



# LA3161

## 2-Channel Preamplifier For Car Stereo

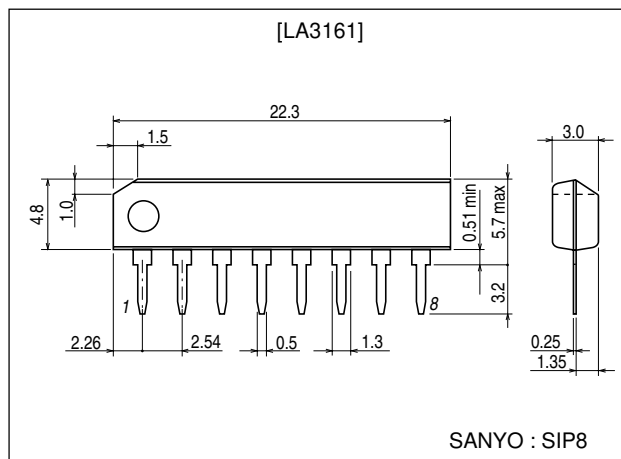
### Features

- On-chip 2 preamplifiers.
- Good ripple rejection owing to on-chip voltage regulator.
- Minimum number of external parts required.
- Low noise.
- 8-pin SIP package facilitating easy mounting.
- Pin-compatible with LA3160.

### Package Dimensions

unit:mm

3016B-SIP8



### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum Supply Voltage	$V_{CC\text{ max}}$		18	V
Allowable Power Dissipation	$P_d\text{ max}$		200	mW
Operating Temperature	$T_{opr}$		-20 to +75	$^\circ\text{C}$
Storage Temperature	$T_{stg}$		-40 to +125	$^\circ\text{C}$

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

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	$V_{CC}$		9	V
Load Resistance	$R_L$		10k	$\Omega$

#### Operating Conditions at $T_a = 25^\circ\text{C}$ , $V_{CC}=9\text{V}$ , $R_L=10\text{k}\Omega$ , $R_g=600\Omega$ , $f=1\text{kHz}$ , NAB

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current Dissipation	$I_{CC}$			6.5	8.0	mA
Voltage Gain	VG	Closed loop		35		dB
		Open loop, $V_O=0.77\text{V}$	70	78		dB
Output Voltage	$V_O$	THD=1%	1.0	1.3		V
Total Harmonic Distortion	THD	$V_O=0.5\text{V}$		0.05	0.30	%
Input Resistance	$r_i$		70k	100k		$\Omega$

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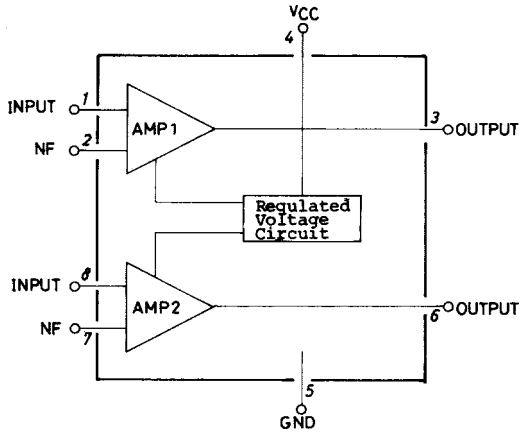
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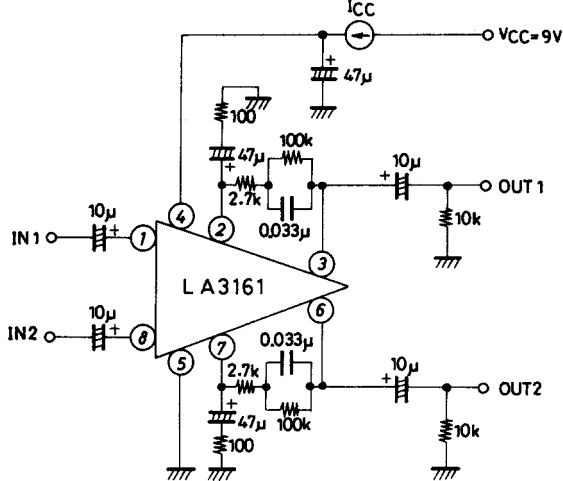
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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Equivalent Input Noise Voltage	$V_{NI}$	$R_g=2.2k\Omega$		1.2	2.0	$\mu F$
Crosstalk	CT	$R_g=2.2k\Omega$	-50	-65		dB
Ripple Rejection	Rr			-40		dB

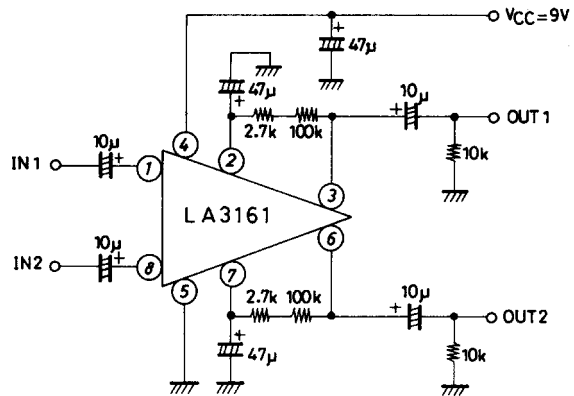
## Equivalent Circuit Block Diagram



## Test Circuit1 : $V_O, V_G, THD, I_{CC}, f_i$

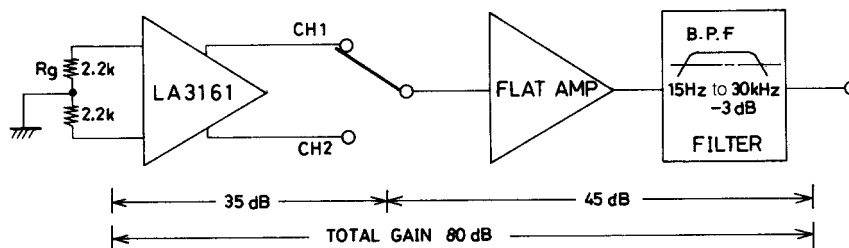


## Test Circuit2 : $V_{G_O}$

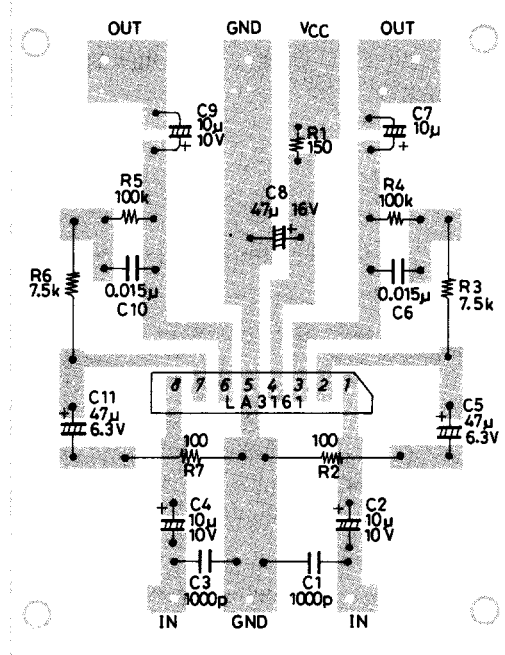
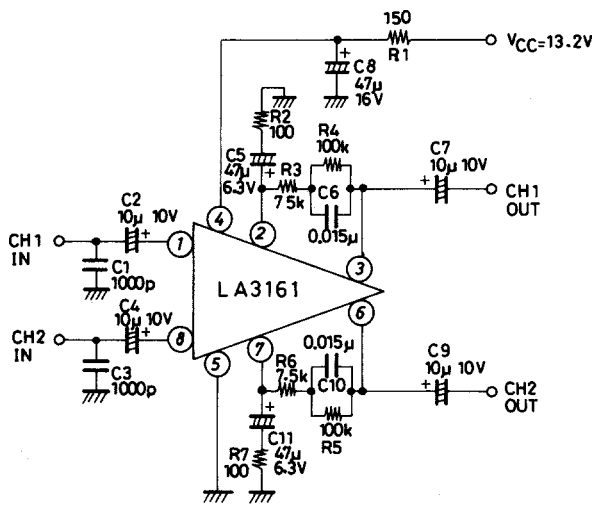


Unit (resistance:  $\Omega$ , capacitance: F)

## Test Circuit3 : Noise



## Sample Application Circuit 1 : Preamplifier for Car Stereo



Unit (resistance: Ω, capacitance: F)

### Function of External Parts

C<sub>2</sub>, C<sub>4</sub> are input coupling capacitors. In NAB equalizer amplifier, the gain at low frequencies is high and 1/f noise inside the IC is emphasized as output noise. Therefore, if the reactance of capacitor at low frequencies is increased, the dependence of 1/f noise on the signal source resistance causes the output noise voltage to deteriorate, and the value of reactance must be made small enough as compared with the signal source resistance. C<sub>2</sub>, C<sub>4</sub> also influence the operation start time and the adequate value of these capacitors is 10μF. (Since C<sub>2</sub>, C<sub>4</sub> of less than 4.7μF make the operation start time longer, use C<sub>2</sub>, C<sub>4</sub> of 4.7μF or more).

C<sub>5</sub>, C<sub>11</sub> are NF capacitors. The lower cut-off frequency depends on the value of these capacitors.

If the lower cut-off frequency is taken as f<sub>L</sub> :

$$C_5 (C_{11}) = 1/2\pi \cdot f_L \cdot R_2 (R_7)$$

If the value of this capacitor is made larger, the operation start time of amplifier is more delayed. The adequate value of capacitor is 47μF.

The frequency characteristic of the equalizer amplifier depends on C<sub>6</sub> and R<sub>4</sub>, R<sub>3</sub> (C<sub>10</sub> and R<sub>5</sub>, R<sub>6</sub>).

The time constants to obtain the standard NAB characteristic are as shown below.

Tape speed	9.5cm/s	4.75cm/s
C6 (R3 + R4)	3180μs	1590μs
R3 C6	90μs	120μs

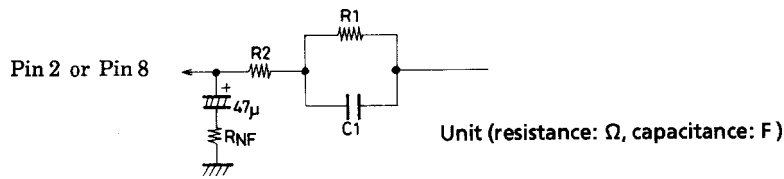
C<sub>8</sub> is bias capacitor for the power line. C<sub>8</sub> of 47μF is inserted at a point as close to the power supply pin (pin 4) as possible.

C<sub>1</sub>, C<sub>3</sub> are for preventing radio interference in the strong electric field, interference attributable to engine noise, and blocking oscillation at the time of large amplitude operation. The adequate value of C<sub>1</sub>, C<sub>3</sub> is approximately 1000pF.

C<sub>7</sub>, C<sub>9</sub> are output coupling capacitors. The adequate value of C<sub>7</sub>, C<sub>9</sub> is 10μF.

**NAB element and determination of gain**

Since the DC feedback is provided by R<sub>1</sub>, R<sub>2</sub> of NAB element, which brings about DC output potential at pins 3, 6, it is impossible to change the value of R<sub>1</sub>, R<sub>2</sub> of NAB element greatly. Therefore, when determining the gain, change R<sub>NF</sub> with R<sub>1</sub>, R<sub>2</sub>, C<sub>1</sub> (NAB element) kept constant.



- (1) How to obtain R<sub>NF</sub>  
Impedance Z of NAB element is

$$Z = \frac{1}{1/R1 + j\omega C1} + R2$$

$$= (R1 + R2) \left\{ \frac{1 + j\omega C1 \{R1R2 / (R1 + R2)\}}{1 + j\omega C1R1} \right\}$$

For a general negative feedback amplifier circuit, A = A<sub>o</sub> / (1 + A<sub>o</sub>β) applies, and Z = A · R<sub>NF</sub> is obtained under conditions of A<sub>o</sub> >> A, A >> 1 (β = R<sub>NF</sub> / (R<sub>NF</sub> + Z), A<sub>o</sub> = open-loop gain, A = feedback gain).

Therefore, we can use an approximation of R<sub>NF</sub> = Z / A.

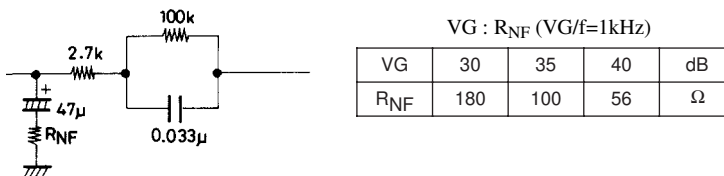
A = (VG for 1kHz) times, (Set R<sub>1</sub>, R<sub>2</sub> at approximately 100kΩ)

Each time constant of NAB characteristic.

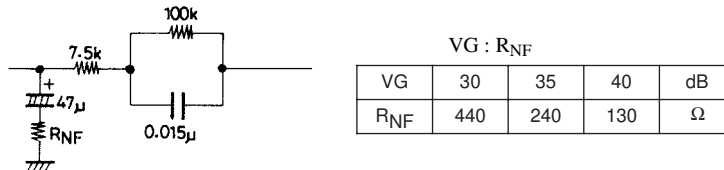
Tape speed		9.5cm/s	4.75cm/s
T1	C1, R1	3180µs	1590µs
T2	C1 (R1//R2)	90µs	120µs

- (2) Examples of NAB Constants

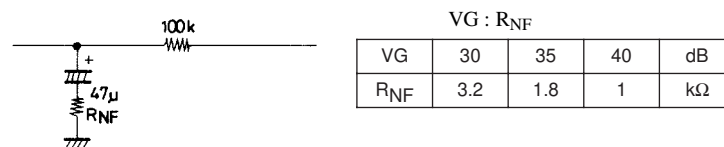
- (a) Tape speed : 9.5cm/s. (8 tracks)



- (b) Tape speed : 4.75cm/s. (cassette)



- (c) Flat amplifier



**Proper cares in using IC**

1. Maximum Rating

If the IC is used in the vicinity of the maximum rating, even a slight variation in conditions may cause the maximum rating to be exceeded, thereby leading to a breakdown. Allow an ample margin of variation for supply voltage, etc. and use the IC in the range where the maximum rating is not exceed.

2. Short between pins

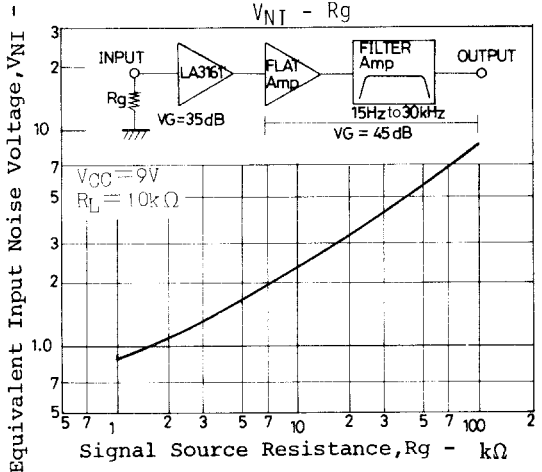
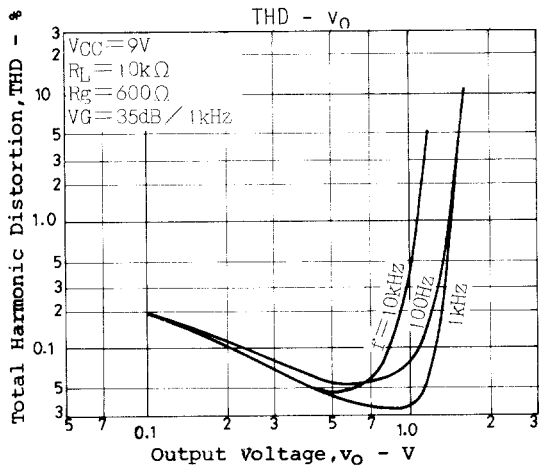
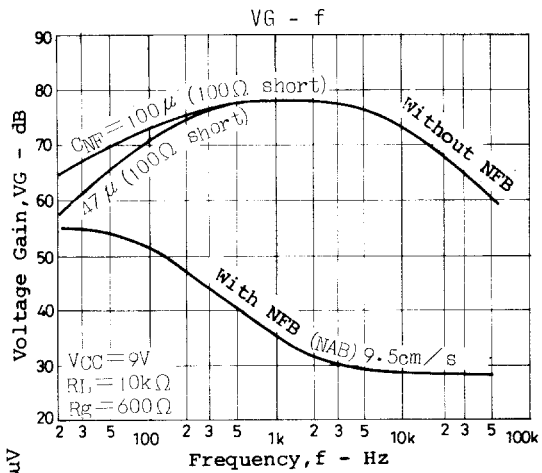
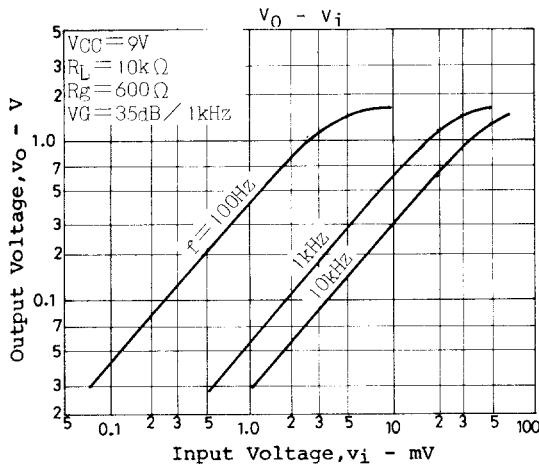
If the supply voltage is applied when the space between pins is shorted, a breakdown or deterioration may occur. When installing the IC on the board or applying the supply voltage, make sure that the space between pins is not shorted with solder, etc.

3. Breakdown of IC attributable to inverted insertion

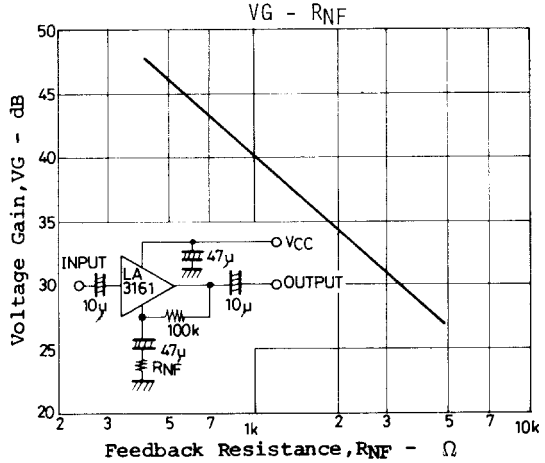
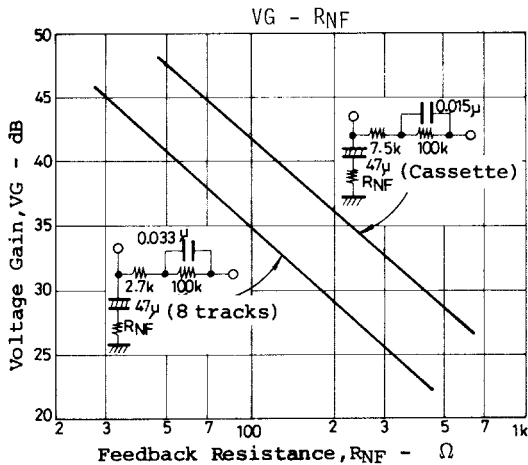
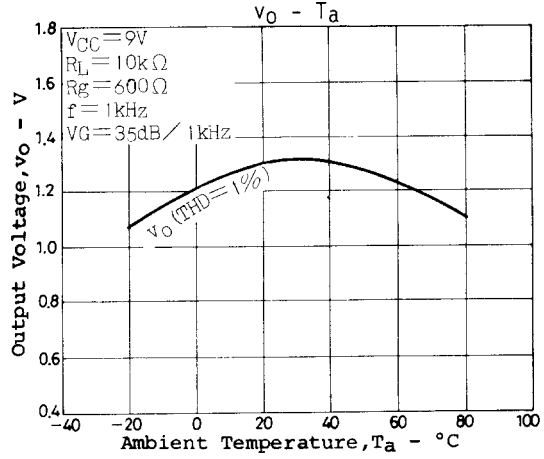
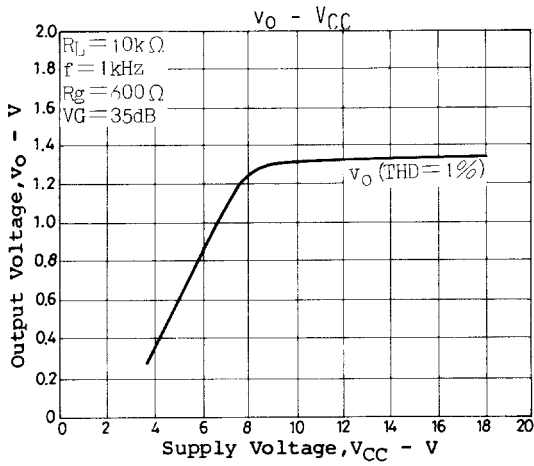
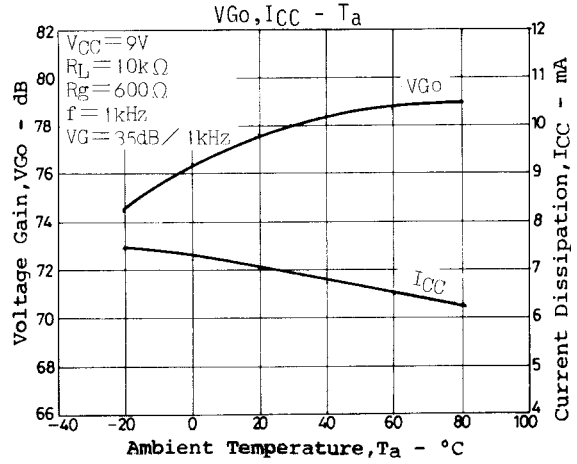
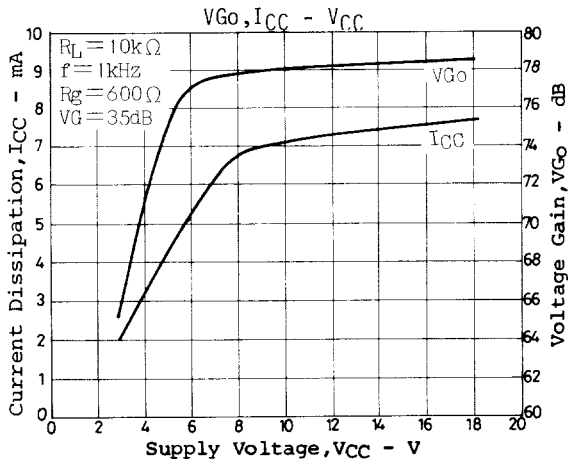
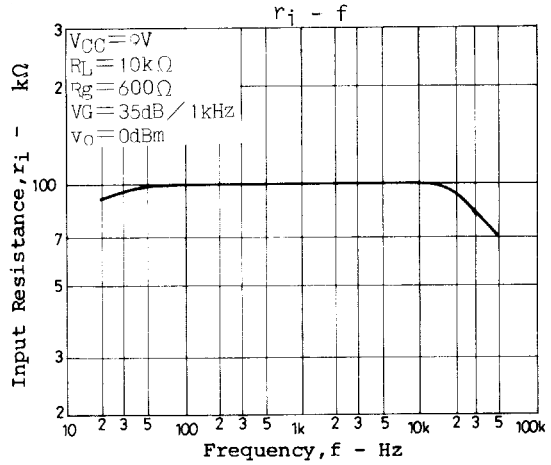
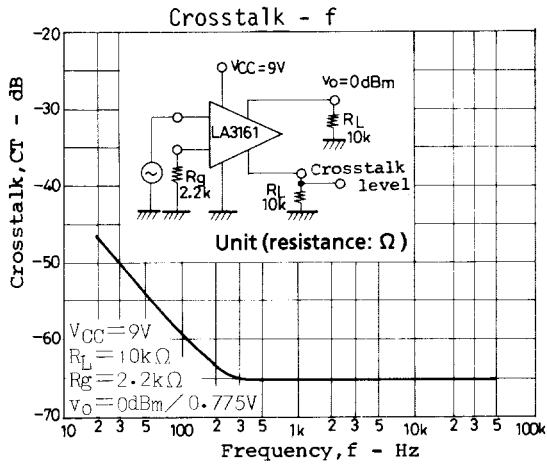
If the IC is inserted inversely and operated, the IC may suffer from something unusual, thereby leading to a breakdown or deterioration of the IC. When installing the IC on the board or operating the IC, check the marked surface of IC.

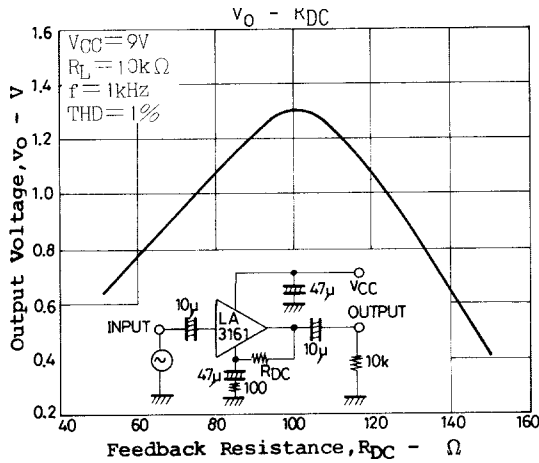
**Proper cares to be taken for obtaining optimum operation of IC**

- Set DC resistance of  $R_1$ ,  $R_2$  of NAB element at approximately  $100k\Omega$ .
- Determine the gain by changing  $R_{NF}$  without chaging NAB constant (Refer to Examples of NAB constant.).



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Unit (resistance:  $\Omega$ , capacitance: F)

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