Ordering number : EN5734

Monolithic Linear IC

LA75691

IF Signal-Processing IC for PAL/NTSC Multichannel Audio TV and VCR Systems

Overview

The LA75691 is a PAL/NTSC multichannel audio VIF/SIF signal-processing IC that makes the minimum number of adjustments possible. The system is designed so that VCO adjustment makes AFT adjustment unnecessary, thus simplifying the adjustment steps in end-product manufacturing. PLL detection is adopted in the FM detector, allowing the LA75691 to support multichannel detection for the audio signal. In addition, it also incorporates a buzz canceller that suppresses Nyquist buzz for improved audio quality.

Functions

[VIF Block]
- PLL detector with minimum number of adjustments
- AFT
- Equalizer amplifier
- RF AGC

[First SIF BLOCK]
- First SIF detector
- HPF

[SIF Block]
- PLL-based FM detector

[Muting Block]
- AV muting

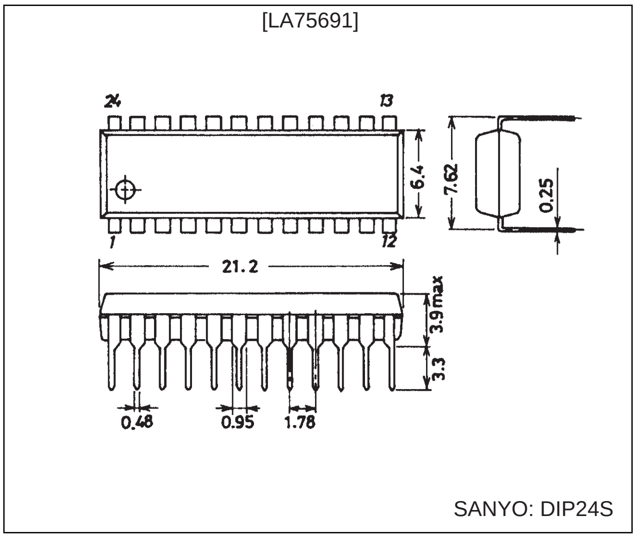
Features

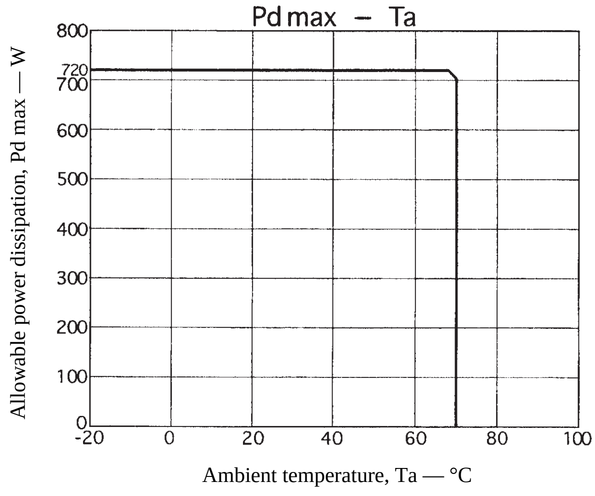
- Excellent buzz and buzz/beating characteristics provided by a PLL detection technique that includes a buzz canceller.
- The second IF AGC filter is built in.
- No coils are used in the AFT and SIF circuits, making them adjustment free.

Package Dimensions

unit: mm

3067-DIP24S





SANYO Electric Co.,Ltd. Semiconductor Bussiness Headquarters

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		13.2	V
Circuit voltage	V13, V17		V_{CC}	V
Circuit current	I6		–3	mA
	I10		–10	mA
	I24		–2	mA
Allowable power dissipation	Pd max	Ta ≤ 68°C	720	mW
Operating temperature	Topr		–20 to +70	°C
Storage temperature	Tstg		–55 to +150	°C

Note: When mounted on a 65 × 72 × 1.6 mm laminated paper phenolic resin printed circuit board.

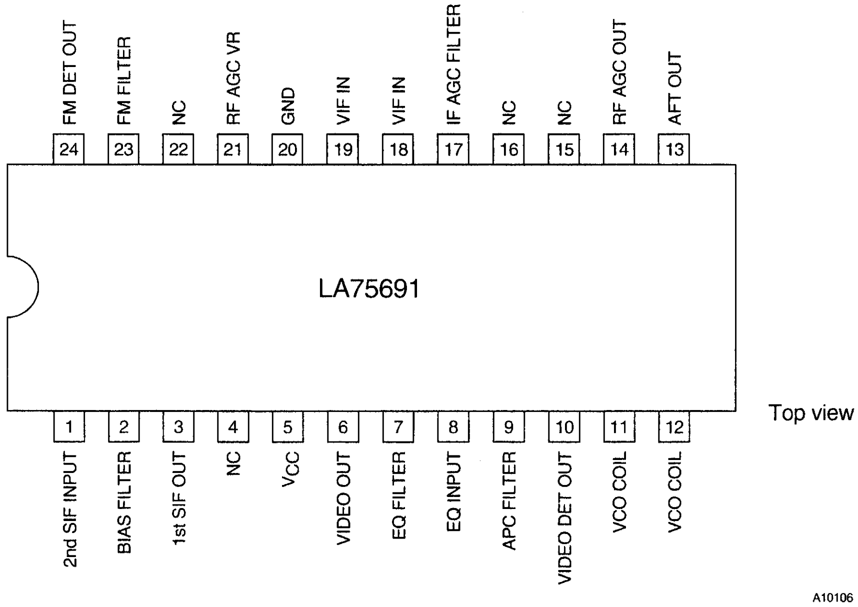
Operating Conditions

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		9	V
Operating supply voltage range	V_{CC} op		8.5 to 12.5	V

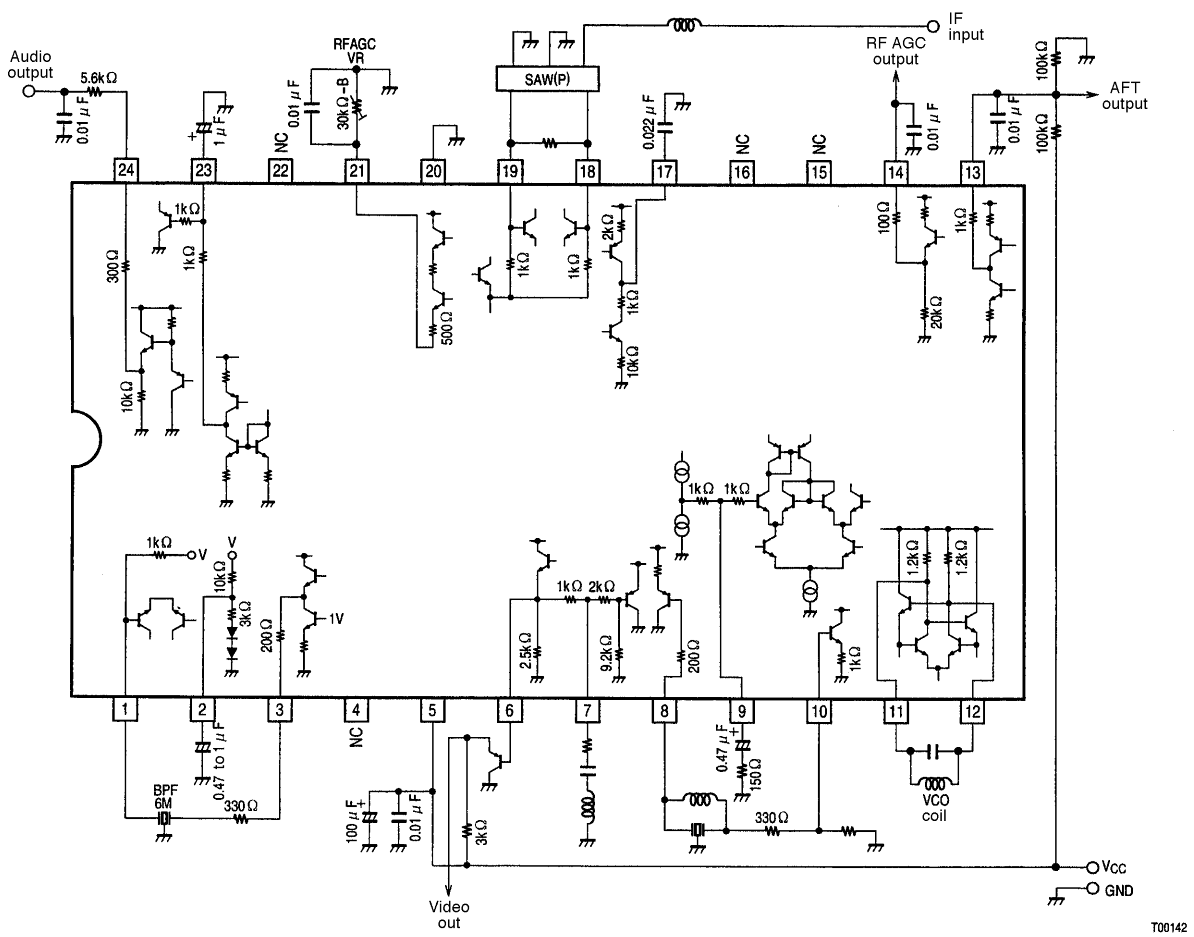
Operating Characteristics at Ta = 25°C, V_{CC} = 9 V, f_P = 38.9 MHz

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[VIF Block]						
Circuit current	I_5		35.5	42.0	48.5	V
Maximum RF AGC voltage	V_{14H}		7.5	8.1		V
Minimum RF AGC voltage	V_{14L}			0	0.5	V
Input sensitivity	V_{IN}	S1 = Off	24	30	36	dBμV
AGC range	G_R		62	68		dB
Maximum allowable input	V_{IN} max		92	97		dBμV
No-signal video output voltage	V_6		3.5	3.8	4.2	V
Synchronizing signal tip voltage	V_6 tip		1.15	1.45	1.74	V
Video output level	V_O		1.7	2.0	2.3	Vp-p
Black noise threshold voltage	V_{BTH}		0.5	0.8	1.1	V
Black noise clamp voltage	V_{BCL}		2.5	2.8	3.1	V
Video signal-to-noise ratio	S/N		48	50		dB
C-S beating	IC-S		38	43		dB
Frequency characteristics	f_C	6 MHz	–3.0	–1.5		dB
Differential gain	DG			3.0	6.5	%
Differential phase	DP			3	5	deg
Maximum AFT voltage	V_{13H}		8.5	8.7	9.0	V
Minimum AFT voltage	V_{13L}		0	0.18	0.5	V
AFT detection sensitivity	Sf		22.4	28.0	33.6	mV/kHz
VIF input resistance	Ri	38.9 MHz		1.5		kΩ
VIF input capacitance	Ci	38.9 MHz		3		pF
APC pull-in range (U)	f_{PU}		0.8	1.3		MHz
APC pull-in range (L)	f_{PL}			–1.5	–0.8	MHz
AFT frequency tolerances 1	dfa 1		–300	0	+300	kHz
VCO1 maximum variability range (U)	dfu		1.0	1.3		MHz
VCO1 maximum variability range (L)	dfl			–1.5	–1.0	MHz
VCO control sensitivity	B		1.4	2.8	5.6	kHz/mV
5.5 MHZ output level	S_O	P/S = 14 dB	92	95	98	mVrms
[SIF Block]						
Limiting voltage	Vi (lim)	5.5 MHz ± 30 kHz	43	48	53	dBμV
FM detector output voltage	V_O (FM)	5.5 MHz ± 30 kHz	720	900	1100	mVrms
AM rejection ratio	AMR	AM = 30 %	50	60		dB
Total harmonic distortion	THD			0.3	0.8	%
SIF signal-to-noise ratio	S/N (FM)		57	62		dB

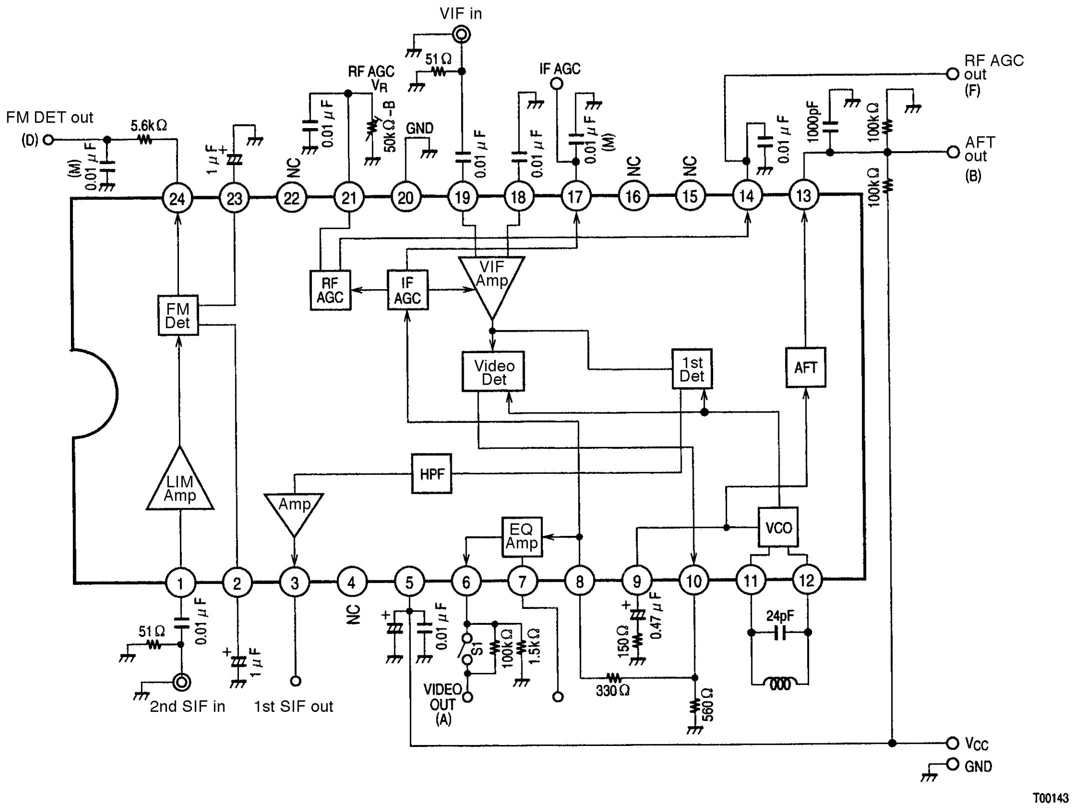
Pin Assignment



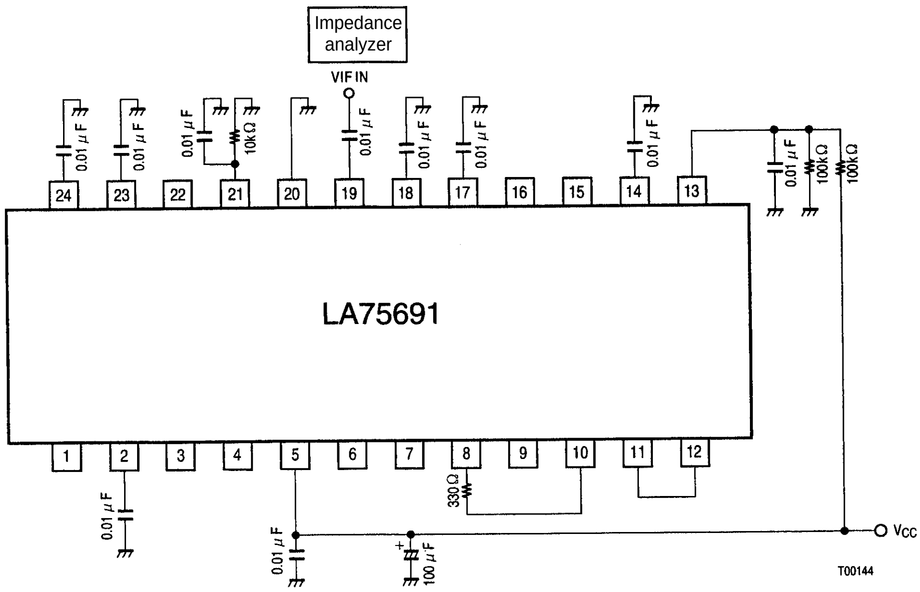
Internal Equivalent Circuit and External Circuits



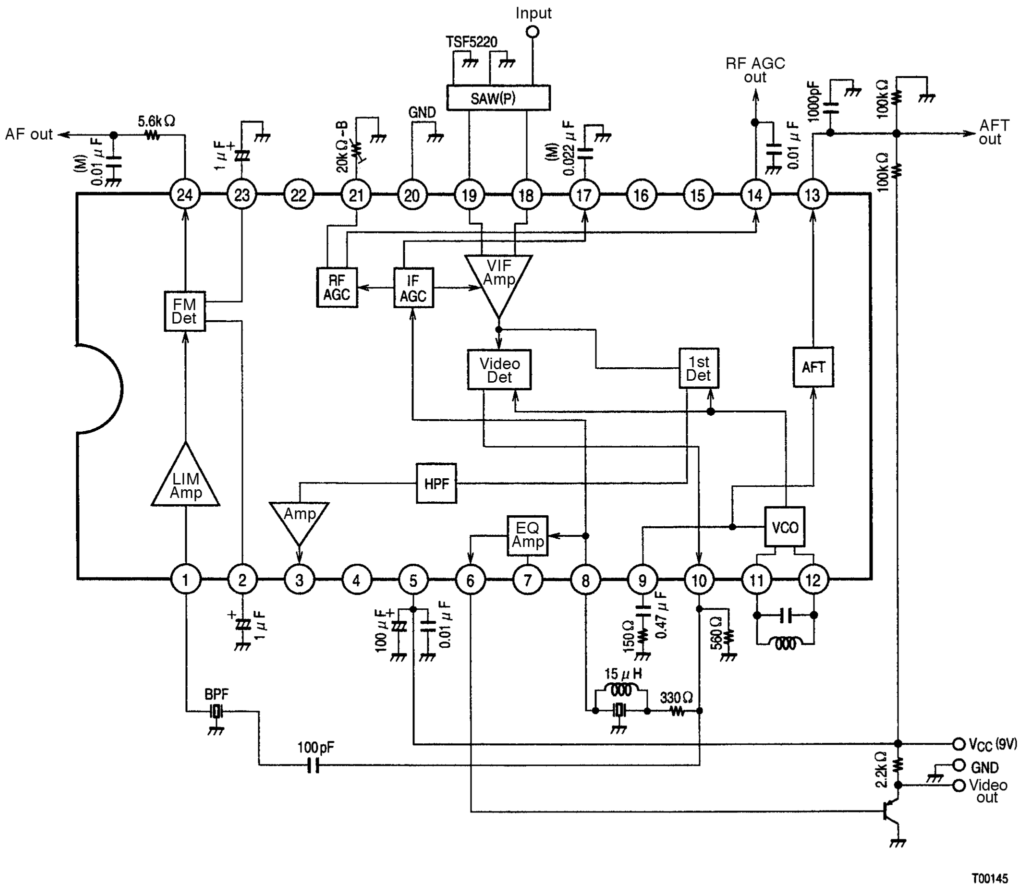
AC Characteristics Test Circuit



Test Circuit



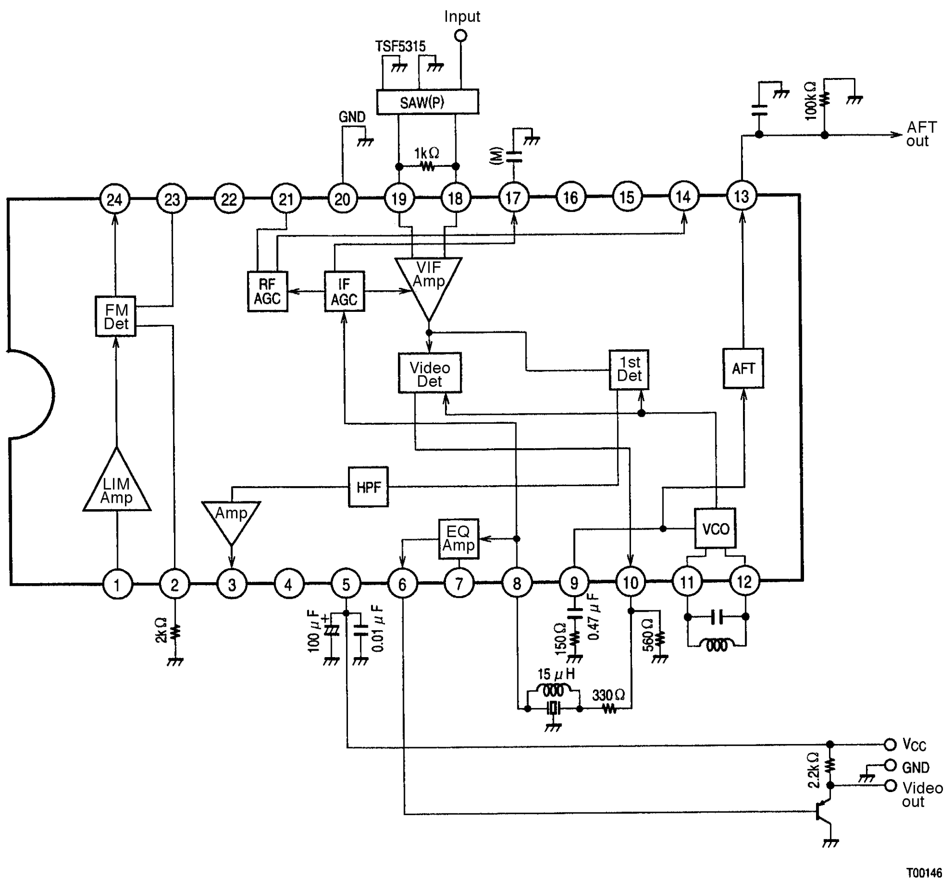
NT (US) INTER


Input
TSF5220
SAW(P)
RF AGC
out
AFT
out
AF out
5.6kΩ
(M)
0.01μF
1μF
20kΩ-B
GND
(M)
0.022μF
0.01μF
1000pF
100kΩ
100kΩ
RF
AGC
IF
AGC
VIF
Amp
FM
Det
Video
Det
1st
Det
AFT
LIM
Amp
HPF
Amp
EQ
Amp
VCO
1μF
100μF
0.01μF
150Ω
0.47μF
560Ω
15μH
330Ω
BPF
100pF
VCC (9V)
GND
Video
out
2.2kΩ
T00145

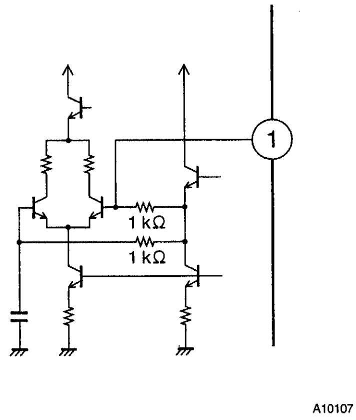
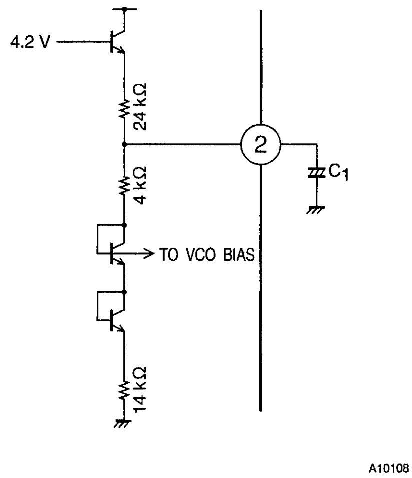
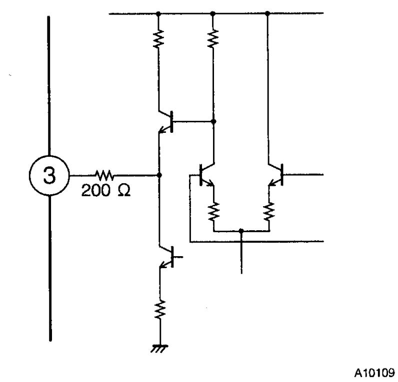
Sample Application Circuit

If the SIF, AFT, and RF AGC circuits are not used:

- If the SIF circuit is not used:
  Pins 1, 23, and 24 should be left open.
  Insert a 2-kΩ resistor between pin 2 and ground.
- If the AFT circuit is not used:
  Since there is no way to defeat the AFT circuit, connect a 100-kΩ resistor and a 0.01-μF capacitor in parallel between pin 13 and ground.
- If the RF AGC circuit is not used:
  Pins 14 and 21 should be left open.
  Insert a 0.01-μF capacitor between pin 21 and ground to prevent oscillation.



Pin Descriptions

Pin No.	Pin	Function	Equivalent circuit
1	SIF INPUT	SIF input The input impedance is about 1 kΩ. The pattern layout for the input circuit for this pin must be designed carefully, since buzzing and/or beating can be caused by interference signals. Video signals, the chrominance signal, and the VIF carrier signal can cause interference in the audio signal.	
2	FM power supply filter	The FM detector signal-to-noise ratio can be improved by inserting a filter in the FM detector bias line. C1 must be at least 0.47 μF, and 1 μF is recommended. If the FM detector is not used, insert a 2-kΩ resistor between pin 2 and ground. This stops the FM detector VCO.	
3	First SIF output	Pin 3 is the first SIF output. This is the output pin for the audio carrier to which P/S separate detection has been applied. This is an emitter-follower output with a 200 Ω series resistor inserted.	

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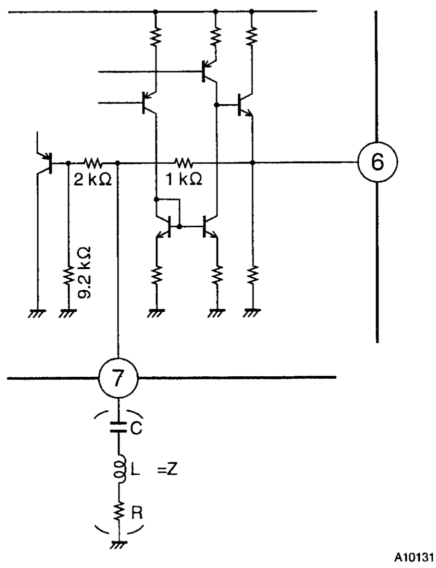
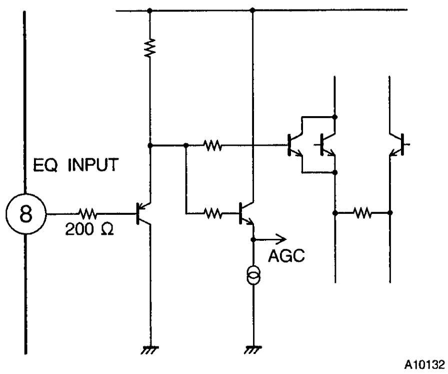
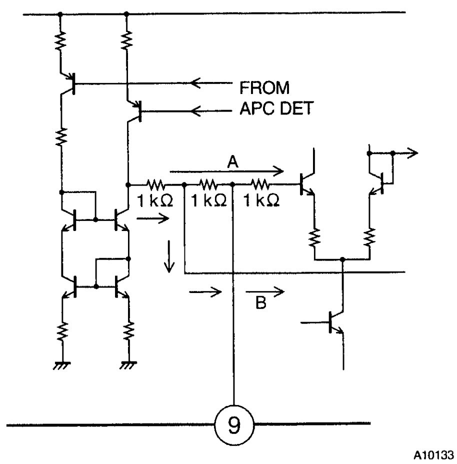
Pin No.	Pin	Function	Equivalent circuit
5	V_{CC}	The V_{CC} to ground decoupling capacitors must be placed as close to the IC as possible.	
6 7 8	EQ amp	Equalizer circuit. This circuit corrects the frequency characteristics of the video signal. Pin 17 is the equalizer amplifier input. A 1.5-V p-p signal is input to pin 17, and that signal is amplified to be a 2-V p-p signal by the equalizer amplifier. Equalizer amplifier design: The equalizer amplifier is designed as a voltage-follower amplifier with a gain of about 2.3 dB. Connect an inductor, a capacitor, and a resistor in series between pin 7 and ground if the frequency characteristics require correction. Notes on the equalizer amplifier: If the input signal is vi and the output signal is vo, then: $\frac{R1}{Z} +1\ (vi + vin) = Vo \times G$ G: The voltage-follower amplifier gain. vin: Imaginary short G: About 2.3 dB Assuming that vin is 0, then: $AV = \frac{VoG}{Vi} = \frac{R1}{Z} +1$ R1 is the IC internal resistance of 1 kΩ. Simply select Z to match the desired characteristics. However, note that Z must be chosen carefully in order not to cause distortion, since the equalizer amplifier gain will be maximum at the resonance determined by Z.	 
9	APC FILTER	PLL detector APC filter The APC time constant is switched internally in the IC. When locked, the VCO is controlled by loop A, and the gain is reduced. When unlocked and in weak field reception, the VCO is controlled by loop B, and the gain is increased. For this APC filter the recommended values are: R should be between 150 and 390 Ω. C should be 0.47 μF.	

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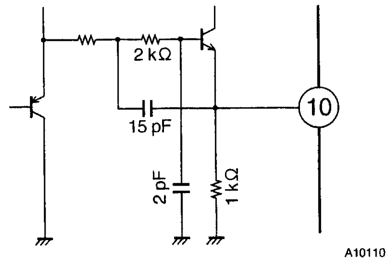
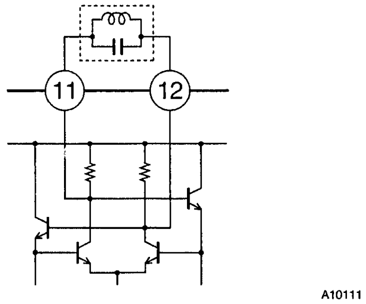
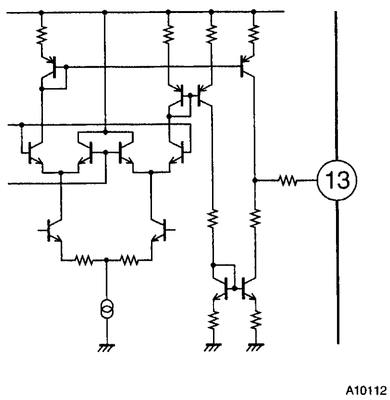
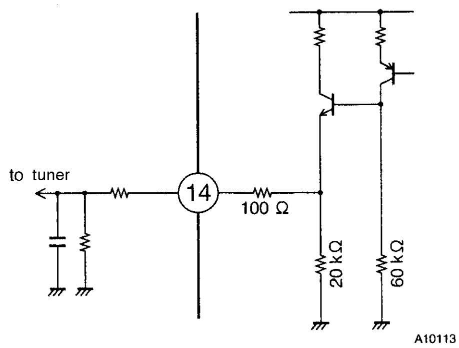
Pin No.	Pin	Function	Equivalent circuit
10	Conposite video output	Output for the video signal that includes the SIF carrier A resistor must be inserted between pin 10 and ground to assure adequate drive capabilities. R ≥ 300Ω	
11 12	VCO tank	Connections for the VCO tank circuit used by the video detector. See the coil specifications for the tank circuit provided separately. This VCO is a vector synthesis VCO.	
13	AFT OUTPUT	AFT output The AFT center voltage is created by an external bleeder resistor. The AFT gain increases as the value of this bleeder resistor increases. This resistor must not exceed 390 kΩ. This circuit includes a function that controls the AFT voltage to naturally approach the center voltage during weak field reception.	
14	RF AGC OUTPUT	RF AGC output This signal controls the tuner RF AGC. This is an emitter output with a 200Ω protective resistor inserted in series. Determine the value of the external bleeder resistor according to the specifications of the tuner.	
15	NC		
16	NC		

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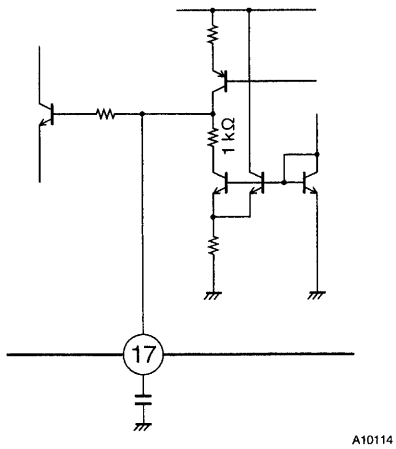
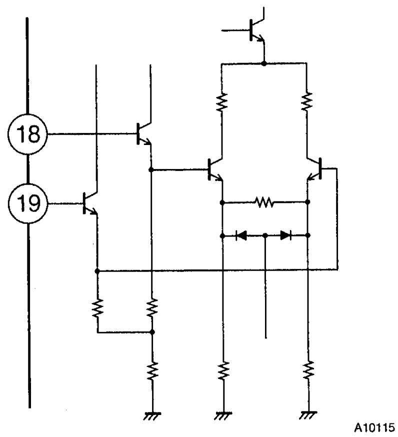
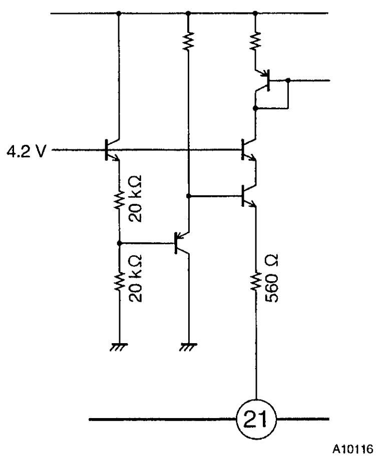
Pin No.	Pin	Function	Equivalent circuit
17	IF AGC FILTER	IF AGC filter connection The AGC voltage is created at pin 17 from the peak detection output produced by the internal AGC detector. A second AGC filter (a lag-lead filter) is built in the IC to create a dual time constant. Use a 0.022-μF capacitor as the external capacitor. Adjust the value of the capacitor to compensate for sag, or modify the AGC speed as required.	
18 19	VIF input	VIF amplifier input The input circuit is a balanced input and the input impedance corresponds to: R ≈ 1.5 kΩ and C ≈ 3 pF.	
20	GND		
21	RF AGC VR	RF AGC trimmer connection This pin is used to set the tuner RF AGC operating point. The FM and video outputs can be muted at the same time by shorting this pin to ground.	
22	NC		

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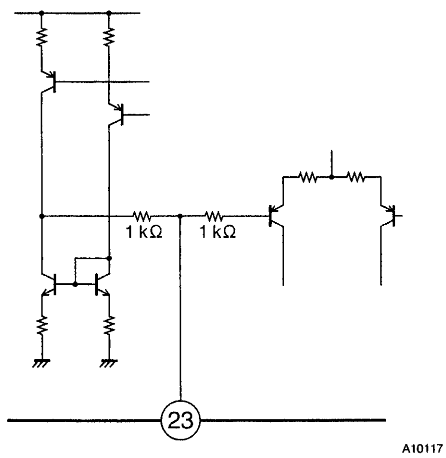
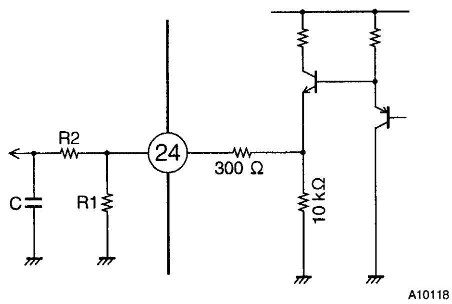
Pin No.	Pin	Function	Equivalent circuit
23	FM filter	This filter is used to hold the FM detector output DC voltage fixed. Normally, a 1-μF electrolytic capacitor should be used. The value of this capacitor can be increased to improve the low band (around 50 Hz) frequency characteristics.	
24	FM Detector output	Audio FM detector output This is an emitter follower output with a 200-Ω resistor inserted in series. • Stereo applications Some applications may find that the stereo decoder input has a low input impedance, and that the left and right signals are distorted, i.e. that the stereo characteristics are degraded. If that is a problem, add the resistor R1 shown in the figure between pin 24 and ground. R1 ≥ 5.1 kΩ • Mono applications Use an external deemphasis circuit with the following time constant: t = 2RC	

Notes on Sanyo SAW Filters

There are two types of SAW filter that differ in the piezoelectric substrate material used.

- Lithium-tantalum (LiTaO3) SAW filters
  TSF11□ □ ... Japan
  TSF12□ □ ... US

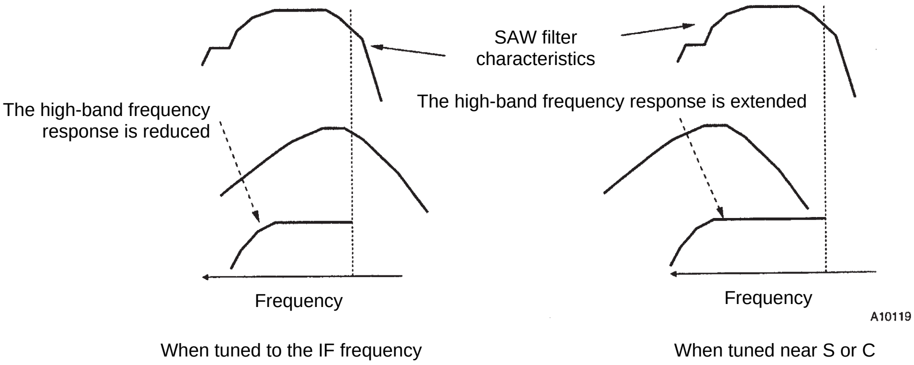
Although lithium tantalate SAW filters have the low temperature coefficient of -18 ppm/°C, they suffer from a large insertion loss. However, it is possible, at the cost of increasing the number of external components required, to minimize this insertion loss by using a matching circuit consisting of coils and other components at the SAW filter output. At the same time as minimizing insertion loss, this technique also allows the frequency characteristics, level, and other aspects to be varied, and thus provides increased circuit design flexibility. Also, since the SAW filter reflected wave level is minimal, the circuit can be designed with a small in-band ripple level.

- Lithium niobate (LiNbO3) SAW filter
  TSF52□ □ ... US
  TSF53□ □ ... PAL

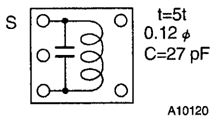
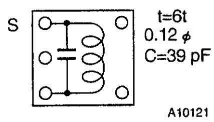
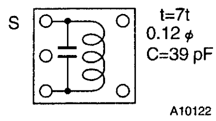
Although lithium niobate SAW filters have the high temperature coefficient of -72 ppm/°C, they feature an insertion loss about 10 dB lower than that of lithium tantalate SAW filters. Accordingly, there is no need for a matching circuit at the SAW filter output. Although the in-band ripple is somewhat larger than with lithium tantalate SAW filters, since they have a low impedance and a small field slew, they are relatively immune to influences from peripheral circuit components and the geometry of the printed circuit board pattern. This allows stable out-of-band trap characteristics to be acquired. Due to the above considerations, lithium tantalate SAW filters are used in applications for the US and Japan that have a high IF frequency, and lithium niobate SAW filters are used in PAL and US applications that have a low IF frequency.

Notes on SAW Filter Matching

In SAW filter input circuit matching, rather than matching the IF frequency, flatter video band characteristics can be acquired by designing the tuning point to be in the vicinity of the audio carrier rather than the chrominance carrier. The situation shown in figure on the right makes it easier to acquire flat band characteristics than that in figure on the left.



Coil Specifications

	JAPAN f = 58.75 MHz	US f = 45.75 MHz	PAL f = 38.9 MHz
VCO coils	 Test production no. 16991B Tokyo Parts Industrial Co., Ltd.	 Test production no. 16687B Tokyo Parts Industrial Co., Ltd.	 Test production no. 16686B Tokyo Parts Industrial Co., Ltd.
SAW filters (split)	Picture TSF1137U Sound	Picture TSF1241 Sound	Picture TSF5315 Sound
SAW filters (inter)		TSF5220 TSF5221	TSF5321 TSF5344

Notes on VCO Tank Circuits

- Built-in capacitor VCO tank circuits

  When power is applied to the IC, the heat generated by the IC is transmitted through the printed circuit board to the VCO tank circuit. At this point, the VCO coil frame functions as a heat sink and the IC heat is dissipated. As a result, this heat is not transmitted readily to the VCO tank circuit's built-in capacitor, and drift at power on is reduced. Therefore, it suffices to design the circuit so that the coil and capacitor thermal characteristics cancel. Ideally, it is better to use a coil with a core material that has low temperature coefficient characteristics.
- External capacitor VCO tank circuits

  When an external capacitor is used, heat generated by the IC is transmitted through the printed circuit board directly to the VCO tank circuit external capacitor. While this capacitor is heated relatively early after the power is turned on, the coil is not influenced as much by this heat, and as a result the power-on drift is larger. Accordingly, a coil whose core material has low temperature coefficient characteristics must be used. It is also desirable to use a capacitor with similarly low temperature coefficient characteristics.

  Note: Applications that use an external capacitor here must use a chip capacitor. If an ordinary capacitor is used, problems such as the oscillator frequency changing with the capacitor orientation may occur.

This catalog provides information as of June, 1998. Specifications and information herein are subject to change without notice.