DESCRIPTION

The M52390FP is a single-chip semiconductor integrated circuit which has a function to convert R/G/B signal to NTSC/PAL composite video signal and the superimpose function.

FEATURES

RGB encode

• LPF for chroma difference signal is built-in. Cutoff frequency control is possible by connecting a resistor externally.

• Because VCA circuit is built-in, gain control at chroma block is possible.

• Carrier leak is on a low level because of built-in high-precision modulation circuit and clamp circuit.

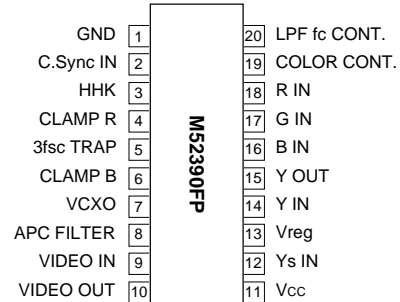• Burst signal and sync signal are generated within the IC.

Superimpose function

• Ys IN (control input) is used for switching 2 input signals, VIDEO IN and RGB IN.

• Because high-speed analog switch is built-in, even microscopic characters can be inserted.

• Built-in an APC circuit to adjust tint of the parent picture (VIDEO IN) and the RGB encode signal automatically.

Overall functions

• A drive circuit (75Ω) can be configured with one transistor by outputting the video output signal at 2V$_{P-P}$.

• This device can be used for both NTSC system and PAL system.

PIN CONFIGURATION (TOP VIEW)

	M52390FP	
GND 1		20 LPF fc CONT.
C.Sync IN 2		19 COLOR CONT.
HHK 3		18 R IN
CLAMP R 4		17 G IN
3fsc TRAP 5		16 B IN
CLAMP B 6		15 Y OUT
VCXO 7		14 Y IN
APC FILTER 8		13 Vreg
VIDEO IN 9		12 Ys IN
VIDEO OUT 10		11 Vcc

Outline 20P2N-A
(Lead pitch:1.27mm)

APPLICATION

TV, VCR, monitor, and other AV equipments

RECOMMENDED OPERATING CONDITION

Supply voltage range .... 4.7 to 5.3V
Rated supply voltage 5V

BLOCK DIAGRAM
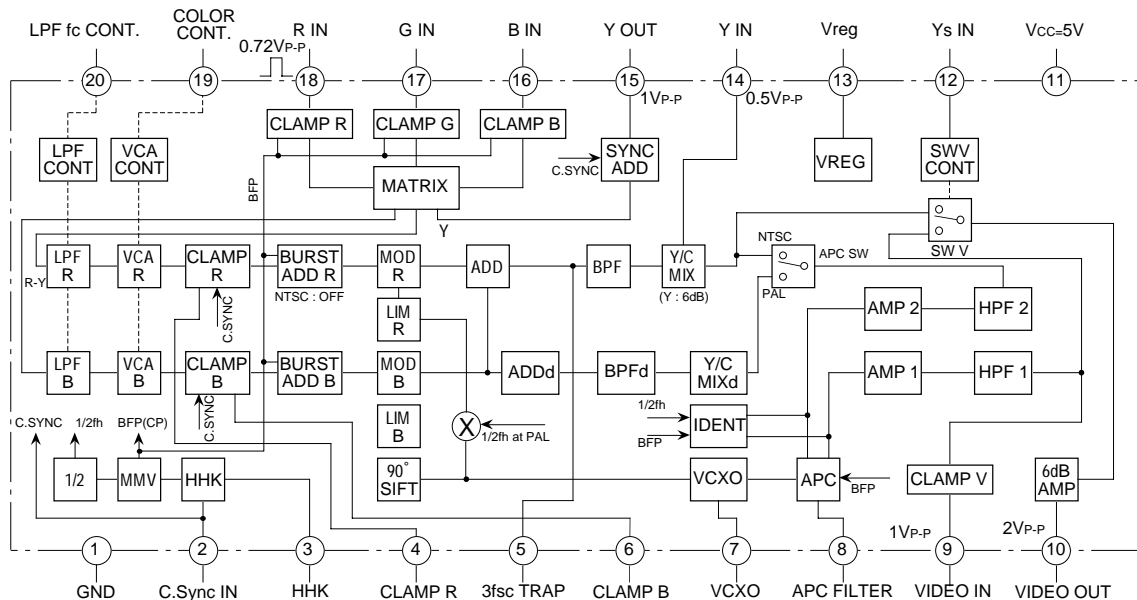
ABSOLUTE MAXIMUM RATINGS (Ta=25˚C, unless otherwise noted)

Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	7	V
Pd	Power dissipation	620 (900)	mW
Topr	Operating temperature	-20 to 75	˚C
Tstg	Storage temperature	-40 to 125	˚C
K_{θ}	Thermal derating (Ta≥25˚C)	6.2 (9.0)	mW/˚C

Values in parentheses are those measured when the IC is mounted on a standard board.

ELECTRICAL CHARACTERISTICS (Ta=25˚C, Vcc=5V, Sa2=sync input, unless otherwise noted)
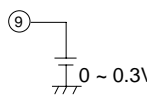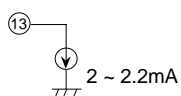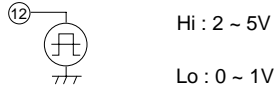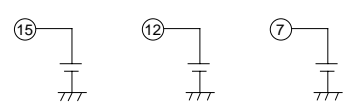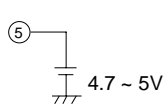
Test No.	Symbol	Parameter	Test conditions	Test point	Min.	Typ.	Max.	Unit
1	I_{CC1}	Current dissipation 1	NTSC MODE ⑫ 5V	⑪	35	50	65	mA
2	I_{CC2}	Current dissipation 2	PAL MODE (SW13 : ON) ⑫ 5V	⑪	37	52	67	mA
RGB IN → Y OUT								
3	E_R	Matrix ratio R	SG18 : 1V$_{P-P}$	⑮	0.27	0.30	0.33	V$_{P-P}$
4	E_G	Matrix ratio G	SG17 : 1V$_{P-P}$	⑮	0.53	0.59	0.65	V$_{P-P}$
5	E_B	Matrix ratio B	SG16 : 1V$_{P-P}$	⑮	0.09	0.11	0.13	V$_{P-P}$
6	E_Y	Y level at RGB 100%	SG16, SG17, SG18 : 0.71V$_{P-P}$	⑮	0.63	0.71	0.79	V$_{P-P}$
7	F_R	R IN - Y OUT frequency characteristics	SG18 : 500kHz/5MHz, 0.5V$_{P-P}$ CW SW16, 17, 18 : ON ② 0V (SG2 : OFF)	⑮	-1.5	0	1.5	dB
8	F_G	G IN - Y OUT frequency characteristics	SG17 : 500kHz/5MHz, 0.5V$_{P-P}$ CW SW16, 17, 18 : ON ② 0V (SG2 : OFF)	⑮	-1.5	0	1.5	dB
9	F_B	B IN - Y OUT frequency characteristics	SG16 : 500kHz/5MHz, 0.5V$_{P-P}$ CW SW16, 17, 18 : ON ② 0V (SG2 : OFF)	⑮	-1.5	0	1.5	dB
10	V_{S1}	Sync level 1	NTSC MODE	⑮	257	286	315	mV$_{P-P}$
11	V_{S2}	Sync level 2	PAL MODE (SW13 : ON)	⑮	270	300	330	mV$_{P-P}$
Y IN → VIDEO OUT								
12	G_Y	Y IN - VIDEO OUT Gain	SG14 : 500kHz, 0.5V$_{P-P}$ CW ⑫ 5V	⑩	10.5	12	13.5	dB
13	F_Y	Y IN - VIDEO OUT frequency characteristics	SG14 : 5MHz, 0.5V$_{P-P}$ CW ⑫ 5V	⑩	-1.5	0	1.5	dB
RGB IN → TRAP								
14	$DL_{(R-Y)}$	Delay (R-Y)	SG18 : 1V$_{P-P}$ ⑮ 5V, ⑫ 5V, ⑦ 0V	⑤	210	310	410	ns
15	$DL_{(B-Y)}$	Delay (B-Y)	SG16 : 1V$_{P-P}$ ⑮ 5V, ⑫ 0V, ⑦ 0V	⑤	210	310	410	ns
16	$GH_{(R-Y)}$	Gain (R-Y) VCA:Hi	SG18 : 500kHz, 0.5V$_{P-P}$ CW SW4, 6, 16, 17, 18 : ON ⑮ 5V, ⑫ 5V, ⑦ 0V, ⑲ 5V/2.5V ② 0V (SG2 : OFF)	⑤	1	2	3.5	dB
17	$GH_{(B-Y)}$	Gain (B-Y) VCA:Hi	SG16 : 500kHz, 0.5V$_{P-P}$ CW SW4, 6, 16, 17, 18 : ON ⑮ 5V, ⑫ 0V, ⑦ 0V, ⑲ 5V/2.5V ② 0V (SG2 : OFF)	⑤	1	2	3.5	dB
18	$GL_{(R-Y)}$	Gain (R-Y) VCA:Lo	SG18 : 500kHz, 0.5V$_{P-P}$ CW SW4, 6, 16, 17, 18 : ON ⑮ 5V, ⑫ 5V, ⑦ 0V, ⑲ 0V/2.5V ② 0V (SG2 : OFF)	⑤	-4.5	-3	-2	dB

ELECTRICAL CHARACTERISTICS (cont.)

Test No.	Symbol	Parameter	Test conditions	Test point	Min.	Typ.	Max.	Unit
19	$GL_{(B-Y)}$	Gain (B-Y) VCA:Lo	SG16 : 500kHz, 0.5V$_{P-P}$ CW SW4, 6, 16, 17, 18 : ON ⑮ 5V, ⑫ 0V, ⑦ 0V, ⑲ 0V/2.5V ② 0V (SG2 : OFF)	⑤	-4.5	-3	-2	dB
RGB IN → VIDEO OUT								
20	V_{B1}	NTSC burst level	NTSC MODE ⑫ 5V	⑩B	243	286	329	mV$_{P-P}$
21	V_{B2}	PAL burst level	PAL MODE (SW13 : ON) ⑫ 5V	⑩B	255	300	345	mV$_{P-P}$
22	V_{B3}	PAL burst level difference	PAL MODE (SW13 : ON) ⑫ 5V	⑩B	-30	0	30	mV$_{P-P}$
23	P_{PB}	PAL burst phase difference	PAL MODE (SW13 : ON) ⑫ 5V	⑩B	82	90	98	deg
24	$V_{R/B}$	R/burst level ratio	SG18 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	2.68	3.15	3.62	
25	$V_{G/B}$	G/burst level ratio	SG17 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	2.51	2.95	3.39	
26	$V_{B/B}$	B/burst level ratio	SG16 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	1.91	2.25	2.59	
27	$V_{C/B}$	Carrier leak in NTSC mode	NTSC MODE ⑫ 5V	⑩B	-	-40	-28	dB
28	$P_{R/B}$	R/burst phase difference	SG18 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	96	104	112	deg
29	$P_{G/B}$	G/burst phase difference	SG17 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	233	241	249	deg
30	$P_{B/B}$	B/burst phase difference	SG16 : 0.71V$_{P-P}$ ⑫ 5V	⑩B	339	347	355	deg
VIDEO IN → VIDEO OUT								
31	G_{VIO}	VIDEO IN → VIDEO OUT Gain	SG9 : 500kHz, 0.5V$_{P-P}$ CW SW9 : ON ⑫ 0V, ② 0V (SG2 : OFF)	⑩	5	6	7	dB
32	F_{VIO}	VIDEO IN→VIDEO OUT frequency characteristics	SG9 : 5MHz, 0.5V$_{P-P}$ CW SW9 : ON ⑫ 0V, ② 0V (SG2 : OFF)	⑩	-1.5	0	1.5	dB
SUPER IMPOSE								
33	P_{SI}	RGB/VIDEO IN burst phase difference	SG9 : 3.58MHz, 286mV$_{P-P}$ CW SG12 : 1V$_{P-P}$	⑩B	-5	0	5	deg
34	V_{OS}	DC offset	SG9 : burst, 286mV$_{P-P}$ SG12 : 1V$_{P-P}$	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 point (burst point)	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 TEST METHOD
Mode table (common to each test)
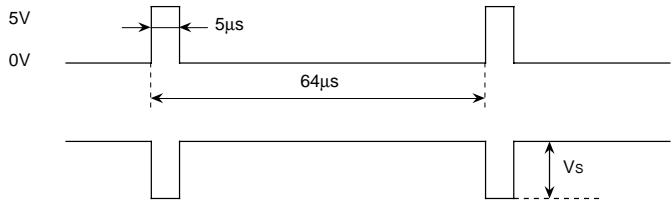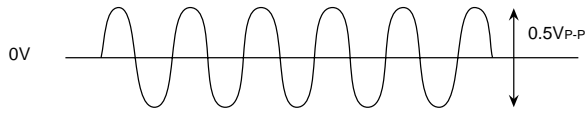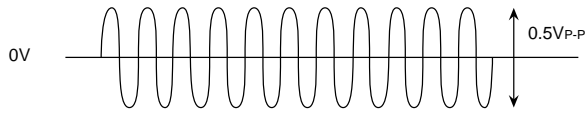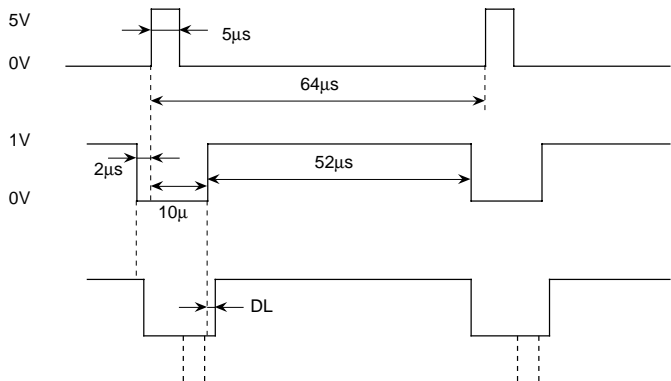
Mode	Conditions	Functions
FREE RUN MODE	⑨ 0 ~ 0.3V	VCXO FREE RUN
PAL MODE	⑬ 2 ~ 2.2mA	Carrier phase for MOD R is inverted on line

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 Chroma 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	⑮ PULSE output PAL MODE : BFP, HHK mix NTSC MODE : BFP

V4, V6, V9, V16, V17, V18	Voltage at each pin when SYNC is input to pin ② (C.SYNC IN). (In clamp operation)
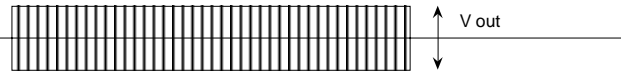
TEST METHOD AND LIMITS CALCULATION METHOD
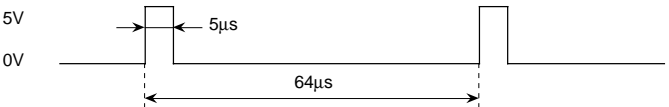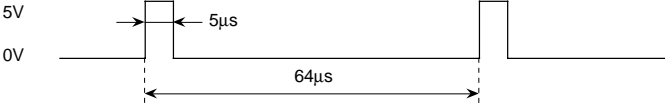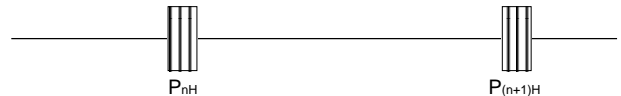
Test No.	Test method and limits calculation method
1 2	Measure the current to flow in pin ⑪
$\binom{3}{4}_{5}$	SG2 5V / 0V 5µs 64µs SG18 SG17 SG16 1V / 0V 2µs 52µs 10µs Output at pin ⑮ E
6	SG2 5V / 0V 5µs 64µs SG16 SG17 SG18 0.71V / 0V 2µs 52µs 10µs Output at pin ⑮ E_Y
$\binom{7}{8}_{9}$	SG18 SG17 SG16 0V f=500kHz / 5MHz 0.5V$_{P-P}$ CW Output at pin ⑮ V out $F = 20 \log \dfrac{V \text{ out (5MHz)}}{V \text{ out (500kHz)}}$ (dB)
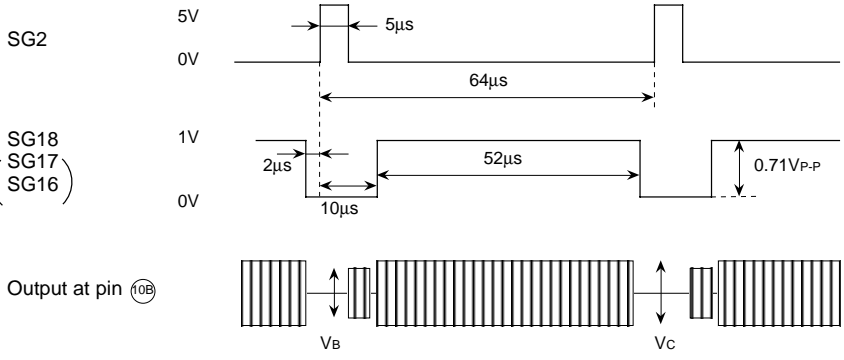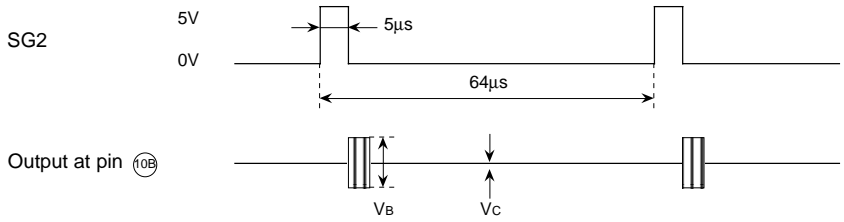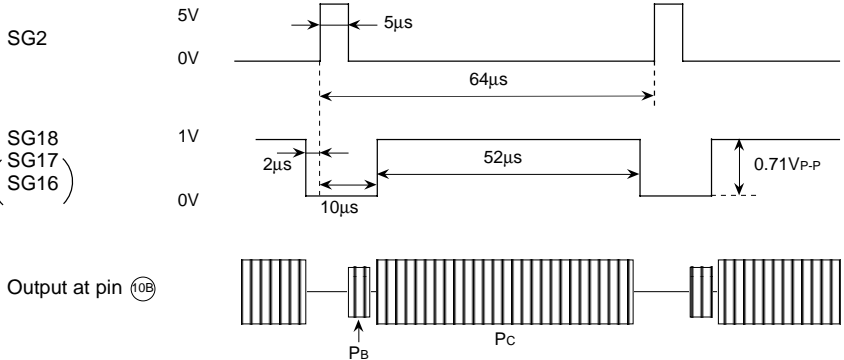
TEST METHOD AND LIMITS CALCULATION METHOD (cont.)

Test No.	Test method and limits calculation method
10 11	
12	Measure the element of 500kHz at pin ⑩ (V_{12}) and calculate GY as follows. $$G_Y = 20 \log \frac{V_{12}}{0.5V_{P\text{-}P}} \quad (dB)$$
13	Measure the element of 5MHz at pin ⑩ (V_{13}) and calculate fcY as follows. $$fc_Y = 20 \log \frac{V_{13}}{V_{12}} \quad (dB)$$
14 (15)	
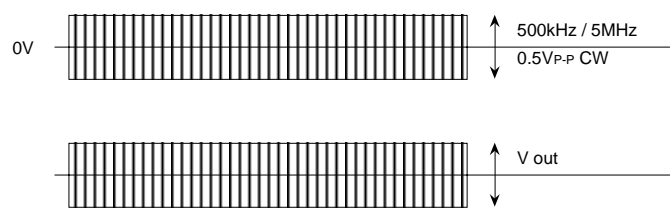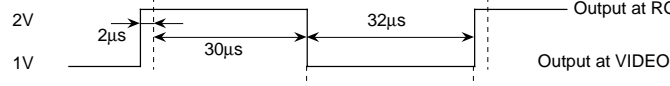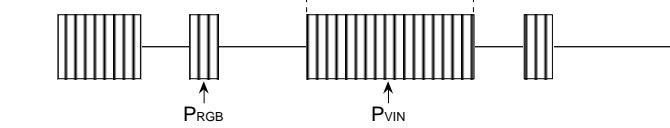
TEST METHOD AND LIMITS CALCULATION METHOD (cont.)

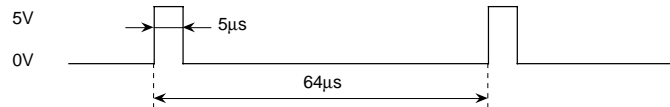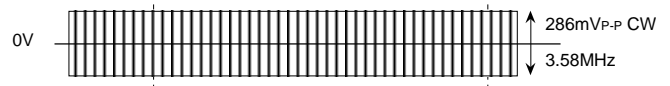| Test No.	Test method and limits calculation method
16 (17) 18 (19)	SG18 (SG16), 0V, f=500kHz, 0.5VP-P CW Output at pin ⑮, V out $GH = 20 \log \dfrac{V\ out\ (⑲\ 5V)}{V\ out\ (⑲2.5V)}$ (dB) $GL = 20 \log \dfrac{V\ out\ (⑲\ 5V)}{V\ out\ (⑲2.5V)}$ (dB)
20 21 22	SG2, 5V, 0V, 5µs, 64µs Output at pin ⑩B, V_{nH}, $V_{(n+1)H}$ $V_{B1}=V_{nH}$ $V_{B2}=V_{nH}$ $V_{B3}=V_{nH} - V_{(n+1)H}$
23	SG2, 5V, 0V, 5µs, 64µs Output at pin ⑩B, P_{nH}, $P_{(n+1)H}$ $P_{PB} = \left| P_{nH}\ burst\ phase - P_{(n+1)H}\ burst\ phase \right|$

TEST METHOD AND LIMITS CALCULATION METHOD (cont.)

Test No.	Test method and limits calculation method
24 ⎛25⎞ ⎝26⎠	SG2 5V 0V ←5μs→ 64μs SG18 SG17 SG16 1V 0V 2μs 52μs 10μs 0.71V P-P Output at pin ⑩B V_B V_C $R\,(G,\,B)\,/\,\text{Burst level ratio} = \dfrac{V_C}{V_B}$
27	SG2 5V 0V ←5μs→ 64μs Output at pin ⑩B V_B V_C $V_{C/B} = 20\,\log\,\dfrac{V_C}{V_B}\quad(dB)$
28 ⎛29⎞ ⎝30⎠	SG2 5V 0V ←5μs→ 64μs SG18 SG17 SG16 1V 0V 2μs 52μs 10μs 0.71V P-P Output at pin ⑩B P_B P_C $R\,(G,\,B)\,/\,\text{Burst phase difference} = P_C - P_B\quad(deg)$

TEST METHOD AND LIMITS CALCULATION METHOD (cont.)

Test No.	Test method and limits calculation method
31 32	SG9 0V 500kHz / 5MHz 0.5VP-P CW Output at pin ⑩B V out $G_{VIO} = 20 \log \dfrac{V \text{ out } (500kHz)}{0.5V_{P-P}}$ (dB) $F_{VIO} = 20 \log \dfrac{V \text{ out } (5MHz)}{V \text{ out } (500kHz)}$ (dB)
33	SG2 5V / 0V 5µs 64µs SG9 0V 286mVP-P CW 3.58MHz SG12 2V / 1V 2µs 30µs 32µs Output at RGB side Output at VIDEO IN side Output at pin ⑩B P_{RGB} P_{VIN} $P_{SI} = P_{RGB} - P_{VIN}$ (deg)

TEST METHOD AND LIMITS CALCULATION METHOD (cont.)

Test No.	Test method and limits calculation method
34	
35	
36 37	

TEST CIRCUIT

Unit Resistance : Ω
Capacitance : F

PRECAUTIONS FOR APPLICATION

(1) Input signal

Pin No.	Name	Specifications
②	C.Sync IN	5V · · · V$_{TH}$=2.5V · · · 0V
⑨	VIDEO IN	In case that no signal is input, this pin should be set to free run mode. 100IRE, 40IRE, 40IRE, 1V$_{P-P}$, 286mV$_{P-P}$, V DL Refer to (9)
⑫	Ys	RGB ENCODE OUTPUT, 2V, V$_{TH}$=1.5V, 1V, Ys DL Refer to (9), VIDEO OUTPUT, VIDEO OUTPUT
⑯ ⑰ ⑱	B IN G IN R IN	0.71V$_{P-P}$

(2) Setting of free run frequency

In this IC, the VCXO circuit generates fsc. Therefore, set the oscillator frequency of VCXO to fsc as follows before using this IC.
1) Connect pin ⑨ (VIDEO IN) to GND and set it to free run mode.
2) V4 is the voltage at pin ④ (OFFSET R) when sync is input to pin ② (C.Sync IN). Apply voltage V4 - 0.5V to pin ④ (OFFSET R).
3) Set pin ② (C.Sync IN) to H. (5V is applied.)
4) Set the output frequency at pin ⑤ (TRAP) by adjusting the trimmer capacitor at pin ⑦ (VCXO IN).

(3)Setting of chroma difference LPF

The frequency characteristics of the chroma difference LPF which is built in this IC can be set as shown in Fig. 1 by connecting a resistor externally to pin ⑳ (fc CONT.).
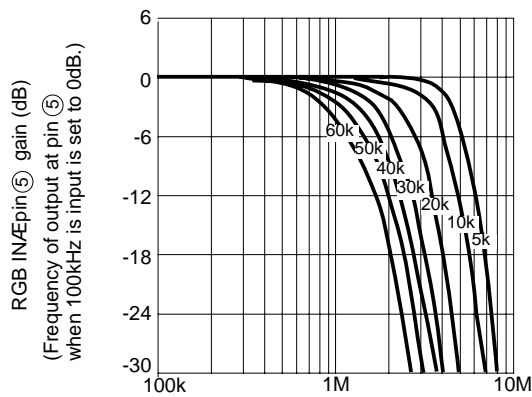The group delay characteristics also change as shown in Fig. 2.

Fig. 1 Frequency characteristics of color difference LPF
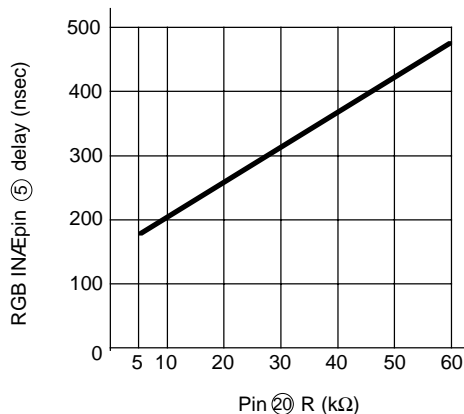(As for the test conditions, refer to test No.14 and 15.)

Fig. 2 Group delay characteristics of color difference LPF
(As for the test conditions, refer to test No.14 and 15.)

(4) Setting of Y DL

The group delay characteristics of color signal of RGB encode output changes by connecting a resistor externally to pin ⑳ (fc CONT.). Therefore, set Y DL based on the delay volume (group delay volume derived from group delay characteristics + 40ns).
In case that a trap circuit is connected to pin ⑤ , take the delay from +5 to +10ns into consideration.

(5) Color control characteristics

Gain in chroma section can be set as shown in Fig. 3 by applying voltage to pin ⑲ (COLOR CONT.). (The burst amplitude is fixed.)
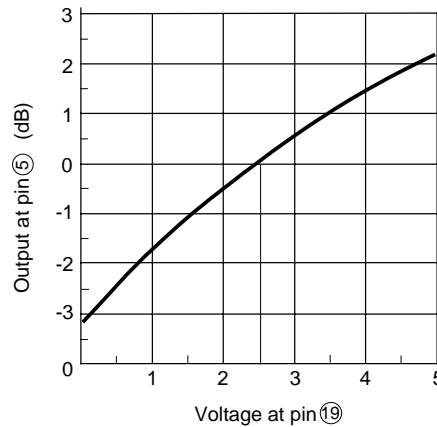

Fig. 3 Color control characteristics
(As for the test conditions, refer to test No.16, 17, 18 and 19.)

(6) Relation between BFP and HHK

The pulse width of GFP and HHK can be set as shown in Fig. 4 by connecting DR externally to pin ③ (HHK).
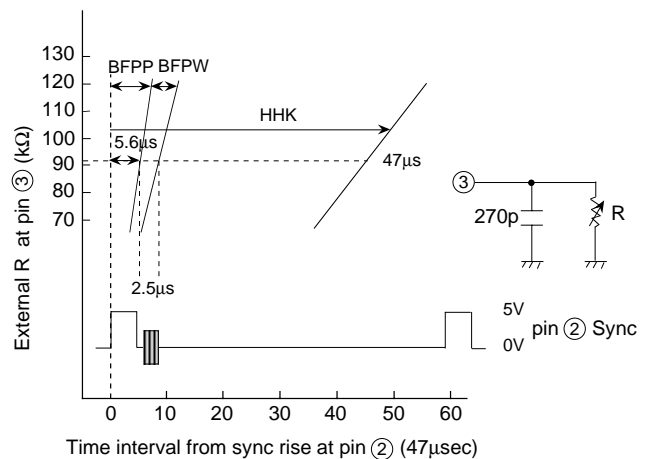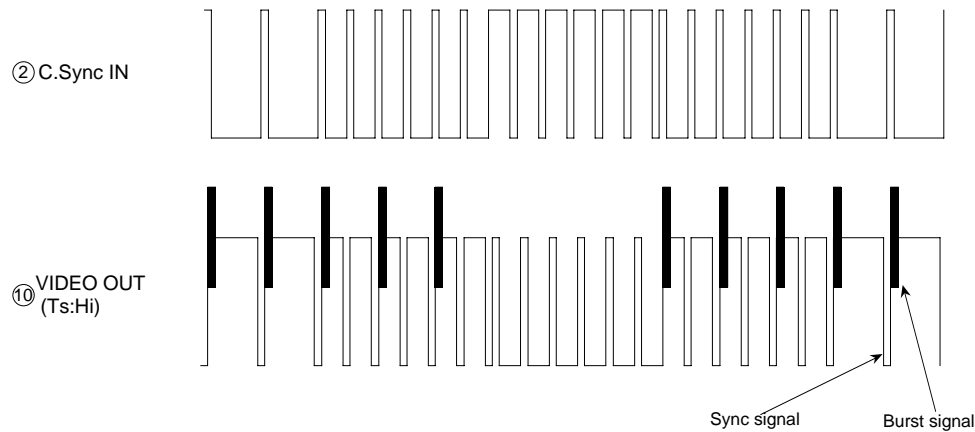

Fig. 4 RC product at pin ③ vs. internal pulse
(As for the test conditions, refer to test No.35, 36 and 37.)

(7) Driving of input pins

Drive pins ⑨ , ⑯, ⑰ and ⑱ at low impedance because they are clamped by IC input.

(8) I/O relation between sync signal and burst signal during the period V

② C.Sync IN

⑩ VIDEO OUT (Ts:Hi)

Sync signal   Burst signal

I/O relation between sync signal and burst signal

(9) Setting of V DL and Ys DL in superimpose mode

1) V DL is used to adjust the timing of RGB encode signal and VIDEO IN signal.

2) Ys DL is used to adjust the timing of RGB encode signal and Ys IN signal.

3) In case that signals are input to C.SYNC IN, RGB IN, VIDEO IN or Ys IN at the same timing, set V DL and Ys DL based on the delay volume as below.

V DL = Y DL (Refer to (4)) + 10 (nsec)

Ys DL = Y DL - 10 (nsec)

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)
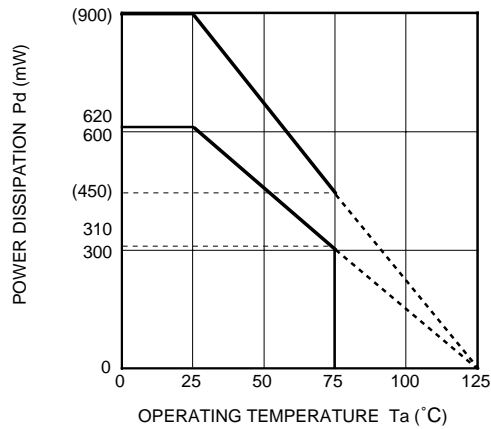
Values are measured when any external circuits are connected to this IC.
Values in parentheses are those measured when the IC is mounted on a standard board.

POWER DISSIPATION Pd (mW)

OPERATING TEMPERATURE Ta (˚C)

Standard board
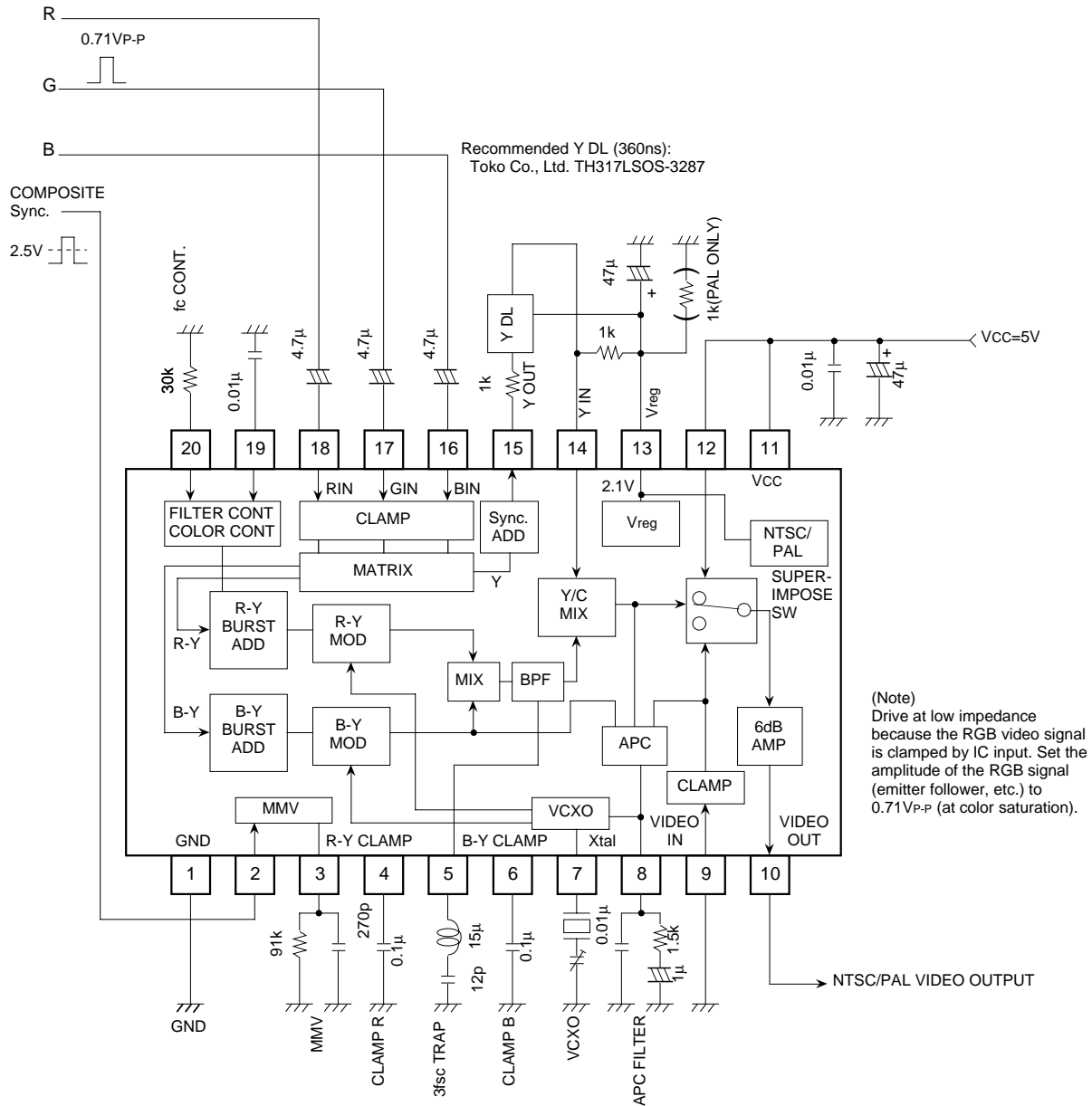 Material : glass epoxy (Cu leaf pattern is put over one side of the board.)
  Size : 70mm, thickness=1.6mm
  Thickness of Cu leaf : 18μm

APPLICATION EXAMPLE (1)

Encoding RGB video signal to NTSC/PAL signal RGB video signal input

RGB VIDEO SIGNAL INPUT

Unit Resistance : Ω
      Capacitance : F

Example of Xtal:Nippon denpa industry Co., Ltd. AT-51
(NTSC = 3.579545MHz)
(PAL = 4.433619MHz)

NTSC/PAL ENCODER

APPLICATION EXAMPLE (2)

Superimposing RGB Character Signal on NTSC/PAL Signal
(*The case that RGB signal of personal computers, etc. is superimposed on NTSC/PAL signal as a child picture is mentioned in parentheses.)

RGB CHARACTER SIGNAL INPUT
(*RGB child picture signal input after processing time axis)

In case that the signal which is about 350ns behind the character (*child picture) RGB signal is directly generated as Ys signal, Ys DL is not necessary. When the timing of RGB coincides with that of Ys, set the delay time of Ys DL to 350ns (typ.).

Recommended Y DL (360ns):
Toko Co., Ltd. TH317LSOS-3287
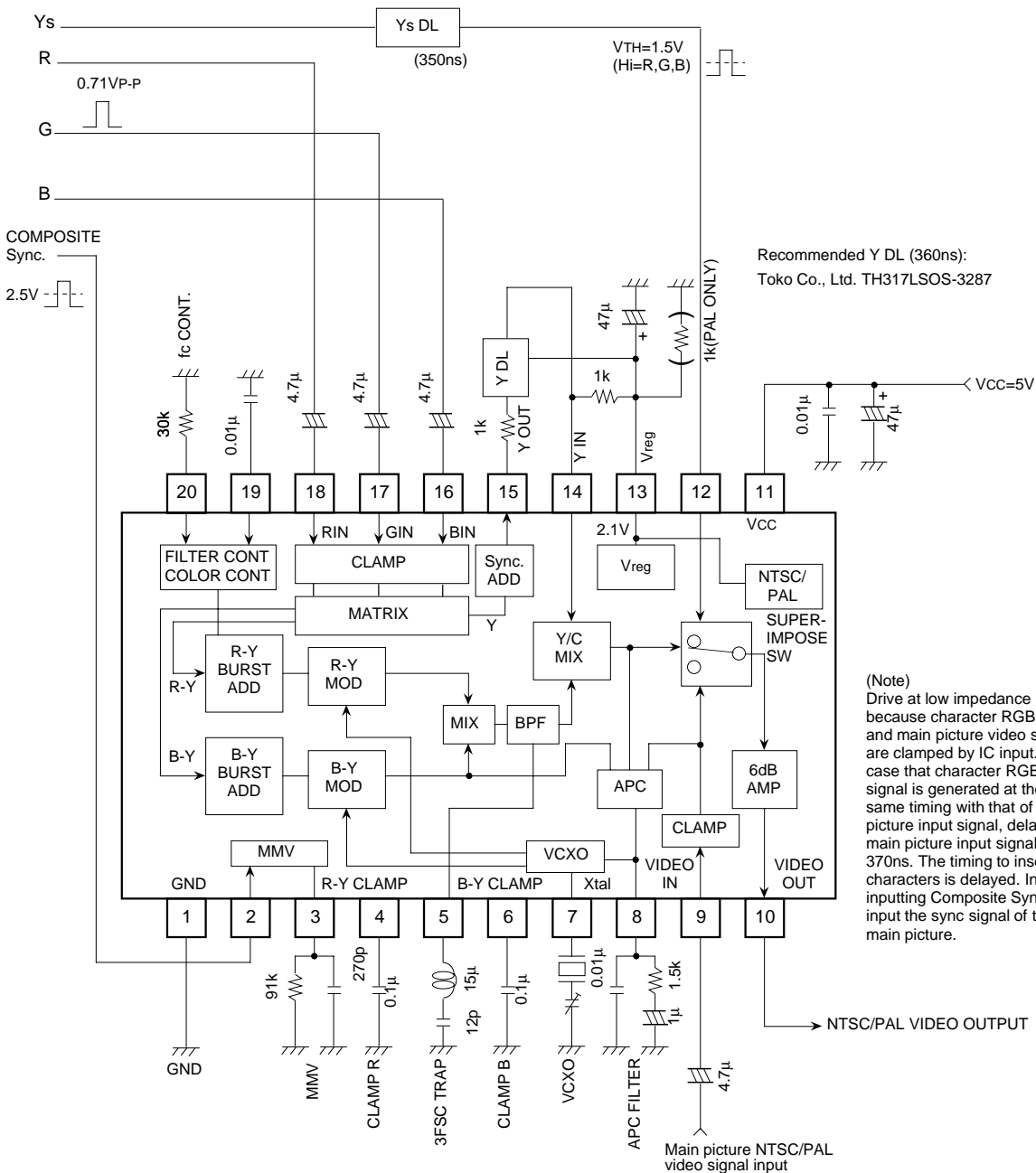
(Note)
Drive at low impedance because character RGB signal and main picture video signal are clamped by IC input. In case that character RGB signal is generated at the same timing with that of main picture input signal, delay the main picture input signal about 370ns. The timing to insert characters is delayed. In inputting Composite Sync, input the sync signal of the main picture.

NTSC/PAL VIDEO OUTPUT

Main picture NTSC/PAL video signal input

Example of Xtal:Nippon denpa industry Co., Ltd. AT-51
        (NTSC = 3.579545MHz)
        (PAL   = 4.433619MHz)

Unit Resistance   : Ω
        Capacitance : F

DESCRIPTION OF PIN

Pin No.	Name	Peripheral circuit of pins	Pin voltage	Remarks
①	GND			
②	C.SYNC IN		AC : Sync input $V_{TH}=2.5V\pm0.3V$	
③	HHK		AC	HHK pulse width can be adjusted by connecting RC externally. Recommended value HHK:3/4H R=91K C=270p
④	OFFSET R		DC : 3.1V	Recommended value of external circuit C=0.1μ
⑤	TRAP		AC : Chroma 2.4V Burst : 300mVP-P ⑮ Test mode output when voltage at pin ⑮ is 5V ⑫ Hi : R-Y output ⑫ Lo : B-Y output	Recommended value of external circuit L C NTSC : 15μ 12P PAL : 10μ 12P ⑤5V : Test mode setting ⑮Pulse output

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Peripheral circuit of pins	Pin voltage	Remarks
⑥	OFFSET B		DC : 3.1V	Recommended value of external circuit C=0.1μ
⑦	VCXO IN		DC : 3.2V	Free run frequency is set by the trimmer capacitor
				⑦ 0V : Carrier OFF
⑧	APC FILTER		DC : 3.3V In free run mode DC : 2.7V	ß characteristics Frequency Recommended value of external circuit R=1.5k C1=0.001μ C2=1μ
⑨	VIDEO IN		AC : VIDEO 1VP-P Pedestal section 2.9V	Clamp input (burst timing) Recommended value of external circuit C=4.7μ
				⑨ 0V : Free run mode setting

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Peripheral circuit of pins	Pin voltage	Remarks
⑩	VIDEO OUT		AC : VIDEO 2VP-P Pedestal section 1.8V	
⑪	Vcc		DC : 5V	Icc : 50mA
⑫	Ys		Switching signal input for superimposing 5 VTH 0 Hi : picture insertion (RGB IN output)	VTH=1.5±0.3V Hi : RGB IN output Lo : VIDEO IN output Setting of output at pin ⑤ when voltage at pin ⑮ is ⑤ V ⑫ / ⑤ Output at pin Hi / R-Y Lo / B-Y
⑬	VRE G		DC : 2.1V	Recommended value of external circuit C=47µ ⑬ PAL mode at 2mA
⑭	Y IN		AC : Y 0.5VP-P Pedestal section 2.1V	
⑮	Y OUT		AC : Y 1VP-P Pedestal section 2.1V ⑤ Test mode output when voltage at pin ⑤ is 5V Pulse output	⑫ / ⑤ Output at pin Hi / R-Y Lo / B-Y

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Peripheral circuit of pins	Pin voltage	Remarks
⑯	B IN		AC : B0.71VP-P Sync section : 2.9V	Clamp input (burst timing) C=4.7µ
⑰	G IN		AC : B0.71VP-P Sync section : 2.9V	Clamp input (burst timing) C=4.7µ
⑱	R IN		AC : B0.71VP-P Sync section : 2.9V	Clamp input (burst timing) C=4.7µ
⑲	COLOR CONT.		DC : 2.5V	Color control of RGB encode output 5V : Chroma section+2dB 2.5V : Standard 0V : Chroma section-3dB

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Peripheral circuit of pins	Pin voltage	Remarks
⑳	fc. CONT.		DC : 3.3V	fc of LPF can be adjusted by connecting a resistor externally. R=30k