M51405AFP/VP

NTSC VIDEO CHROMA SIGNAL PROCESSOR

DESCRIPTION

The M51405A are a semiconductor integrated circuit for processing video signals in an NTSC system color LCD TV. It contains ACC, color signal demodulator, picture quality control, APC, VCXO, RGB matrix amplifier, tint and killer circuits.

FEATURES

- Low supply voltage, low power dissipation IC
- Picture soft/sharp-adjustable via picture quality control circuit
- Primary color contrast control
- 24-pin flat package

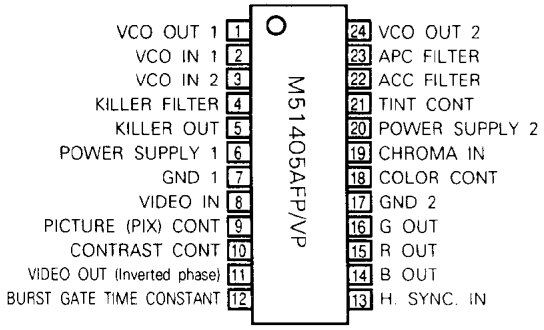
APPLICATION

LCD TV

RECOMMENDED OPERATING CONDITION

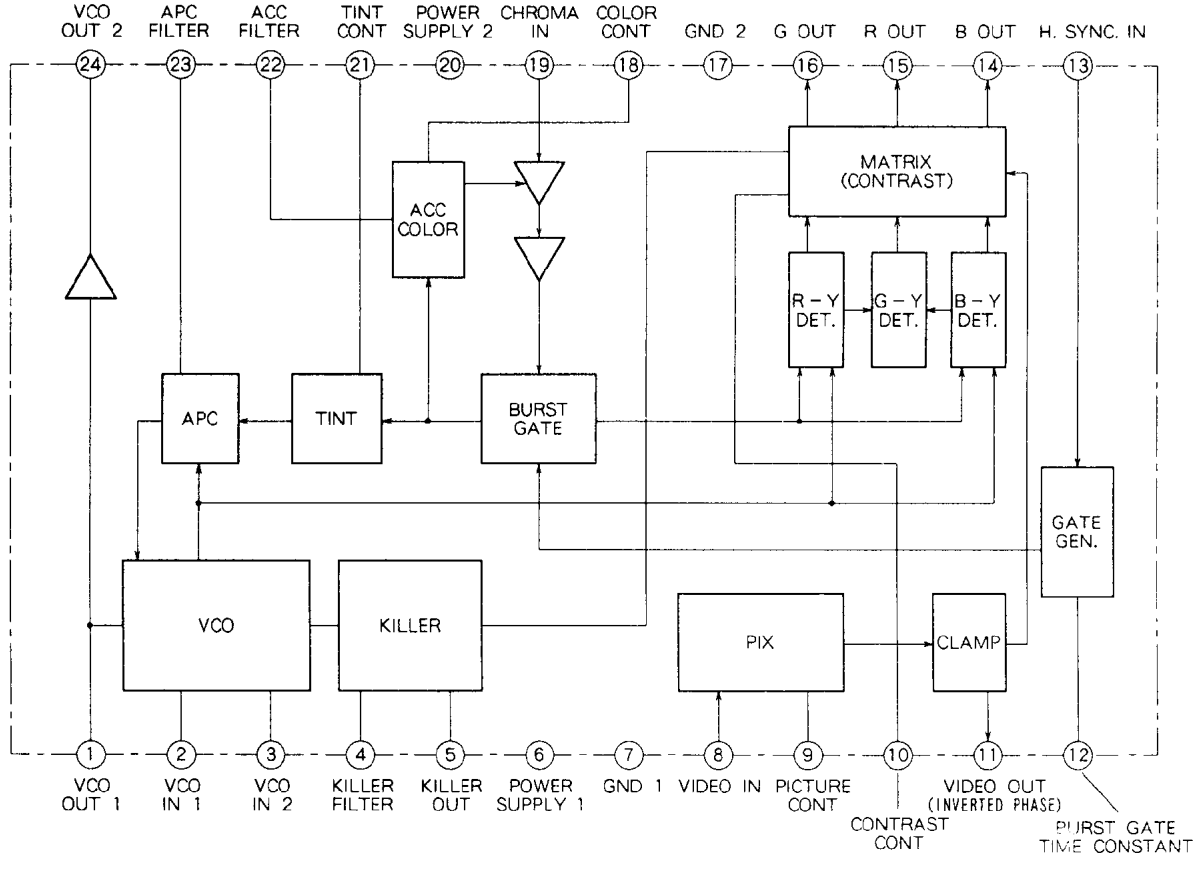
Supply voltage range ..... 3.5~4.5V
Rated supply voltage 4.0V

PIN CONFIGURATION (TOP VIEW)



Outline 24P2W-D (AFP)
24P2E-A (AVP)

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	4.8	V
V_{IN2}	Input amplitude at pin ②	500	mV_{P-P}
I_{OUT5}	Output current at pin ⑤	800	mA
I_{OUT11}	Output current at pin ⑪	900	mA
V_{IN13}	Input voltage at pin ⑬	V_{CC} + 0.3	V
I_{OUT} 14 15 16	Output current at pins ⑭, ⑮ and ⑯	900	mA
I_{OUT24}	Output current at pin ㉔	450	mA
P_d	Power dissipation	500(AFP) 360(AVP)	mW
T_{opr}	Operating temperature	− 20~75	℃
T_{stg}	Storage temperature	− 40~125	℃

ELECTRICAL CHARACTERISTICS (Ta = 25℃, Vcc = 4.0V, unless otherwise noted)

Symbol	Parameter	Test conditions/Method Circled numerals indicate pin numbers	Limits Min.	Typ.	Max.	Unit
I_{CC}	Circuit current	Measure input current with $4V_{DC}$ applied to pins ⑥ and ⑳.	8.0	13.0	17.0	mA
VIDEO SECTION *						
Ymax	Maximum output	Input 100kHz sine wave of $0.3V_{P-P}$ to pin ⑧, and measure output amplitude at pin ⑭ with $4V_{DC}$ at pin ⑩.	1.8	2.2		V_{P-P}
GY	Video amplifier gain	Input 100kHz sine wave of $0.3V_{P-P}$ to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑩ is $2V_{DC}$, and calculate output/input amplitude ratio.	10.5	13.0	15.0	dB
$Y_{CTRST(2)}$	Contrast control characteristics	Input 100kHz sine wave of $0.3V_{P-P}$ to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑩ is changed to 2, 0.5 and $0V_{DC}$, and calculate ratio of measured amplitude to that in GY.	1.0	3.4	5.8	dB
$Y_{CTRST(0.5)}$			− 12.0	− 5.5	0	dB
$Y_{CTRST(0)}$				− 23	− 20	dB
$Y_{TONE(4)}$	Picture quality control characteristics	Input 1.5MHz sine wave of $0.3V_{P-P}$ to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑨ is changed to 2, 4 and $0V_{DC}$ with voltage at pin ⑩ set at $1V_{DC}$, and calculate ratio of measured amplitude to that obtained with pin ⑨ voltage at $2V_{DC}$.	− 4.0	− 2.7	− 1.5	dB
$Y_{TONE(0)}$			3.0	6.3	10.0	dB
Y_{FREQ}	Frequency characteristics	Input 100kHz and 2MHz sine waves of $0.3V_{P-P}$ in sequence to pin ⑧, and measure output amplitudeat pin ⑭ for each input with voltages at pins ⑨ and ⑩ set at $2V_{DC}$ and $1V_{DC}$, respectively. Then calculate output amplitude ratio for 2MHz/100kHz input.	− 9.5	− 6.5	− 4.5	dB
CHROMA SECTION *						
Cmax	Maximum output	Input sine wave of 0dB to pin ⑲, and measure output amplitude at pin ⑭ when voltage at pins ⑩ and ⑱ is $4V_{DC}$. (See Note 2.)	2.0	2.4	3.0	V_{P-P}
Gc	Chroma maximum gain	Input sine wave of -26dB to pin ⑲, and measure output amplitude at pin ⑭ when voltage at pins ⑩ and ⑱ is $4V_{DC}$. (See Note 2.)	45	51	57	dB
$C_{ACC(+6)}$	ACC control characteristics	Input sine waves of 0, +6 and -20dB in sequence to pin ⑲, and measure output amplitude at pin ⑭ for each inputwith voltages at pins ⑩ and ⑱ set at $1V_{DC}$ and 1.5V_{DC}, respectively. Then calculate ratio of measured amplitudeto that for 0dB input. (See Note 2.)	0	0.1	1.0	dB
$C_{ACC(-20)}$			− 5.0	− 2.0	0	dB
C_{IKLR}	Killer operating input	Input sine wave of 0dB to pin ⑲, decrease input amplitude until voltage at pin ⑤ becomes $2.9V_{DC}$ or more, and measureinput amplitude. Then calculate ratio of measured amplitude to that for 0dB input. (See Note 1.)	− 55	− 45	− 35	dB
D_{KLR}	Killer color residual	Input sine wave of 0dB to pin ⑲, and measure output amplitude at pin ⑭ when voltages at pins ⑰ and ⑱ are $1V_{DC}$ and $1.5V_{DC}$, respectively. (See Note 4.)	0	10	25	mV_{P-P}
$C_{SAT(4)}$	Color saturation control characteristics	Input sine wave of 0dB to pin ⑲, and measure output amplitude at pin ⑭ when voltage at pin ⑱ is changed to1.5, 4, 2, 1 and $0.5V_{DC}$ with voltage at pin ⑩ set at $1V_{DC}$. Then calculate ratio of measured amplitude to thatobtained when voltage at pin ⑱ is $1.5V_{DC}$. (See Note 2.)	1.2	2.8	4.8	dB
$C_{SAT(2)}$			0.5	2.3	4.8	dB
$C_{SAT(1)}$			− 6.5	− 4.0	− 0.5	dB
$C_{SAT(0.5)}$			− 17.5	− 12.0	− 8.0	dB
Δf_{VCO}	VCO free run frequency	Input synchronization signal only, measure oscillation frequency at pin ㉔, and calculate difference from 3.579545MHz. (Pin ⑲=No input)	− 950	0	+ 950	Hz
$\Delta f_{VCOpull}$	APC pull-in range	Input sine wave of 0dB to pin ⑲, and change frequency. Measure frequency at which DC voltage ⑤ changes from H to L. (See Note 5.)	+ 300	+ 550	+ 900	Hz
			− 700	− 300	− 100	
D_B	B demodulator sensitivity	Input sine wave of 0dB to pin ⑲, and measure output amplitude at pin ⑭ when voltages at pins ⑰ and ⑱ are $1V_{DC}$ and $1.5V_{DC}$, respectively. (See Note 2.)	1.0	1.4	1.8	V_{P-P}

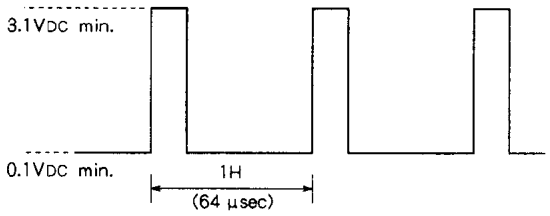
ELECTRICAL CHARACTERISTICS (cont.)

Symbol	Parameter	Test conditions/Method Circled numerals indicate pin numbers	Limits			Unit
			Min.	Typ.	Max.	
R (R/B)	Demodulated output voltage ratio	Input sine wave of 0dB to pin ⑲, measure output amplitude at pin ⑭ when voltages at pins ⑩ and ⑱ are 1VDC and 1.5VDC, respectively, and calculate ratio of measured amplitude to that obtained in test 15. (See Note 2.)	0.5	0.6	0.7	–
R (G/B)			0.28	0.35	0.42	–
DleakB	Demodulated output carrier leak	Input sine wave of 0dB to pin ⑲, and measure output amplitude at pins ⑭, ⑮ and ⑯ for 7.1MHz component whenvoltages at pins ⑩and ⑱ are 1VDC and 1.5VDC, respectively. (See Note 3.)	0	8	20	mVP-P
DleakR			0	8	25	mVP-P
DleakG			0	8	20	mVP-P
VSKLR-H	H voltage at KILLER OUT pin	Input synchronization signal alone, and measureDC voltage at pin ⑤ when pin ④ is connected via 10kΩ to GND(L)and when pin ④ is connectedvia 10kΩ to VCC(H). (Pin ⑲=No input)	3.0	3.3	4.0	VDC
VSKLR-L	L voltage at KILLER OUT pin		0	0.1	0.3	VDC
T	Tint control variation	Input sine wave of 0dB to pin ⑲, and measure phase variation at pin ⑭ when voltage at pin ㉑ is changed from 0 to 4VDC, with voltages at pins ⑩ and ⑱ set at 1VDC and 1.5VDC, respectively.	80	125		deg
Tmin	Tine control characteristics	Input sine wave of 0dB to pin ⑲, and measure phase variation at pin ⑭ when voltage at pin ㉑ is changed from 2 to 0.5VDC and from 2 to 3.5VDC with the voltages at pins ⑩ and ⑱ set at 1VDC and 1.5 VDC, respectively.	– 83	– 57	– 31	deg
Tmax			44	66	90	deg
Y OUTPUT SECTION						
Vcont	Voltage for no signal input	Measure output DC voltage at pin ⑪ whenno signal is input	2.50	2.75	3.00	VDC
Gco	Luminance amplifier gain	Input 100kHz sine wave of 0.1VP-P to pin ⑧, measure output amplitude at pin ⑪, and calculate measured/input amplitude ratio.	11.5	14.0	16.5	dB
Gmax	Maximum output	Input 100kHz sine wave of 0.5VP-P to pin ⑧, and measure output amplitude at pin ⑪.	1.7	2.5		VP-P

ELECTRICAL CHARACTERISTICS TEST METHOD

* Video section..... Unless otherwise specified, measure electrical characteristics with 2VDC at pin ⑨, 0VDC at pin ⑱ and 2VDC at pin ㉑.

Chroma section .. Unless otherwise specified, measure electrical characteristics with 2VDC at pin ⑨, 2VDC at pin ㉑ and 2.85VDC at pin ⑧, and with the following sync signal input to pin ⑬ as shown below.



Note1 Input sine wave signal with a frequency of 3.579545MHz to pin ⑲. Input level of 100 mVP-P is set at 0dB.

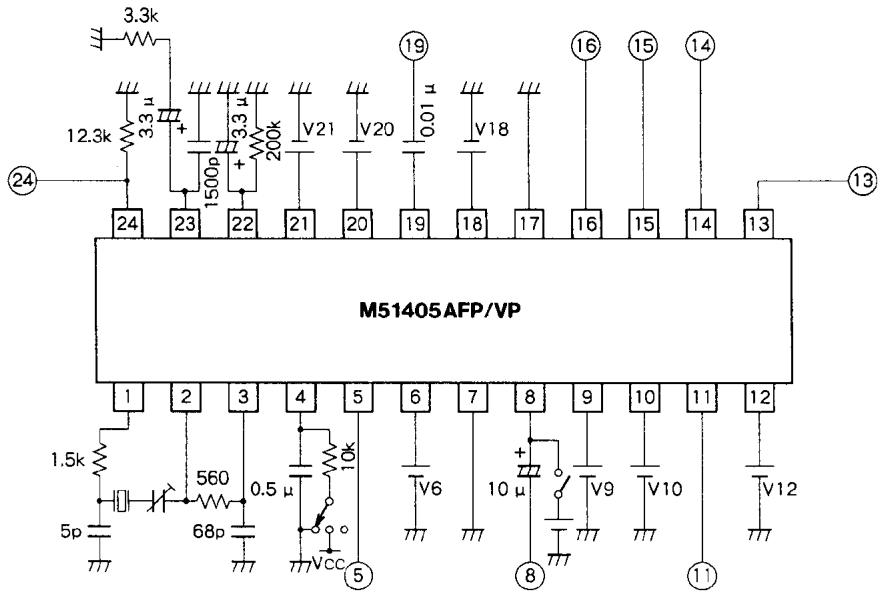
Note2 Same as Note 1. Beat output (input frequency: 3.580545MHz) by VCO is measuach output. Pin ④ is connected via 10kΩ to GND.

Note3 Same as Note 1. Pin ④ is connected via 10kΩ to GND.

Note4 Same as Note 1. Pin ④ is connected via 10kΩ to VCC.

Note5 Same as Note 1. Increase input frequency, and measure frequency at which pin ⑤ DC voltage changes from H (3.2VDC) to L (locked state). Take same measurement after decreasing frequency. Calculate difference between each measured input frequency and free run frequency. When adjusting free run frequency, connect CHROMA INPUT pin ⑲ and POWER SUPPLY 2 pin ⑳ via 0.1µF, and input a signal with no chroma component. Measure an oscillation frequency at pin ㉔. Adjust typical trimmer capacitor of X'tal circuit to set free run frequency at 3.579545MHz; and maintain this frequency during test.

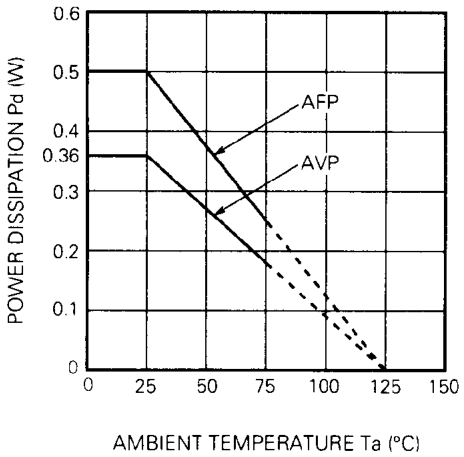
TEST CIRCUIT



Units Resistance: Ω
Capacitance: F

TYPICAL CHARACTERISTICS

THERMAL DERATING (MAXIMUM RATING)



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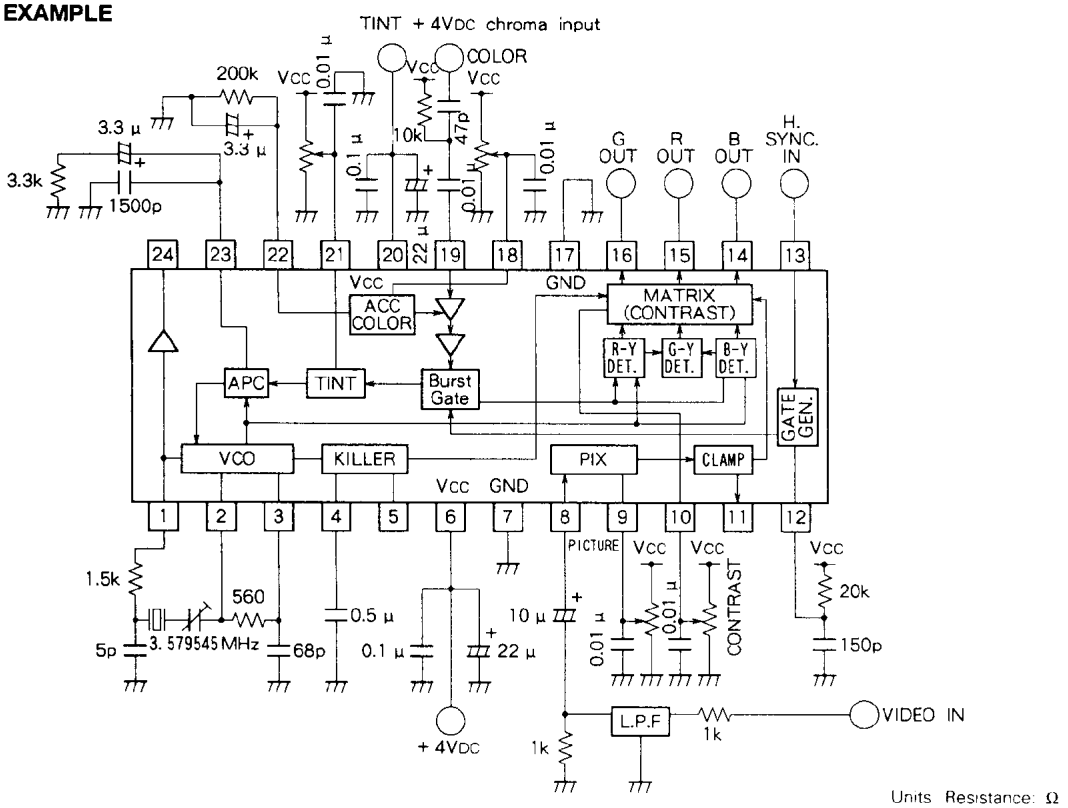
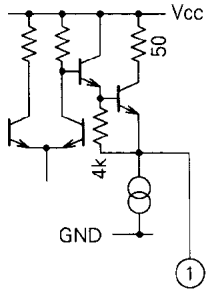
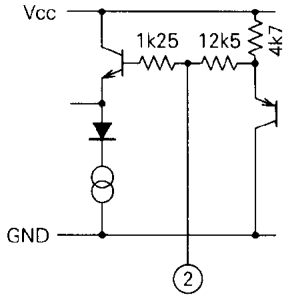
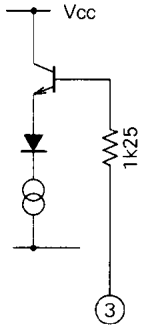
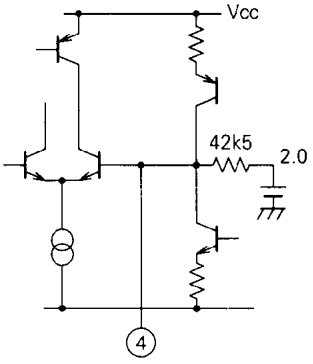
APPLICATION EXAMPLE

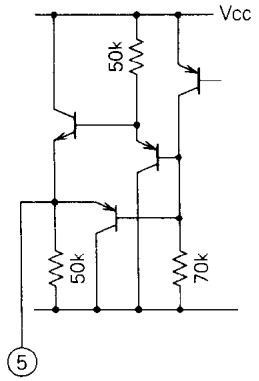
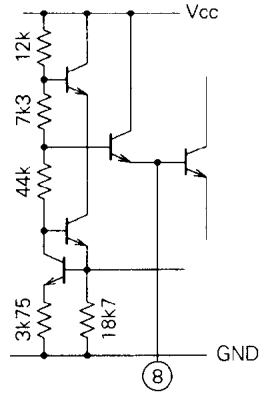
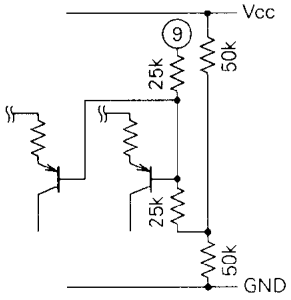
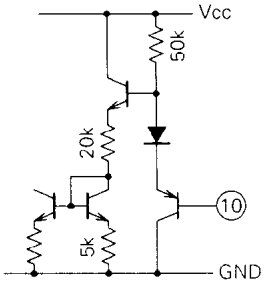


Units Resistance: Ω
Capacitance: F

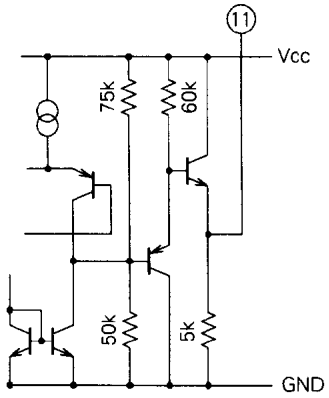
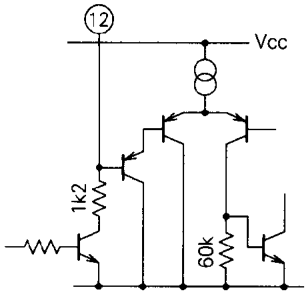
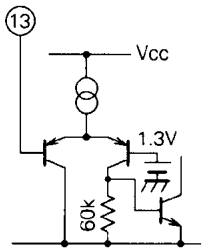
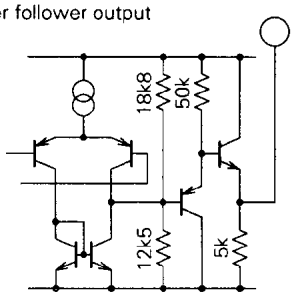
DESCRIPTION OF PIN

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
①	VCXO OUT 1	2.3V Emitter follower output Zo=10Ω	
②	VCXO IN 1	3.3V Zi=17K2	
③	VCXO IN 2	Open base input Zi>100KΩ	
④	KILLER FILTER	3.0V Zi>100KΩ 42K5 with B.G.P. ON	

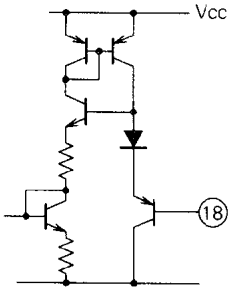
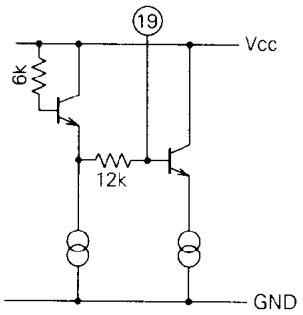
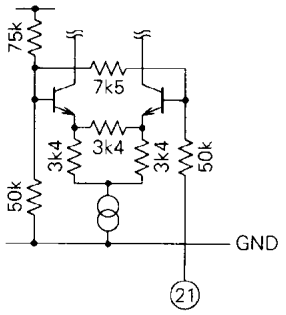
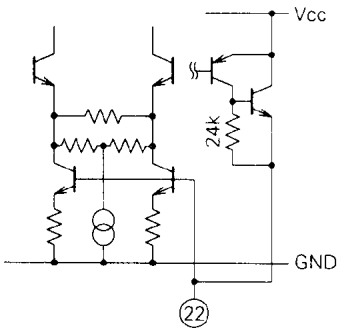
DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
⑤	KILLER OUT	H: 3.3V L: 0.1V Emitter follower output Zo = 300Ω	
⑥	POWER SUPPLY 1	4.0V	—
⑦	GND 1	0V	—
⑧	VIDEO IN	Sync tip 2.5V Sync tip clamping input Low Zi<100Ω at clamping	
⑨	PICTURE CONT	2.5V Zi=75K	
⑩	CONTRAST CONT	Open base input Zi>100KΩ	

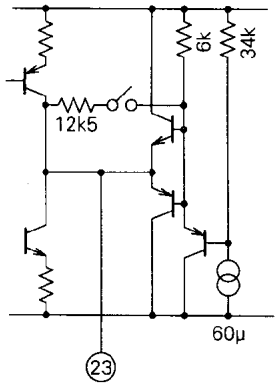
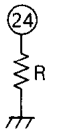
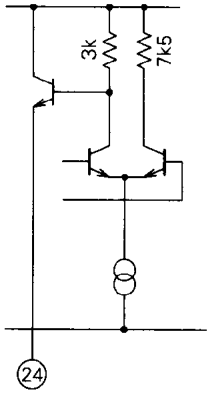
DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
⑪	VIDEO OUT	2.5~0V Emitter follower output Approx. Zo≈60Ω	
⑫	BURST GATE TIME CONSTANT	Zi>100kΩ	
⑬	H. SYNC IN	Same as above	
⑭	B OUT	2.2~0V Zo≈100Ω	Emitter follower output 
⑮	R OUT		
⑯	G OUT		
⑰	GND 2	0V	——
⑳	POWER SUPPLY 2	4.0V	——

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
⑱	COLOR CONT	Zi>100kΩ	
⑲	CHROMA IN	3.3V Zi=12kΩ	
㉑	TINT CONT	1.6V Zi=87K5	
㉒	ACC FILTER	0.9V Hi Zi	

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
㉓	APC FILTER	2.6V *Zi=12K5 with B. G. P. "ON" *Zi>100kΩ with B. G. P. "OFF"	
㉔	VCXO OUT 2	3.2V  Zo=26Ω when R=3K2	

PRECAUTIONS FOR APPLICATION

1) Adjust the trimmer capacitor to set VCO free-run frequency at 3.579545MHz.
2) Pin ㉔ outputs VCO signal through the open emitter. Use this pin to measure a VCO oscillation frequency.
3) The burst gate width varies with a time constant at pin ⑫. Set a resistance at 20kΩ or higher.
4) A sync tip-clamped luminance signal is output to pin ⑪ in inverted phase through the emitter follower. At standard input, the amplitude is approx. 1.5V_{P-P}.
5) R, G and B output clamping voltages vary, depending on contrast voltage. No signals other than color burst components of the chroma signal are blanked.