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To Replace	Use Sprague Type	To Replace	Use Sprague Type	To Replace	Use Sprague Type	To Replace	Use Sprague Type
NATIONAL SEMI.		NUCLEONIC PRODUCTS		SGS-ATES		TEXAS INSTRUMENTS	
MICRO. DIV.		CO. INC.				Cont.	
CA 3045	ULN2045H	NC7401N	US8881A	TDA 1200	ULN2289A	SN55462JP	UDS3612H
CA 3046	ULN2046A	SFC2046E	ULN2046A	L141T1	ULN2151D	SN55463JP	UDS3613H
CA 3054	ULN2054A	SFC2054EC	ULN2054A	T7401B1	US8881A	SN55464JP	UDS3614H
CA 3086	ULN2086A			SIEMENS		SN55471JP	UDS3611H
DM7401N	US8881A	N V PHILIPS		TBA221	ULN2151D	SN55472JP	UDS3612H
DM7427N	US7427A	TBA221B	ULN2151M	SIGNETICS		SN55473JP	UDS3613H
DM7432N	US7432A	PLESSEY		CORP.		SN55474JP	UDS3614H
DM7437N	US7437A	SEMICONDUCTORS		N5065A	ULN2165A	SN75451BP	UDN3611M
DM7438N	US7438A	SL3045	ULN2046A	N5070B	ULN2124A	SN75452BP	UDN3612M
DS3611N	UDN3611M	SL3046	ULN2046A	N5072A	ULN2114A	SN75453BP	UDN3613M
DS3612N	UDN3612M	SL3086	ULN2086A	N5111A	ULN2111A	SN75454BP	UDN3614M
DS3613N	UDN3613M	SL3145	ULN2045H	N7401A	US8881A	SN75461P	UDN3611M
DS3614N	UDN3614M	PRECISION		N7437A	US7437A	SN75462P	UDN3612M
DS7889N*	UHP482	MONOLITHICS INC.		N7438A	US7438A	SN75463P	UDN3613M
DS8885N*	UHP481	DVR-01	UHP480	N8881A	US8881A	SN75464P	UDN3614M
		SSS741BJ	ULN2151D	NE546A	ULN2137A	SN75471P	UDN3611M
DS8889N*	UHP482	RAYTHEON COMPANY		PA239	ULN2126A	SN75472P	UDN3612M
LM377	ULN2278P			UA741CT	ULN2151D	SN75473P	UDN3613M
LM380	ULN2280B			UA741CV	ULN2151M	SN75474P	UDN3614M
LM384	ULN2281B	SILICON GENERAL INC.		SG741CM	ULN2151M	SN76104N	ULN2120A
LM741CH	ULN2151D	RC741T	ULN2151D	SG741SCM	ULN2151M	SN76105N	ULN2122A
LM741CN	ULN2151M	RCA CORP.		SG741SCT	ULN2151D	SN76111N	ULN2121A
LM746N	ULN2114A	SOLID STATE DIV.		SG3081N	ULN2081A	SN76113N	ULN2128A
LM1304N	ULN2120A	CA758E	ULN2244A	SG3082N	ULN2082A	SN76115N	ULN2110A
LM1304N-01	ULN2120N	CA1310E	ULN2110A	SG3086	ULN2086A	SN76116N	ULN2244A
LM1305N	ULN2122A	CA1398E	ULN2298A	SG3217J	ULN2151D	SN76130N	ULN2126A
LM1305N-01	ULN2122N	CA2111AE	ULN2111A	SG3821J	ULN2045H	SN76177ND	ULN2278P
LM1307N	ULN2128A	CA3014	ULN2113A	SG3821N	ULN2046A	SN76226	ULN2216
LM1307N-01	ULN2128N	CA3045	ULN2045H	SG3822N	ULN2054A	SN76227	ULN2217
LM1310N	ULN2110A	CA3046	ULN2046A	SG3886N	ULN2086A	SN76242N	ULN2124A
LM1800	ULN2244A	CA3047	ULN2047			SN76243AN	ULN2127A
LM1820N	ULN2137A	CA3054	ULN2054A	SOLITRON DEVICES INC.		SN76246N	ULN2114A
LM1841N	ULN2136A	CA3065	ULN2165A	UC4741C	ULN2151D	SN76246N	ULN2228A
LM2111N	ULN2111A	CA3067	ULN2267A	UC4741CE	ULN2151M	SN76267N	ULN2267A
LM2111N-01	ULN2111N	CA3070	ULN2124A	STEWART-WARNER		SN76298N	ULN2298A
LM2113N	ULN2113A	CA3071	ULN2127A	MICROCIRCUITS INC.		SN76564N	ULN2264A
LM2113N-01	ULN2113N	CA3072	ULN2114A	SW7401N	US8881A	SN76635N	ULN2137A
LM3045H	ULN2045H	CA3075	ULN2129A	SW7437N	US7437A	SN76642N	ULN2113A
LM3046N	ULN2046A	CA3081	ULN2081A	SW7438N	US7438A	SN76643N	ULN2111A
LM3054N	ULN2054A	CA3082	ULN2082A	TEXAS INSTRUMENTS		SN76665N	ULN2165A
LM3064N	ULN2264A	CA3083	ULN2083	SN7427N	US7427A	SN76669N	ULN2136A
LM3065N	ULN2165A	CA3086	ULN2086A	SN7437N	US7437A	SN76675N	ULN2129A
LM3065N-01	ULN2165N	CA3089	ULN2289A	SN7438N	US7438A	SN76678P	ULN2209M
LM3067N	ULN2267A	R T C		SN72741L	ULN2151D	SN76688ND	ULN2211P
LM3070N	ULN2124A	TBA221B	ULN2151M	SN72741P	ULN2151M	SN76689N	ULN2289A
LM3071N	ULN2127A	TBA221N	ULN2151D	SN55451BJP	UDS3611H	THOMSON CSF	
LM3075N	ULN2129A	SESCOSEM		SN55452BJP	UDS3612H	SFC2741C	ULN2151D
LM3075N-01	ULN2129N	TBA331	ULN2046	SN55453BJP	UDS3613H	SFC2741DC	ULN2151M
LM3086N	ULN2086A	TBA341	ULN2054	SN55454BJP	UDS3614H	TRANSISTRON	
LM3611N	UDN3611M			SN55461JP	UDS3611H	ELECTRONICS CORP.	
LM3612N	UDN3612M					T2741WV	ULN2151D
LM3613N	UDN3613M						
LM3614N	UDN3614M						
MC1304P	ULN2120A						
MC1305P	ULN2122A						
MC1307P	ULN2128A						
MC1310P	ULN2210A						

*Indicates the Sprague suggested replacement is similar but not an exact pin-for-pin electrical replacement.

Although care has been taken in the preparation of this guide to insure its technical correctness, no responsibility is assumed by the Sprague World Trade Corp. for any consequences of the use of items listed.

Warranty is limited to replacement of defective parts only.

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CA3070, CA3071, CA3072 Types

Television Chroma System

The RCA CA3070, CA3071, and CA3072 are monolithic silicon integrated circuits that constitute a complete chroma system for color television receivers. The CA3070 is a complete subcarrier regeneration system featuring a new concept of phase control applied to the oscillator circuit. The CA3071 is a chroma amplifier system and the CA3072

performs the demodulation function.

The CA3070 utilizes the 16-lead plastic dual-in-line package; the CA3071 and CA3072 are supplied 14-lead plastic dual-in-line packages.

SYSTEM FEATURES

CA3070

- Voltage Controlled Oscillator
- Keyed APC & ACC Detectors
- DC Hue Control
- Shunt Regulator

CA3071

- ACC Controlled Chroma Amplifier
- DC Chroma Gain Control
- Color Killer
- Amplifier Short-Circuit Protection

CA3072

- Synchronous Detector with Color Difference Matrix
- Emitter-Follower Output Amplifiers with Short-Circuit Protection

CA3070 Chroma Signal Processor

The CA3070 is a complete subcarrier regeneration system with automatic phase control applied to the oscillator. An amplified chroma signal from the CA3071 is applied to terminals No. 13 and No. 14, which are the automatic phase control (APC) and the automatic chroma control (ACC) inputs. APC and ACC detection is keyed by the horizontal pulse which also inhibits the oscillator output amplifier during the burst interval.

The ACC system uses a synchronous detector to develop a correction voltage at the differential output terminal Nos. 15 & 16. This control signal is applied to the input terminal Nos. 1 & 14 of the CA3071. The APC system also uses a synchronous detector. The APC error voltage is internally coupled to the 3.58 MHz oscillator at balance; the phase of the signal at terminal No. 13 is in quadrature with the oscillator.

To accomplish phasing requirements, an RC phase shift network is used between the chroma input and terminal Nos. 13 and 14. The feedback loop of the oscillator is from terminal Nos. 7 and 8 back to No. 6. The same oscillator signal is available at terminal Nos. 7 and 8, but the dc output of the APC detector controls the relative signal levels at terminal Nos. 7 or 8. Because the output at terminal No. 8 is shifted in phase compared to the output at terminal No. 7, which is applied directly to the crystal circuit, control of the relative amplitudes at terminal Nos. 7 and 8 alters the phase in the feedback loop, thereby changing the frequency of the crystal oscillator. Balance adjustments of dc offsets are provided to establish an initial no-signal offset control in the ACC output, and a no-signal, on-frequency adjustment through the APC detector-amplifier circuit which controls the oscillator frequency. The oscillator output stage is differentially controlled at terminal Nos. 2 and 3 by the hue control input to terminal No. 1. The hue phase shift is accomplished by the external R, L, and C components that couple the oscillator output to the demodulator input terminals. The CA3070 includes a shunt regulator to establish a 12-volt dc supply.

Maximum Voltage and Current Ratings at $T_A = +25^\circ\text{C}$

Voltage ^A			Current		
Terminal No.	Min. Volts	Max. Volts	Terminal No.	I_I mA	I_O mA
1	0	*	1	20	1
2	0	+16	2	—	—
3	0	+16	3	—	—
4	-5	N2	4	20	1
6	—	—	10	N3	1
7	—	—	11	—	—
8	—	—	12	—	—
10	0	N3	13	20	1
11	0	N1	14	20	1
12	0	N1			
13	0	N1			
14	0	N1			
15	0	+16			
16	0	+16			

^A With respect to terminal No. 5 and with terminal No. 10 connected through 470Ω to +24 V.
N1 Regulated voltage at terminal No. 10.
N2 Controlled by max. input current.
N3 Limited by dissipation.

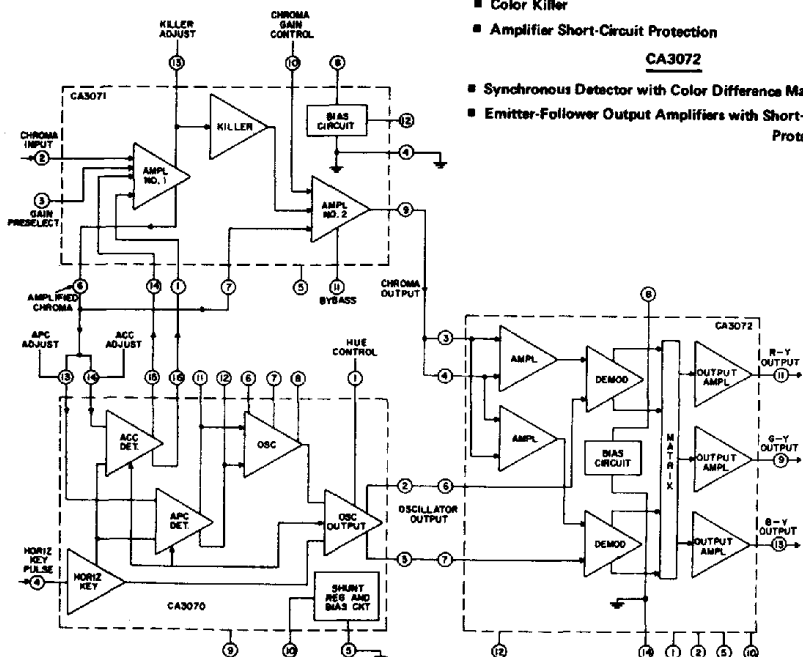


Fig. 1 - Simplified block diagram of TV chroma system.

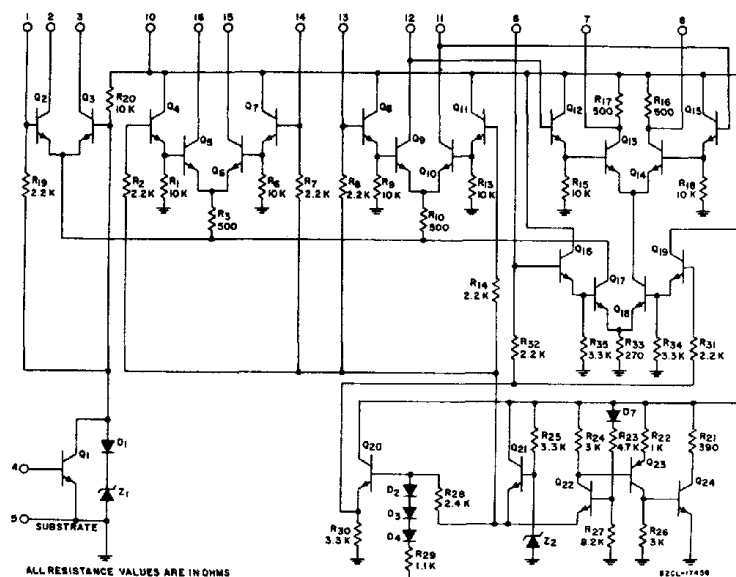


Fig. 2 - Schematic diagram CA3070.

CA3070, CA3071, CA3072 Types

MAXIMUM RATINGS, Absolute Maximum Values at $T_A = 25^\circ\text{C}$

Device Dissipation:
Up to $T_A = +70^\circ\text{C}$ 530 mW
Above $T_A = +70^\circ\text{C}$... Derate Linearly at 6.7 mW/ $^\circ\text{C}$
Ambient Temperature Range:
Operating -40 to $+85^\circ\text{C}$
Storage -65 to $+160^\circ\text{C}$
Lead Temperature (During Soldering):
At distance 1/32 in. (3.17 mm) from seating plane
for 10 s max. $+265^\circ\text{C}$

ELECTRICAL CHARACTERISTICS, at $T_A = 25^\circ\text{C}$ and $V^+ = +24\text{ V}$ unless otherwise specified

CHARACTERISTICS	SYMBOLS	SPECIAL TEST CONDITIONS	LIMITS			UNITS	TEST
			CA3070				CIRCUITS
			MIN.	TYP.	MAX.		FIG.
Static Characteristics							
Voltage:						V	
Hue Control	V ₁	Switch in position 2	6.9	7.7	8.6		3c
Oscillator Input	V ₆		—	2.8	—		3a
APC Input	V ₁₃		—	6.5	—		
Regulator	V ₁₀	V ⁺ = 21 V	11	12.3	13.5		
Regulator Change	V ₁₀	V ⁺ = 27 V	-0.2	—	+0.2		
Horizontal Key Input	V ₄	I ₄ = -10 μA	5	—	—		
Currents:						mA	
Oscillator Output	I ₂		—	5.8	—		3c
APC Output	I ₁₁ , I ₁₂		—	1.45	—		3b
ACC Output	I ₁₅ , I ₁₆		—	1.45	—		
Dynamic Characteristics							
Oscillator Outputs:						V _{p-p}	
Terminal No. 2	V ₂	S ₁ in position 1	0.75	1.0	—		4
Terminal No. 3	V ₃	S ₁ in position 2	0.75	1.0	—		
ACC Detected Output	V ₁₆ -V ₁₅	S ₁ in position 1	115	150	—	mV	4
Oscillator Pull-In Range	—		—	±400	—	Hz	4

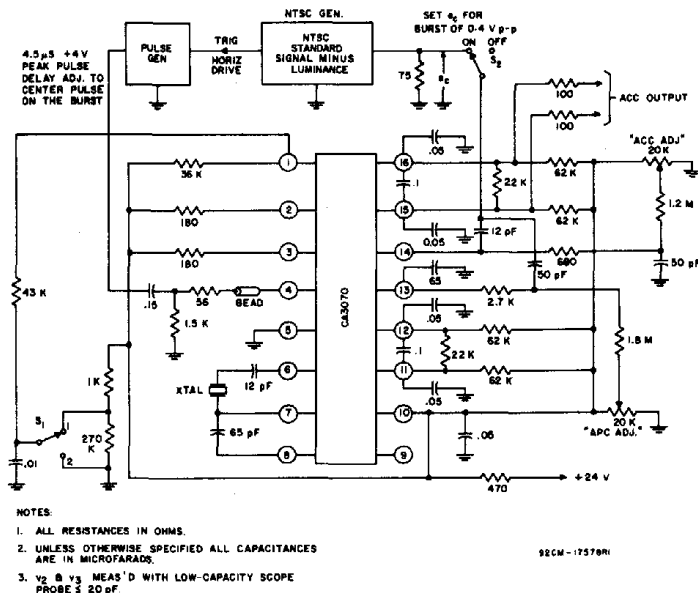


Fig. 4 - CA3070 Dynamic test circuit.

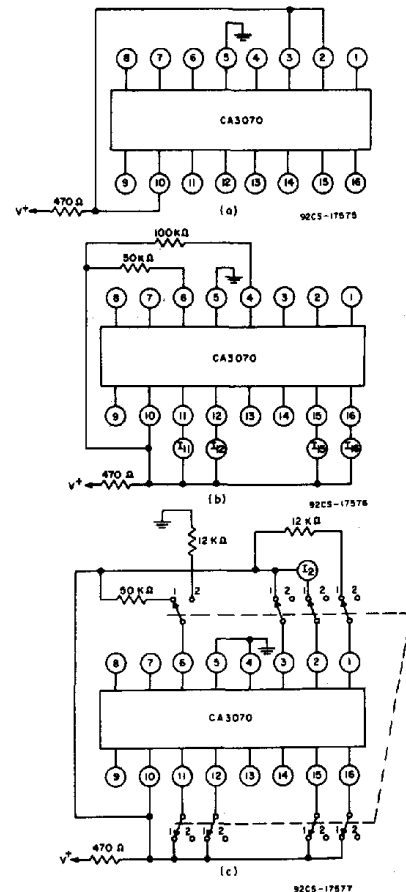


Fig. 3 - Static characteristics test circuits.

Dynamic Test Initial Adjustments

1. APC ADJUST: With S_2 in "OFF" position adjust the "APC ADJ." potentiometer to set oscillator frequency at 3.579545 MHz $\pm 25\text{ Hz}$. With S_1 in position 1 measure frequency at terminal No. 2 output, using crystal probe shown in Fig. 6.

2. ACC ADJUST: With S_2 in "OFF" position adjust "ACC ADJ." potentiometer to give an ACC output reading of $0 \pm 2\text{ mV}$.

Procedure to Pull-In Range Measurement

- Set S_1 in position 1 and connect the crystal probe to terminal No. 2.
- Turn S_2 to "OFF" and set "APC ADJ." arm to ground.
- Turn S_2 to "ON" and gradually adjust "APC ADJ." until oscillator "locks" as witnessed by a sharp increase in ACC output voltage between terminal Nos. 15 and 16.
- Turn S_2 to "OFF" and adjust capacitor C_p of crystal probe for maximum deflection on Ballantine Meter.
- Switch Ballantine meter to "Amplifier" position and read oscillator frequency on counter.
- Repeat steps 2 - 5 with "APC ADJ." arm set to terminal No. 10 instead of to ground.

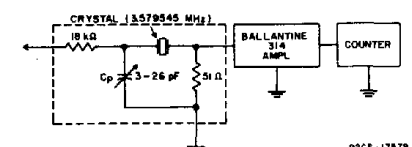


Fig. 5 - Crystal probe for frequency measurements.

CA3070, CA3071, CA3072 Types

CA3071 Chroma Amplifier

The CA3071 is a combined two-stage chroma amplifier and functional control circuit. The input signal is received from the video amplifier and applied to terminal No. 2 of the input amplifier stage. The first amplifier stage is part of the ACC system and is controlled by differential adjustment from the ACC input terminal Nos. 1 and 14. The output of the 1st amplifier is directed to terminal No. 6 from where the signal may be applied to the ACC detection system of the CA3070 or an equivalent circuit. The output at terminal No. 6 is also applied to terminal No. 7 which is the input to the 2nd amplifier stage. Another output of the 1st amplifier at terminal No. 13 is directed to the killer adjustment circuit.

The dc voltage level at terminal No. 13 rises as the ACC differential voltage decreases with a reduction in the burst amplitude. At a pre-set condition determined by the killer adjustment resistor the killer circuit is activated and causes the 2nd chroma amplifier stage to be cut off. The 2nd chroma amplifier stage is also gain controlled by the adjustment of dc voltage at terminal No. 10. The output of the 2nd chroma amplifier stage is available at terminal No. 9. The typical output termination circuit that is shown, provides differential chroma drive signal to the demodulator circuit. Both amplifier outputs utilize emitter-followers with short-circuit protection.

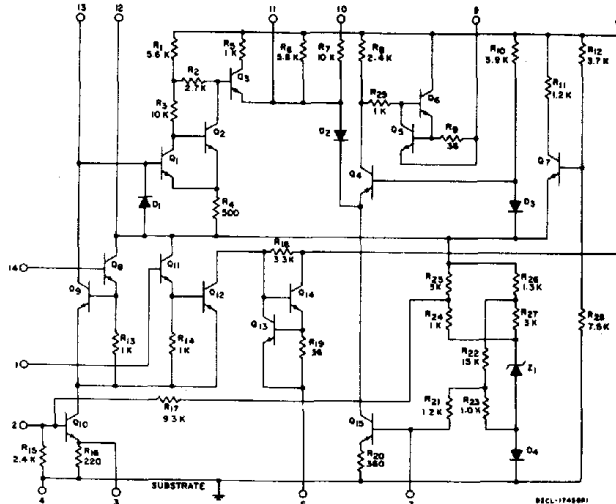


Fig. 6 - Schematic diagram for CA3071.

ELECTRICAL CHARACTERISTICS, at $T_A = 25^\circ\text{C}$

CHARACTERISTICS	SYMBOLS (Measure)	SPECIAL TEST CONDITIONS	LIMITS CA3071			UNITS	CURVES & TEST CIRCUITS FIG.
			MIN	TYP	MAX.		
Static Characteristics							
Bias Reference Terminal	V ₁₂	S ₁ Open, S ₂ Open		17.3	-	V	7
Ampl. No. 1 Chroma Input	V ₂	S ₁ Open, S ₂ Open	-	1.75			
Ampl. No. 1 Chroma Output Balanced	V ₆	S ₁ Open, S ₂ Open	-	20	-		
Unbalanced	V ₆	S ₁ Open, S ₂ Closed	-	13.5	-		
Ampl. No. 2 Chroma Input	V ₇	S ₁ Open, S ₂ Open		1.5	-		
Ampl. No. 2 Chroma Output	V ₉	S ₁ Closed, S ₂ Open	-	20.6	-		
Supply Current	I _T	S ₁ Open, S ₂ Open	17	24.5	31	mA	
Dynamic Characteristics							
Amplifier No. 1 Voltage Gain	A _{V1}	E _g 30 mVRMS Measure v ₆	14			dB	8
Amplifier No. 2 Voltage Gain	A _{V2}	V _g 1.0 V (RMS) Measure v ₇	-	14	-	dB	
Max. Chroma Output Voltage	v _g		-	2	-	VRMS	11
10% Chroma Gain Control Reference Voltage	V _g - V ₁₀	E _g 50 mVRMS; adjust Chroma Gain Control to Change v _g to 10% of Maximum Chroma Output	2.1	3.8	6.8	V	8
Output Voltage, Killer Off	v ₉	S ₁ in Position 2 E _g 50 mVRMS; adjust "Killer Adjust" for an abrupt decrease in V _g			12	mV RMS	
Output Voltage, Chroma Off	v _g	E _g 50 mVRMS; adjust Chroma control to min. Chroma Output			12	mV RMS	
Bandwidth	BW			12	-	MHz	9, 10
Amplifier No. 1				30			
Amplifier No. 2				2	-	k Ω	8
Ampl. No. 1 Input Impedance	r _{i1}			4	-	pF	
	c _{i1}						
Ampl. No. 1 Output Impedance	r _{o1}			85	-	Ω	
Ampl. No. 2 Input Impedance	r _{i2}			2.1	-	k Ω	
	c _{i2}			3.5	-	pF	
Ampl. No. 2 Output Impedance	r _{o2}			85	-	Ω	

MAXIMUM RATINGS, Absolute Maximum-Values at $T_A = 25^\circ\text{C}$

DC Supply Voltage (Terminal 8 to Terminal 4)	30	VDC
Device Dissipation:		
Up to $T_A = +70^\circ\text{C}$	530	mW
Above $T_A = +70^\circ\text{C}$	Derate Linearly at 6.7 mW/ $^\circ\text{C}$	
Ambient Temperature Range:		
Operating	-40 to +85	$^\circ\text{C}$
Storage	-85 to +150	$^\circ\text{C}$
Lead Temperature (During Soldering):		
At distance 1/32 in (3.17 mm) from seating plane for 10 s max.	+265	$^\circ\text{C}$

Maximum Voltage and Current Ratings @ $T_A = +25^\circ\text{C}$

Current			Voltage*		
Terminal No.	I _I mA	I _O mA	Terminal No.	MIN VOLTS	MAX VOLTS
1	5	1.0	1	-5	+15
2	5	1.0	2	-5	+5
3	10	10	3	0	+2
6	1.0	20	6	0	+24
7	5	1.0	7	-5	+5
9	1.0	20	8	0	+30
12	1.0	5	9	0	+24
14	5	1.0	10	0	+24
			11	0	+24
			12	0	+20
			13	0	+20
			14	-5	+15

* With reference to terminal No. 4 and with +24 V on terminal No. 8 except for the rating given for terminal No. 8.

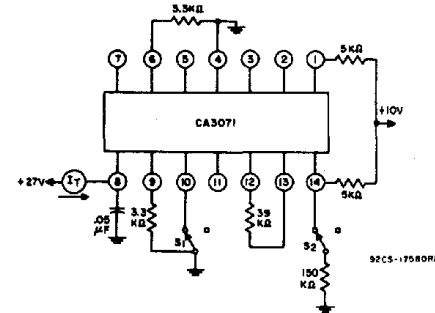
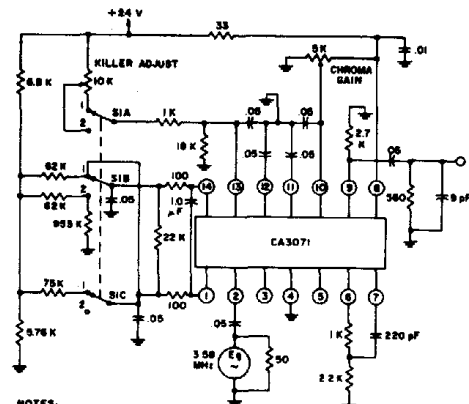


Fig. 7 - Static characteristics test circuit-CA3071.



- NOTES:
- SWITCH S1 IN POSITION 1 UNLESS OTHERWISE NOTED IN TABLE OF DYNAMIC CHARACTERISTICS
 - CHROMA GAIN CONTROL SET TO GROUND UNLESS OTHERWISE NOTED IN TABLE OF DYNAMIC CHARACTERISTICS
 - ALL RESISTANCES IN OHMS
 - ALL CAPACITANCES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED

Fig. 8 - Dynamic characteristics circuit-CA3071.

CA3070, CA3071, CA3072 Types

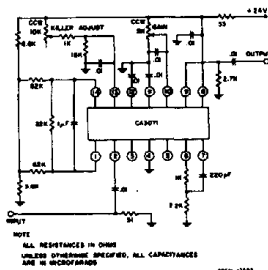


Fig. 9 - CA3071 Wideband amplifier circuit.

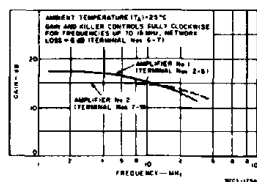


Fig. 10 - Frequency response for wideband amplifier CA3071.

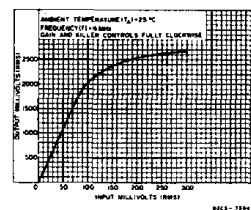


Fig. 11 - Typical CA3071 wideband amplifier linearity

CA3072 Chroma Demodulator

The CA3072 has two sets of synchronous detectors with matrix circuits to achieve the R-Y, G-Y, and B-Y color difference output signals. The chroma input signal is applied to terminal Nos. 3 and 4 while the oscillator injection signal is applied to terminal Nos. 6 and 7. The color difference signals, after matrix, have a fixed relationship of amplitude and phase nominally equal dc voltage levels. The outputs of the CA3072 are suitable for driving high level color difference or R, G, B output amplifiers. Emitter-follower output stages used to drive the high level color amplifiers have short-circuit protection.

MAXIMUM RATINGS, Absolute Maximum-Values at $T_A = 25^\circ\text{C}$

DC Supply Voltage (Terminal 8 to Terminal 14)	27 V
Reference Input Voltage	5 V _{p-p}
Chroma Input Voltage	5 V _{p-p}
Device Dissipation:	
Up to $T_A = +70^\circ\text{C}$	530 mW
Above $T_A = +70^\circ\text{C}$	Derate Linearly at 6.7 mW/ $^\circ\text{C}$
Ambient Temperature Range:	
Operating	-40 to +85 $^\circ\text{C}$
Storage	-65 to +150 $^\circ\text{C}$
Lead Temperature (During Soldering):	
At distance 1/32 in (3.17 mm) from seating plane for 10 s max	+265 $^\circ\text{C}$

Maximum Voltage and Current Ratings

at $T_A = +25^\circ\text{C}$

Voltage*			Current		
Terminal No.	MIN VOLTS	MAX VOLTS	Terminal No.	I_I mA	I_O mA
3	0	+5	3	-	-
4	0	+5	4	-	-
6	0	+12	6	-	-
7	0	+12	7	-	-
8	0	+27	8	-	-
9	0	+20	9	1.0	20
11	0	+20	11	1.0	20
13	0	+20	13	1.0	20

*With reference to terminal No. 14 and with the voltage between terminal No. 8 and terminal No. 14 at +24 V except as given in rating for terminal No. 8.

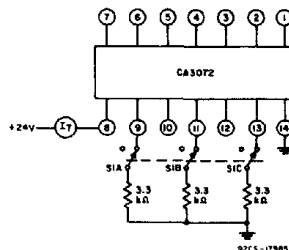


Fig. 13 - Static characteristics test circuit-CA3072.

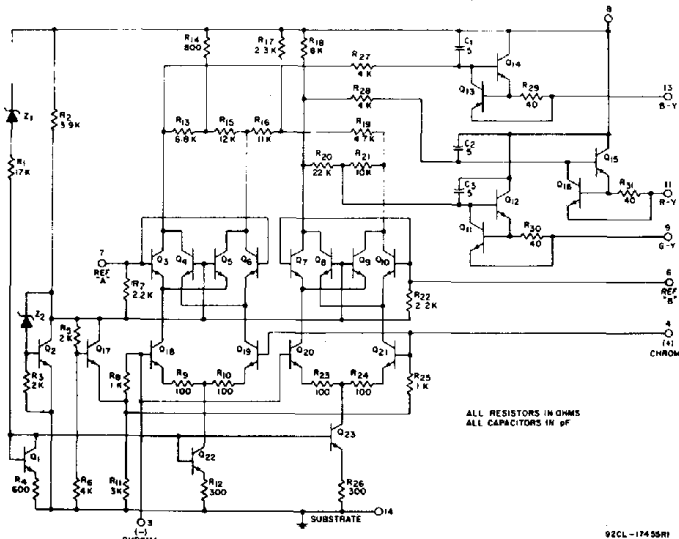


Fig. 12 - Schematic diagram for CA3072.

ELECTRICAL CHARACTERISTICS, at $T_A = 25^\circ\text{C}$ and $V^+ = +24\text{ V}$ unless otherwise specified

CHARACTERISTICS	SYMBOLS	SPECIAL TEST CONDITIONS	LIMITS CA3072			UNITS	TEST CIRCUIT FIG.
			MIN.	TYP.	MAX.		
Static Characteristics							
Supply Current With Output Loads	I_T	S_1 Closed	16.5	—	26.5	mA	13
With No Output Loads		S_1 Open	—	9	—		
G-Y, R-Y, B-Y Outputs	V_9, V_{11}, V_{13}	S_1 Closed	13.2	14.7	15.8	V	
Chroma Inputs	V_3, V_4	S_1 Open	—	3.3	—		
Reference Subcarrier	V_6, V_7	S_1 Open	—	6.2	—		
Dynamic Characteristics							
Demodulator Unbalance	V_9, V_{11}, V_{13}	$V_3 = V_4 = 0$	—	—	0.8	V_{p-p}	14
Maximum Color Difference Output Voltage	V_{13}	$V_3 = V_4 = 0.6 V_{p-p}$	8.0	—	—	V_{p-p}	
	V_{11}		5.5	—	—		
	V_9		1.2	—	—		
Chroma Input Sensitivity	V_3	Adjust e_c for 5.0 V_{p-p} @ term No. 13 (B-Y)	—	0.2	0.35		
Relative R-Y Output	V_{11}		3.5	—	4.2		
Relative G-Y Output	V_9		0.75	—	1.25		
V_{DC} Difference Between any two Output Terminals	$ V_9 - V_{11} $ $ V_9 - V_{13} $ $ V_{11} - V_{13} $	$e_c = 0$	—	—	0.6	V	
Input Impedance Reference Subcarrier Inputs	$r_{i6,7}$		—	1.7	—	k Ω	
	$c_{i6,7}$		—	6	—	pF	
Input Impedance at Chroma Inputs	$r_{i3,4}$		—	0.95	—	k Ω	
	$c_{i3,4}$		—	6	—	pF	
Output Resistance	$r_{o9}, r_{o11},$ r_{o13}		—	180	—	Ω	

CA3070, CA3071, CA3072 Types

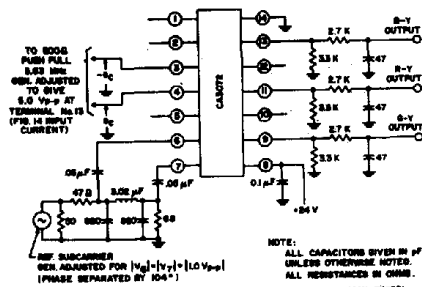


Fig. 14 - Dynamic characteristics test circuit for CA3072.

Application Information

TYPICAL APPLICATION CIRCUIT FOR THE CHROMA SYSTEM

The circuit of Fig. 15 is a complete signal processing system for color TV. The RCA types CA3070, CA3071 and CA3072 monolithic integrated circuits are respectively used as the subcarrier regenerator, chroma amplifier, and chroma demodulator.

The input to the system is the chroma signal which may be taken from the first or second video stage and is coupled into the CA3071 chroma amplifier through a bandpass filter. The outputs from the system are the color difference signals which are intended to drive high level amplifiers. Luminance mixing may be external to the picture tube or, the difference signals may be amplified and applied to the picture tube grid or cathode, where they are internally mixed with the luminance signal.

Other input requirements to the system are the power supply voltage of +24 volts and the horizontal keying pulse. The power supply voltage should be maintained within ± 3 volts of the recommended value of +24 volts. The total current for the system is approximately 70 milliamperes. The horizontal keying pulse input to the subcarrier regenerator is approximately +4 volts peak and centered on the burst as seen at terminal Nos. 13 and 14 of the CA3070. The pulse width should be maintained as close as possible to the recommended value of 4.5 microseconds.

CA3070 Circuit Operation

The CA3070 circuit as shown in Fig. 2, consists of an oscillator, automatic phase control (APC) detector, automatic chroma control (ACC) detector, gated oscillator output amplifier and a shunt regulator. The shunt regulator provides the necessary bias stability for the 3.579545 MHz oscillator, as well as the bias to all functions of the CA3070 circuit. The regulation voltage is nominally +12 volts as measured at terminal No. 10.

The APC and ACC detectors are synchronous detectors which are keyed by the horizontal input pulse. This form of detection eliminates the need for a burst separator as an individual amplifier stage. When a positive pulse is present at terminal No. 4, the oscillator output is cutoff and the oscillator drive signal is diverted to the APC and ACC detectors. Referring to Fig. 2, the APC detector (Q9 & Q10) and the ACC detector (Q5 & Q6) are emitter driven from the

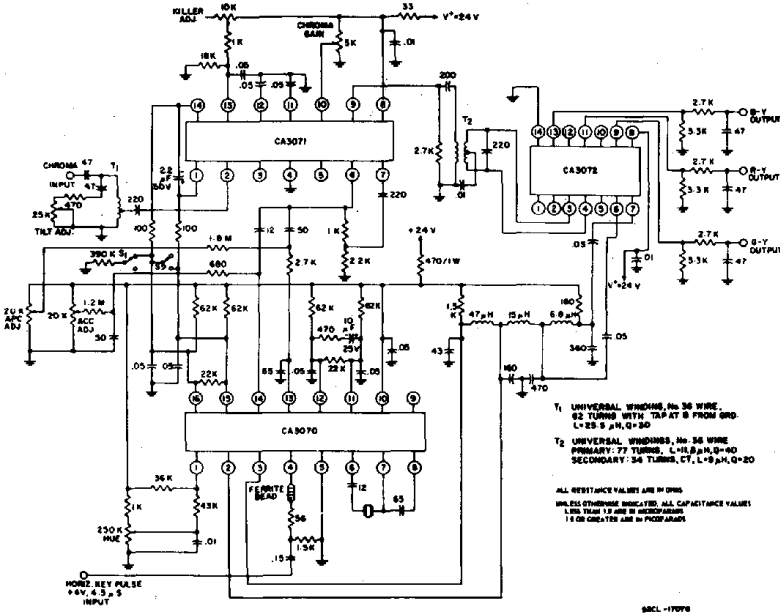


Fig. 15 - Typical chroma system for color-TV receivers utilizing RCA-CA3070, CA3071, and CA3072.

oscillator transistor (Q17), when the oscillator output amplifier transistors (Q2 & Q3) are cutoff. The chroma signal is applied to terminal Nos. 13 and 14. There is oscillator current drive to the APC and ACC detectors during the keying interval; burst separation is effectively accomplished by the gating action of the detectors. A further advantage of the keying action is the high gain made possible as a result of the low average current flow of the APC and ACC detectors. High resistor values of 82 kilohms at the detector output terminals provide proper detector bias consistent with the duty factor of the keying pulse. For a wider keying pulse, it is necessary that smaller values of detector load resistors be used.

In the absence of the keying pulse (line period), the resistor, R20, biases the oscillator's output amplifier transistors (Q2 & Q3) on by keeping their emitters at a higher potential than the base bias voltages of Q5, Q6, Q9, and Q10. The 3.58 MHz signal is now present at terminal Nos. 2 & 3. Photographs of oscilloscope traces for one line period at the terminal Nos. 1, 2, and 3 are shown in Fig. 16. The effect of the keying pulse is shown in Fig. 16a, and the cutoff of the oscillator output amplifier is shown in Fig. 16(b) and 16c.

The oscillator section of the CA3070 consists of the loop formed by Q18 and the emitter driven differential pair, Q13 & Q14. The signal output from terminal Nos. 7 & 8 is coupled through the series tuned crystal circuit back through terminal No. 6 to Q16 & Q17. The collector of Q17 drives the oscillator output amplifier and the APC & ACC detectors. Q17 is emitter coupled to transistor Q18. The oscillator frequency and phase control is accomplished by

the differential drive from the APC detector to transistors Q12 & Q15 which control the balance of Q13 & Q14. The resulting phase of the feedback loop is determined by the relative amplitudes of the oscillator output signal at terminal Nos. 7 and 8. The 65 pF capacitor between terminal No. 7 and 8 provides the phase shifting component as the balance of Q13 and Q14 is varied. In this way the APC detector controls the crystal frequency at which the phase shift is cancelled in the feedback loop.

The controls for the CA3070 subcarrier regenerator circuit are the APC balance, the ACC balance, and the hue control. The hue control is a dc balance adjustment of the oscillator output amplifier transistors Q2 & Q3. A phase delay network between the output terminals Nos. 2 & 3 determines the range of the hue control, which for the value shown in Fig. 15, is approximately 90°.

The ACC adjustment sets the initial balance of the ACC drive to the input of the CA3071 in Fig. 15 (terminal Nos. 1 and 14 of the CA3071). The APC is a frequency adjustment of the oscillator through the balance control of the APC detector.

As a setup adjustment, for both the ACC and APC, switch S1 is opened and S2 is closed. The chroma input to the system is removed and the dc voltage at terminal No. 6 of the CA3071 is noted. The switch S2 is then opened and the ACC adjusted to set the voltage at terminal No. 6 to that previously noted. Alternatively, the differential dc voltage at terminal Nos. 15 & 16 of the CA3070 may be set to 0 mV (± 2 mV) when S1 and S2 are open, and the CA3071 is removed from the circuit.

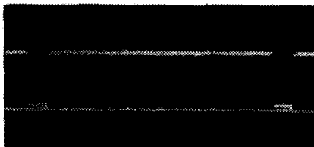


Fig. 16(a) - CA3070 terminal No. 1. 7.5 V oscillator "gate off" pulse.

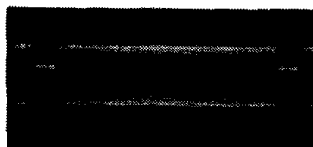


Fig. 16(b) - CA3070 terminal No. 2. 3.5 V_{p-p} oscillator output; one horizontal line, (gated off during burst).

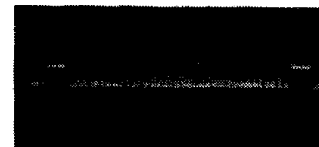


Fig. 16(c) - CA3070 terminal No. 3. 2.0 V_{p-p} oscillator output; one horizontal line, (gated off during burst).

CA3070, CA3071, CA3072 Types

With the chroma signal still removed, the APC adjustment sets the frequency of the oscillator to 3.579545 MHz. Due to the gated off interval, a counter will not accurately record the frequency at the oscillator output amplifier terminals. Two simple and accurate methods are as follows: (1) a buffered crystal filter circuit, connected to the oscillator output amplifier terminals will continue to ring and fill the gated off window providing the proper interface to a counter; (2) the other method involves monitoring the demodulated output at the color difference output terminals of the CA3072. A zero beat signal, at the color difference outputs may be seen on an oscilloscope.

When these adjustments are made, similar oscilloscope traces should be seen as shown in Fig. 17.

CA3071 CIRCUIT OPERATION

The CA3071 is the basic amplifier and control circuit of the chroma system. It contains the gain control functions of the ACC loop, the color killer, and the dc chroma gain control. The CA3071 is a wide band amplifier having two stages of voltage gain. Curves of frequency-response and linearity are shown in Figs. 10 & 11 for the wideband circuits shown in Fig. 9. This is the same basic amplifier as the one in the system shown in Fig. 15 except for the omission of the tuned circuits and the ACC loop connection. The amplifiers have bandwidths of greater than 10 MHz, and are usable well beyond 30 MHz. The signal swing of the wide band amplifier is in excess of 5 V_{p-p}, even with the typical load coupling as shown in Fig. 15. Fig. 18 (a, b and c) show the oscilloscope traces for an NTSC signal at the chroma input. The overall frequency-response curves are shown in Fig. 19.

CA3071 operation is as follows (Refer to Figs. 6 & 15). The input chroma signal is applied to terminal No. 2. This signal is amplified in a cascode differential circuit from Q₁₀ to Q₁₂ and the output is an emitter follower, Q₁₄ (Terminal No. 6.) The signal is divided in the Q₉ & Q₁₂ differential amplifier, depending on the applied ACC error signal amplitude at terminal Nos. 1 & 14. The ACC error signal is derived from terminal Nos. 15 & 16 of the CA3070 and after filtering, is applied to terminal Nos. 1 & 14 of the CA3071.

At low signal drive, the 390 kilohm resistor at switch S1 (normally closed) unbalances the differential amplifier for high signal gain through Q₁₂. As the burst level at the chroma input increases, the ACC drive changes differentially in a positive direction at terminal No. 14 and a negative direction at terminal No. 1 and a negative direction at terminal No. 1. At strong signal levels the gain is reduced by diverting the balance of ac current in the differential amplifier from Q₁₂ to Q₉, which is shunted to ac ground at terminal Nos. 12 and 13. The ACC loop is completed through the chroma signal at terminal No. 6 of the CA3071 to terminal No. 14 (input) of the CA3070. A typical ACC characteristic is shown in Fig. 23.

The chroma signal is buffer connected from terminal No. 6 to terminal No. 7 of the CA3071 and is amplified in the 2nd stage of voltage gain. Both the color killer adjustment and the dc chroma gain control are applied to the 2nd stage to control the chroma output at terminal No. 9. The color killer section of the CA3071 is a Schmitt trigger & amplifier circuit consisting of transistors Q₁, Q₂ and Q₃. Under maximum chroma output conditions, the diode D₂ is reversed biased, and the signal path is through Q₁₅, Q₄ and Q₅ to terminal No. 9. When the color killer circuit is actuated, or the chroma gain control is adjusted to a higher positive voltage at terminal No. 10, the anode voltage of diode D₂ is increased to draw current from the signal path at the emitter of Q₄. This decreases the chroma gain as the potential at terminal No. 10 is increased. When the potential at terminal No. 10 is the same as terminal No. 8, the chroma output at terminal 9 is cutoff.

The color killer circuit provides an abrupt voltage swing at the anode of D₂ to cutoff the chroma output when the Schmitt trigger circuit is forward biased at terminal No. 13. In the circuit of Fig. 18, the color killer adjustment is a resistance divider circuit which establishes the threshold of burst level at which the killer operates the chroma amplifier.

CA3072 CIRCUIT OPERATION

The CA3072 is a chroma demodulator having full color difference signal demodulation capability. The chroma signal is applied to terminal Nos. 3 & 4 and the reference subcarrier signal is applied to terminals Nos. 6 & 7 of the CA3072. The output color difference signals are B-Y at terminal No. 13, R-Y at terminal No. 11, and G-Y at terminal No. 9. The typical level of differential chroma drive required at terminal Nos. 3 & 4 is 400 mV_{p-p}. The amplitude of chroma at terminal No. 6 & 7 is approximately 1.0 volt at 104° relative phase difference which results in a B-Y output amplitude of 5V_{p-p}. The voltages of the R-Y & G-Y outputs are at 3.8 and 1.0 V_{p-p} respectively, when there is 5V_{p-p} output at B-Y. These comparative signals are based upon a complete phase rotation of the chroma relative to the subcarrier signal reference. The relative demodulation phase and amplitude ratios of the Fig. 15 circuit are shown in the oscilloscope trace photographs of Fig. 21. Using the hue control setting for B-Y phase at the B-Y output, the G-Y color-difference signal is approximately -104° and the R-Y color-difference signal is approximately +106°. Since the amplitude ratios are a function of the applied signal phase relationship, the NTSC color difference output signals are shown here primarily for phase reference conditions.

CHROMA SYSTEM CONSTRUCTION

Fig. 25 shows the complete CA3070, CA3071 and CA3072 chroma system in the Fig. 18 circuit. Table I lists the dc terminal voltages for the system. The chroma gain and hue controls, as well as the switches S1 and S2 are removed. The template circuit board layout is also shown for duplication purposes. It should be noted that a few component values are modified in Fig. 18 from the dynamic circuit values of the data sheet. These are necessary for system matching and overall filter requirements.

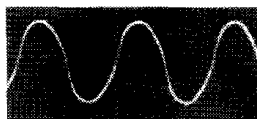


Fig. 17(a) - CA3070 terminal No. 6, oscillator waveform 1.1 V_{p-p} 3.58 MHz.



Fig. 17(b) - CA3070 terminal No. 7, oscillator waveform 1.4 V_{p-p} 3.58 MHz.



Fig. 17(c) - CA3070 terminal No. 8, oscillator waveform 1.6 V_{p-p} 3.58 MHz.

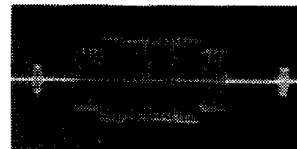


Fig. 18(a) - CA3071 chroma input 1.25 V_{p-p}; one horizontal line of NTSC input signal.

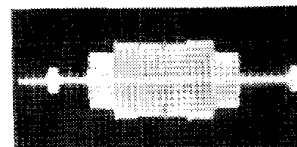


Fig. 18(b) - CA3071 terminal No. 6, amplifier No. 1 chroma output 2.3 V_{p-p}; one horizontal line for 1.25 V_{p-p} chroma input

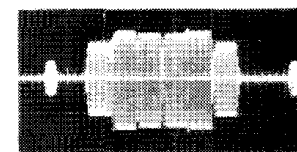


Fig. 18(c) - CA3071 terminal No. 9, amplifier No. 2 chroma output 5.5 V_{p-p}; one horizontal line for 1.25 V_{p-p} chroma input

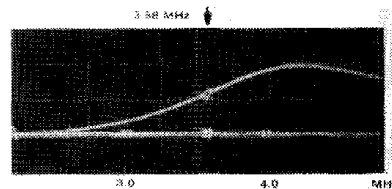


Fig. 19(a) - Frequency response sweep curve between terminal Nos. 2 & 6 for CA3071. $f = 250$ KHz/div.

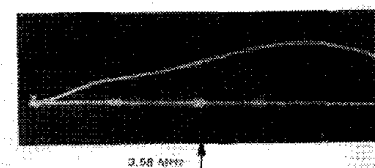


Fig. 19(b) - Frequency response sweep curve between terminal No. 2 of CA3071 and terminal No. 3 of CA3072. $f = 250$ KHz/div.

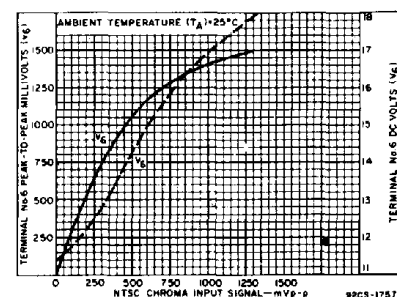


Fig. 20 - Typical ACC characteristics for chroma system of Fig. 18

CA3070, CA3071, CA3072 Types



Fig. 21(a) - CA3072 - terminal No. 3 or 4, chroma input signal, 220 mV_{p-p}, one horizontal line



Fig. 21(b) - CA3072 - terminal No. 6 or 7, reference subcarrier 1.2V_{p-p}, one horizontal line



Fig. 21(c) - CA3072 terminal No. 13, 4.8 V_{p-p} B-Y output, one horizontal line

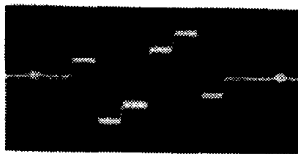


Fig. 21(d) - CA3072 - terminal No. 11, 5.2 V_{p-p} R-Y output, one horizontal line



Fig. 21(e) - CA3072 - terminal No. 9, 1.2 V_{p-p} G-Y output, one horizontal line