



SANYO Semiconductors

DATA SHEET

LA8677V — Monolithic Linear IC

IF Signal Processor for Cordless Phones

Overview

The LA8677V is IF signal processor for cordless phones.

Features

- Since 2nd-MIX, IF filter, IF amplifier, FM detection, a comparator, etc. are implemented, FM wireless data transmission receiver can easily be composed.
- Since IF ceramic filter and discriminator for FM demodulation are implemented, it is effective on the reduction of external components.

Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage	$V_{CC\text{ max}}$		7	V
Allowable power dissipation	$P_d\text{ max}$	$T_a \leq 70^\circ\text{C}$	150	mW
Operating temperature	T_{opr}		-20 to +70	$^\circ\text{C}$
Storage temperature	T_{stg}		-50 to +125	$^\circ\text{C}$

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage	V_{CC}	V_{CC1}, V_{CC2}	1.8	2.0	5.5	V
Mixer input frequency	F_{in}	MIXIN		21.3		MHz
Local input amplitude	VLO	LOIN	95	100	105	dB μ

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LA8677V

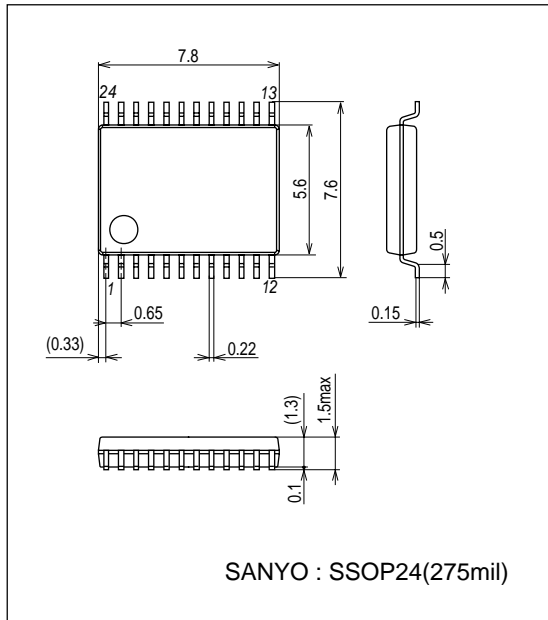
Electrical characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 2.0\text{V}$, $f_{in} = 21.3\text{MHz}$, $f_m = 1\text{kHz}$, $\Delta f = \pm 1.5\text{kHz}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current	I_{CCO}	No signal input	4.3	7	9.0	mA
Mixer image rejection ratio	I_{rr}	$V_{IN} = 70\text{dB}\mu\text{EMF}$ 4-pin GND	20	35		dB
Mixer conversion gain	G_c	$V_{IN} = 60\text{dB}\mu\text{EMF}$ 4-pin GND	26	30		dB
Mixer input impedance	R_{IN}			5		k Ω
	C_{IN}			3		pF
Input sensitivity	V_{SN}	$(S+N)/N = 12\text{dB}$		20		dB μEMF
Demodulation output	V_{det}	$V_{IN} = 80\text{dB}\mu\text{EMF}$	110	140	170	mVrms
SN ratio	SNR	$V_{IN} = 80\text{dB}\mu\text{EMF}$	40	54		dB
AM rejection ratio	AMR	$V_{IN} = 80\text{dB}\mu\text{EMF}$ AM = 30%	32	38		dB
Distortion factor	THD	$V_{IN} = 80\text{dB}\mu\text{EMF}$		-38	-30	dB
Demodulation bandwidth	F_c	-3dB		3		kHz
IF filter bandwidth	BW	-3dB bandwidth	6	8		kHz
IF filter attenuation	ATT	$f = 50\text{kHz} \pm 12.5\text{kHz}$	50	57		dB
RSSI output voltage	V_{rssi1}	$V_{CC} = 3\text{V}$, $V_{IN} = 20\text{dB}\mu\text{EMF}$	0.3	0.6	0.9	V
	V_{rssi2}	$V_{CC} = 3\text{V}$, $V_{IN} = 90\text{dB}\mu\text{EMF}$	1.8	2.2	2.6	V
RSSI comparator reference input range	V_{REF}	10pin input	0.3		$V_{CC}-1$	V
RSSI comparator hysteresis width	V_{HYS}			30		mV
RSSI comparator output voltage	V_{RDET}	20pin output, $V_{REF} < V_{RSS1}$, $I_S = 0.2\text{mA}$		0.1	0.5	V
Noise detection output voltage	V_{ndet}	19pin, $I_S = 0.2\text{mA}$		0.1	0.5	V
Noise comparator detection level	V_{THH}			0.5		V
	V_{THL}			0.4		V

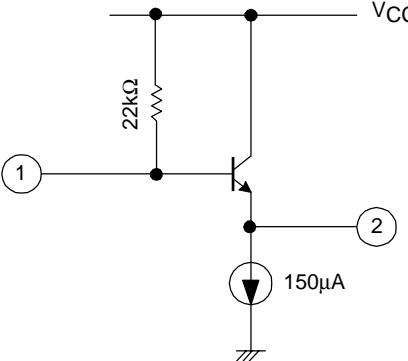
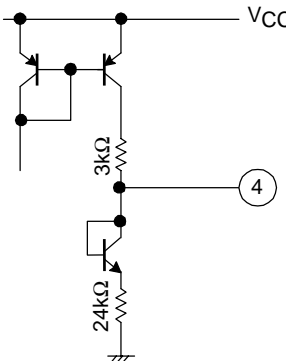
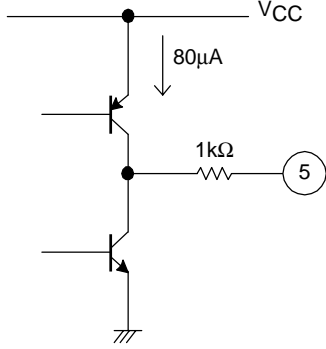
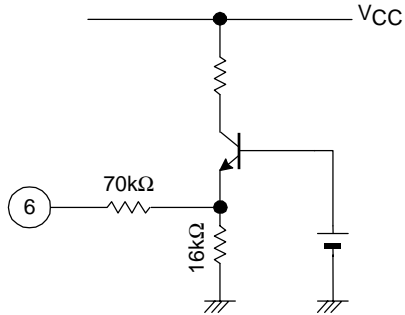
Package Dimensions

unit : mm (typ)

3175C



Pin Functions Description

Pin No.	Pin Name	Function	Internal Equivalent circuit
1	LOIN	Pin for local oscillator Input to internal mixer through emitter follower	
2	TEST		
3	V _{CC1}	Power supply pin	
4	AGC	Mixer circuit's AGC pin A smoothing capacitor is connected between this pin and GND.	
5	MIXOUT	Mixer output pin	
6	IFIN	IF filter input	

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Pin No.	Pin Name	Function	Internal Equivalent circuit
7	VCOM	The built-in filter's common voltage pin A bypass capacitor is connected between this pin and GND.	
8	TEST	Test pin Open in use	
9	NF	IF AMP's DC feedback bias pin A capacitor is connected between this pin and GND.	
10	VREF	RSSI comparator's reference input pin	
11	RSSI	DC voltage output pin proportional (logarithmic proportion) to IF AMP input signal D Range: 80dB(approx.)	
12	AFC	Quadrature detector's AFC pin A capacitor is connected between this pin and GND.	

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Pin No.	Pin Name	Function	Internal Equivalent circuit
13	IFOUT	IF AMP output pin	
14	DETIN	FM demodulation circuit's input pin	
15	AFOUT	FM demodulation output pin	
16	AOUT	Filter AMP input/output pin The external CR is used to compose BPF. Connected internally to noise detection circuit.	
17	AIN		
18	CN	Noise detection pin Connect a smoothing capacitor and obtain the DC voltage proportional to noise input.	

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Pin No.	Pin Name	Function	Internal Equivalent circuit
19	N-DETOUT	Comparator circuit output pin for noise detection output (pin 18) Open collector pin with hysteresis at 100mV	
20	R-DETOUT	Comparator circuit pin between VR pin input and RSSI pin output Open collector output "LOW" when VR < RSSI.	
21	V _{CC2}	Power pin for filter automatic regulation circuit	
22	CTUN	Filter automatic regulation circuit's capacitor pin A capacitor is connected between this pin and GND.	
23	GND		
24	MIXIN	Second mixer input pin	

Cautions for Application

1. IF filter (BPF) and FM demodulation 90° phase converter

The RF input is converted to 2nd IF 50Hz by the 2nd mixer circuit and enters the IF filter (BPF).

This IF filter consists of active filters, each with the center frequency of 50kHz, -3dB bandwidth 8kHz, and attenuation of about 55dB at ± 12.5 kHz.

The 90° phase converter of quadrature type FM demodulation circuit also consists of active filter.

Since features of these built-in filters affects substantially the selectivity and demodulation output distortion, these features must be stable not susceptible to device variations and ambient temperature.

Accordingly, this IC is designed to perform automatic adjustment of the center frequency of built-in filters by means of the reference signal generated from the local signal. It is therefore necessary to use the high-accuracy frequency, such as a crystal oscillator circuit output, for the local signal.

2. Filter composition with noise input OP amplifier

BPF or LPF can be composed as shown in the figure

① BPF

• Calculation formula

The constant design equation with the center frequency $\omega = 1$ is shown below.

In actual design, scaling is made for the device value and frequency.

$$R_{\text{new}} = R \cdot K_m$$

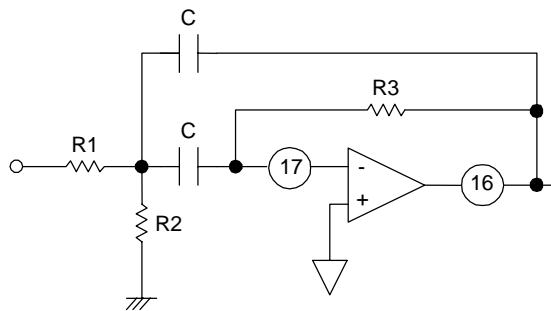
$$C_{\text{new}} = C / (K_m \cdot K_f)$$

Where

$K_m = R_{\text{min}}$: Scaling constant for device value. Select minimum resistance

$K_f = 2\pi f_0$: Frequency scaling constant

f_0 : Center frequency



Original circuit constant

$$R_1 = 2Q^2$$

$$R_2 = \frac{2Q^2}{2Q^2 - 1}$$

$$R_3 = 4Q^2$$

$$C = \frac{1}{2Q}$$

• Design example

Target specifications:

$$Q = 3, f_0 = 20\text{kHz}, R_{\text{min}} = 5.1\text{k}\Omega$$

$$R_1 = 2 \cdot Q^2 \cdot K_m = 91.8\text{k}\Omega \rightarrow 91\text{k}\Omega$$

$$R_2 = \frac{2Q^2}{2Q^2 - 1} \cdot K_m = 5.4\text{k}\Omega \rightarrow 5.6\text{k}\Omega$$

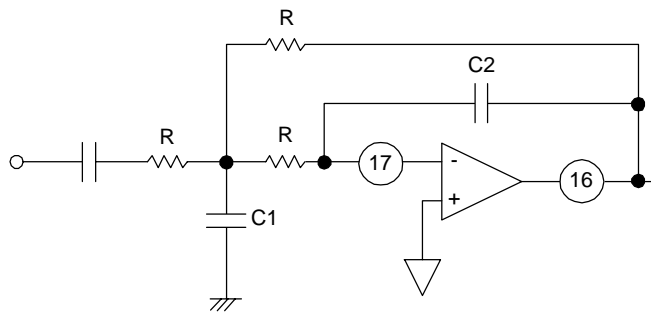
$$R_3 = 4Q^2 K_m = 183.6\text{k}\Omega \rightarrow 180\text{k}\Omega$$

$$C = \frac{1}{2Q} \cdot \frac{1}{K_m \cdot K_f} = 260\text{pF} \rightarrow 270\text{pF}$$

② LPF

• Calculation formula

The design equation with the cut off frequency $\omega = 1$ is also shown below.



Original circuit constant

$$\begin{aligned} R_1 &= 1 \\ C_1 &= 3Q \\ C_2 &= 1/3Q \end{aligned}$$

• Design example

Target specifications:

$$f_c = 30\text{kHz}, Q = \frac{1}{\sqrt{2}}, R_{\min} = 10\text{k}\Omega$$

$$R = K_m = 10\text{k}\Omega$$

$$C_1 = 3Q \cdot \frac{1}{K_m \cdot K_f} = 1.13\text{nF} \rightarrow 1.2\text{nF}$$

$$C_2 = \frac{1}{3Q} \cdot \frac{1}{K_m \cdot K_f} = 250\text{pF} \rightarrow 270\text{pF}$$

3. Noise detection circuit response time and noise detection output

The response time is determined from the product of the noise detection capacity (pin 18) and internal resistance (75k).

Note that decreasing the detection capacity can reduce the response time, but causes malfunction readily. On the other hand, increasing the detection capacity can ensure the reliable operation, but causes longer response time.

When a malfunction occurs due to the 50kHz carrier leak component overlapping the FM demodulation output, the use of LPF incorporating an OP amplifier to attenuate such leak component ensures stable operation.

On detection, the noise comparator output (pin 19) becomes “HIGH”.

4. RSSI comparator

The RSSI comparator output is the result of comparison between the RSSI output and reference voltage.

With $VRSSI > VREF$, the comparator output becomes “LOW”.

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