



LA70020, 70020M

Recording/Playback Amplifier for VHS VCRs

Overview

The LA70020 and LA70020M are 6-head amplifiers adding hi-fi recording/playback amplifiers to the LA70011/LA70011M recording/playback amplifiers for VHS VCR video signals. When used in combination with the LA71000M and LA71500M Series of video signal processing ICs, they permit Y/C recording without current adjustment.

Features

- Combining hi-fi and video amplifiers onto a single chip saves space on the circuit board.
- Connecting the playback amplifier input directly to the head reduces the number of external elements required.
- The recording amplifiers use a fixed-current drive configuration that yields stable recording characteristics even under changing loads. They include built-in automatic gain control circuits.
- The LA70020, encapsulated in DIP package, can be mounted at the right end of the LA70001 and LA70011 sockets. The LA70020M lacks this flexibility because its MFP package has a different pin pitch.

Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	$V_{CC \text{ max}}$		6.0	V
Maximum power dissipation	$P_d \text{ max}$	$T_a \leq 65^\circ\text{C}$ [LA70020]	1000	mW
		$T_a \leq 65^\circ\text{C}$ [LA70020M]	1000	mW
		114.3 × 76.1 × 1.6 mm: glass epoxy		
Operating temperature	T_{opr}		-10 to +65	$^\circ\text{C}$
Storage temperature	T_{stg}		-40 to +150	$^\circ\text{C}$

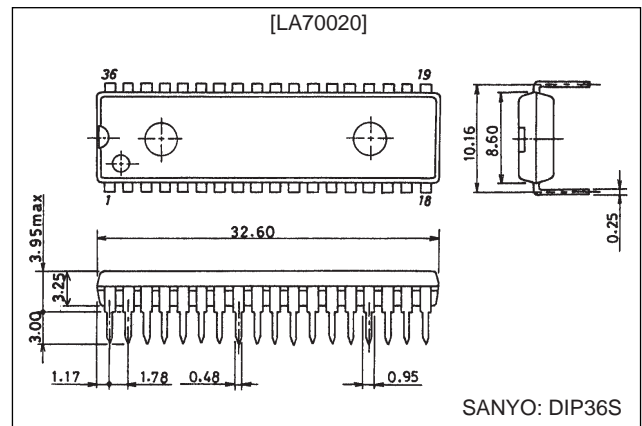
Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		5.0	V
Operating supply voltage range	V_{CCop}		4.8 to 5.3	V

Package Dimensions

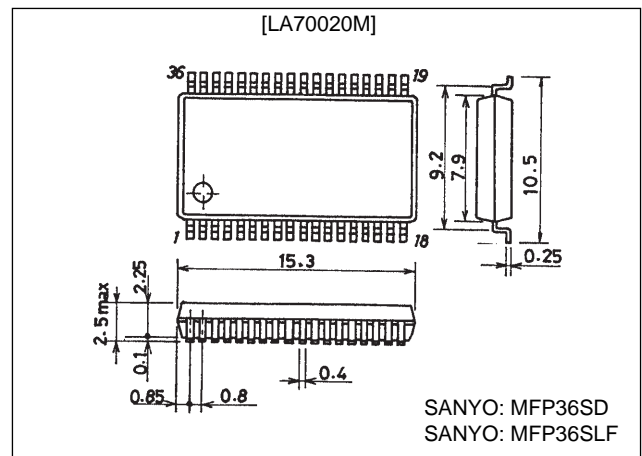
unit: mm

3170-DIP36S 400mil



unit: mm

3129-MFP36SD, MFP36SLF



LA70020, 70020M

Electrical Characteristics at Ta = 25°C (Video Circuits)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Playback Mode						
Current drain	I _{CCP}	Current flowing into pin 13	44	53	60	mA
Voltage gain	SP-L CH1 G _{VP1}	V _{IN} = 38 mVp-p, f = 4 MHz	56	59	62	dB
	SP-H CH2 G _{VP2}		56	59	62	
	EP-L CH3 G _{VP3}		56	59	62	
	EP-H CH4 G _{VP4}		56	59	62	
Voltage gain difference	ΔG _{VP1}	G _{VP1} — G _{VP2}	-1	0	+1	dB
	ΔG _{VP2}	G _{VP3} — G _{VP4}	-1	0	+1	
Intermode gain difference	ΔG _{VP3}	G _{VP3} — G _{VP1}	-1	0	+1	dB
Converted input noise voltage	CH1 V _{NIN1} CH2 V _{NIN2} CH3 V _{NIN3} CH4 V _{NIN4}	Ratio of the output from a 1.1 MHz low pass filter to the output with no input under the same conditions as those used for measuring voltage gain.		1.0	1.5	μVrms
Frequency characteristic	CH1 ΔV _{fp1} CH2 ΔV _{fp2} CH3 ΔV _{fp3} CH4 ΔV _{fp4}	Ratios of the output for V _{IN} = 38 mVp-p and f = 7 MHz to the voltage gains G _{VP1} , G _{VP2} , G _{VP3} , and G _{VP4} .	-2.5	0		dB
Secondary harmonic distortion	CH1 ΔV _{HDP1} CH2 ΔV _{HDP2} CH3 ΔV _{HDP3} CH4 ΔV _{HDP4}	Ratio of the 8 MHz (secondary) component of the output to its 4 MHz (primary) component for V _{IN} = 38 mVp-p and f = 4 MHz.		-40	-35	dB
Maximum output level	CH1 ΔV _{OMP1} CH2 ΔV _{OMP2} CH3 ΔV _{OMP3} CH4 ΔV _{OMP4}	Output level, for f = 1 MHz, at which the ratio of the 3 MHz (tertiary) component to the 1 MHz (primary) component is -30 dB.	1.0	1.2		Vp-p
Crosstalk SP	V _{CR1}	Ratio of the output for V _{IN} = 38 mVp-p and f = 4 MHz to G _{VP1} .		-40	-35	dB
	V _{CR2}	Ratio of the output for V _{IN} = 38 mVp-p and f = 4 MHz to G _{VP2} .		-40	-35	
Crosstalk EP	V _{CR3}	Ratio of the output for V _{IN} = 38 mVp-p and f = 4 MHz to G _{VP3} .		-40	-35	dB
	V _{CR4}	Ratio of the output for V _{IN} = 38 mVp-p and f = 4 MHz to G _{VP4} .		-40	-35	
Output DC offset	ΔV _{ODC1}	CH1 — CH2	-100	0	+100	mV
	ΔV _{ODC2}	CH3 — CH4				
	ΔV _{ODC3}	CH1 — CH3				
	ΔV _{ODC4}	CH2 — CH4				
	ΔV _{ODC5}	CH1 — CH4				
	ΔV _{ODC6}	CH2 — CH3				
Envelope detector output pin voltage	V _{ENV}	T12 DC level with no signal input.	0	0.8	1.4	V
Envelope detector output pin voltage SP	V _{ENVSP1}	T12 DC level at which T13A output level is 150 mVp-p for f = 4 MHz.	2.0	2.5	3.0	V
	V _{ENVSP2}	T12 DC level at which T13A output level is 400 mVp-p for f = 4 MHz.	4.0	4.5	5.0	
Envelope detector output pin voltage EP	V _{ENVEP1}	T12 DC level at which T13A output level is 125 mVp-p for f = 4 MHz.	2.0	2.5	3.0	V
	V _{ENVEP2}	T6 DC level at which T7A output level is 300 mVp-p for f = 4 MHz.	4.0	4.5	5.0	
Comparator output voltage	V _{COMP1}	T8 DC level for V _{IN} = 38 mVp-p and f = 4 MHz.		0.4	0.7	V
	V _{COMP2}	T8 DC level for V _{IN} = 38 mVp-p and f = 4 MHz.	4.5	4.8		
SW-Tr on resistance during playback	R _{PON24} R _{PON29}	DC difference for 1 and 2 mA current inputs.		4	6	Ω
Trick threshold level	TR1-1	Normal → Trick1 : *1	3.2		5.0	V
	TR1-2	Trick1 → Normal	1.2		2.8	
	TR2-1	Normal → Trick2 : *1	0.0		0.8	
	TR2-2	Trick2 → Normal	1.2		2.8	

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LA70020, 70020M

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
HA playback threshold level	HAP-1	SP → EP : *1	1.7		5.0	V
	HAP-2	EPSP	0.0		1.3	V
SW30 threshold level	SW30-1	Lch → Hch : *1	1.2		5.0	V
	SW30-2	Hch → Lch	0.0		0.8	V
Recording Mode						
Current drain	I _{CCR}	Current input at pin 13.	52	59	66	mA
REC AGC AMP output level	V _{RSP}	Output level for V _{IN} = 400 mVp-p and f = 4 MHz.	127	135	143	mVp-p
	V _{REP}		104	111	119	mVp-p
Intermode gain difference	ΔGVR	VRSP/VREP	1.4	1.7	2.0	dB
REC AGC AMP control characteristic	ΔV _{AGC1-SP} ΔV _{AGC1-EP}	Output level divided by V _{RSP} or V _{REP} for f = 4 MHz and V _{IN} = 700 mVp-p.		0.5	1.0	dB
	ΔV _{AGC2-SP} ΔV _{AGC2-EP}	Output level divided by V _{RSP} or V _{REP} for f = 4 MHz and V _{IN} = 100 mVp-p.	-1.0	-0.5		dB
REC AGC AMP frequency characteristic	ΔV _{FRS} ΔV _{FRE}	Ratio of f = 7 MHz output to f = 1 MHz output for V _{IN} = 400 mVp-p. *2	-1	0	+1	dB
REC AGC AMP secondary primary distortion	ΔV _{HDRS} ΔV _{HDRE}	Ratio of the 8 MHz (secondary) component of the output to its 4-MHz (primary) component for V _{IN} = 400 mVp-p and f = 4 MHz.		-45	-40	dB
REC AGC AMP maximum output level	ΔV _{MOSP} ΔV _{MOEP}	Output level, for f = 4 MHz, at which the secondary distortion is -35 dB.	20	22		mApp
REC AGC AMP muting attenuation	ΔV _{MRS} ΔV _{MRE}	Output level divided by V _{RSP} or V _{REP} for f = 4 MHz and V _{IN} = 400 mVp-p.		-45	-40	dB
REC AGC AMP cross modulation relative level	ΔV _{CYS} ΔV _{CYE}	Output ratio (4M +/- 629k)/4M for V _{IN} = 400 mVp-p and f = 4 MHz at T9A and V _{IN} = 2.4 Vp-p and f = 629 kHz at T10A.		-45	-40	dB
HA REC threshold level	HAR-1	SP → EP : *1	1.7		5.0	V
	HAR-2	EP → SP	0.0		1.3	V
REC MUTE threshold level	MUTE-1	MUTE OFF → MUTE ON *1	1.2		2.8	V
	MUTE-2	MUTE ON → MUTE OFF	3.2		5.0	V
REC PB threshold level	PB-REC	PB → REC *1	1.2		5.0	V
	REC-PB	REC → PB	0.0		0.8	V

Notes: * Before measuring the items under Playback Mode, input a 0 to 5.0 V trigger pulse to T11 (H-SYNC), the pin from which the LA70020 takes its T9 (HA) control switch timing.

* The resistance between pins 19 and 20 must be accurate to within 1.0%.

*1. These are voltage application points.

*2. Apply a DC voltage of approximately 1.8 V to the AGC wave detector filter pin (pin 21) to fix the AGC amplifier gain.

*3. Apply a DC voltage to the REC-CUR-Adj pin (pin 18) and adjust the output level.

LA70020, 70020M

Electrical Characteristics at Ta = 25°C (Hi-Fi Circuits)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Playback Mode						
Current drain		H_{ICCP} Current flowing into pin 36	20	25	30	mA
Voltage gain	CH1	H_{GVp1} $V_{IN} = 20$ mVp-p, $f = 1.5$ MHz	72.5	75.5	78.5	dB
	CH2	H_{GVp2}	72.5	75.5	78.5	dB
Voltage gain difference		ΔH_{GVp} $H_{GVp1} - H_{GVp2}$	-2	0	+2	dB
Intermode gain difference		ΔH_{GEP} Voltage gain difference between SP and EP modes. *1	1.7	2.4	3.1	dB
Converted input noise voltage	CH1	H_{VNIN1} H_{VNIN2} Ratio of the output from a 1.1-MHz low pass filter to the output with no input under the same conditions as those used for measuring voltage gain.	0.8		1.2	μ Vrms
	CH2					
Frequency characteristic	CH1 CH2	ΔH_{Vfp1} ΔH_{Vfp2} Ratios of the output for $V_{IN} = 20$ mVp-p and $f = 2$ MHz to the voltage gains H_{GVp1} and H_{GVp2} .	-3	-1		dB
Secondary harmonic distortion	CH1 CH2	ΔH_{VHDP1} ΔH_{VHDP2} Ratio of the 3-MHz (secondary) component of the output to its 1.5-MHz (primary) component for $V_{IN} = 20$ mVp-p and $f = 1.5$ MHz.		-50	-40	dB
Maximum output level	CH1 CH2	ΔH_{VOMP1} ΔH_{VOMP2} Output level, for $f = 1.5$ MHz, at which the ratio of the 4.5 MHz (secondary) component to the 1.5 MHz (primary) component is -30 dB	2			Vp-p
Crosstalk SP		V_{HCR1} Ratio of the output for $V_{IN} = 20$ mVp-p and $f = 1.5$ MHz to H_{GVp1} .		-40	-35	dB
		V_{HCR2} Ratio of the output for $V_{IN} = 20$ mVp-p and $f = 1.5$ MHz to H_{GVp2} .		-40	-35	dB
Crosstalk EP		V_{HCR3} Ratio of the output for $V_{IN} = 20$ mVp-p and $f = 1.5$ MHz to H_{GVp1} .		-40	-35	dB
		V_{HCR4} Ratio of the output for $V_{IN} = 20$ mVp-p and $f = 1.5$ MHz to H_{GVp2} .		-40	-35	dB
Output DC offset SP mode		ΔV_{ODC1} CH1 — CH2	-30	0	+30	mV
Output DC offset EP mode		ΔV_{ODC2} CH1 — CH2	-50	0	+50	mV
HA threshold level		H_{HAP-1} SP → EP : *1	1.7		5.0	V
		H_{HAP-2} EP → SP	0.0		1.3	V
SW30 threshold level		H_{SW30-1} Lch → Hch : *1	1.2		5.0	V
		H_{SW30-2} Hch → Lch	0.0		0.8	V
SW-Tr on resistance during playback		H_{RPO} DC difference for 1 and 2 mA current inputs.		4	6	Ω
Recording Mode						
Current drain		H_{ICCR} Current input at pin 36.	55	65	75	mA
REC AGC AMP output level		H_{VOR} Output level for $V_{IN} = 180$ mVp-p and $f = 1.5$ MHz.	270	280	290	mVp-p
REC AGC AMP control characteristic		ΔH_{VAGC1} Output level divided by H_{VOR} for $f = 1.5$ MHz and $V_{IN} = 360$ mVp-p.		0.2	0.5	dB
		ΔV_{AGC2} Output level divided by H_{VOR} for $f = 1.5$ MHz and $V_{IN} = 90$ mVp-p.	-0.5	-0.2		dB
REC AGC AMP muting attenuation		ΔH_{VMR} Output level divided by H_{VOR} for $f = 4$ MHz and $V_{IN} = 180$ mVp-p.			-40	dB
REC AGC AMP cross modulation relative level for 0.4-MHz component		H_{CMD04} 0.4-MHz component for T3A $V_{IN} = 90$ mVp-p, $f = 1.3$ MHz + $V_{IN} = 270$ mVp-p, $f = 1.7$ MHz.			-40	dB
REC AGC AMP cross modulation relative level for 0.9-MHz component		H_{CMD09} 0.9-MHz component for T3A $V_{IN} = 90$ mVp-p, $f = 1.3$ MHz + $V_{IN} = 270$ mVp-p, $f = 1.7$ MHz.			-40	dB
REC MUTE threshold level		H_{MUTE1} MUTE OFF → MUTE ON *1	1.2		2.8	V
		H_{MUTE2} MUTE ON → MUTE OFF	3.2		5.0	V
REC PB threshold level		PB-REC PB → REC *1	1.2		5.0	V
		REC-PB REC → PB	0.0		0.8	V

Note : These are voltage application points.

LA70020, 70020M

Pin Descriptions

Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes							
1	HiFi PB-FM-OUT	PB	2.6	<p>A09444</p>								
		REC	4.0									
2 31	HiFi GND											
3	HiFi REC-FM-IN	PB	0	<p>A09445</p>								
		REC	3.0									
4	HiFi REC-AGC-Filt	PB	0	<p>A09446</p>								
		REC	1.2									
5	HiFi REC-CURRENT- ADJ	PB	0.7	<p>A09447</p>								
		REC	1.5									
6	HiFi RF-SW (REC-MUTE)			<p>A09448</p>	<p>SW30 MUTE</p> <table border="1"> <tr> <td rowspan="2">Hch</td> <td>ON</td> <td rowspan="2">3.2 V</td> </tr> <tr> <td>OFF</td> </tr> <tr> <td>Lch</td> <td></td> <td></td> </tr> </table> <p>1.0</p>	Hch	ON	3.2 V	OFF	Lch		
Hch	ON	3.2 V										
	OFF											
Lch												

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LA70020, 70020M

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Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes				
7	TRICK-H				<table border="1"> <tr> <td>Trick1</td> <td rowspan="3">3.0 V</td> </tr> <tr> <td>NORMAL</td> </tr> <tr> <td>Trick2</td> </tr> </table>	Trick1	3.0 V	NORMAL	Trick2
Trick1	3.0 V								
NORMAL									
Trick2									
8	COMP-OUT	PB	H: min. 4.5 V L: max. 0.7 V		EP > SP ENV High				
		REC	Open						
9	HA (EP/SP)				<table border="1"> <tr> <td>EP</td> <td rowspan="2">1.0 V</td> </tr> <tr> <td>SP</td> </tr> </table>	EP	1.0 V	SP	
EP	1.0 V								
SP									
10	SW30				<table border="1"> <tr> <td>Hch</td> <td rowspan="2">1.0 V</td> </tr> <tr> <td>Lch</td> </tr> </table>	Hch	1.0 V	Lch	
Hch	1.0 V								
Lch									
11	H-SYNC				<table border="1"> <tr> <td>SYNC H</td> <td rowspan="2">1.5 V</td> </tr> <tr> <td>L</td> </tr> </table>	SYNC H	1.5 V	L	
SYNC H	1.5 V								
L									

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LA70020, 70020M

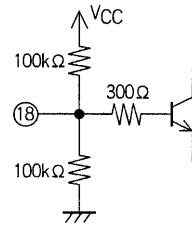
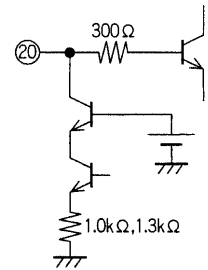
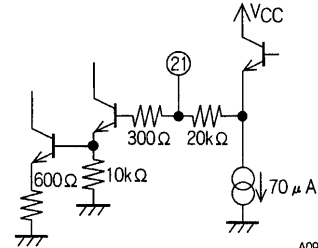
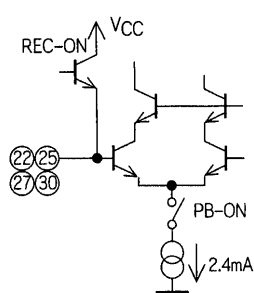
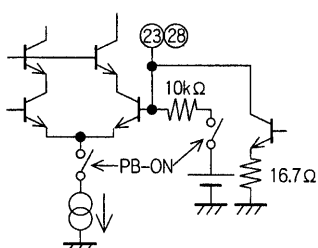
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Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes				
12	ENVDET-OUT	PB	See relevant documents.	<p>A09454</p>					
		REC	0						
13	PB-OUT	PB	1.7	<p>A09455</p>					
		REC	0						
14 26	GND								
15	REC-Y-IN	PB	0	<p>A09456</p>					
		REC	3.7						
16	REC-C-IN	PB	0	<p>A09457</p>					
		REC	3.7						
17	REC/MUTE/PB			<p>A09458</p>	<table border="1"> <tr> <td>REC</td> <td rowspan="3">3.0 V</td> </tr> <tr> <td>REC MUTE</td> </tr> <tr> <td>PB</td> </tr> </table>	REC	3.0 V	REC MUTE	PB
REC	3.0 V								
REC MUTE									
PB									

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LA70020, 70020M

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Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
18	REC-CURRENT-ADJ2	PB	2.5 V		A09459
		REC	2.5 V		
19	VCC				
20	REC-CURRENT-ADJ1	PB	5.0		A09460
		REC	4.5		
21	REC-AGC-FILT	PB	0		A09461
		REC	1.6		
22 25 27 30	SP L-IN SP H-IN EP L-IN EP H-IN	PB	2.1		A09462
		REC	4.1		
23 28	REC SP OUT EP OUT	PB	2.1		A09463
		REC	4.1		

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LA70020, 70020M

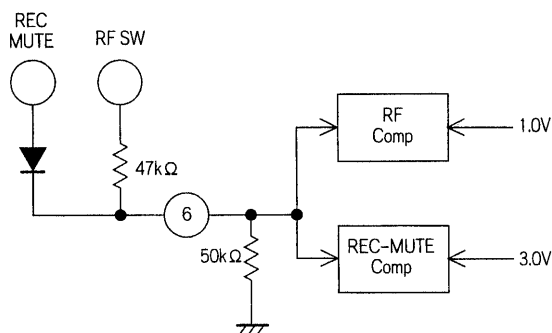
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Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
24 29 34	PB FILT	PB	0	<p style="text-align: right;">A09464</p>	
		REC	2.5		
32 35	HiFi PB-Lch-IN PB-Hch-IN	PB	2.1	<p style="text-align: right;">A09465</p>	
		REC	4.1		
33	HiFi REC-OUT	PB	2.1	<p style="text-align: right;">A09466</p>	
		REC	4.1		
36	HiFi V _{CC}	5.0			

Usage Notes

Control Pin Logic

HiFi RF-SW, REC-MUTE : Pin 6



A09467

During playback

Pin 6 level - DC < 1.0 V: Lch

Pin 6 level - DC > 1.0 V: Hch

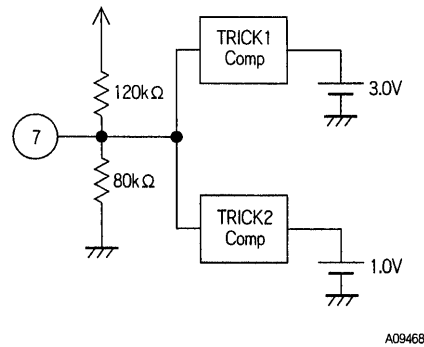
During recording

Pin 6 level - DC < 3.0 V: Mute off

Pin 6 level - DC > 3.0 V: Mute on

LA70020, 70020M

Switching Video Trick Mode with Pin 7



GND < pin 7 level - DC < 1.0 V: TRICK2
 1.0 V < pin 7 level - DC < 3.0 V: NORMAL
 3.0 V < pin 7 level - DC < 5.0 V: TRICK2

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NORMAL Mode

Two channels selected with pin 9 (EP/SP): ON

Envelope comparator: OFF

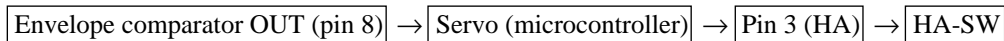
TRICK Modes

All four channels: ON

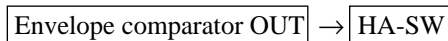
Envelope comparator: OFF

Difference between TRICK1 and TRICK2 modes

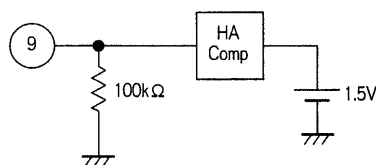
TRICK1 is a special playback mode using the following path



TRICK2 provides SP searching



HA-SW (EP/SP mode switch): Pin 9

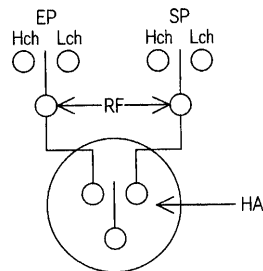


GND < pin 9 level - DC < 1.5 V: SP mode
 1.5 V < pin 9 level - DC < 5 V: EP mode

A09469

Video Synchronization of HA Switching Timing during Playback with H-SYNC Signal

During playback, the LA70020's video circuits synchronize the HA-SW switching timing shown in the following figure with the H-SYNC signal from pin 11. (Other EP/SP switching takes place in real time.)



A09470

The hi-fi playback amplifier's gain is approximately 2.4 dB higher in EP mode than in SP mode.

SP: 75.0 dB

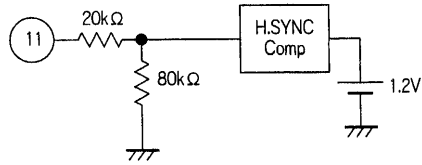
EP: 77.4 dB

LA70020, 70020M

Comparator Output: Pin 8

- EP envelope > SP envelope: High (min. 4.0 V)
- EP envelope < SP envelope: Low (max. 0.7 V)

H-SYNC Input: Pin 11



Pin 11 level - DC > 1.5 V: H-SYNC interval

A09471

Video circuit operation only

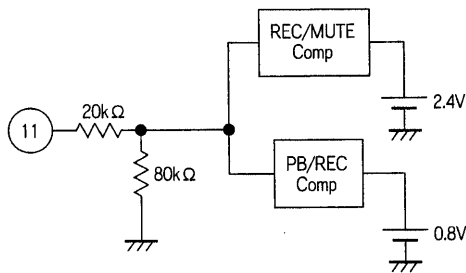
Playback:

- Determines timing of HA switching (EP/SP)
- Determines timing of special playback

Recording:

- Serves as gate pulse for REC-AGC-AMP SYNC unit

REC/REC-MUTE/PB Switching: Pin 17

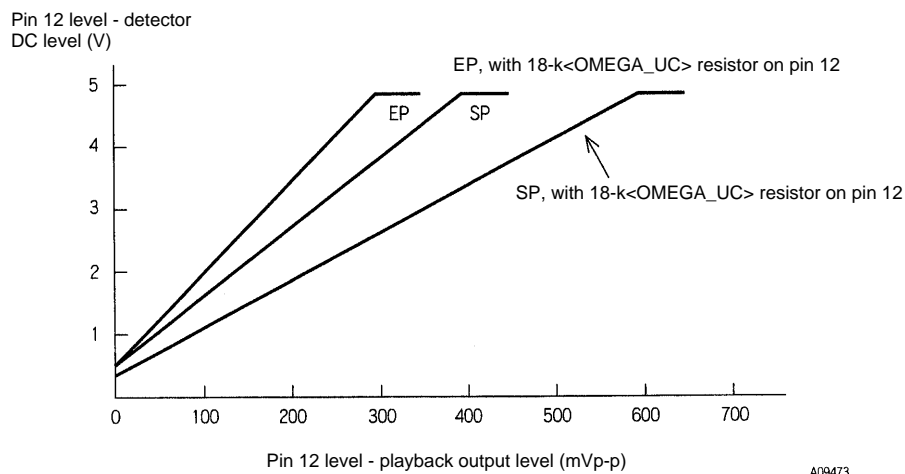


A09472

Envelope Detector Characteristic: Pin 12

The LA70020 includes a built-in playback signal envelope detector circuit for use in automating tracking adjustment.

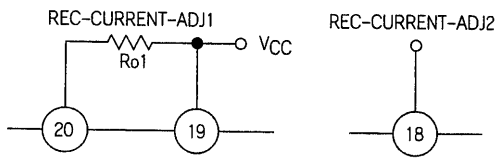
Envelope detector voltage characteristic



A09473

Video REC AMP Gain Control

The LA70020 eliminates recording current adjustment by adding an automatic gain control circuit to the recording amplifier. It is also possible to change the recording current with the following methods.



A09474

REC-CURRENT-ADJ2 Open

The internal bias forces the DC level at pin 18 to 1/2 V_{CC} (that is, approximately 2.5 V), and R_{O1} determines the recording current.

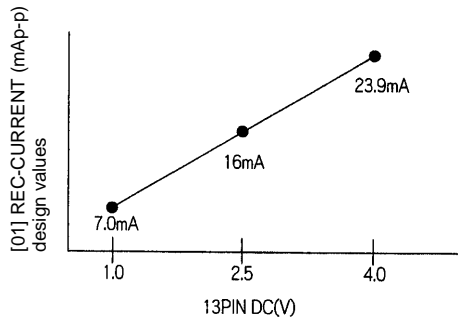
Design values

R_{O1} = 1.5 kΩ = 16.0 mA (SP) (per channel)

R_{O1} = 1.5 kΩ = 12.7 mA (EP)

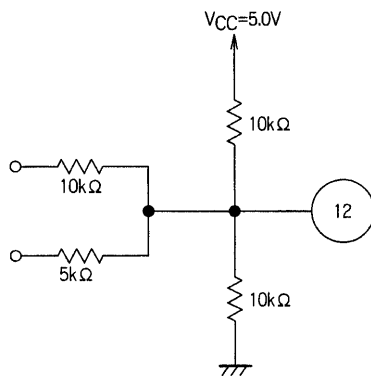
REC-CURRENT-ADJ2 Used

Applying a DC control voltage between 1 and 4 V to pin 18 adjusts the figure determined by R_{O1} between -6.0 dB and +3.5 dB.



A09475

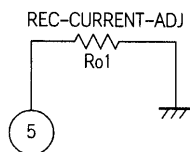
Note: One possible circuit for applying this voltage is the following, which provides 9 modes between 1 and 4 V.



A09476

Hi-Fi REC AMP Gain Control

The LA70020 eliminates recording current adjustment by adding an automatic gain control circuit to the recording amplifier. It is also possible to change the recording current with the following methods.



A09477

REC-CURRENT-ADJ

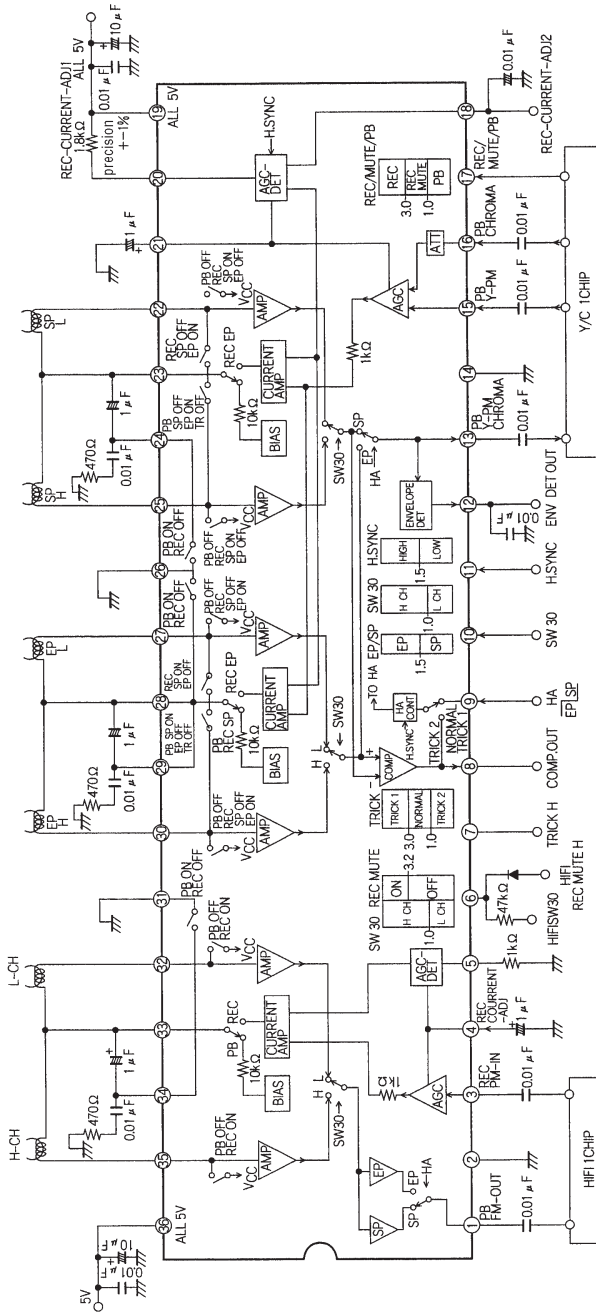
R_{O1} determines the recording current.

Design values

R_{O1} = 1.0 kΩ = 24.0 mA (SP) (per channel)

R_{O1} = 1.5 kΩ = 16.0 mA (EP)

Block Diagram



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