Ordering number : EN5711A

Monolithic Linear IC

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

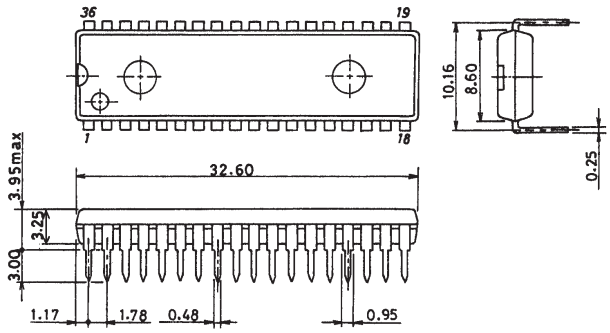
- Combining hi-fi and video amplifiers onto a single chip saves space on the circuit board.
- Connecting the playback amplifier input directly to the head reduces the number of external elements required.
- The recording amplifiers use a fixed-current drive configuration that yields stable recording 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.

Package Dimensions

unit: mm

3170-DIP36S 400mil

[LA70020]

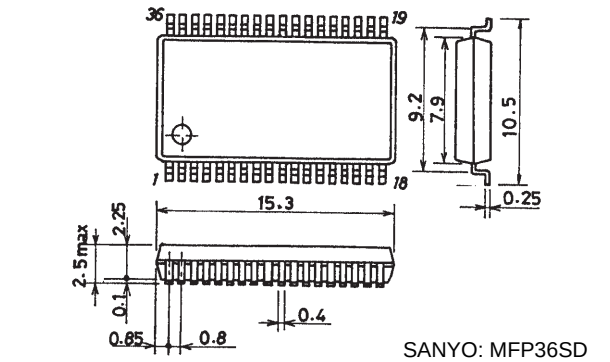


SANYO: DIP36S

unit: mm

3129-MFP36SD, MFP36SLF

[LA70020M]



SANYO: MFP36SD
SANYO: MFP36SLF

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	V_{CC} max		6.0	V
Maximum power dissipation	Pd max	Ta ≤ 65°C [LA70020]	1000	mW
		Ta ≤ 65°C [LA70020M] 114.3 × 76.1 × 1.6 mm: glass epoxy	1000	mW
Operating temperature	Topr		–10 to +65	°C
Storage temperature	Tstg		–40 to +150	°C

Operating Conditions at Ta = 25°C

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

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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	$G_{VP}1$	V_{IN} = 38 mVp-p, f = 4 MHz	56	59	62	dB
	SP-H CH2	$G_{VP}2$		56	59	62	dB
	EP-L CH3	$G_{VP}3$		56	59	62	dB
	EP-H CH4	$G_{VP}4$		56	59	62	dB
Voltage gain difference		$\Delta G_{VP}1$	$G_{VP}1$ — $G_{VP}2$	–1	0	+1	dB
		$\Delta G_{VP}2$	$G_{VP}3$ — $G_{VP}4$	–1	0	+1	dB
Intermode gain difference		$\Delta G_{VP}3$	$G_{VP}3$ — $G_{VP}1$	–1	0	+1	dB
Converted input noise voltage	CH1 CH2 CH3 CH4	V_{NIN1} V_{NIN2} V_{NIN3} 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 CH2 CH3 CH4	$\Delta V_{fp}1$ ΔV_{fp2} ΔV_{fp3} ΔV_{fp4}	Ratios of the output for V_{IN} = 38 mVp-p and f = 7 MHz to the voltage gains $G_{VP}1$, $G_{VP}2$, $G_{VP}3$, and $G_{VP}4$.	–2.5	0		dB
Secondary harmonic distortion	CH1 CH2 CH3 CH4	$\Delta V_{HDP}1$ ΔV_{HDP2} ΔV_{HDP3} 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 CH2 CH3 CH4	$\Delta V_{OMP}1$ ΔV_{OMP2} ΔV_{OMP3} 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		$V_{CR}1$	Ratio of the output for V_{IN} = 38 mVp-p and f = 4 MHz to $G_{VP}1$.		–40	–35	dB
		$V_{CR}2$	Ratio of the output for V_{IN} = 38 mVp-p and f = 4 MHz to $G_{VP}2$.		–40	–35	dB
Crosstalk EP		$V_{CR}3$	Ratio of the output for V_{IN} = 38 mVp-p and f = 4 MHz to $G_{VP}3$.		–40	–35	dB
		$V_{CR}4$	Ratio of the output for V_{IN} = 38 mVp-p and f = 4 MHz to $G_{VP}4$.		–40	–35	dB
Output DC offset		$\Delta V_{ODC}1$	CH1 — CH2	–100	0	+100	mV
		$\Delta V_{ODC}2$	CH3 — CH4				
		$\Delta V_{ODC}3$	CH1 — CH3				
		$\Delta V_{ODC}4$	CH2 — CH4				
		$\Delta V_{ODC}5$	CH1 — CH4				
		$\Delta V_{ODC}6$	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		$V_{ENVSP}1$	T12 DC level at which T13A output level is 150 mVp-p for f = 4 MHz.	2.0	2.5	3.0	V
		$V_{ENVSP}2$	T12 DC level at which T13A output level is 400 mVp-p for f = 4 MHz.	4.0	4.5	5.0	V
Envelope detector output pin voltage EP		$V_{ENVEP}1$	T12 DC level at which T13A output level is 125 mVp-p for f = 4 MHz.	2.0	2.5	3.0	V
		$V_{ENVEP}2$	T6 DC level at which T7A output level is 300 mVp-p for f = 4 MHz.	4.0	4.5	5.0	V
Comparator output voltage		$V_{COMP}1$	T8 DC level for V_{IN} = 38 mVp-p and f = 4 MHz.		0.4	0.7	V
		$V_{COMP}2$	T8 DC level for V_{IN} = 38 mVp-p and f = 4 MHz.	4.5	4.8		V
SW-Tr on resistance during playback		$R_{PON}24$ $R_{PON}29$	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	V
		TR2-1	Normal → Trick2 : *1	0.0		0.8	V
		TR2-2	Trick2 → Normal	1.2		2.8	V

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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_{AGC}1-SP ΔV_{AGC}1-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_{AGC}2-SP ΔV_{AGC}2-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	H_{AR}-1	SP → EP : *1	1.7		5.0	V
	H_{AR}-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.

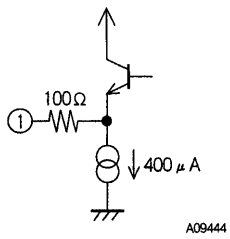
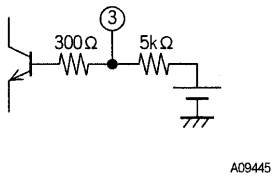
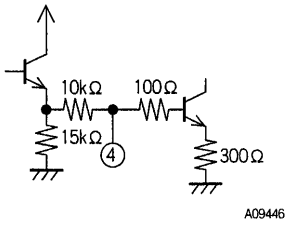
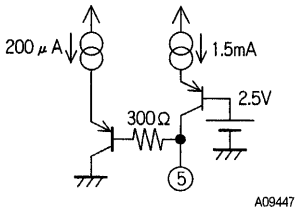
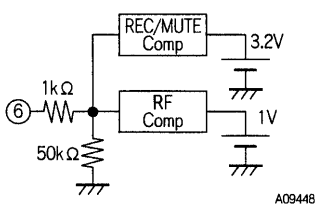
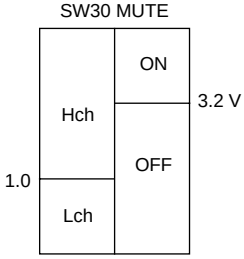
*3. Apply a DC voltage to the REC-CUR-Adj pin (pin 18) and adjust the output level.

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

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Playback Mode							
Current drain		HI_{CCP}	Current flowing into pin 36	20	25	30	mA
Voltage gain	CH1	$HG_{VP}1$	V_{IN} = 20 mVp-p, f = 1.5 MHz	72.5	75.5	78.5	dB
	CH2	$HG_{VP}2$		72.5	75.5	78.5	dB
Voltage gain difference		ΔHG_{VP}	$HG_{VP}1$ — $HG_{VP}2$	–2	0	+2	dB
Intermode gain difference		ΔHGEP	Voltage gain difference between SP and EP modes. *1	1.7	2.4	3.1	dB
Converted input noise voltage	CH1 CH2	HV_{NIN1} HV_{NIN2}	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	µVrms
Frequency characteristic	CH1 CH2	ΔHV_{fp1} ΔHV_{fp2}	Ratios of the output for V_{IN} = 20 mVp-p and f = 2 MHz to the voltage gains $HG_{VP}1$ and $HG_{VP}2$.	–3	–1		dB
Secondary harmonic distortion	CH1 CH2	$\Delta HV_{HDP}1$ ΔHV_{HDP2}	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	$\Delta HV_{OMP}1$ ΔHV_{OMP2}	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		$V_{HCR}1$	Ratio of the output for V_{IN} = 20 mVp-p and f = 1.5 MHz to $HG_{VP}1$.		–40	–35	dB
		$V_{HCR}2$	Ratio of the output for V_{IN} = 20 mVp-p and f = 1.5 MHz to $HG_{VP}2$.		–40	–35	dB
Crosstalk EP		$V_{HCR}3$	Ratio of the output for V_{IN} = 20 mVp-p and f = 1.5 MHz to $HG_{VP}1$.		–40	–35	dB
		$V_{HCR}4$	Ratio of the output for V_{IN} = 20 mVp-p and f = 1.5 MHz to $HG_{VP}2$.		–40	–35	dB
Output DC offset SP mode		$\Delta V_{ODC}1$	CH1 — CH2	–30	0	+30	mV
Output DC offset EP mode		$\Delta V_{ODC}2$	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_{RPON}	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		ΔHV_{AGC1}	Output level divided by HV_{OR} for f = 1.5 MHz and V_{IN} = 360 mVp-p.		0.2	0.5	dB
		ΔV_{AGC2}	Output level divided by HV_{OR} for f = 1.5 MHz and V_{IN} = 90 mVp-p.	–0.5	–0.2		dB
REC AGC AMP muting attenuation		ΔHV_{MR}	Output level divided by HV_{OR} for f = 4 MHz and V_{IN} = 180 mVp-p.			–40	dB
REC AGC AMP cross modulation relative level for 0.4-MHz component		HCMD04	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		HCMD09	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.

Pin Descriptions

Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
1	HiFi PB-FM-OUT	PB	2.6		
		REC	4.0		
2 31	HiFi GND				
3	HiFi REC-FM-IN	PB	0		
		REC	3.0		
4	HiFi REC-AGC-Filt	PB	0		
		REC	1.2		
5	HiFi REC-CURRENT-ADJ	PB	0.7		
		REC	1.5		
6	HiFi RF-SW (REC-MUTE)				SW30 MUTE 

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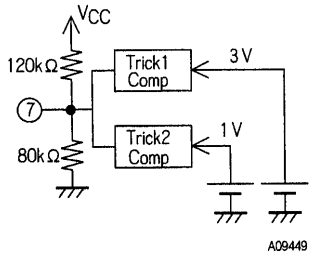
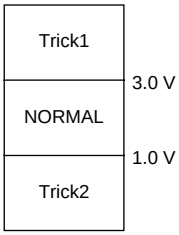
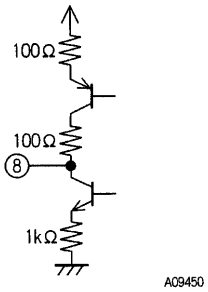
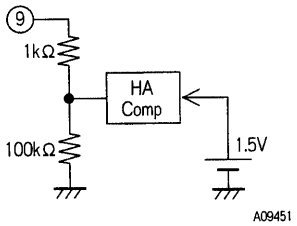
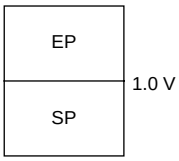
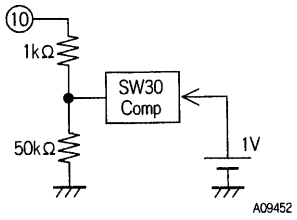
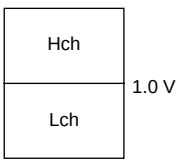
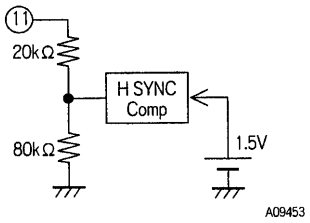
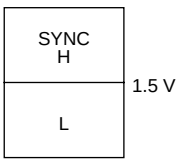
Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
7	TRICK-H				
8	COMP-OUT	PB	H: min. 4.5 V L: max. 0.7 V		EP > SP ENV High
		REC	Open		
9	HA (EP/SP)				
10	SW30				
11	H-SYNC				

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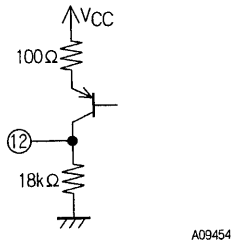
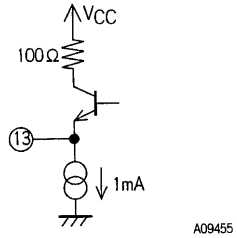
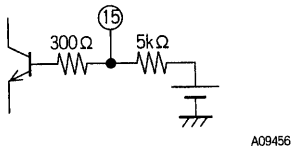
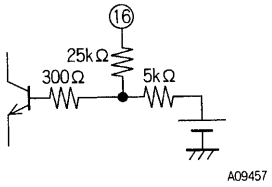
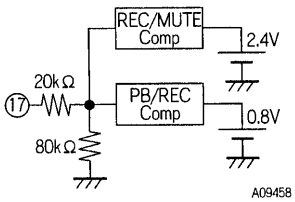
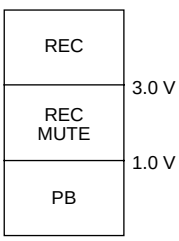
Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
12	ENVDET-OUT	PB	See relevant documents.		
		REC	0		
13	PB-OUT	PB	1.7		
		REC	0		
14 26	GND				
15	REC-Y-IN	PB	0		
		REC	3.7		
16	REC-C-IN	PB	0		
		REC	3.7		
17	REC/MUTE/PB				

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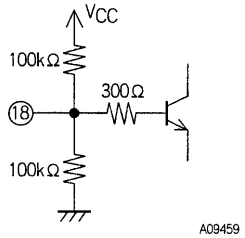
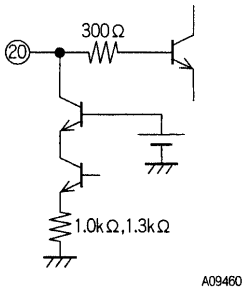
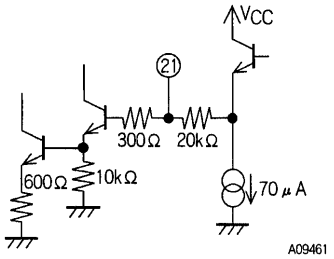
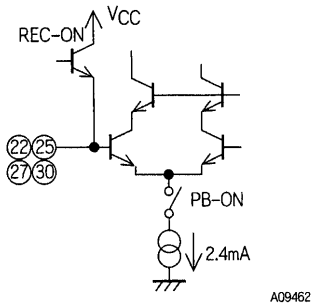
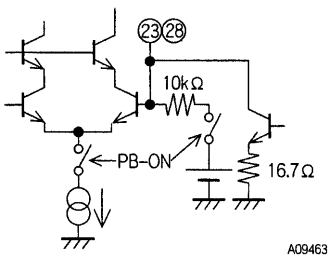
Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
18	REC-CURRENT-ADJ2	PB	2.5 V		
		REC	2.5 V		
19	V_{CC}				
20	REC-CURRENT-ADJ1	PB	5.0		
		REC	4.5		
21	REC-AGC-FILT	PB	0		
		REC	1.6		
22 25 27 30	SP L-IN SP H-IN EP L-IN EP H-IN	PB	2.1		
		REC	4.1		
23 28	REC SP OUT EP OUT	PB	2.1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

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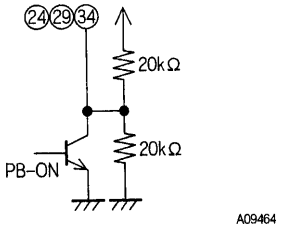
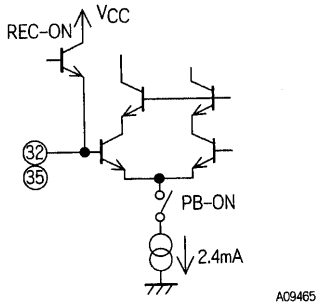
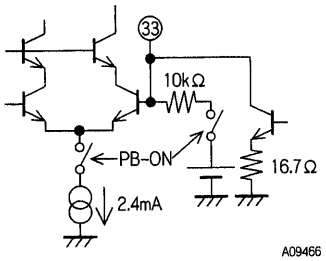
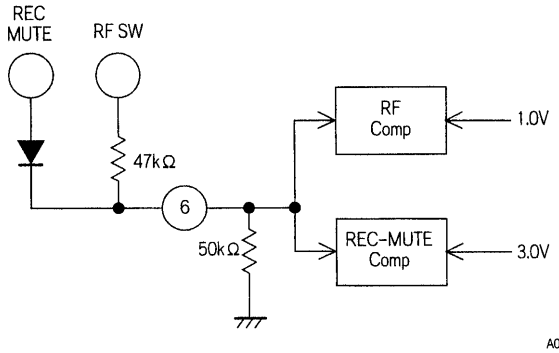
Pin Number	Pin Name	Standard DC Voltage (V)		Equivalent Circuit	Notes
24 29 34	PB FILT	PB	0		
		REC	2.5		
32 35	HiFi PB-Lch-IN PB-Hch-IN	PB	2.1		
		REC	4.1		
33	HiFi REC-OUT	PB	2.1		
		REC	4.1		
36	HiFi V_{CC}	5.0			

Usage Notes

Control Pin Logic

HiFi RF-SW, REC-MUTE : Pin 6



During playback

Pin 6 level - DC < 1.0 V: Lch

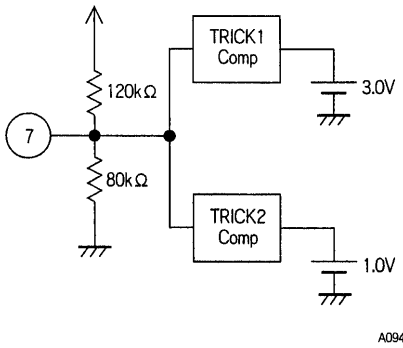
Pin 6 level - DC > 1.0 V: Hch

During recording

Pin 6 level - DC < 3.0 V: Mute off

Pin 6 level - DC > 3.0 V: Mute on

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

NORMAL Mode
Two channels selected with pin 9 (EP/SP): ON
Envelope comparator: OFF

TRICK Modes
All four channels: ON
Envelope comparator: OFF

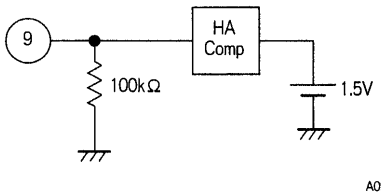
Difference between TRICK1 and TRICK2 modes
TRICK1 is a special playback mode using the following path

Envelope comparator OUT (pin 8) → Servo (microcontroller) → Pin 3 (HA) → HA-SW

TRICK2 provides SP searching

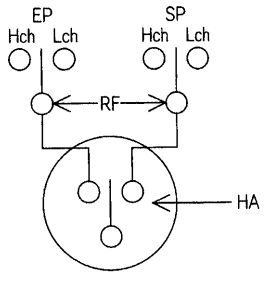
Envelope comparator OUT → HA-SW

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

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.)

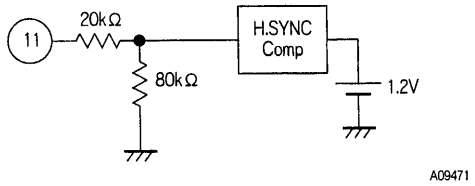


The hi-fi playback amplifier's gain is approximately 2.4 dB higher in EP mode than in SP mode.

SP: 75.0 dB
EP: 77.4 dB

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

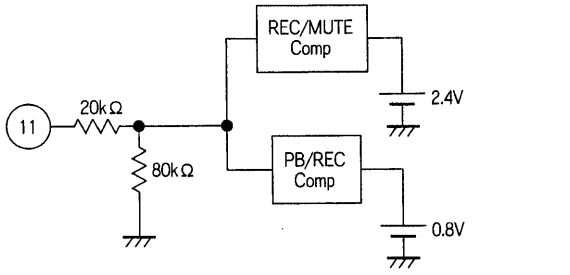


Pin 11 level - DC > 1.5 V: H-SYNC interval

Video circuit operation only
Playback:
— Determines timing of HA switching (EP/SP)
— Determines timing of special playback

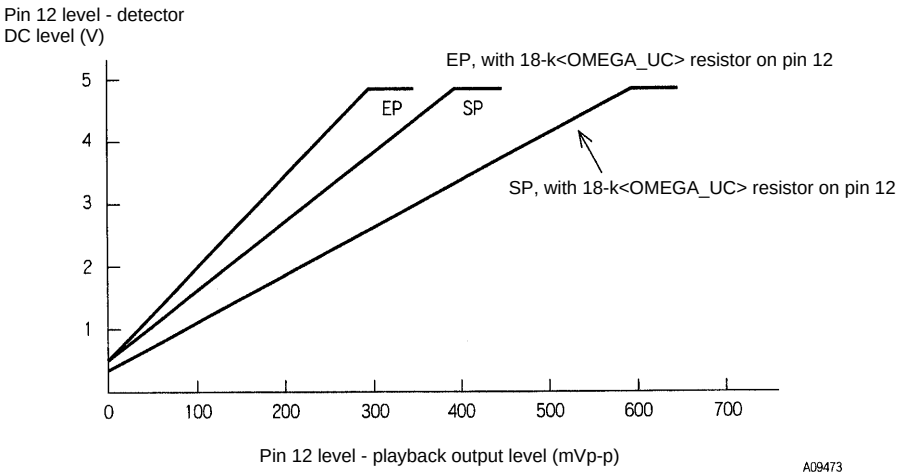
Recording:
— Serves as gate pulse for REC-AGC-AMP SYNC unit

REC/REC-MUTE/PB Switching: Pin 17



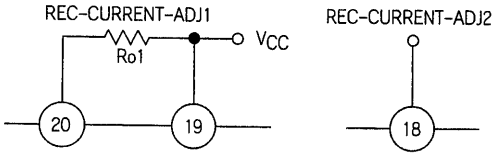
Envelope Detector Characteristic: Pin 12
The LA70020 includes a built-in playback signal envelope detector circuit for use in automating tracking adjustment.

Envelope detector voltage characteristic



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.



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.

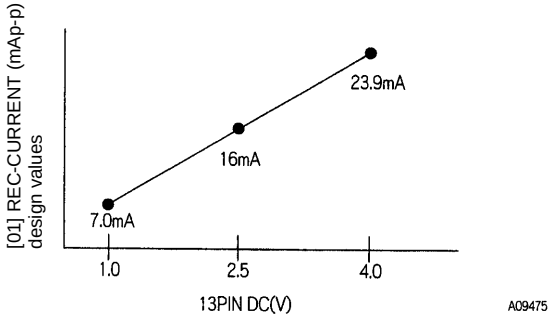
Design values

R_O1 = 1.5 kΩ = 16.0 mA (SP) (per channel)

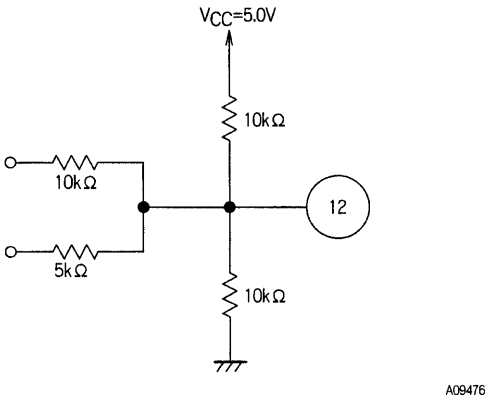
R_O1 = 1.5 kΩ = 12.7 mA (EP)

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.

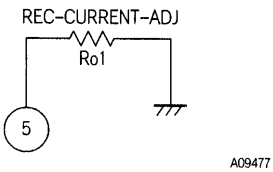


Note: One possible circuit for applying this voltage is the following, which provides 9 modes between 1 and 4 V.



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.



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