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

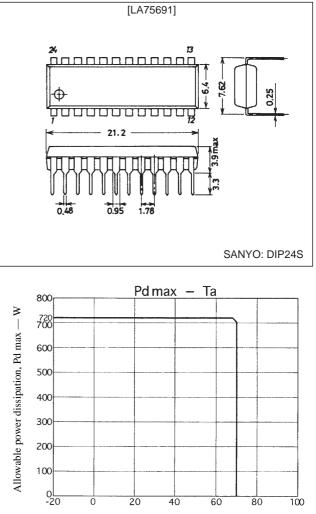
# **Features**

- 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



Ambient temperature, Ta — °C

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# **Specifications** Maximum Ratings at $Ta = 25^{\circ}C$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		13.2	V
Circuit voltage	V13, V17		V <sub>CC</sub>	V
	16		-3	mA
Circuit current	l10		-10	mA
	124		-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  $65 \times 72 \times 1.6$  mm laminated paper phenolic resin printed circuit board.

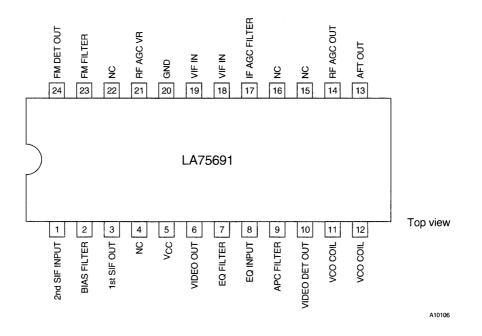
## **Operating Conditions**

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V <sub>CC</sub>		9	V
Operating supply voltage range	V <sub>CC</sub> op		8.5 to 12.5	V

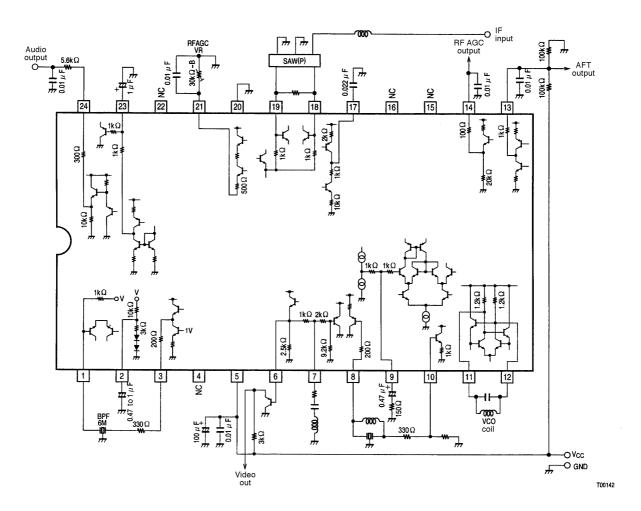
# Operating Characteristics at Ta = 25°C, $V_{CC}$ = 9 V, $f_P$ = 38.9 MHz

Parameter	Symbol	Conditions		Ratings		Unit
Falameter	Symbol	Conditions	min	typ	max	
[VIF Block]						
Circuit current	I <sub>5</sub>		35.5	42.0	48.5	V
Maximum RF AGC voltage	V <sub>14H</sub>		7.5	8.1		V
Minimum RF AGC voltage	V <sub>14L</sub>			0	0.5	V
Input sensitivity	V <sub>IN</sub>	S1 = Off	24	30	36	dBµV
AGC range	G <sub>R</sub>		62	68		dB
Maximum allowable input	V <sub>IN</sub> max		92	97		dBµV
No-signal video output voltage	V <sub>6</sub>		3.5	3.8	4.2	V
Synchronizing signal tip voltage	V <sub>6</sub> tip		1.15	1.45	1.74	V
Video output level	Vo		1.7	2.0	2.3	Vp-p
Black noise threshold voltage	V <sub>BTH</sub>		0.5	0.8	1.1	V
Black noise clamp voltage	V <sub>BCL</sub>		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 <sub>C</sub>	6 MHz	-3.0	-1.5		dB
Differential gain	DG			3.0	6.5	%
Differential phase	DP			3	5	deg
Maximum AFT voltage	V <sub>13H</sub>		8.5	8.7	9.0	V
Minimum AFT voltage	V <sub>13L</sub>		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 <sub>PU</sub>		0.8	1.3		MHz
APC pull-in range (L)	f <sub>PL</sub>			-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	В		1.4	2.8	5.6	kHz/mV
5.5 MHZ output level	So	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 <sub>O</sub> (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

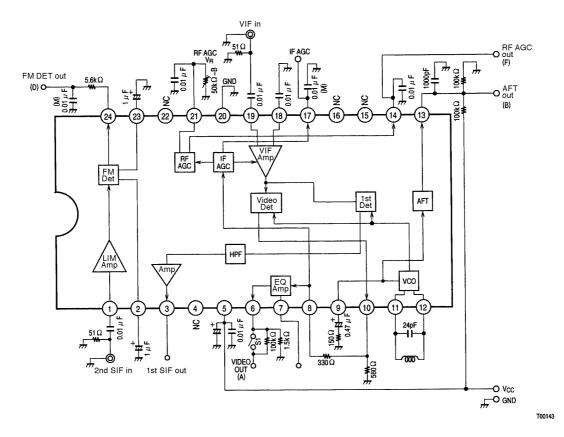
#### **Pin Assignment**



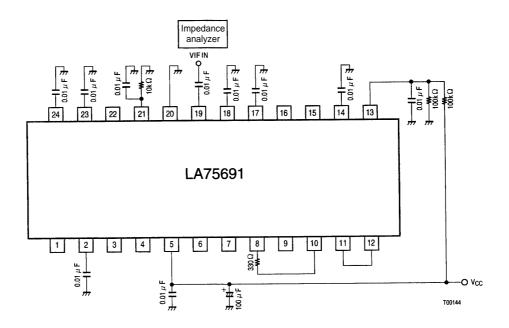
#### Internal Equivalent Circuit and External Circuits



#### **AC Characteristics Test Circuit**

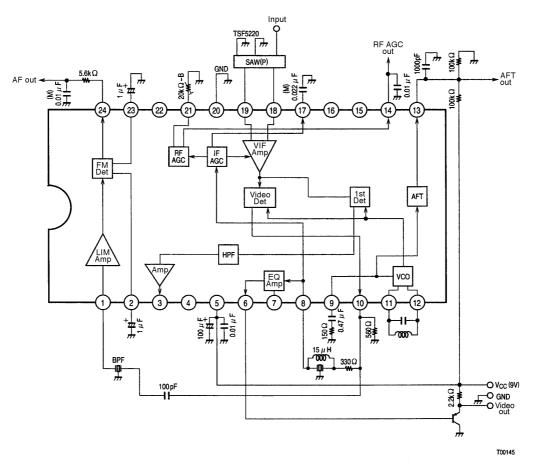


**Test Circuit** 



No. 5734-4/13

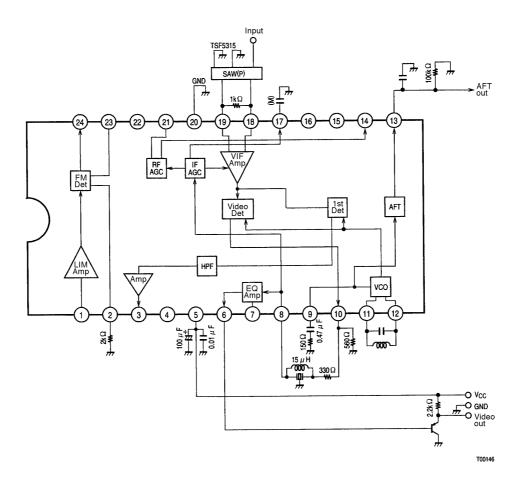
# NT (US) INTER



#### **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-k $\Omega$  resistor and a 0.01- $\mu$ F 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 k $\Omega$ . 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.	A10107
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 $\mu$ F, and 1 $\mu$ F is recommended. If the FM detector is not used, insert a 2-k $\Omega$ resistor between pin 2 and ground. This stops the FM detector VCO.	4.2 V G W TO VCO BIAS G W TO VCO BIAS G W TO VCO BIAS A10108
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 $\Omega$ series resistor inserted.	3 200Ω

Pin No.	Pin	Function	Equivalent circuit
5	V <sub>CC</sub>	The $V_{\mbox{CC}}$ 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.	A10132
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 $\Omega$ . C should be 0.47 $\mu$ F.	$FROM \\ APC DET \\ from the second se$

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. $R \ge 300\Omega$	
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 k $\Omega$ . This circuit includes a function that controls the AFT voltage to naturally approach the center voltage during weak field reception.	A10112
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.	to tuner 14 $100 \Omega$ $300 \Omega$ 300
15	NC		
16	NC		

11       IF AGC FILTER       IF AGC filter connection         12       IF AGC FILTER       IF AGC filter connection         13       IF AGC FILTER       IF AGC filter connection         14       IF AGC FILTER       IF AGC filter connection         15       IF AGC FILTER       IF AGC filter connection         16       IF AGC FILTER       IF AGC filter connection         17       IF AGC FILTER       IF AGC filter connection         18       0.023-pf - connection to compensate for sag, or modely       If any of the approximate connection         19       VIF input       If armofilier input       If armofilier input         19       VIF input       If armofilier input       If any of consel to a balanced input and the input impedance         20       OND       If armofilier input       If armofilier input         21       SF AGC VR       If AGC filterer connection       If armofilier input impedance         21       SF AGC VR       If AGC filter connection       If armofilier input impedance       If armofilier input impedance         21       SF AGC VR       If AGC filter connection       If armofilier input impedance in bit model at the same time input impedance       If armofilier input impedance         22       NC       If armofilier input impedance       If armofilier input imp	Pin No.	Pin	Function	Equivalent circuit
18       VIF input       ViF input       The input circuit is a balanced input and the input impedance corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Corresponds to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: R = 1.5 kΩ and C = 3 pF.       Image: Correspond to: Corres	17	IF AGC FILTER	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	
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.	19		The input circuit is a balanced input and the input impedance corresponds to: $R\approx 1.5\ k\Omega \ \text{and}$	
21 RF AGC VR 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.	20	GND		
22 NC	21	RF AGC VR	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	
	22	NC		

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.	$1 \text{ k}\Omega$
24	FM Detector output	Audio FM detector output This is an emitter follower output with a 200- $\Omega$ 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 $\ge$ 5.1 k $\Omega$ • 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

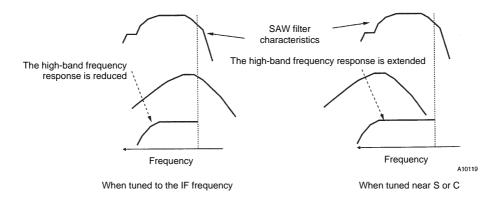
Although lithium tantalate SAW filters have the low temperature coefficient of -18 ppm/°C, they suffer from a large insertion loss. However, it is possible, at the cost of increasing the number of external components required, to minimize this insertion loss by using a matching circuit consisting of 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	US	PAL
	f = 58.75 MHz	f = 45.75 MHz	f = 38.9 MHz
VCO coils			
	S O O O C C 27 pF	S O O O O O O O O O O O O O O O O O O O	S O O O O O O O O O O O O O O O O O O O
	Test production no. 16991B	Test production no. 16687B	Test production no. 16686B
	Tokyo Parts Industrial Co., Ltd.	Tokyo Parts Industrial Co., Ltd.	Tokyo Parts Industrial Co., Ltd.
SAW filters (split)	Picture	Picture	Picture
	TSF1137U	TSF1241	TSF5315
	Sound	Sound	Sound
SAW filters (inter)		TSF5220	TSF5321
		TSF5221	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.

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