

# 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.

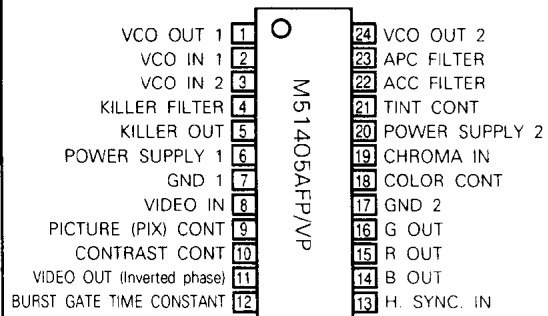
### FEATURES

- 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

### PIN CONFIGURATION (TOP VIEW)

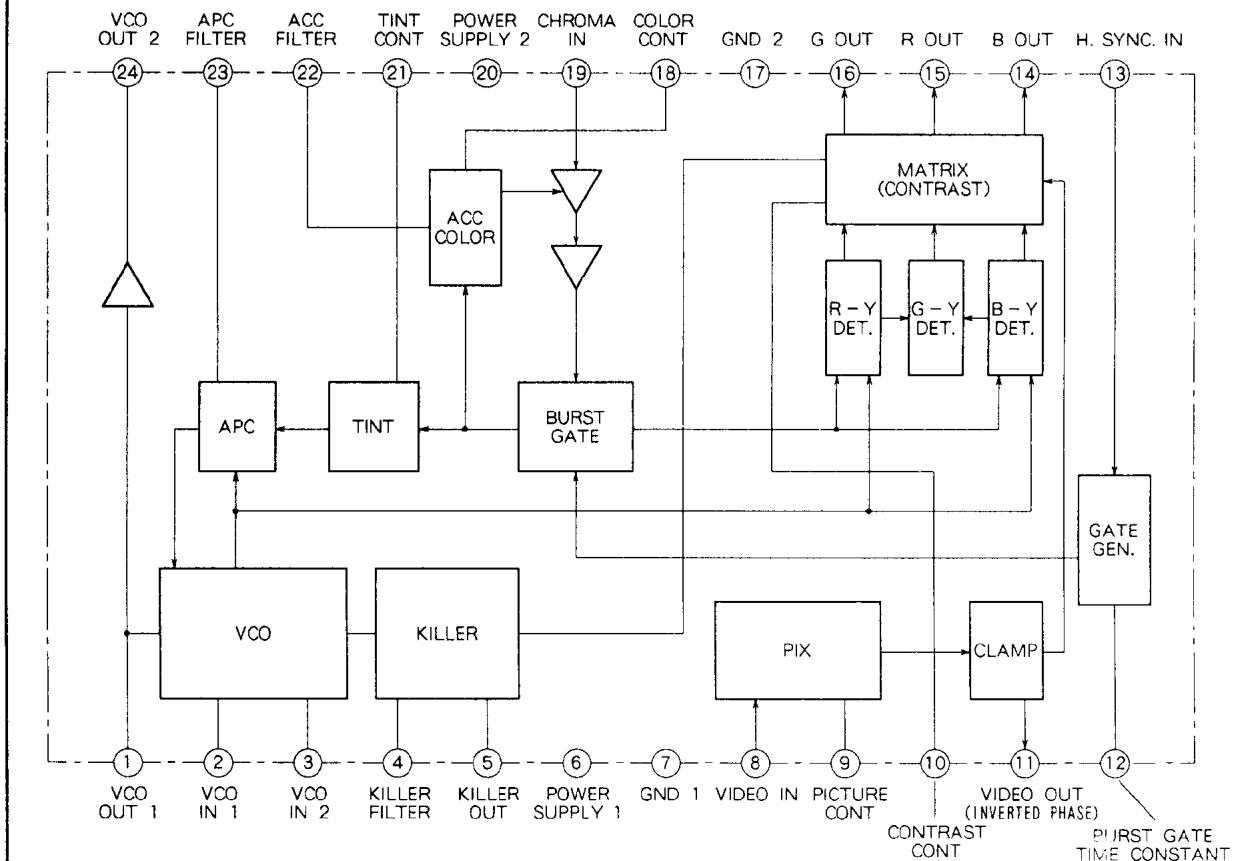


Outline 24P2W-D (AFP)  
24P2E-A (AVP)

### RECOMMENDED OPERATING CONDITION

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

### BLOCK DIAGRAM



## NTSC VIDEO CHROMA SIGNAL PROCESSOR

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rated	Unit
V <sub>CC</sub>	Supply voltage	4.8	V
V <sub>IN2</sub>	Input amplitude at pin ②	500	mV <sub>P-P</sub>
I <sub>OUT5</sub>	Output current at pin ⑤	800	mA
I <sub>OUT11</sub>	Output current at pin ⑪	900	mA
V <sub>IN13</sub>	Input voltage at pin ⑬	V <sub>CC</sub> + 0.3	V
I <sub>OUT<sup>14</sup><sub>15</sub><sub>16</sub></sub>	Output current at pins ⑭, ⑮ and ⑯	900	mA
I <sub>OUT24</sub>	Output current at pin ⑳	450	mA
P <sub>d</sub>	Power dissipation	500(AFP) 360(AVP)	mW
T <sub>opr</sub>	Operating temperature	-20~75	°C
T <sub>stg</sub>	Storage temperature	-40~125	°C

ELECTRICAL CHARACTERISTICS (T<sub>a</sub> = 25°C, V<sub>CC</sub> = 4.0V, unless otherwise noted)

Symbol	Parameter	Test conditions/Method Circled numerals indicate pin numbers	Limits			Unit
			Min.	Typ.	Max.	
I <sub>CC</sub>	Circuit current	Measure input current with 4V <sub>CC</sub> applied to pins ⑥ and ⑳.	8.0	13.0	17.0	mA
VIDEO SECTION *						
Y <sub>max</sub>	Maximum output	Input 100kHz sine wave of 0.3V <sub>P-P</sub> to pin ⑧, and measure output amplitude at pin ⑭ with 4V <sub>CC</sub> at pin ⑩.	1.8	2.2		V <sub>P-P</sub>
GY	Video amplifier gain	Input 100kHz sine wave of 0.3V <sub>P-P</sub> to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑩ is 2V <sub>CC</sub> , and calculate output/input amplitude ratio.	10.5	13.0	15.0	dB
Y <sub>CTRST(2)</sub>	Contrast control characteristics	Input 100kHz sine wave of 0.3V <sub>P-P</sub> to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑩ is changed to 2, 0.5 and 0V <sub>CC</sub> , and calculate ratio of measured amplitude to that in GY.	1.0	3.4	5.8	dB
Y <sub>CTRST(0.5)</sub>			-12.0	-5.5	0	dB
Y <sub>CTRST(0)</sub>				-23	-20	dB
Y <sub>TONE(4)</sub>	Picture quality control characteristics	Input 1.5MHz sine wave of 0.3V <sub>P-P</sub> to pin ⑧, measure output amplitude at pin ⑭ when voltage at pin ⑩ is changed to 2, 4 and 0V <sub>CC</sub> with voltage at pin ⑩ set at 1V <sub>CC</sub> , and calculate ratio of measured amplitude to that obtained with pin ⑩ voltage at 2V <sub>CC</sub> .	-4.0	-2.7	-1.5	dB
Y <sub>TONE(0)</sub>			3.0	6.3	10.0	dB
Y <sub>FREQ</sub>	Frequency characteristics	Input 100kHz and 2MHz sine waves of 0.3V <sub>P-P</sub> in sequence to pin ⑧, and measure output amplitude at pin ⑭ for each input with voltages at pins ⑩ and ⑰ set at 2V <sub>CC</sub> and 1V <sub>CC</sub> , respectively. Then calculate output amplitude ratio for 2MHz/100kHz input.	-9.5	-6.5	-4.5	dB
CHROMA SECTION *						
C <sub>max</sub>	Maximum output	Input sine wave of 0dB to pin ⑧, and measure output amplitude at pin ⑭ when voltage at pins ⑩ and ⑰ is 4V <sub>CC</sub> . (See Note 2.)	2.0	2.4	3.0	V <sub>P-P</sub>
G <sub>c</sub>	Chroma maximum gain	Input sine wave of -26dB to pin ⑧, and measure output amplitude at pin ⑭ when voltage at pins ⑩ and ⑰ is 4V <sub>CC</sub> . (See Note 2.)	45	51	57	dB
C <sub>ACC(+6)</sub>	ACC control characteristics	Input sine waves of 0, +6 and -20dB in sequence to pin ⑧, and measure output amplitude at pin ⑭ for each input with voltages at pins ⑩ and ⑰ set at 1V <sub>CC</sub> and 1.5V <sub>CC</sub> , respectively. Then calculate ratio of measured amplitude to that for 0dB input. (See Note 2.)	0	0.1	1.0	dB
C <sub>ACC(-20)</sub>			-5.0	-2.0	0	dB
C <sub>IKLR</sub>	Killer operating input	Input sine wave of 0dB to pin ⑧, decrease input amplitude until voltage at pin ⑤ becomes 2.9V <sub>CC</sub> or more, and measure input amplitude. Then calculate ratio of measured amplitude to that for 0dB input. (See Note 1.)	-55	-45	-35	dB
D <sub>KLR</sub>	Killer color residual	Input sine wave of 0dB to pin ⑧, and measure output amplitude at pin ⑭ when voltages at pins ⑩ and ⑰ are 1V <sub>CC</sub> and 1.5V <sub>CC</sub> , respectively. (See Note 4.)	0	10	25	mV <sub>P-P</sub>
C <sub>SAT(4)</sub>	Color saturation control characteristics	Input sine wave of 0dB to pin ⑧, and measure output amplitude at pin ⑭ when voltage at pin ⑩ is changed to 1.5, 4, 2, 1 and 0.5V <sub>CC</sub> with voltage at pin ⑰ set at 1V <sub>CC</sub> . Then calculate ratio of measured amplitude to that obtained when voltage at pin ⑩ is 1.5V <sub>CC</sub> . (See Note 2.)	1.2	2.8	4.8	dB
C <sub>SAT(2)</sub>			0.5	2.3	4.8	dB
C <sub>SAT(1)</sub>			-6.5	-4.0	-0.5	dB
C <sub>SAT(0.5)</sub>			-17.5	-12.0	-8.0	dB
Δf <sub>vco</sub>	VCO free run frequency	Input synchronization signal only, measure oscillation frequency at pin ⑫, and calculate difference from 3.579545MHz. (Pin ⑨=No input)	-950	0	+950	Hz
Δf <sub>vco pull</sub>	APC pull-in range	Input sine wave of 0dB to pin ⑧, and change frequency. Measure frequency at which DC voltage ⑤ changes from H to L. (See Note 5.)	+300 -700	+550 -300	+900 -100	Hz
DB	B demodulator sensitivity	Input sine wave of 0dB to pin ⑧, and measure output amplitude at pin ⑭ when voltages at pins ⑩ and ⑰ are 1V <sub>CC</sub> and 1.5V <sub>CC</sub> , respectively. (See Note 2.)	1.0	1.4	1.8	V <sub>P-P</sub>

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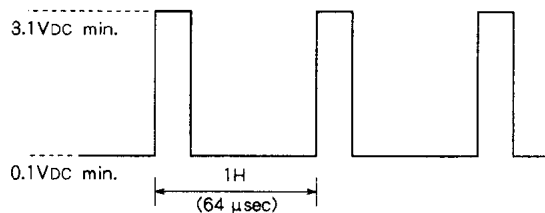
## ELECTRICAL CHARACTERISTICS (cont.)

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 ⑨, measure output amplitude at pin ⑩ when voltages at pins ⑪ and ⑫ are 1V <sub>DC</sub> and 1.5V <sub>DC</sub> , 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	—	
D <sub>leakB</sub>	Demodulated output carrier leak	Input sine wave of 0dB to pin ⑨, and measure output amplitude at pins ⑩, ⑪ and ⑫ for 7.1MHz component when voltages at pins ⑪ and ⑫ are 1V <sub>DC</sub> and 1.5V <sub>DC</sub> , respectively. (See Note 3.)	0	8	20	mV <sub>P-P</sub>
D <sub>leakR</sub>			0	8	25	mV <sub>P-P</sub>
D <sub>leakG</sub>			0	8	20	mV <sub>P-P</sub>
V <sub>SKLR-H</sub>	H voltage at KILLER OUT pin	Input synchronization signal alone, and measure DC voltage at pin ⑤ when pin ④ is connected via 10kΩ to GND(L) and when pin ④ is connected via 10kΩ to VCC(H). (Pin ⑨=No input)	3.0	3.3	4.0	V <sub>DC</sub>
V <sub>SKLR-L</sub>	L voltage at KILLER OUT pin		0	0.1	0.3	V <sub>DC</sub>
T	Tint control variation	Input sine wave of 0dB to pin ⑨, and measure phase variation at pin ⑩ when voltage at pin ⑪ is changed from 0 to 4V <sub>DC</sub> , with voltages at pins ⑫ and ⑬ set at 1V <sub>DC</sub> and 1.5V <sub>DC</sub> , respectively.	80	125		deg
T <sub>min</sub>	Tint control characteristics	Input sine wave of 0dB to pin ⑨, and measure phase variation at pin ⑩ when voltage at pin ⑪ is changed from 2 to 0.5V <sub>DC</sub> and from 2 to 3.5V <sub>DC</sub> with the voltages at pins ⑫ and ⑬ set at 1V <sub>DC</sub> and 1.5V <sub>DC</sub> , respectively.	-83	-57	-31	deg
T <sub>max</sub>			44	66	90	deg
Y OUTPUT SECTION						
V <sub>cont</sub>	Voltage for no signal input	Measure output DC voltage at pin ⑩ when no signal is input	2.50	2.75	3.00	V <sub>DC</sub>
G <sub>co</sub>	Luminance amplifier gain	Input 100kHz sine wave of 0.1V <sub>P-P</sub> to pin ⑧, measure output amplitude at pin ⑩, and calculate measured/input amplitude ratio.	11.5	14.0	16.5	dB
G <sub>max</sub>	Maximum output	Input 100kHz sine wave of 0.5V <sub>P-P</sub> to pin ⑧, and measure output amplitude at pin ⑩.	1.7	2.5		V <sub>P-P</sub>

## ELECTRICAL CHARACTERISTICS TEST METHOD

\* Video section..... Unless otherwise specified, measure electrical characteristics with 2V<sub>DC</sub> at pin ⑨, 0V<sub>DC</sub> at pin ⑫ and 2V<sub>DC</sub> at pin ⑪.

Chroma section .. Unless otherwise specified, measure electrical characteristics with 2V<sub>DC</sub> at pin ⑨, 2V<sub>DC</sub> at pin ⑪ and 2.85V<sub>DC</sub> 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 ⑨. Input level of 100 mV<sub>P-P</sub> is set at 0dB.

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

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

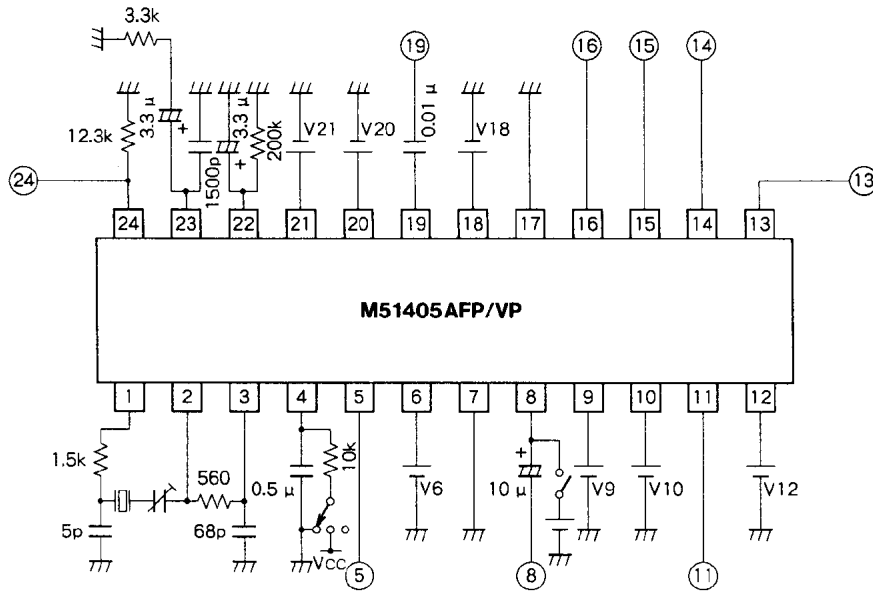
Note4 Same as Note 1. Pin ④ is connected via 10kΩ to V<sub>CC</sub>.

Note5 Same as Note 1. Increase input frequency, and measure frequency at which pin ⑤ DC voltage changes from H (3.2V<sub>DC</sub>) 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 ⑨ and POWER SUPPLY 2 pin ⑫ via 0.1μF, and input a signal with no chroma component. Measure an oscillation frequency at pin ⑫. Adjust typical trimmer capacitor of X'tal circuit to set free run frequency at 3.579545MHz; and maintain this frequency during test.

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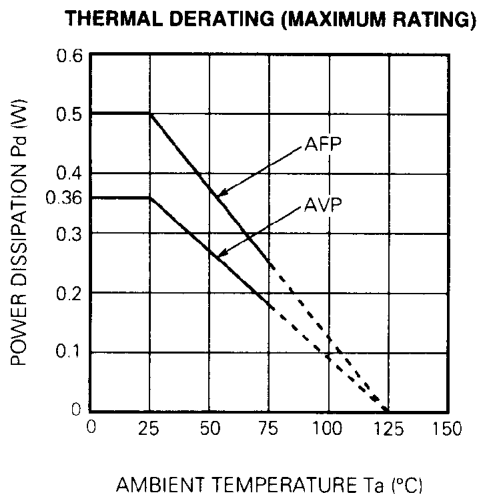
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### TEST CIRCUIT



Units Resistance:  $\Omega$   
Capacitance: F

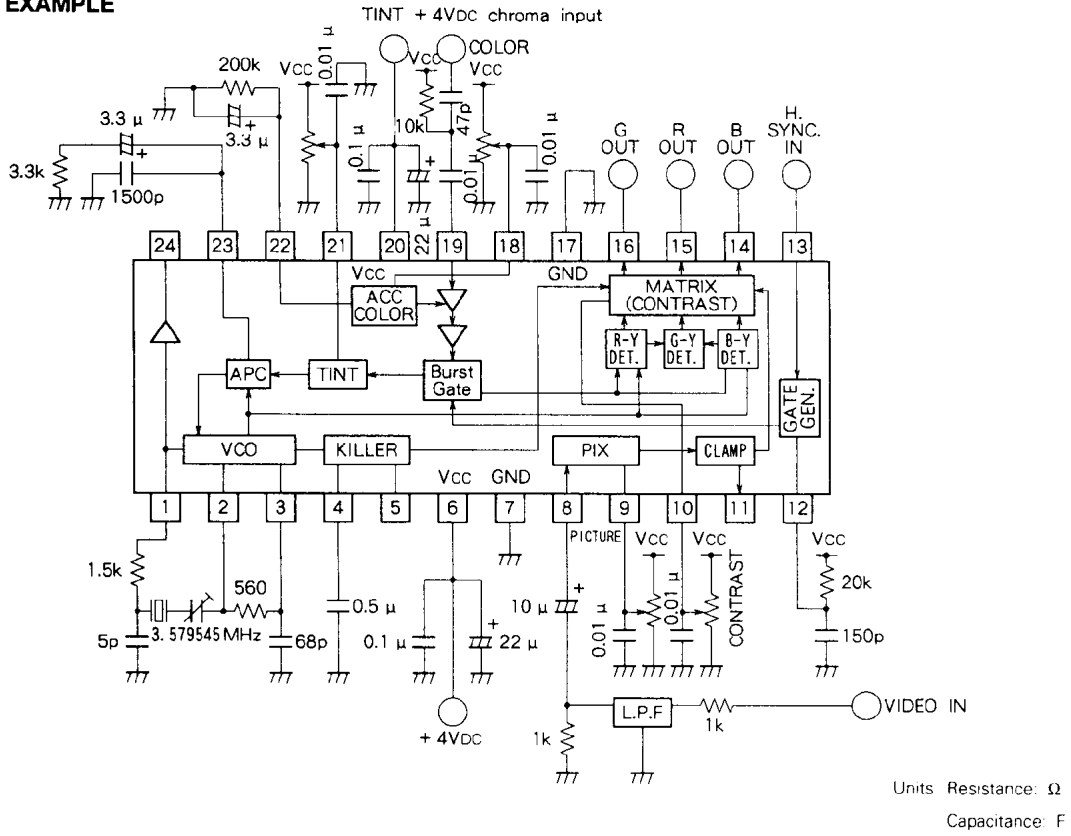
### TYPICAL CHARACTERISTICS



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## NTSC VIDEO CHROMA SIGNAL PROCESSOR

### APPLICATION EXAMPLE



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## NTSC VIDEO CHROMA SIGNAL PROCESSOR

### DESCRIPTION OF PIN

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
①	VCXO OUT 1	2.3V Emitter follower output $Z_o=10\Omega$	
②	VCXO IN 1	3.3V $Z_i=17K\Omega$	
③	VCXO IN 2	Open base input $Z_i>100K\Omega$	
④	KILLER FILTER	3.0V $Z_i>100K\Omega$ 42K5 with B.G.P. ON	

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## NTSC VIDEO CHROMA SIGNAL PROCESSOR

### 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 $Z_o = 300\Omega$	
⑥	POWER SUPPLY 1	4.0V	—
⑦	GND 1	0V	—
⑧	VIDEO IN	Sync tip 2.5V Sync tip clamping input Low $Z_i < 100\Omega$ at clamping	
⑨	PICTURE CONT	2.5V $Z_i = 75K$	
⑩	CONTRAST CONT	Open base input $Z_i > 100K\Omega$	

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## NTSC VIDEO CHROMA SIGNAL PROCESSOR

### 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. $Z_o = 60\Omega$	
⑫	BURST GATE TIME CONSTANT	$Z_i > 100k\Omega$	
⑬	H. SYNC IN	Same as above	
⑭	B OUT	2.2~0V $Z_o \approx 100\Omega$	<p>Emitter follower output</p>
⑮	R OUT		
⑯	G OUT		
⑰	GND 2	0V	—
⑳	POWER SUPPLY 2	4.0V	—



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DESCRIPTION OF PIN (cont.)

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

DESCRIPTION OF PIN (cont.)

Pin No.	Name	Voltage and wave information	Peripheral circuit of pins
⑳	APC FILTER	2.6V *Z <sub>I</sub> =12K5 with B. G. P. "ON" *Z <sub>I</sub> >100kΩ with B. G. P. "OFF"	
㉑	VCXO OUT 2	3.2V  Z <sub>o</sub> =26Ω when R=3K2	

PRECAUTIONS FOR APPLICATION

- 1) Adjust the trimmer capacitor to set VCO free-run frequency at 3.579545MHz.
- 2) Pin ㉑ 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 ㉒. Set a resistance at 20kΩ or higher.
- 4) A sync tip-clamped luminance signal is output to pin ㉓ in inverted phase through the emitter follower. At standard input, the amplitude is approx. 1.5V<sub>P-P</sub>.
- 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.