

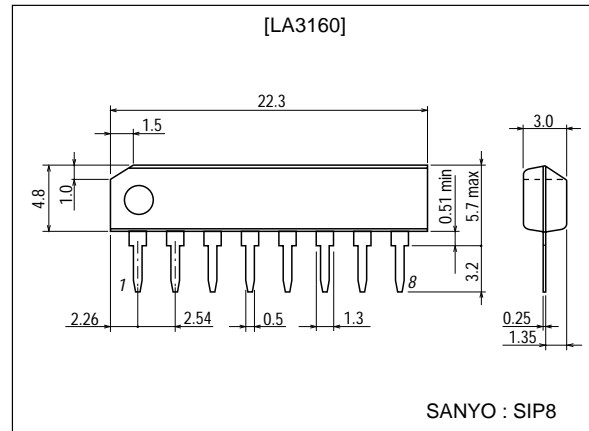
**LA3160****2-Channel Preamplifier For Car Stereo****Features**

- Two preamplifiers on chip.
- Fewer peripheral parts.
- Low noise.
- 8-pin SIP package facilitating easy mounting.

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} max		18	V
Allowable Power Dissipation	P_d 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	Ω

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}			4	6	mA
Voltage Gain	V_G	Closed loop		35		dB
		Open loop, $V_O=0.77\text{V}$	76	80		dB
Output Voltage	V_O	THD=1%	1.1	1.8		V
Total Harmonic Distortion	THD	$V_O=0.5\text{V}$		0.1	0.3	%
Input Resistance	r_i		70k	100k		Ω
Equivalent Input Noise Voltage	V_{NI}	$R_g=2.2\text{k}\Omega$		1.25	2.0	μV
Crosstalk	CT		-50	-65		dB

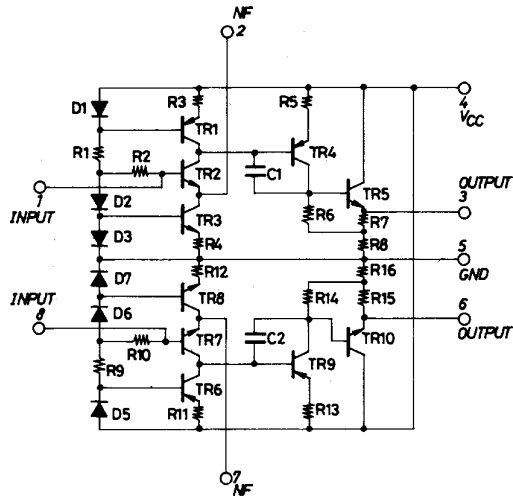
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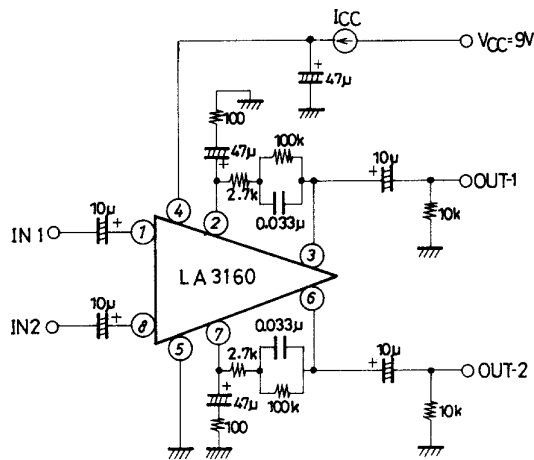
SANYO Electric Co.,Ltd. Semiconductor Company
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

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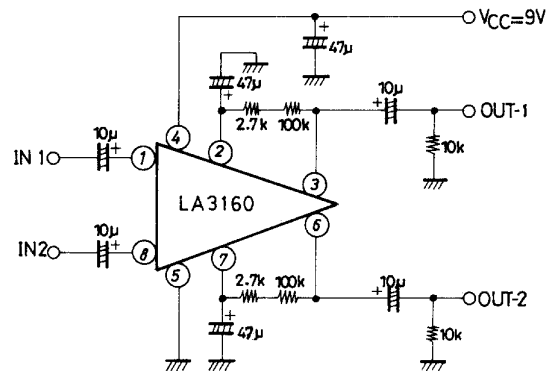
Equivalent Circuit Block Diagram



Test Circuit1 : V_O , V_G , THD, I_{CC} , r_i

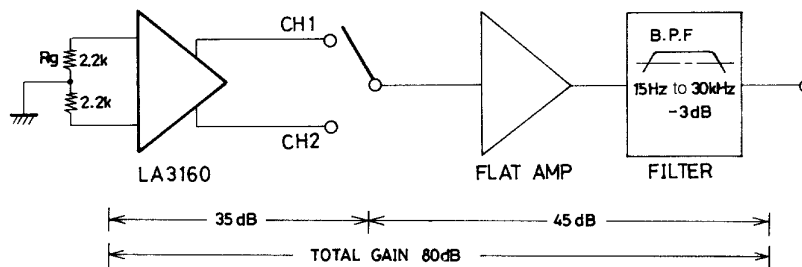


Test Circuit2 : V_{G0}

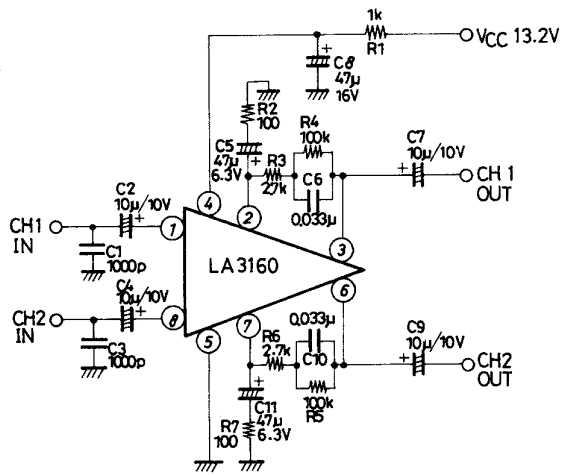


Unit (resistance: Ω , capacitance: F)

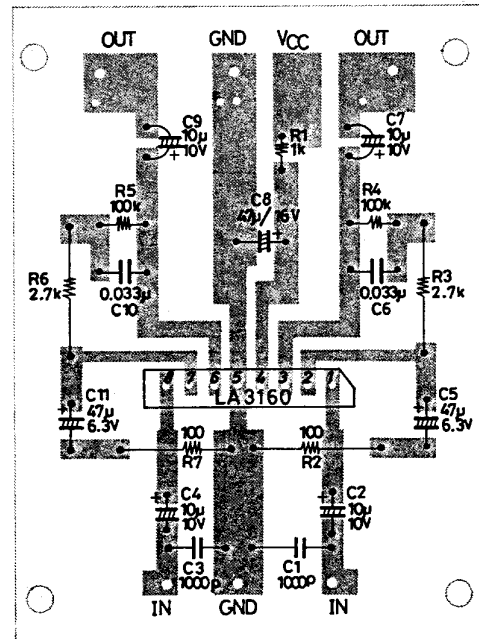
Test Circuit3 : Noise



Sample Application Circuit 1 : Preamplifier for Car Stereo



Unit (resistance: Ω, capacitance: F)



Sample Printed Circuit Pattern
(Cu-foiled area, 67×50mm²)

Function of External Parts

C₂, C₄ 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. C₂, C₄ also influence the operation start time and the adequate value of these capacitors is 10μF. (Since C₂, C₄ of less than 4.7μF make the operation start time longer, use C₂, C₄ of 4.7μF or more).

C₅, C₁₁ 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_L :

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

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 C₆ and R₄, R₃ (C₁₀ and R₅, R₆).

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

Tape speed	9.5cm/s	4.75cm/s
C ₆ (R ₃ + R ₄)	3180μs	1590μs
R ₃ C ₆	90μs	120μs

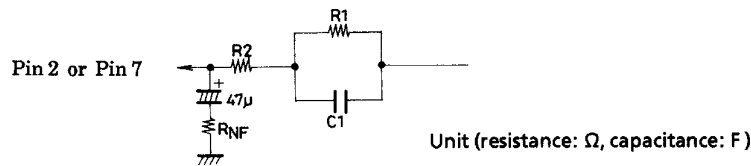
C₈ is bias capacitor for the power line. C₈ of 47μF is inserted at a point as close to the power supply pin (pin 4) as possible.

C₁, C₃ 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 C₁, C₃ is approximately 1000pF.

C₇, C₉ are output coupling capacitors. The adequate value of C₇, C₉ is 10μF

NAB element and determination of gain

Since the DC feedback is provided by R_1 , R_2 of NAB element, which brings about DC output potential at pins 3, 6, it is impossible to change the value of R_1 , R_2 of NAB element greatly. Therefore, when determining the gain, change R_{NF} with R_1 , R_2 , C_1 (NAB element) kept constant.



- (1) How to obtain R_{NF}
Impedance Z of NAB element is

$$Z = \frac{1}{1/R_1 + j\omega C_1} + R_2$$

$$= (R_1 + R_2) \left\{ \frac{1 + j\omega C_1 \{R_1 R_2 / (R_1 + R_2)\}}{1 + j\omega C_1 R_1} \right\}$$

For a general negative feedback amplifier circuit, $A = A_o / (1 + A_o \beta)$ applies, and $Z = A \cdot R_{NF}$ is obtained under conditions of $A_o \gg A$, $A \gg 1$ ($\beta = R_{NF} / (R_{NF} + Z)$, A_o =open-loop gain, A =feedback gain).

Therefore, we can use an approximation of $R_{NF} = Z/A$.

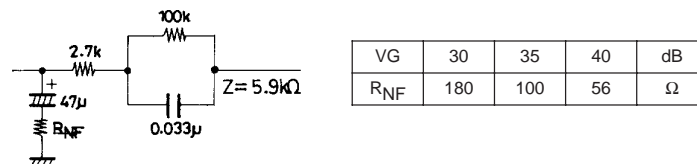
$A = (VG \text{ for } 1\text{kHz}) \text{ times, (Set } R_1, R_2 \text{ at approximately } 100\text{k}\Omega)$

Each time constant of NAB characteristic.

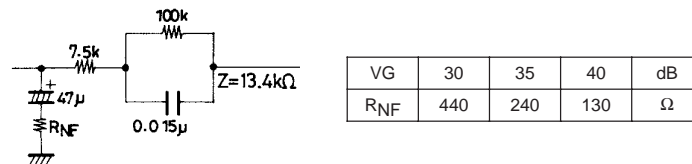
Tape speed		9.5cm/s	4.75cm/s
T1	C_1, R_1	3180 μ s	1590 μ s
T2	$C_1 (R_1/R_2)$	90 μ s	120 μ s

- (2) Examples of NAB Constants

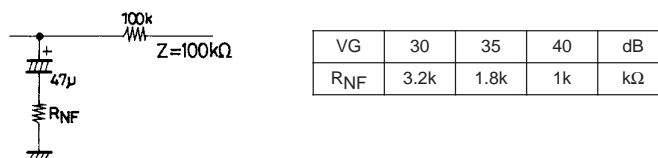
- (a) Tape speed : 9.5cm/s for an 8-track recorder (Z, AG : at $f=1\text{kHz}$)

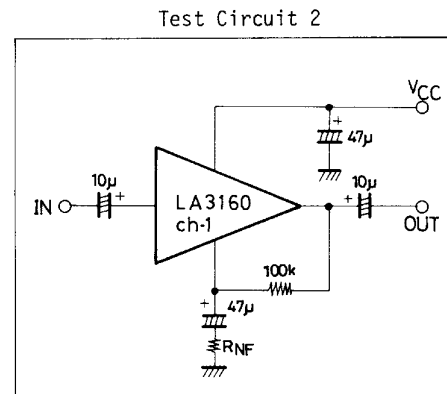
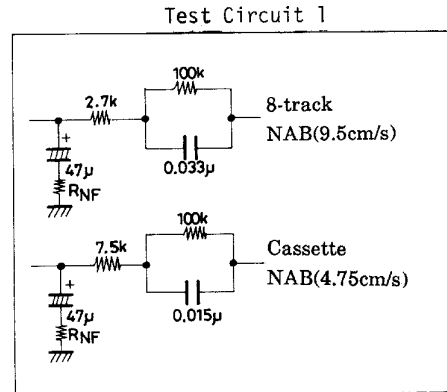
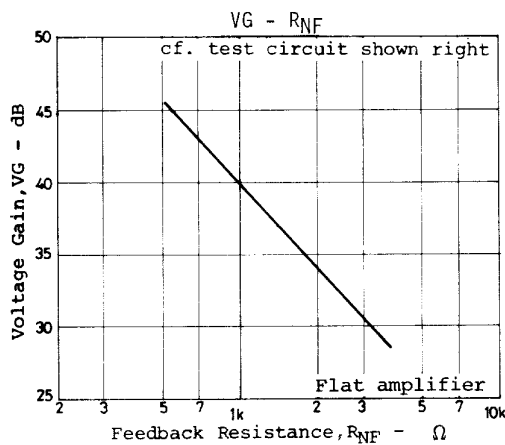
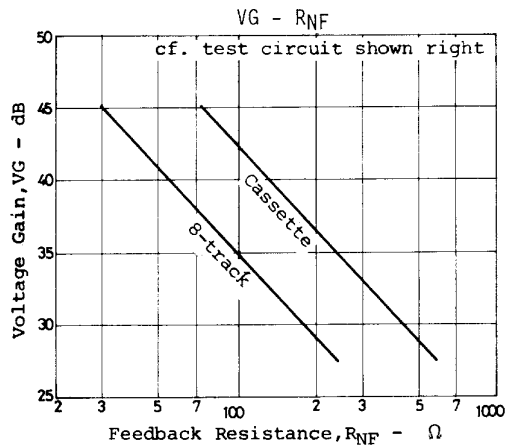
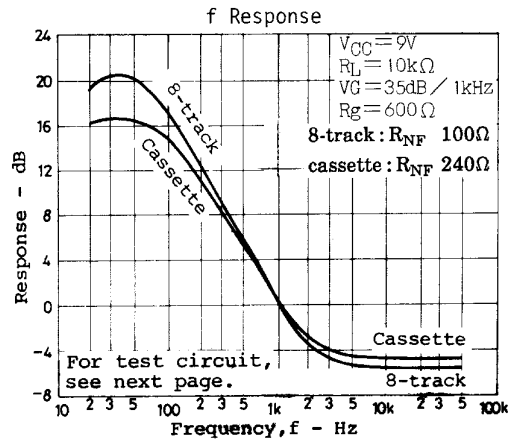
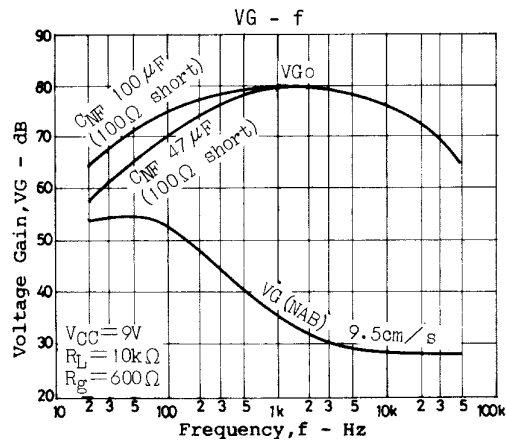
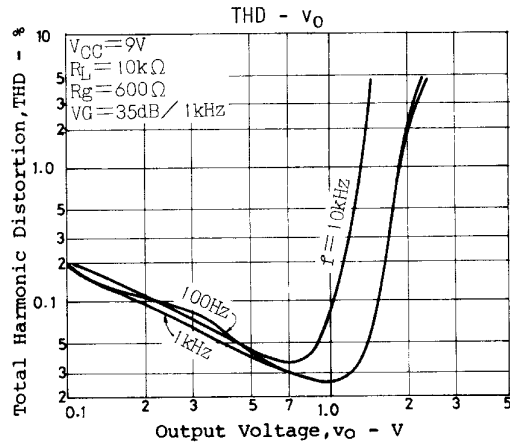
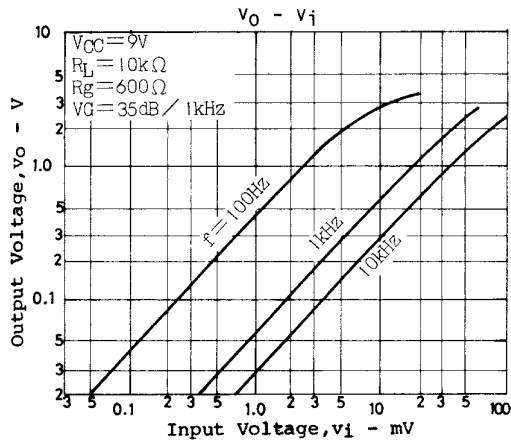


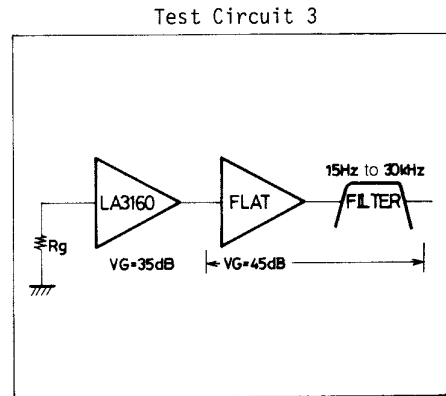
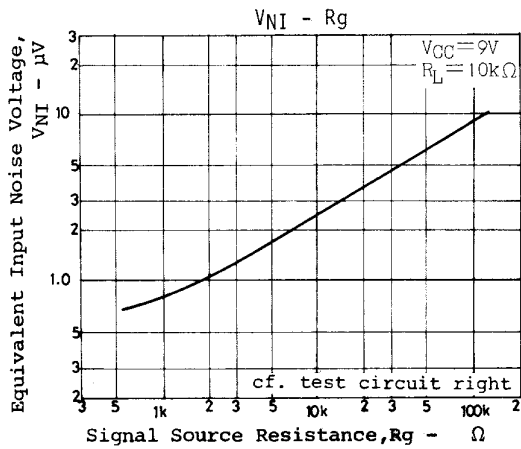
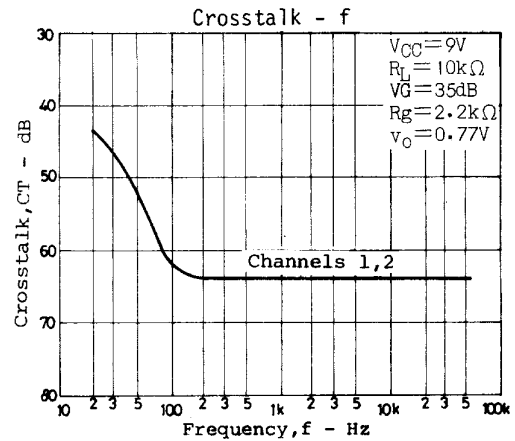
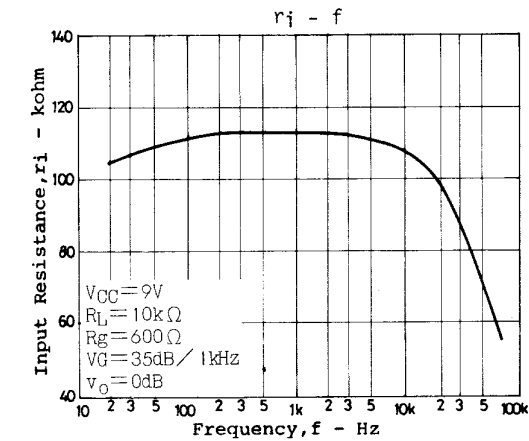
- (b) Tape speed : 4.75cm/s for a cassette tape recorder



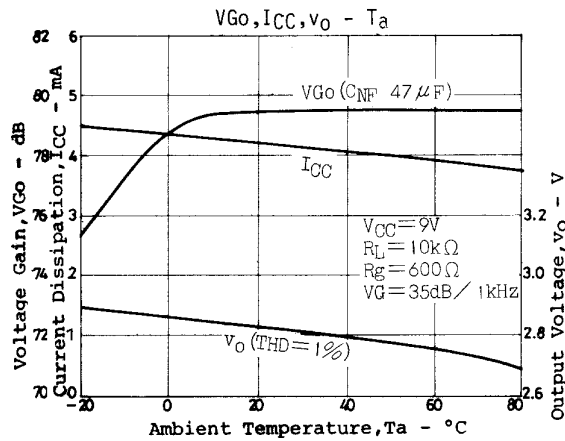
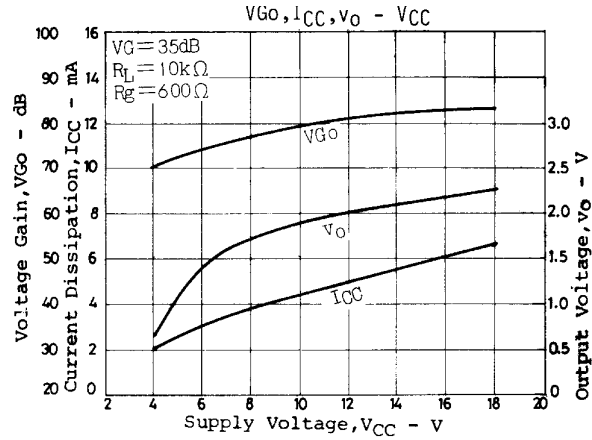
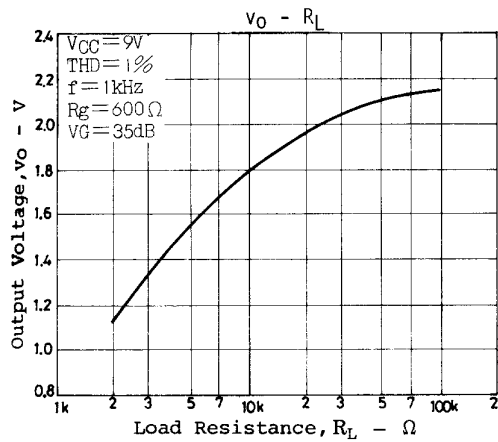
- (c) Flat amplifier







Unit (resistance: Ω , capacitance: F)



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 Ω .
- Determine the gain by changing RNF without chaging NAB constant (Refer to Examples of NAB constant.).
- Supply voltage characteristics are sufficiently considered, but supply voltage is recommended to be between 5V to 18V.

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