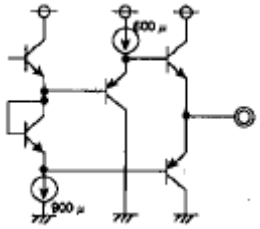
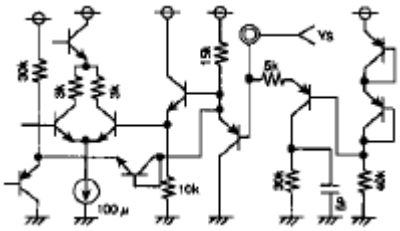
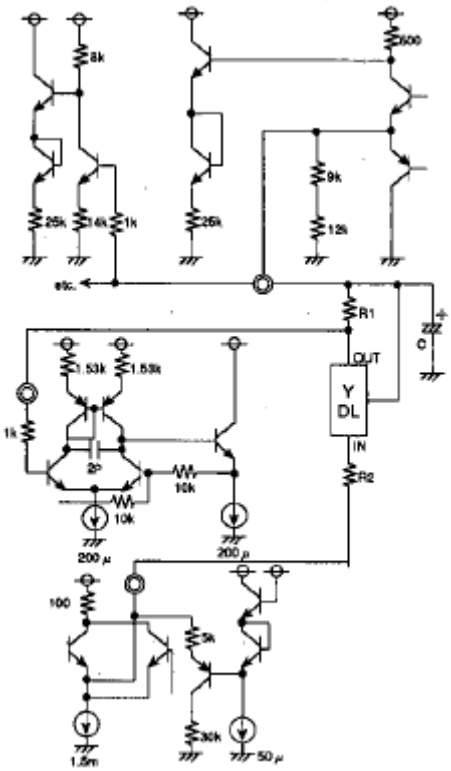
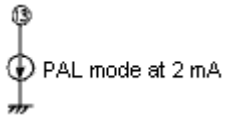
Description of Pin

Pin no.	Pin name	Pin peripheral circuit	Pin voltage	Notes
1	GND			
2	C.SYVC IN		AC: Sync input 	V_{TH} = 2.5 V ± 0.3 V
3	HHK		AC 	The HHK pulse width can be varied using the external resistor. Recommended value: HHK: 3/4H R = 91 k C = 270 p
4	OFFSET R		DC = 3.1 V	External recommended value. C = 0.1 µ
5	TRAP		AC: Chroma  Burst: 300 mV_{P-P}	External recommended value. L C NTSC : 15 µ 12P PAL : 10 µ 12P
			[15] Test mode output at 5 V [12] Hi: R-Y output [12] Lo: B-Y output	[5] 5 V: Test mode setting [15] Pulse output

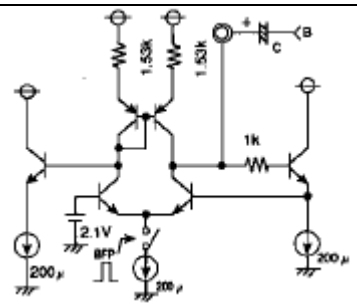
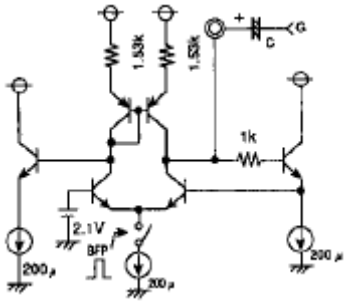
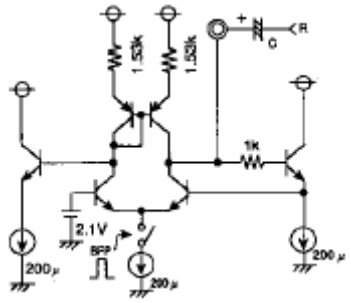
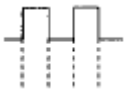
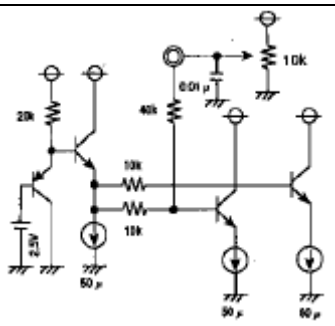
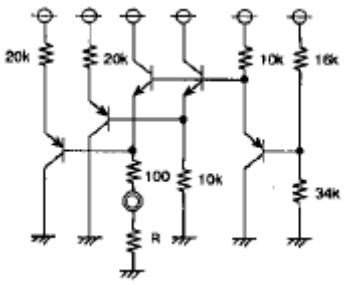
Description of Pin (cont)

Pin no.	Pin name	Pin peripheral circuit	Pin voltage	Notes
6	OFFSET B		DC: 3.1 V	External recommended value C = 0.1 µ
7	VCXO IN		DC: 3.2 V	The free run frequency is set using the trimmer capacitor. [7] 0 V: Carrier OFF
8	APC FILTER		DC: 3.3 V In Free Run mode: DC: 2.7 V	β characteristic Frequency  APC voltage External recommended values R = 1.5 k C1 = 0.01 µ C2 = 1 µ
9	VIDEO IN		AC: VIDEO 1 V_{P-P} Pedestal: 2.9 V 	Clamping input (burst timing) External recommended value C = 4.7 µ [9] 0 V: Free Run mode setting

Description of Pin (cont)

Pin no.	Pin name	Pin peripheral circuit	Pin voltage	Notes
10	VIDEO OUT		AC: VIDEO 2 V_{P-P} Pedestal: 1.8 V 	
11	V_{CC}		DC: 5 V	Icc: 50 mA
12	Ys		Switching signal input when using Superimpose  Hi: Insertion screen (RGB IN output)	V_{TH} = 1.5 V ± 0.3 V Hi: RGB IN output Lo: VIDEO IN output [15 Output setting when using 5 V [5] Output [12] / [5]output: Hi / R-Y; Lo / B-Y
13	VRE G		DC: 2.1 V	External recommended value C = 4.7 µ  PAL mode at 2 mA
14	Y IN		AC: Y 0.5 V_{P-P} Pedestal: 2.1 V 	
15	Y OUT		AC: Y 1 V_{P-P} Pedestal: 2.1 V 	
			(5) Test mode output at 5 V Pulse output	[12] 5 V: Test mode setting [12] / [5]output: Hi / R-Y; Lo / B-Y

Description of Pin (cont)

Pin no.	Pin name	Pin peripheral circuit	Pin voltage	Notes
16	B IN		AC: B 0.71 V_{P-P} Sync: 2.9 V 	Clamping input (burst timing) External recommended value C = 4.7 µ
17	G IN		AC: G 0.71 V_{P-P} Sync: 2.9 V 	Clamping input (burst timing) External recommended value C = 4.7 µ
18	R IN		AC: R 0.71 V_{P-P} Sync: 2.9 V 	Clamping input (burst timing) External recommended value C = 4.7 µ
19	COLOR CONT.		DC: 2.5 V	Color control for RGB encoder output 5 V: Chroma unit +2 dB 2.5 V: Typ. 0 V: Chroma unit –3 dB
20	fc. CONT.		DC: 3.3 V	fc of LPF can be adjusted using external resistor. External recommended value R = 30 k

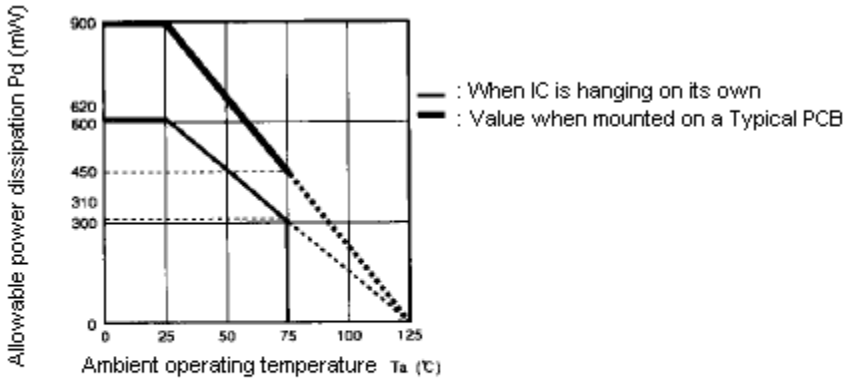
Absolute Maximum Rating

(Unless otherwise noted, Ta = 25°C)

Symbol	Item	Ratings	Units
Vcc	Power supply voltage	7	V
Pd	Internal current consumption	620 (900)	mW
Topr	Ambient operating temperature	–20 to 75	°C
Tstg	Storage temperature	–40 to 125	°C
kθ	Thermal derating (Ta = 25°C)	6.2 (9.0)	mW/°C

Note: Values in parentheses are the values when mounted on a typical PCB.

Thermal Derating (Maximum Rating)



Typical PCB
Material --- Glass epoxy (Cu foil pattern on one side)
Size: 70 mm², thickness = 1.6 mm
Cu foil thickness - 18 μm

Electrical Characteristics

(unless otherwise noted, Ta=25°C, Vcc = 5 V, SG2 = sync)

No.	Symbol	Item	Measurement conditions	Measurement point	Limits			Unit
					Min.	Typ.	Max.	
1	$I_{CC}1$	Circuit current 1	NTSC MODE, [12] 5 V	[11]	35	50	65	mA
2	$I_{CC}2$	Circuit current 2	NTSC MODE, [12] 5 V	[11]	37	52	67	mA
RGB IN → Y OUT								
3	ER	Matrix ratio R	SG18: 1 Vp-p	[15]	0.27	0.30	0.33	Vp-p
4	EG	Matrix ratio G	SG17: 1 Vp-p	[15]	0.53	0.59	0.65	Vp-p
5	EB	Matrix ratio B	SG16: 1 Vp-p	[15]	0.09	0.11	0.13	Vp-p
6	EY	At RGB 100% Y level	SG16, SG17, SG18: 0.71 Vp-p	[15]	0.63	0.71	0.79	Vp-p
7	FR	R IN → Y OUT frequency characteristic	SG18: 500 kHz/5 MHz, 0.5 Vp-p CW, SW16, 17, 18:ON [2] 0 V (SG2: OFF)	[15]	–1.5	0	1.5	dB
8	FG	G IN → Y OUT frequency characteristic	SG17: 500 kHz/5 MHz, 0.5 Vp-p CW, SW16, 17, 18:ON [2] 0 V (SG2: OFF)	[15]	–1.5	0	1.5	dB
9	FB	B IN → Y OUT frequency characteristic	SG16: 500 kHz/5 MHz, 0.5 Vp-p CW, SW16, 17, 18:ON [2] 0 V (SG2: OFF)	[15]	–1.5	0	1.5	dB
10	VS1	Sync level 1	NTSC MODE	[15]	257	286	315	Vp-p
11	VS2	Sync level 2	PAL MODE (SW13: ON)	[15]	270	300	330	Vp-p
Y IN → VIDEO OUT								
12	G_Y	Y IN → VIDEO OUT gain	SG14: 500 kHz, 0.5 Vp-p CW, [12] 5 V	[10]	10.5	12	13.5	dB
13	F_Y	Y IN → VIDEO OUT frequency characteristic	SG14: 500 kHz, 0.5 Vp-p CW, [12] 5 V	[10]	–1.5	0	1.5	dB
RGB IN → TRAP								
14	$D_{L(R-Y)}$	Delay (R-Y)	SG18: 1 Vp-p [15] 5 V, [12] 5 V, [7] 0 V	[5]	210	310	410	ns
15	$D_{L(B-Y)}$	Delay (B-Y)	SG16: 1 Vp-p [15] 5 V, [12] 0 V, [7] 0 V	[5]	210	310	410	ns
16	$G_{H(R-Y)}$	Gain (R-Y) VCA: Hi	SG18: 500 kHz, 0.5 Vp-p CW, SW4, 6, 17, 18: ON [15] 5 V, [12] 5 V, [7] 0 V, [19] 5 V/2.5 V, [2] 0V (SG2: OFF)	[5]	1	2	3.5	dB
17	$G_{H(B-Y)}$	Gain (B-Y) VCA: Hi	SG16: 500 kHz, 0.5 Vp-p CW, SW4, 6, 17, 18: ON [15] 5 V, [12] 0 V, [7] 0 V, [19] 5 V/2.5 V, [2] 0V (SG2: OFF)	[5]	1	2	3.5	dB
18	$G_{L(R-Y)}$	Gain (R-Y) VCA: Lo	SG18: 500 kHz, 0.5 Vp-p CW, SW4, 6, 17, 18: ON [15] 5 V, [12] 5 V, [7] 0 V, [19] 0 V/2.5 V, [2] 0V (SG2: OFF)	[5]	–4.5	–3	–2	dB
19	$G_{L(B-Y)}$	Gain (B-Y) VCA: Lo	SG18: 500 kHz, 0.5 Vp-p CW, SW4, 6, 17, 18: ON [15] 5 V, [12] 5 V, [7] 0 V, [19] 0 V/2.5 V, [2] 0V (SG2: OFF)	[5]	–4.5	–3	–2	dB

Electrical Characteristics (cont)

No.	Symbol	Item	Measurement conditions	Measurement point	Limits			Unit
					Min.	Typ.	Max.	
RGB IN → VIDEO OUT								
20	V_{B1}	NTSC burst level	NTSC MODE [12] 5 V	[10B]	243	286	329	mVp-p
21	V_{B2}	PAL burst level	PAL MODE (SW13: ON) [12] 5 V	[10B]	255	300	345	mVp-p
22	V_{B3}	PAL burst level differential	PAL MODE (SW13: ON) [12] 5 V	[10B]	–30	0	30	mVp-p
23	P_{PB}	PAL burst phase differential	PAL MODE (SW13: ON) [12] 5 V	[10B]	82	90	98	deg
24	$V_{R/B}$	R/burst level ratio	SG18: 0.71 Vp-p [12] 5 V	[10B]	2.68	3.15	3.62	
25	$V_{G/B}$	G/burst level ratio	SG17: 0.71 Vp-p [12] 5 V	[10B]	2.51	2.95	3.39	
26	$V_{B/B}$	B/burst level ratio	SG16: 0.71 Vp-p [12] 5 V	[10B]	1.91	2.25	2.59	
27	$V_{C/B}$	NTSC MODE carrier leak	NTSC MODE [12] 5 V	[10B]	—	–40	–28	dB
28	$P_{R/B}$	R/burst phase differential	SG18: 0.71 Vp-p [12] 5 V	[10B]	96	104	112	deg
29	$P_{G/B}$	G/burst phase differential	SG17: 0.71 Vp-p [12] 5 V	[10B]	233	241	249	deg
30	$P_{B/B}$	B/burst phase differential	SG16: 0.71 Vp-p [12] 5 V	[10B]	339	347	355	deg
VIDEO IN → VIDEO OUT								
31	GVIO	VIDEO IN → VIDEO OUT gain	SG9: 500 kHz, 0.5 Vp-p CW, SW9: ON [12] 0 V, [2] 0 V (SG2: OFF)	[10]	5	6	7	dB
32	FVIO	VIDEO IN → VIDEO OUT frequency characteristic	SG9: 5 MHz, 0.5 Vp-p CW, SW9: ON [12] 0 V, [2] 0 V (SG2: OFF)	[10]	–1.5	0	1.5	dB
SUPER IMPOSE								
33	PDI	RGB/VIDEO IN burst phase differential	SG9: 3.85 MHz, 286 mVp-p CW, SG12: 1 Vp-p	[10B]	–5	0	5	deg
34	VOS	DC offset	SG9: burst, 286 mVp-p CW, SG12: 1 Vp-p	[10]	–20	0	20	mV
MMV								
35	HHK	HHK width	PAL MODE (SW13: ON) [5] 5V	[2] [15]	40	47	54	µs
36	BFPP	BFP position (burst position)	[5] 5V	[2] [15]	4.5	5.6	6.7	µs
37	BFPW	BFP width (burst width)	[5] 5V	[15]	2.0	2.5	3.0	µs

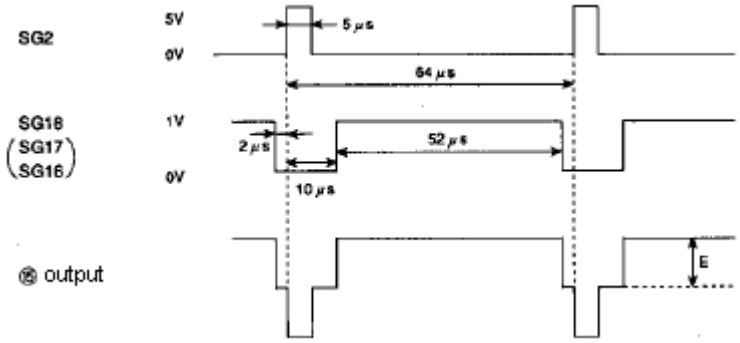
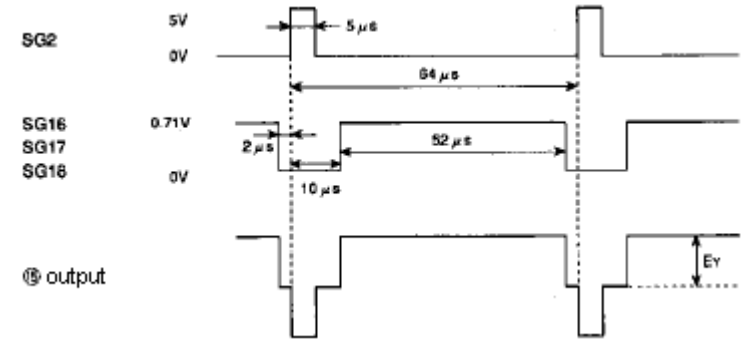
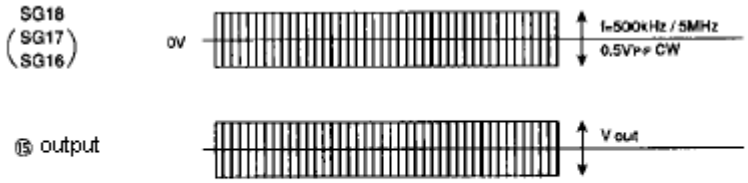
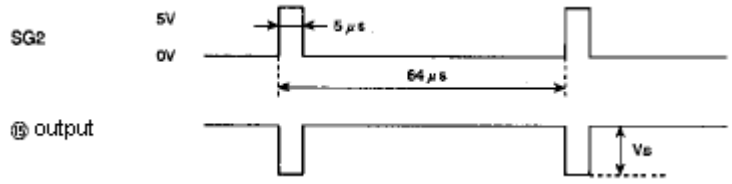
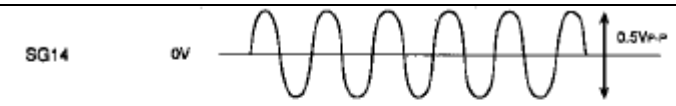
Electrical Characteristics Measurement Method

Tables for the various modes (common to all tests)

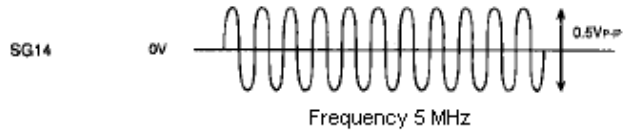
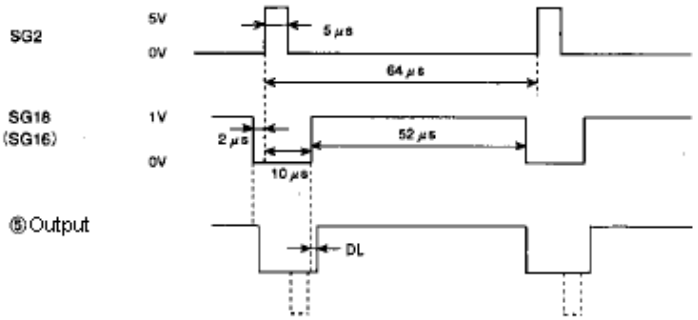
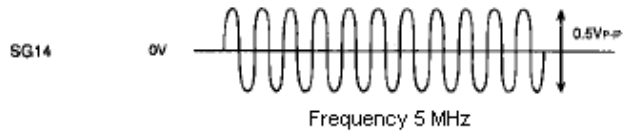
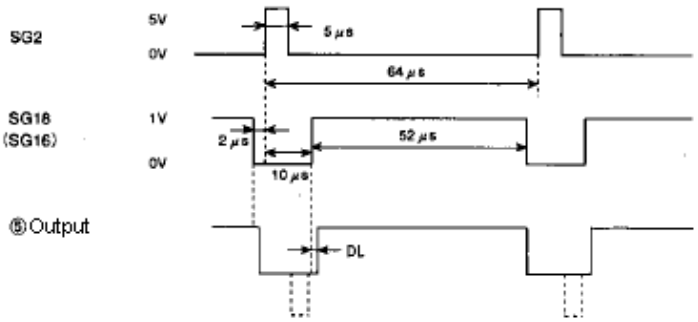
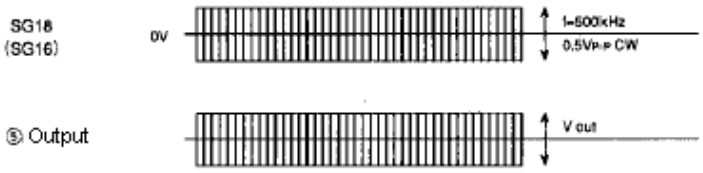
Mode	Setting condition	Function
FREE RUN MODE	⑨ 0~0.3V	VCXO FREE RUN
PAL MODE	⑬ 2~2.2mA	Carrier phase for MOD R reversed at each 1H
SUPER IMPOSE MODE	⑫ HI : 2~5V Lo : 0~1V	[10] VIDEO OUT RGB ENCODE signal out VIDEO IN signal out
TEST MODE MR TEST MODE MB TEST MODE DR TEST MODE DB	⑮ ⑫ ⑦ 4.7~5V 2~5V OPEN 4.7~5V 0~1V OPEN 4.7~5V 2~5V 0~0.3V 4.7~5V 0~1V 0~0.3V	[5] Color difference output MOD R-Y out MOD B-Y out DIFF R-Y out DIFF B-Y out
TEST MODE P	⑤ 4.7~5V	[10] PULSE output PAL MODE: BFP, HHK mix NTSC MODE: BFP

V4, V6, V9, V16, V17, V18	Various pin voltages when SYNC is input to [2] (C. SYNC IN) (for clamping)

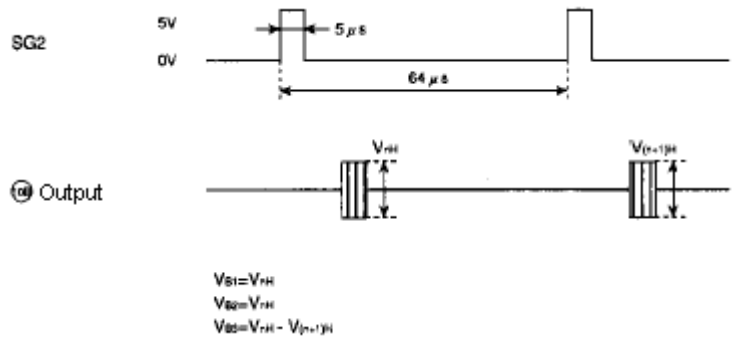
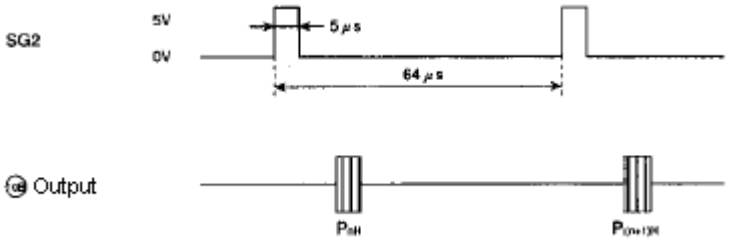
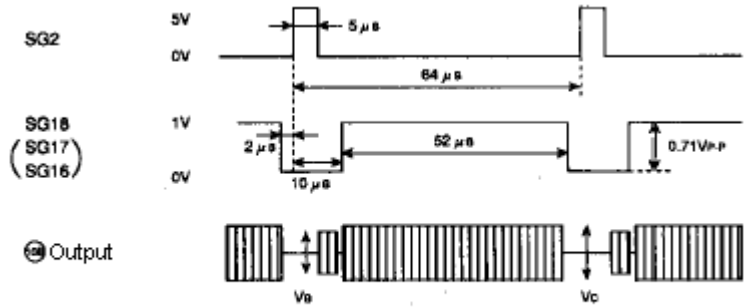
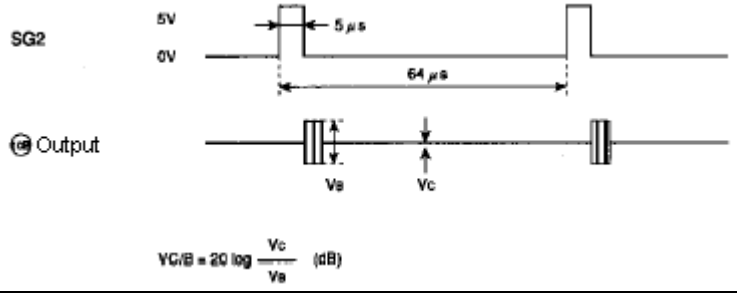
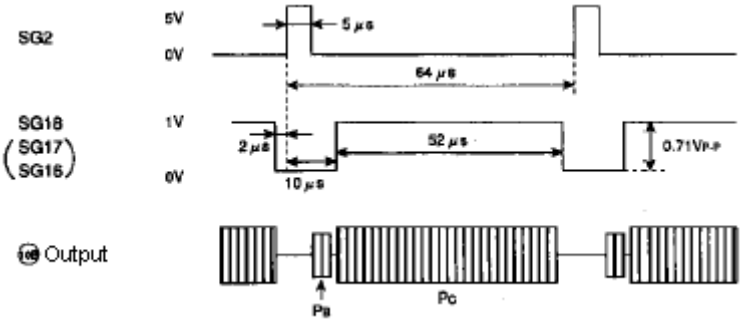
Measurement method and method for computing limit values

Meas. no.	Measurement method and method for computing limit values
1 2	Current flowing into [11] is measured.
3 4 5	
6	
7 (8, 9)	 $F = 20 \log \frac{V\ out\ (5MHz)}{V\ out\ (500kHz)}$ (dB)
10 11	
12	 Frequency 500 kHz The 500 kHz component V12 with respect to [10] is measured, and is computed using the following equation. $G_Y = 20 \log \frac{V_{12}}{0.5V_{p-p}}$ (dB)

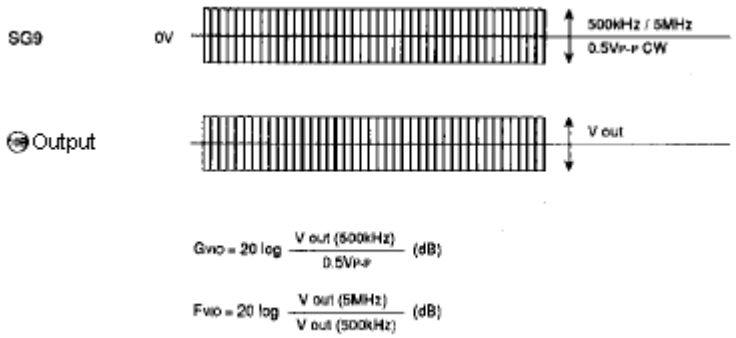
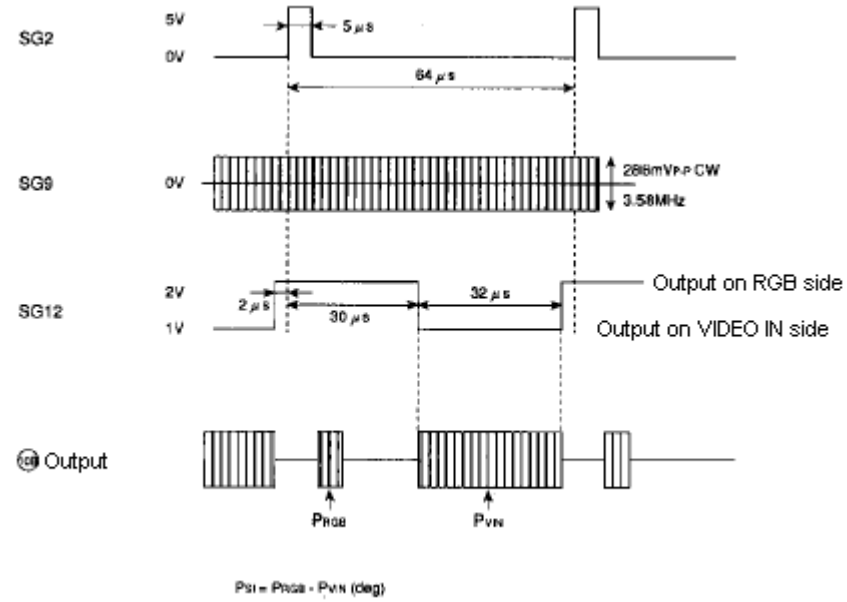
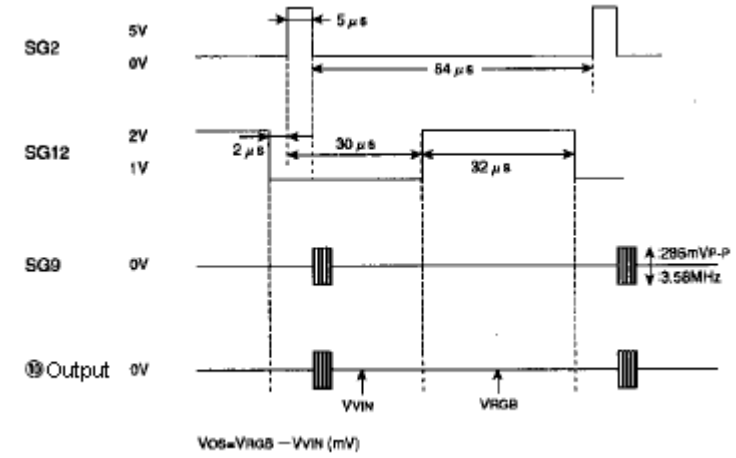
Measurement method and method for computing limit values (cont)

Meas. no.	Measurement method and method for computing limit values
13	 Frequency 5 MHz The 500 MHz component V13 with respect to (10) is measured, and is computed using the following equation. $G_{CY} = 20 \log \frac{V_{13}}{V_{12}}$ (dB)
14 (15)	
13	 Frequency 5 MHz The 500 MHz component V13 with respect to (10) is measured, and is computed using the following equation. $G_{CY} = 20 \log \frac{V_{13}}{V_{12}}$ (dB)
14 (15)	
16 (17) 18 (19)	 $G_H = 20 \log \frac{V_{out}(⑱\ 5V)}{V_{out}(⑱\ 2.5V)}$ (dB) $G_L = 20 \log \frac{V_{out}(⑱\ 0V)}{V_{out}(⑱\ 2.5V)}$ (dB)

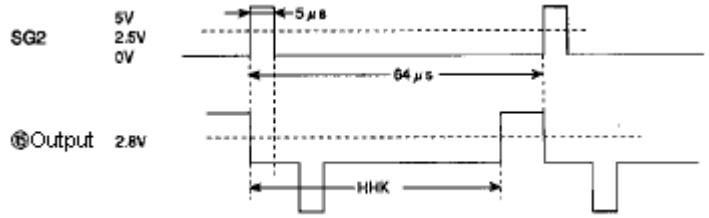
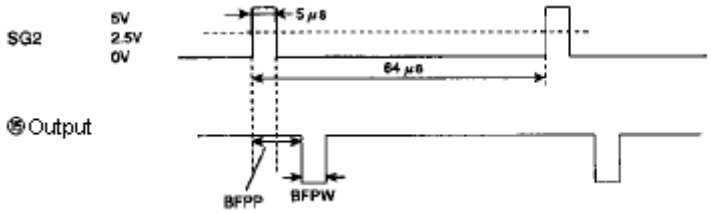
Measurement method and method for computing limit values (cont)

Meas. no.	Measurement method and method for computing limit values
20 21 22	 VS1=VnH VS2=VnH VS3=VnH - V(n+1)H
23	 P_{PS} = |P_{nH} burst phase – $P_{(n+1)H}$ burst phase|
24 (25, 26)	 R (G, B) / Burst level ratio = $\frac{V_C}{V_B}$
27	 $VG/B = 20 \log \frac{V_C}{V_B}$ (dB)
28 (29, 30)	

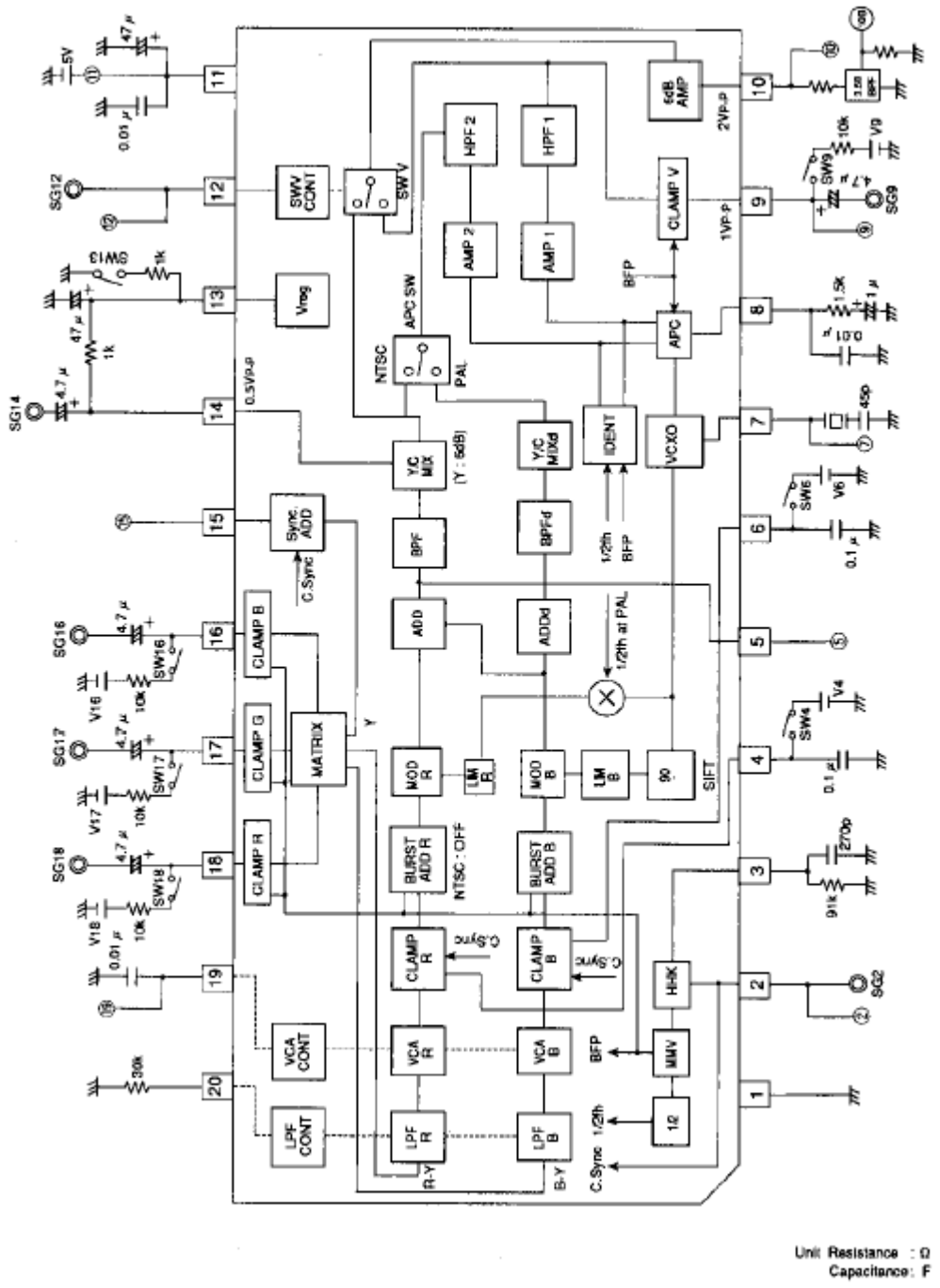
Measurement method and method for computing limit values (cont)

Meas. no.	Measurement method and method for computing limit values
31 32	
33	
34	

Measurement method and method for computing limit values (cont)

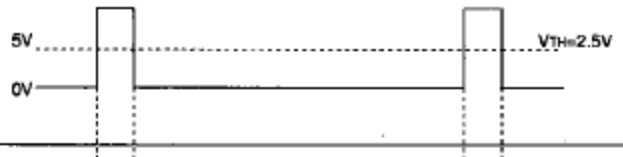
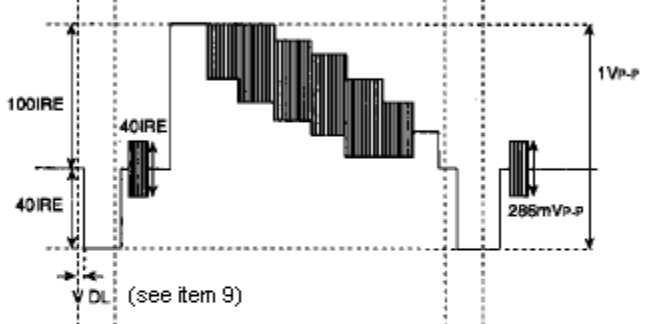
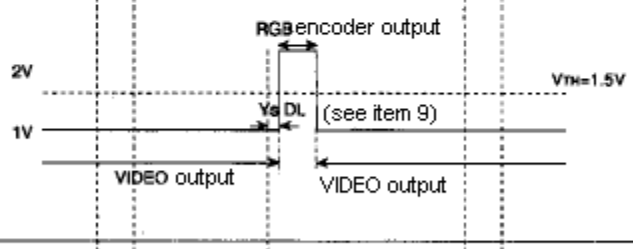
Meas. no.	Measurement method and method for computing limit values
35	
36	

Test Circuit



Usage Precautions

(1) Typical values for input signals

Pin no.	Pin name	Specifications
⑫	C.Sync IN	
⑨	VIDEO IN VIDEO INIf there is no input, this should always be set to the Free Run mode.	
⑫	Ys	
⑯ ⑰ ⑱	B IN G IN R IN	

(2) Setting the Free Run frequency

This IC generates the fsc by means of the VCXO circuit.

Consequently, the VCXO oscillation frequency must always be set to fsc before the IC is used, by following the procedure outlined below.

1. Connect [9] (VIDEO IN) to GND, and set the Free Run mode.
2. Set the [2] (OFFSET R) voltage when SYNC was input to [4] (C. SYNC IN) to V_4, and apply a voltage of V_4 = 0.5 V to [4] (OFFSET R).
3. Fix C.[2] (SYNC IN) in the High state. (5 V applied)
4. Adjust the output frequency of [5] (TRAP) to the trimmer capacitor of [7] (VCXO IN), and set it to fsc.

(3) Setting the color difference LPF

The frequency characteristic of the color difference LPF built into this IC can be set as shown in Fig. 1, using the [20] (fc CONT.) external resistor.

When doing this, the group delay characteristic also changes, as shown in Fig. 2.

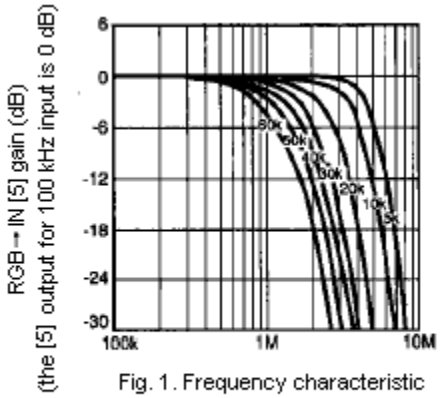


Fig. 1. Frequency characteristic of the color difference LPF (for measurement conditions, see TEST nos. 14 and 15)

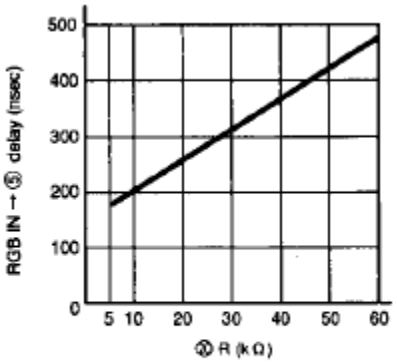


Fig. 2 Group delay characteristic for the color difference LPF (for measurement conditions, see TEST nos. 14 and 15)

(4) Setting Y DL

The group delay characteristic of the color signal of the RGB encoder output changes in response to the [20] (fc CONT) external resistor, so Y DL should be set in such a way that the group delay characteristic is the amount of group delay obtained from the group delay characteristic of Fig. 2, with 40 ns added.

Also, if the [6] (TRAP) circuit is being added, a further delay of +5 to +10 ns should be taken into consideration.

(5) COLOR CONT characteristic

The gain of the chroma unit can be set as shown in Fig. 3, using the [19] (COLOR CONT) applied voltage. (The burst amplitude is constant.)

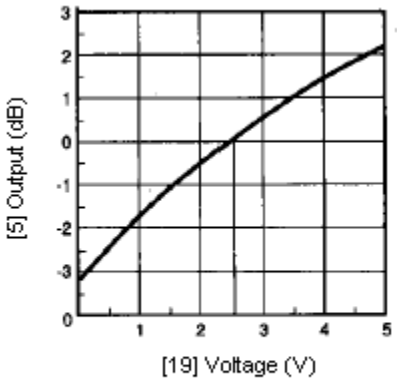


Fig. 3. COLOR CONT. characteristic
(for measurement conditions, see TEST nos. 16, 17, 18, and 19)

(6) The relationship between BFP and HHK

The pulse width of BFP and HHK can be set as shown in Fig. 4, using the [3] (HHK) external CR.

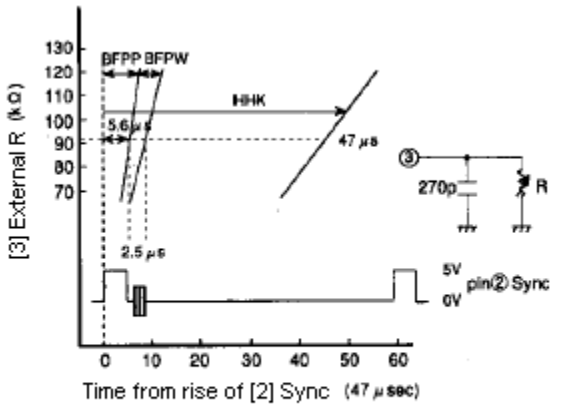
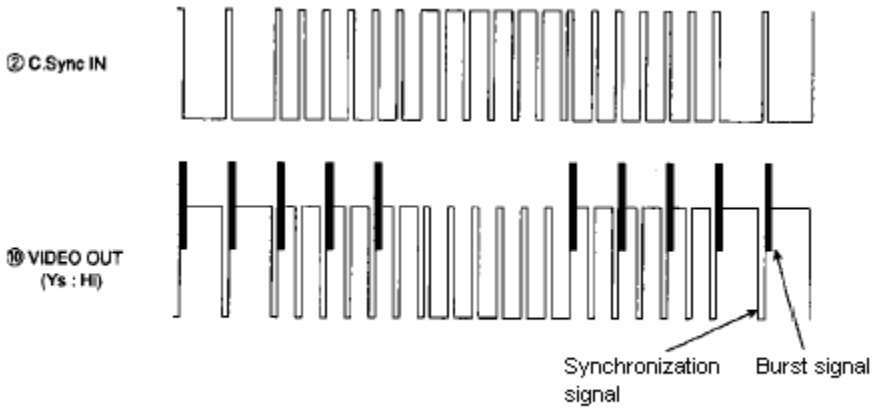


Fig. 4. [3] RC product versus pulse generated internally
(for measurement conditions, see TEST nos. 35, 36, and 37)

(7) Input pin drive

Input pins [9], [16], [17], and [18] use clamp input, so they should always be driven with a low impedance.

(8) Input/output relationship between SYNC and burst during the V cycle



Input/output relationship between SYNC and burst

(9) V DL and Y_S DL settings when the SUPERIMPOSE mode is being used

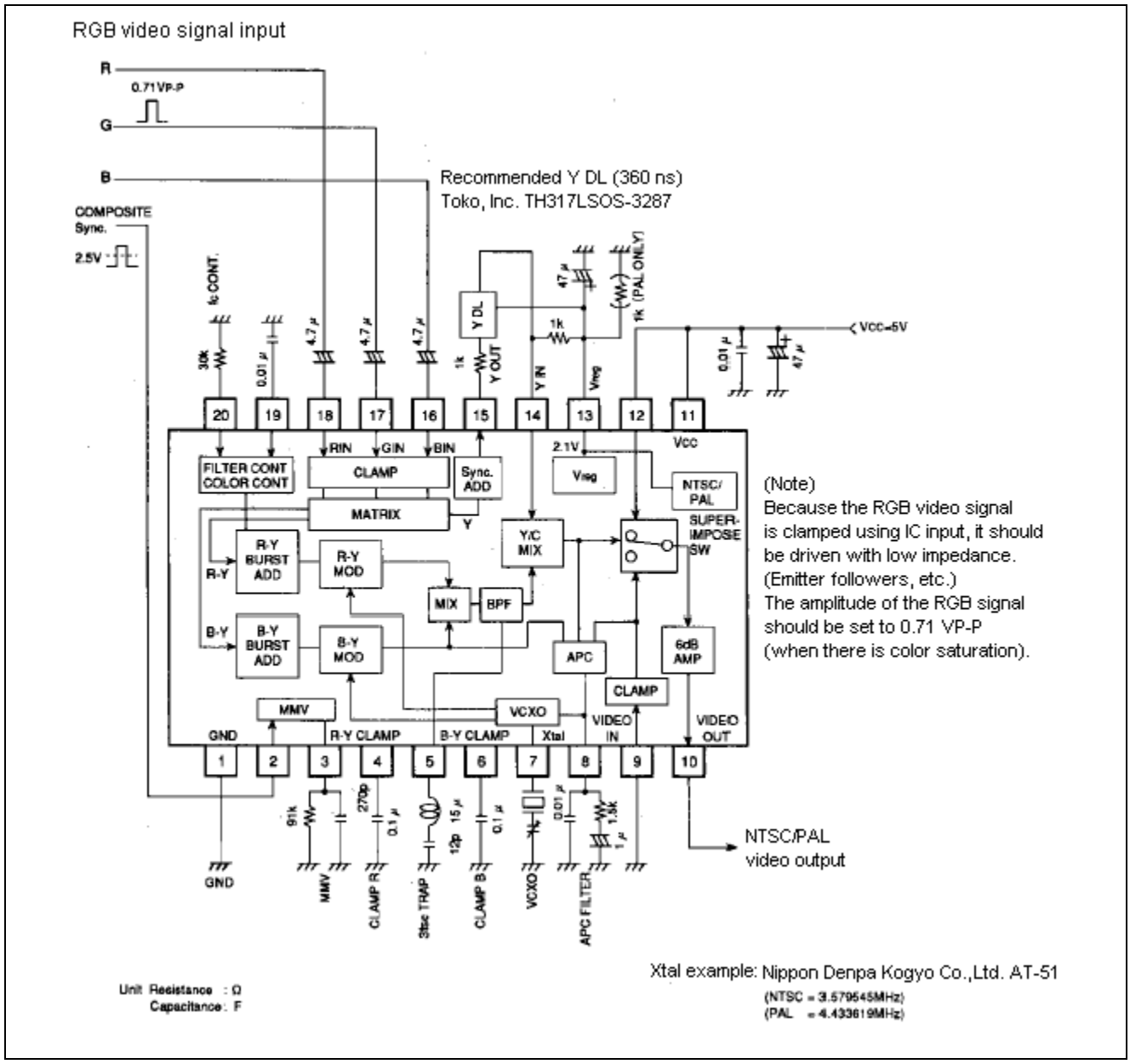
1) V DL is used to adjust the timing of the RGB encoder signal and the VIDEO IN signal.
2) Y_S DL is used to adjust the timing of the RGB encoder signal and the Y_s IN signal.
3) When the timing is the same for C. SYNC IN, RGB IN, VIDEO IN and Y_s IN, V DL and Y_S DL should be set using the amount of delay shown below as a guide.

V DL = Y DL (item 4) + 10 (ns)

Y_S DL = Y DL – 10 (ns)

Application Example (1)

Example showing RGB video signals being encoded in NTSC/PAL signal

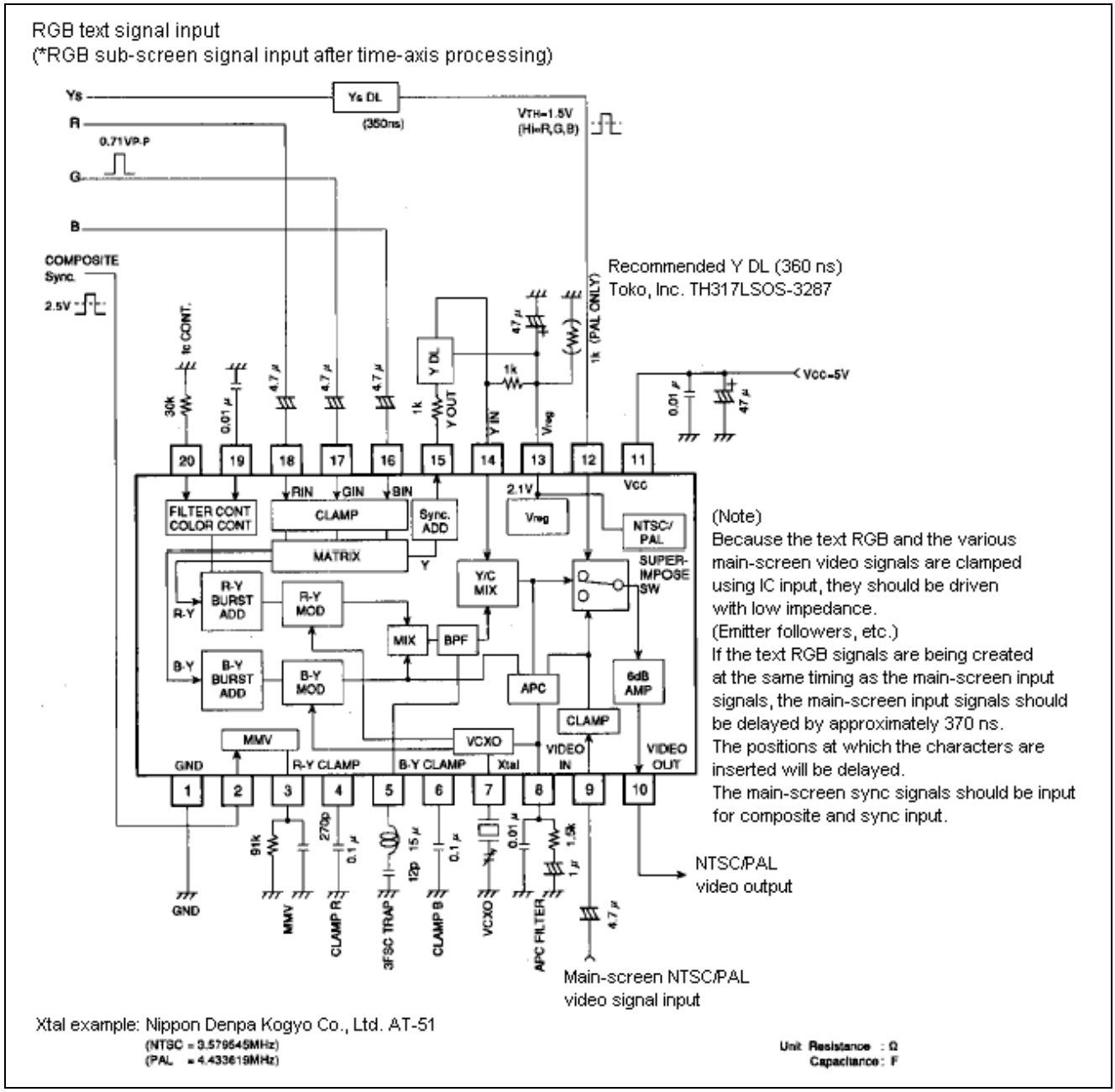


Application Example (2)

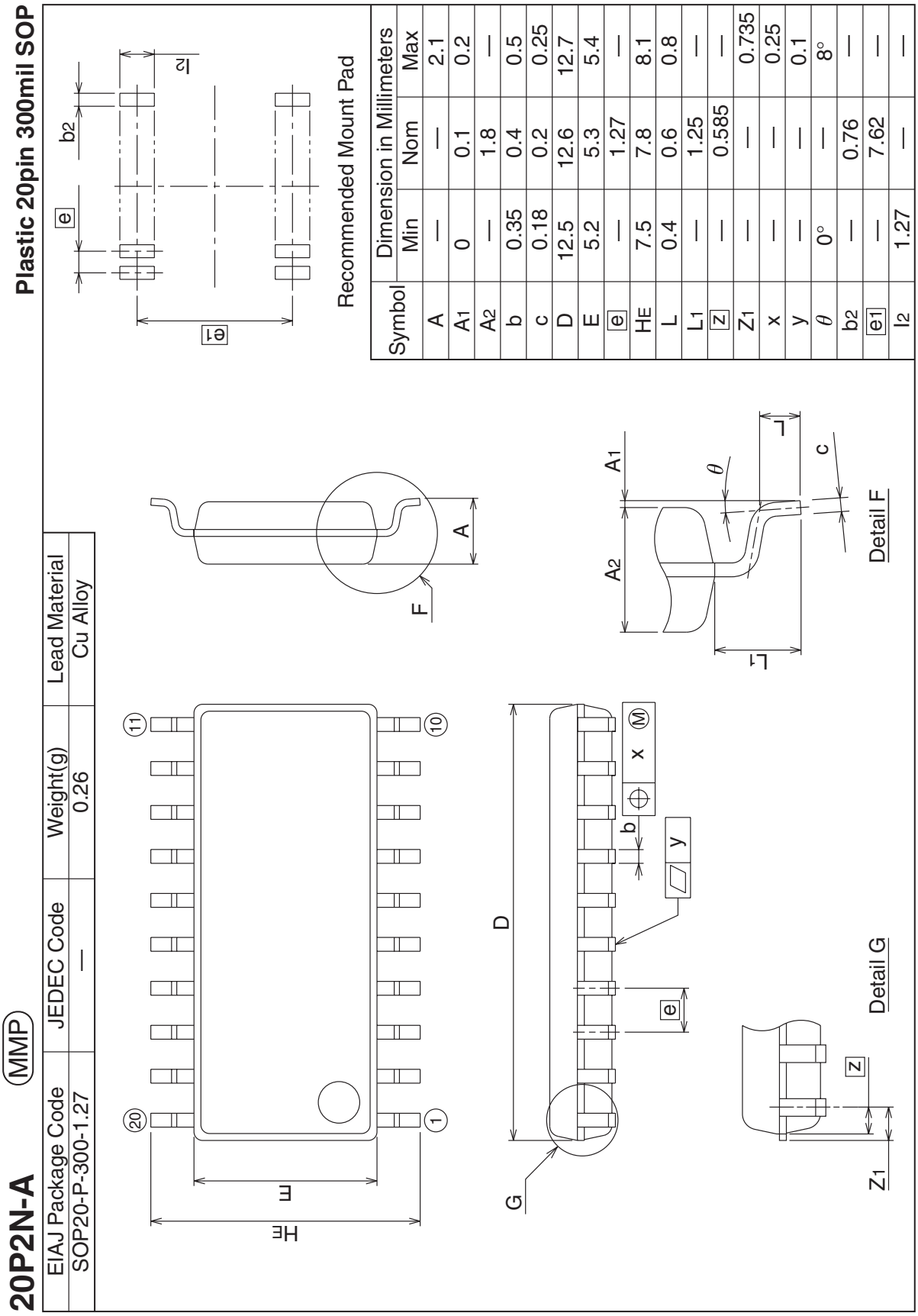
Example showing RGB text signals superimposed on NTSC/PAL signals

(*The values in brackets show what takes place when the RGB signals of a personal computer or other device are superimposed on NTSC/PAL signals as a sub-screen.)

If signals delayed by approximately 350 nm after the text (*sub-screen) RGB signals are created directly, as Ys signals, Ys DL is not necessary. If RGB and Ys are at same timing, the delay time of Ys DL should be set to 350 ns (typical).



Package Dimensions



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Colophon 1.0