

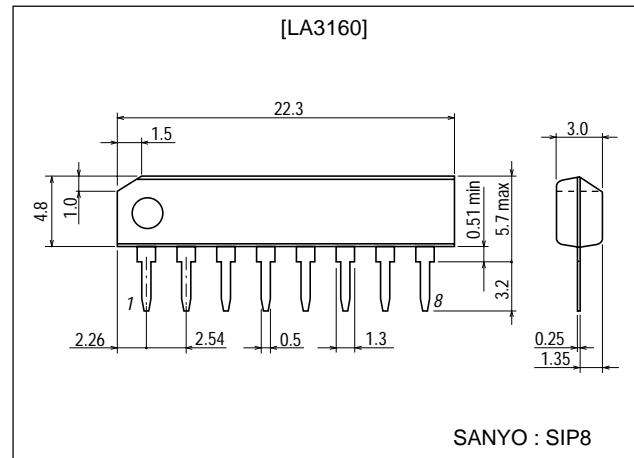
**LA3160****2-Channel Preamplifier For Car Stereo****Features**

- 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	$V_{CC\text{ max}}$		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	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	VG	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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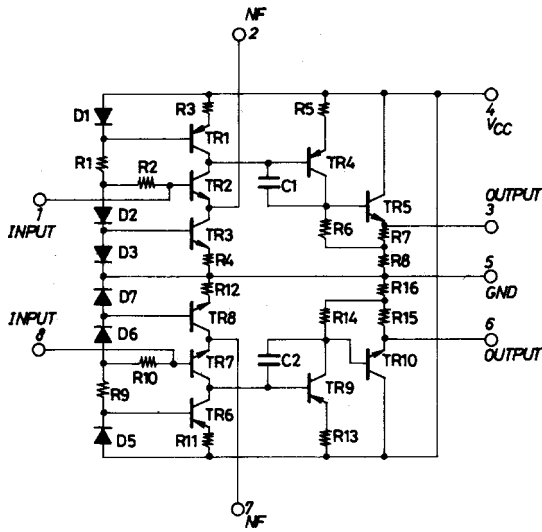
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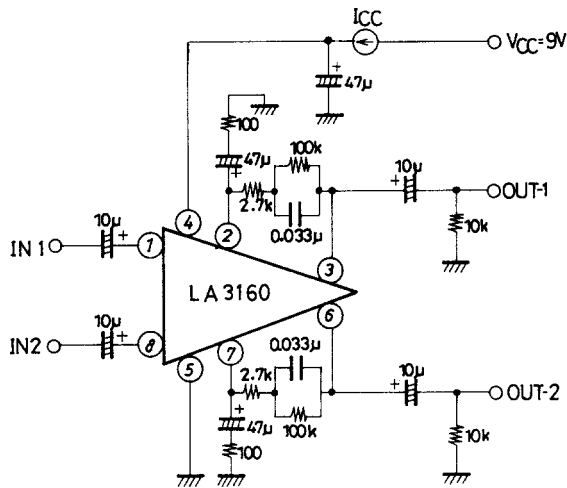
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

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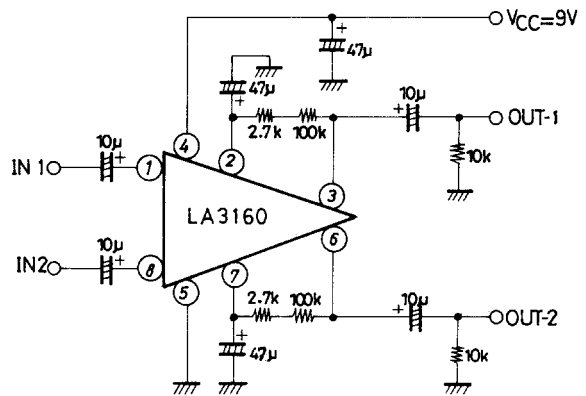
Equivalent Circuit Block Diagram



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

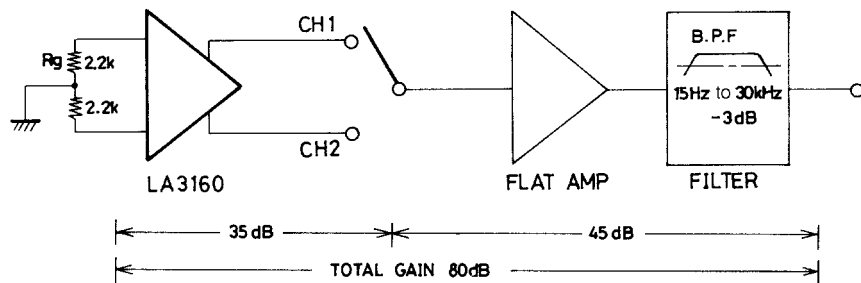


Test Circuit2 : V_{G_O}



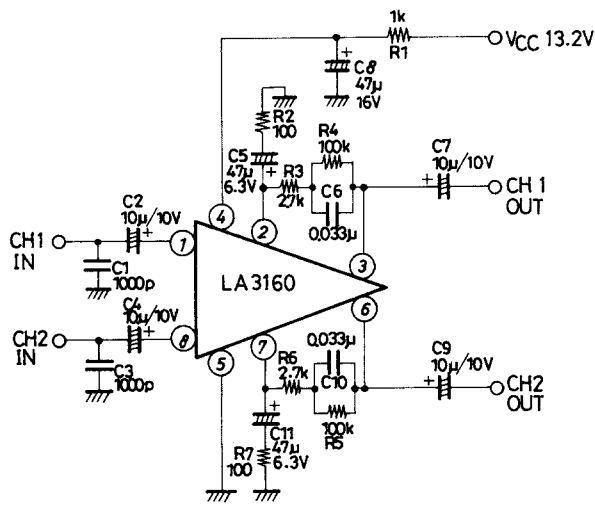
Unit (resistance: Ω , capacitance: F)

Test Circuit3 : Noise

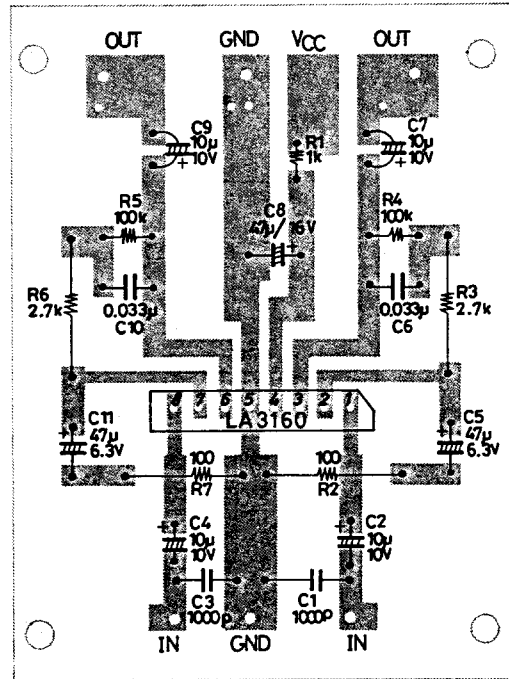


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Sample Application Circuit 1 : Preamplifier for Car Stereo



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 :

$$C5 (C11) = 1/2\pi \cdot f_L \cdot R2 (R7)$$

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
C6 (R3 + R4)	3180µs	1590µs
R3 C6	90µs	120µs

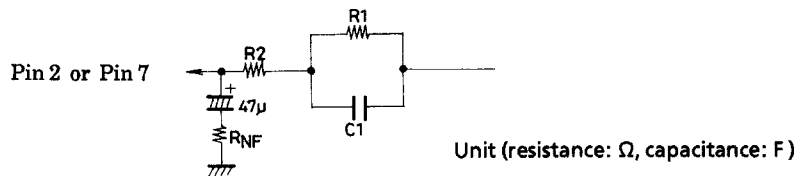
C₈ is bias capacitor for the power line. C₈ of 47µF is inserted at a point as close to the power supply pin (pin 4) as possible.

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 R₁, R₂ of NAB element, which brings about DC output potential at pins 3, 6, it is impossible to change the value of R₁, R₂ of NAB element greatly. Therefore, when determining the gain, change R_{NF} with R₁, R₂, C₁ (NAB element) kept constant.



- (1) How to obtain R_{NF}
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, $A = A_o / (1 + A_o\beta)$ 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 $R_{NF} = Z/A$.

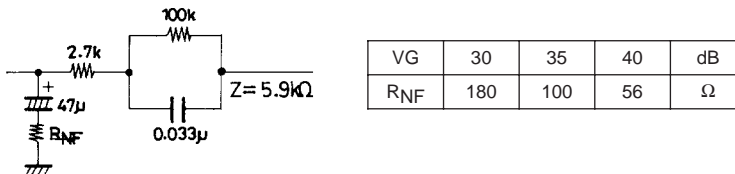
$A =$ (VG for 1kHz) times, (Set R₁, R₂ at approximately 100kΩ)

Each time constant of NAB characteristic.

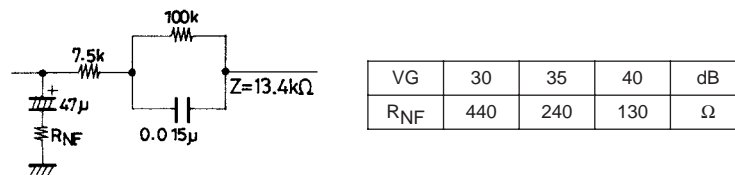
Tape speed		9.5cm/s	4.75cm/s
T1	C1, R1	3180µs	1590µs
T2	C1 (R1//R2)	90µs	120µs

- (2) Examples of NAB Constants

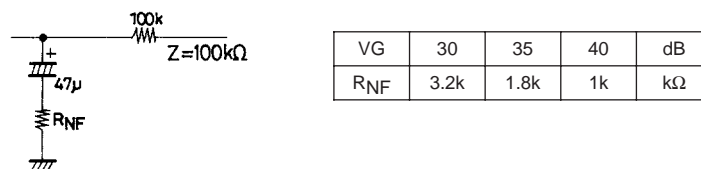
- (a) Tape speed : 9.5cm/s for an 8-track recorder (Z, AG : at f=1kHz)



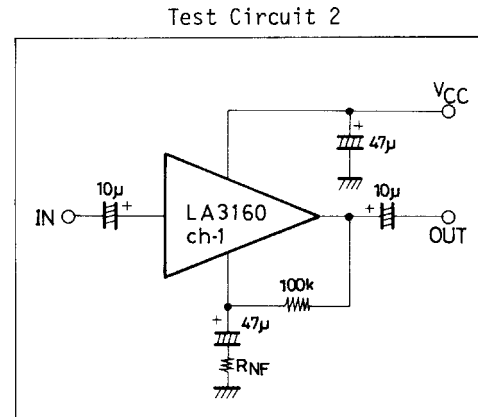
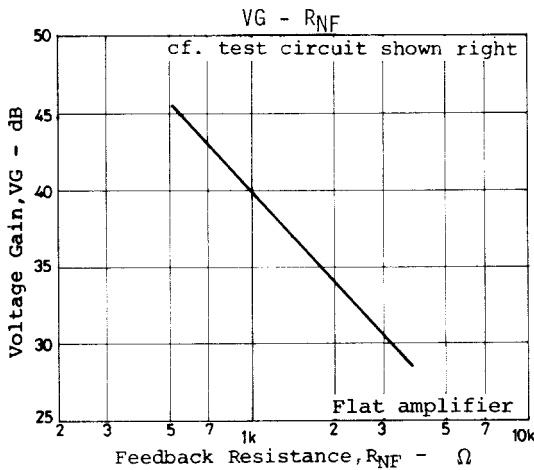
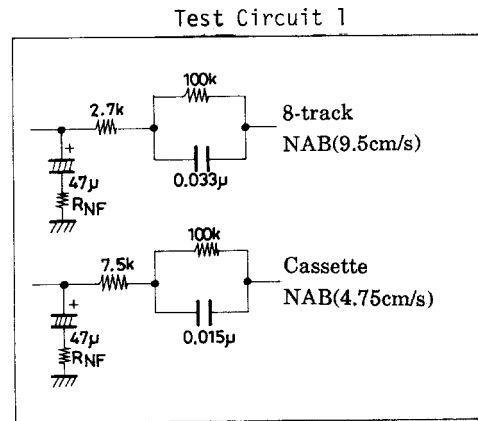
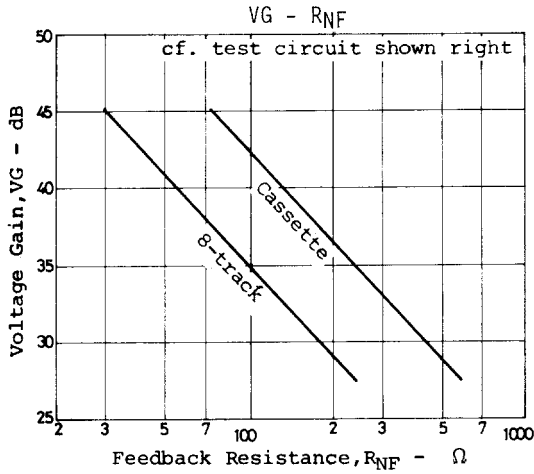
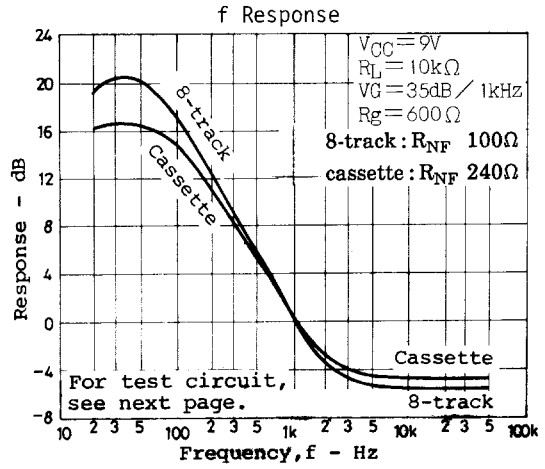
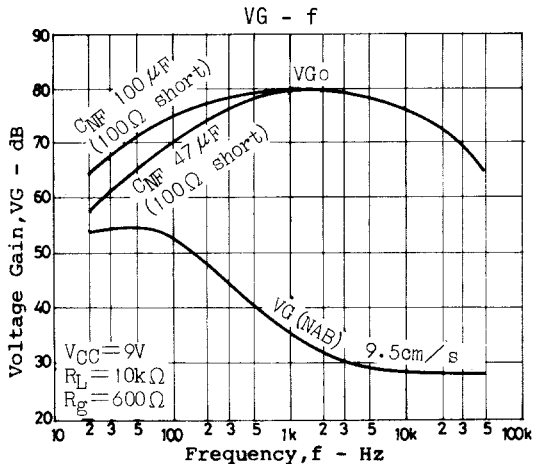
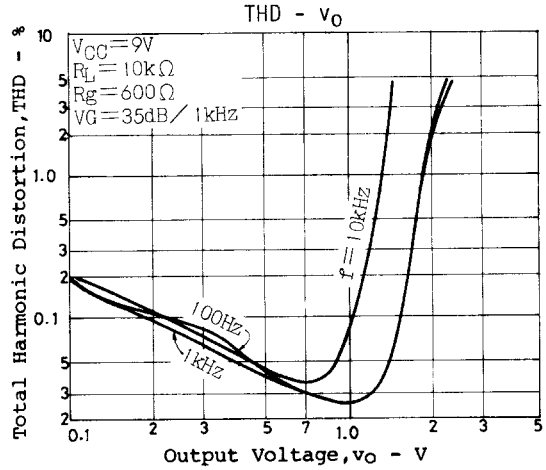
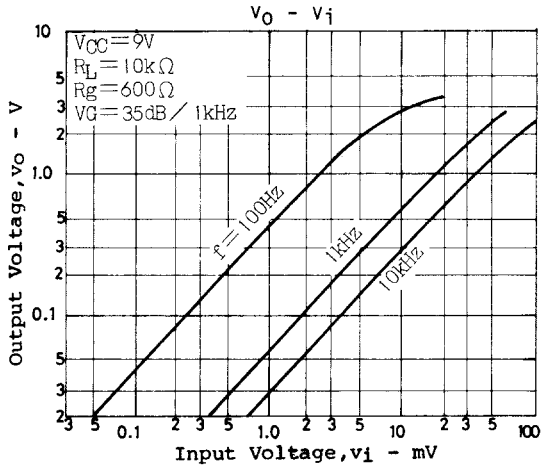
- (b) Tape speed : 4.75cm/s for a cassette tape recorder



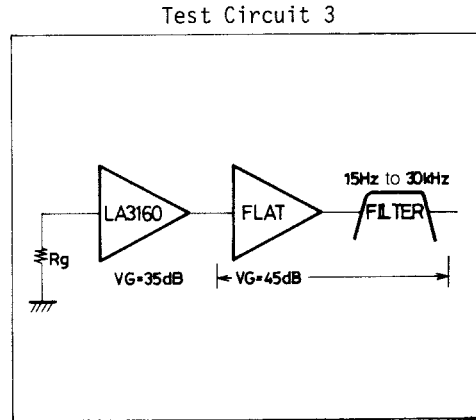
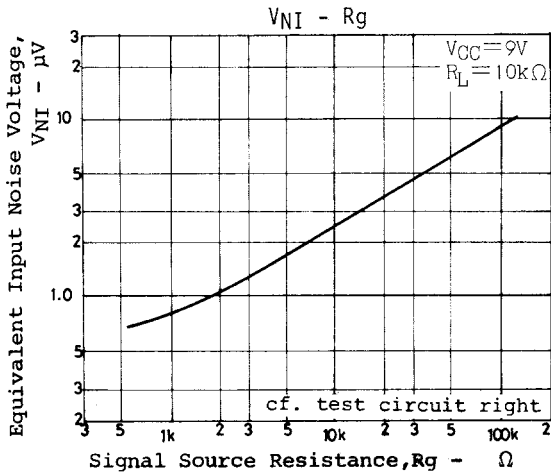
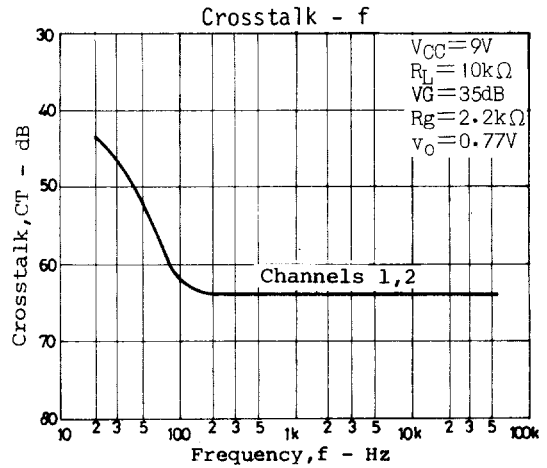
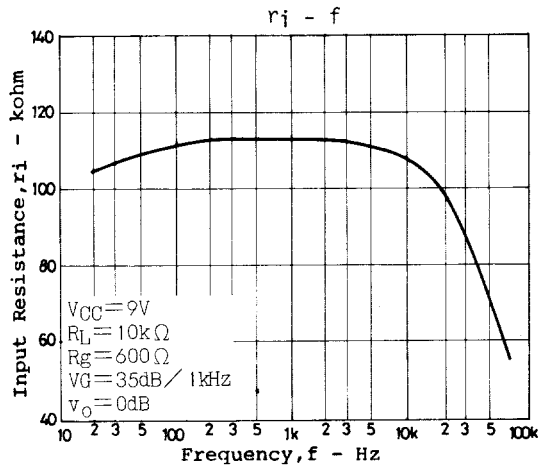
- (c) Flat amplifier



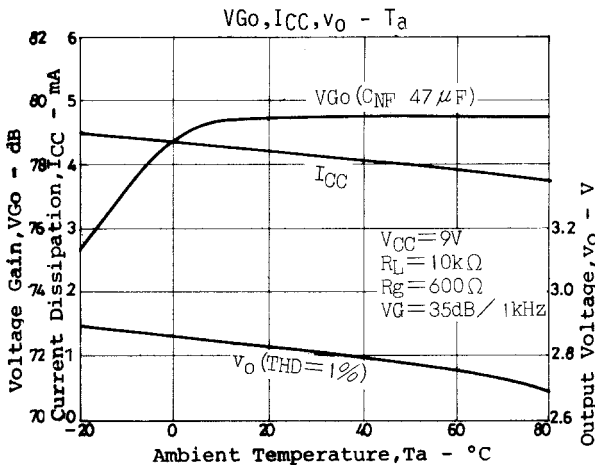
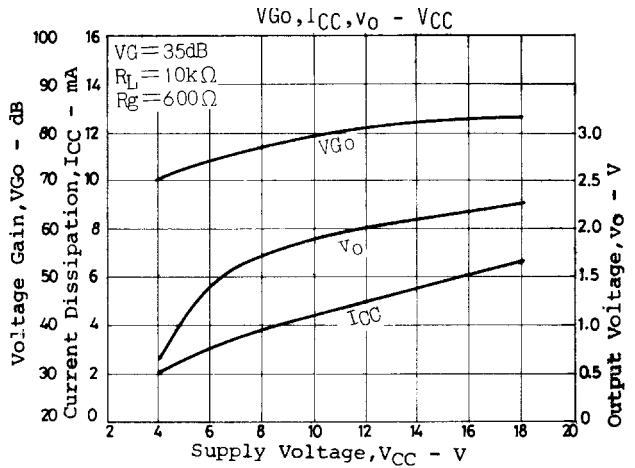
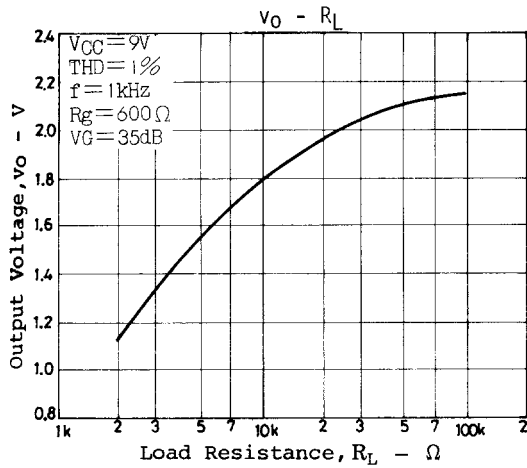
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Unit (resistance: Ω , capacitance: F)



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 exceeded.

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 changing 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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