

**SANYO**

No.494F

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

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

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

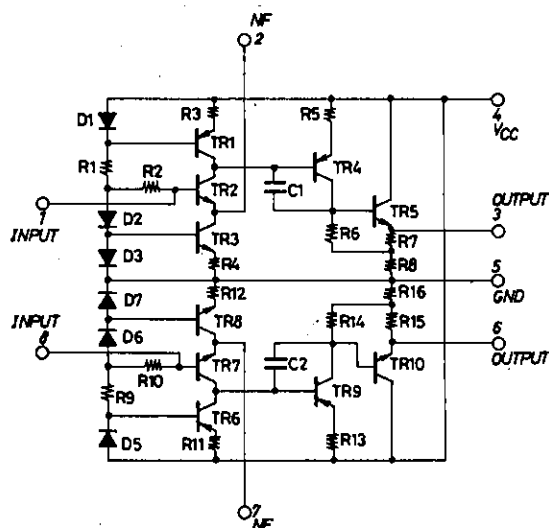
			unit
Maximum Supply Voltage	$V_{CCmax}$	18	V
Allowable Power Dissipation	$P_{Dmax}$	200	mW
Operating Temperature	$T_{opr}$	-20 to +75	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-40 to +125	$^\circ\text{C}$

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

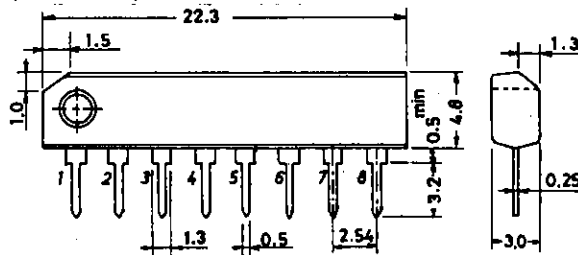
			unit
Supply Voltage	$V_{CC}$	9	V
Load Resistance	$R_L$	10k	$\Omega$

**Operating Characteristics 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**

			min	typ	max	unit
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		$\Omega$
Equivalent Input Noise Voltage	$V_{NI}$	$R_g = 2.2\text{k}\Omega$		1.25	2.0	$\mu\text{V}$
Crosstalk	CT		-50	-65		dB

**Equivalent Circuit Block Diagram****Package Dimensions 3016B**

(unit: mm)



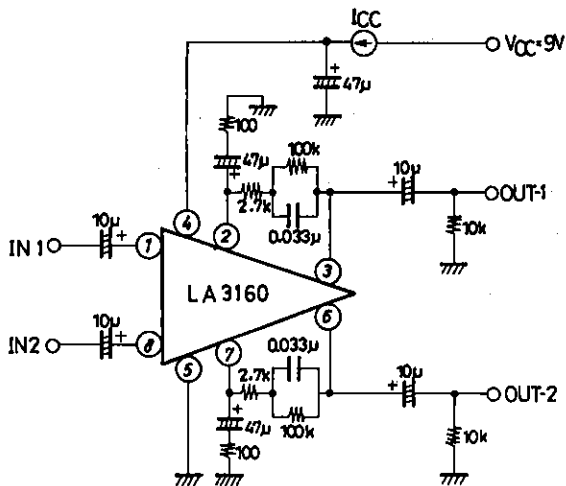
SANYO: SIP8

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

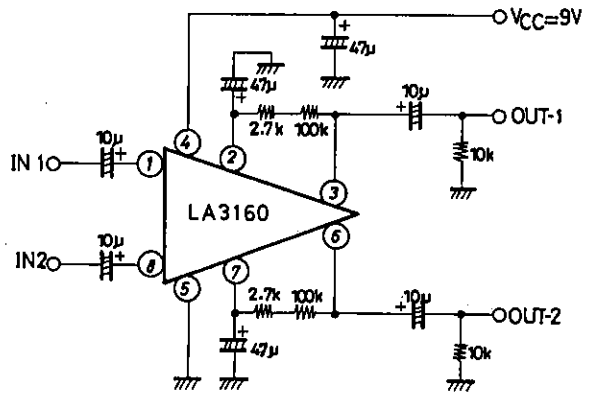
N0493TH/7160TS/O137KI/8044KI/8250KI, TS No.494-1/7

# LA3160

**Test Circuit 1 :  $V_O$ ,  $V_G$ , THD,  $I_{CC}$ ,  $r_i$**

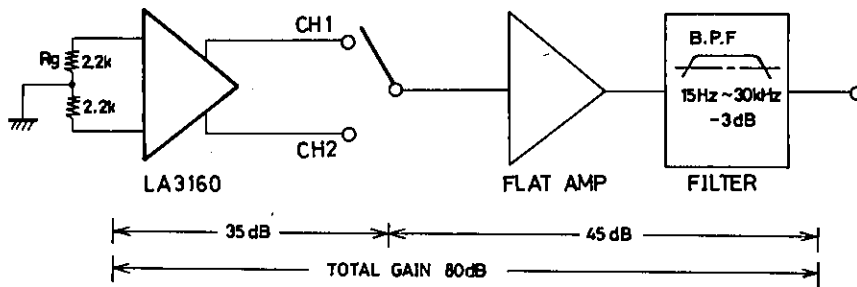


**Test Circuit 2 :  $V_{G0}$**

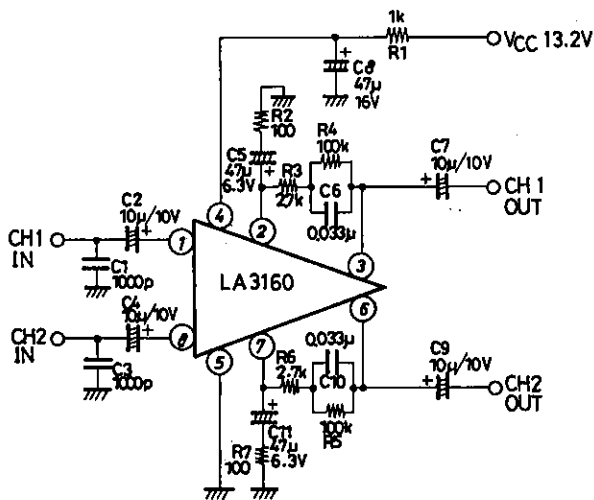


Unit (resistance:  $\Omega$ , capacitance: F)

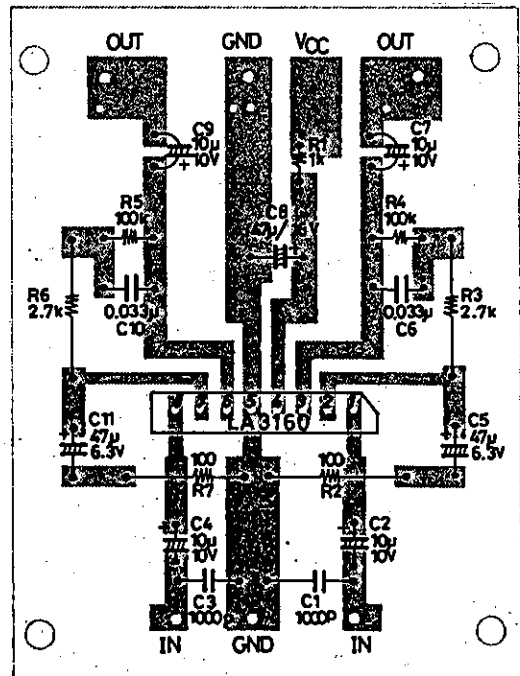
**Test Circuit 3 : Noise**



**Sample Application Circuit 1 : Preamplifier for Car Stereo**



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



Sample Printed Circuit Pattern  
(Cu-foiled area,  $67 \times 50\text{mm}^2$ )

**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 10uF. (Since C<sub>2</sub>, C<sub>4</sub> of less than 4.7uF make the operation start time longer, use C<sub>2</sub>, C<sub>4</sub> of 4.7uF 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> :

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

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

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	9.5 cm/sec	4.75 cm/sec
C6 (R3+R4)	3180 μ sec	1590 μ sec
R3 C6	90 μ sec	120 μ sec

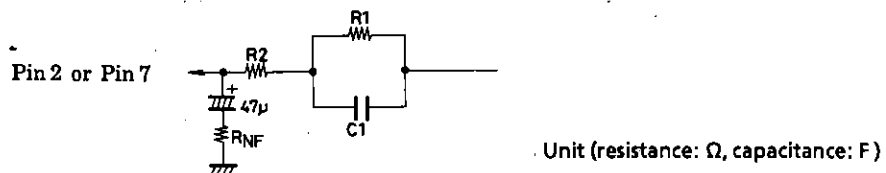
C<sub>8</sub> is a bias capacitor for the power line. C<sub>8</sub> of 47uF is inserted at a point as close to the power supply pin (pin 4) as possible.

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 10uF.

**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

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

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

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 1 kHz) times, (Set R<sub>1</sub>, R<sub>2</sub> at approximately 100kohms.)

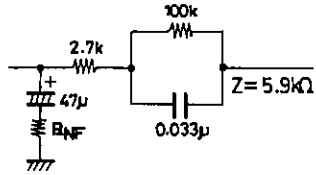
Each time constant of NAB characteristic

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

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

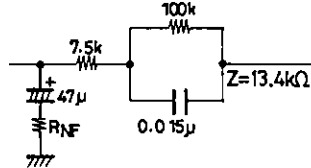
(2) Examples of NAB Constants

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



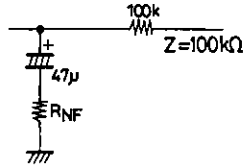
VG	30	35	40	dB
R <sub>NF</sub>	180	100	56	ohm

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

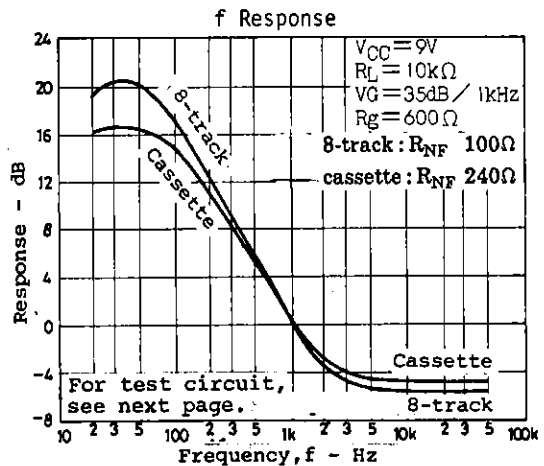
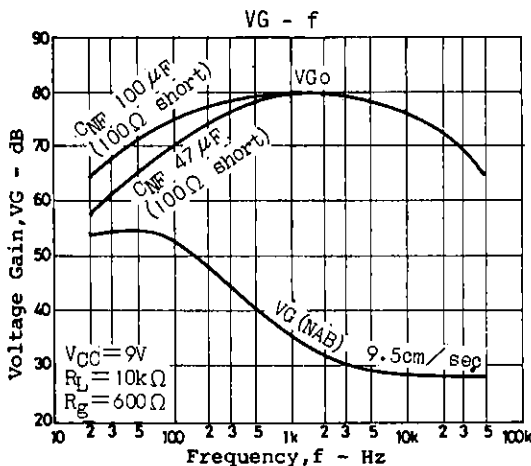
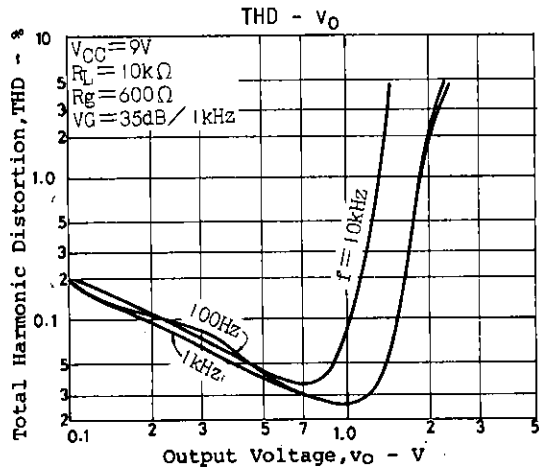
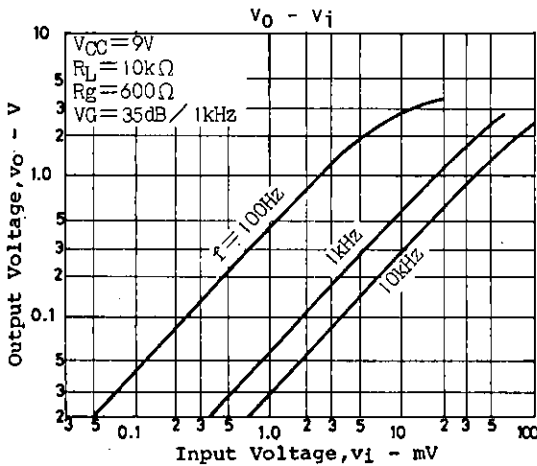


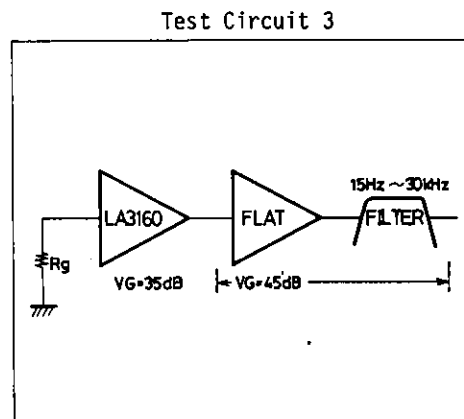
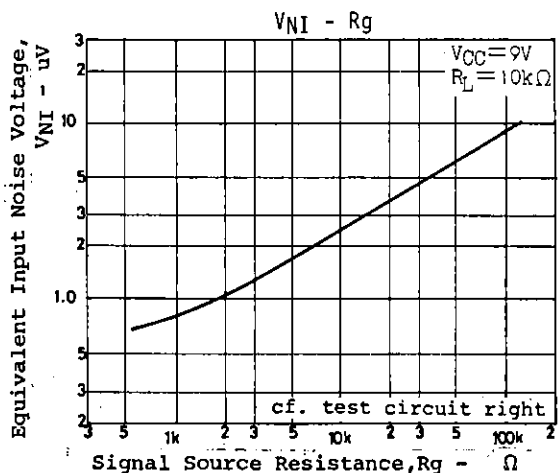
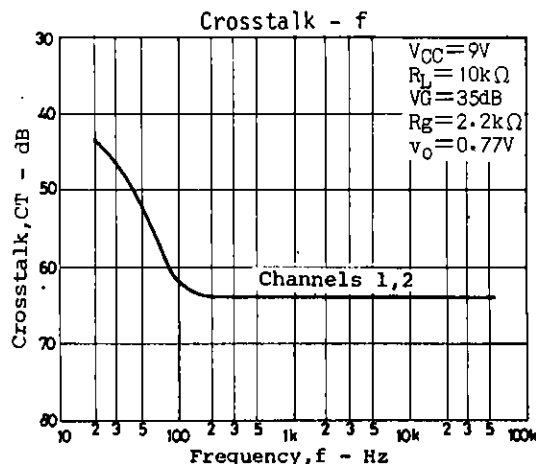
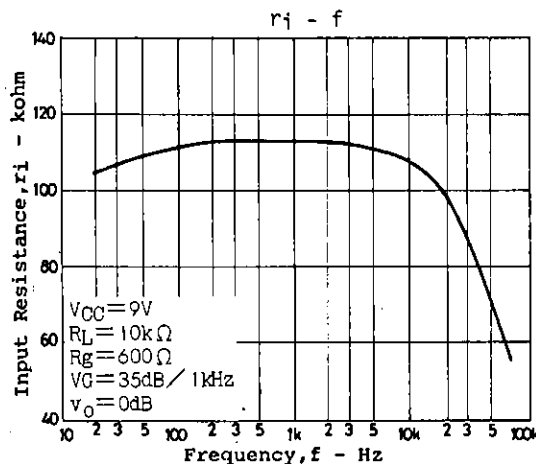
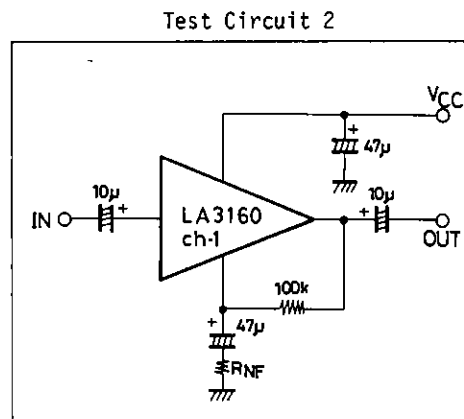
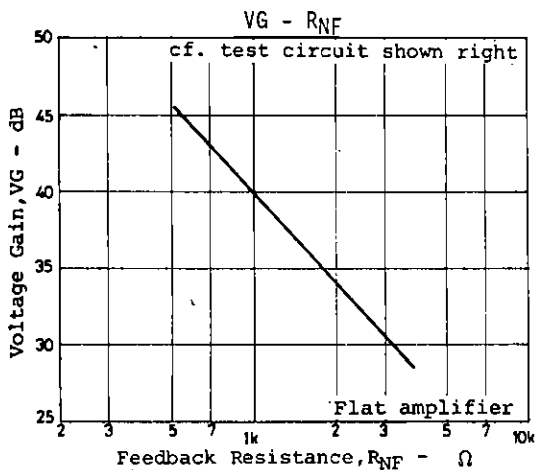
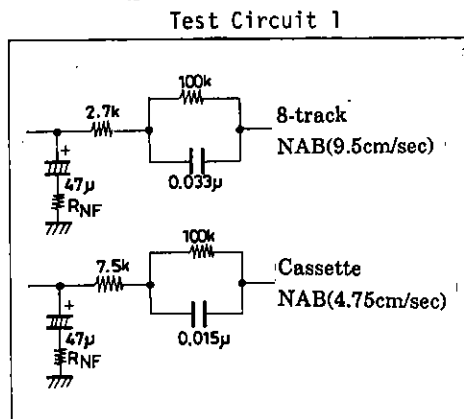
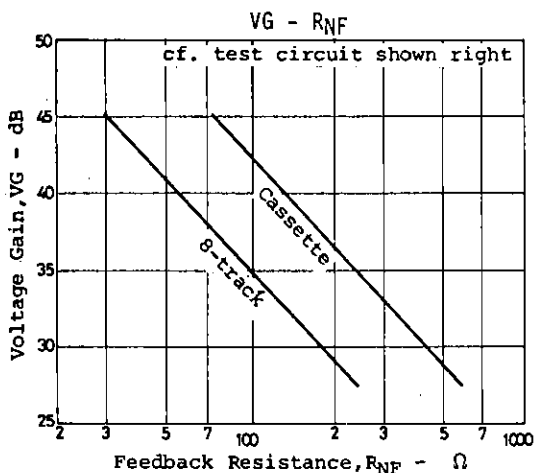
VG	30	35	40	dB
R <sub>NF</sub>	440	240	130	ohm

(c) Flat amplifier

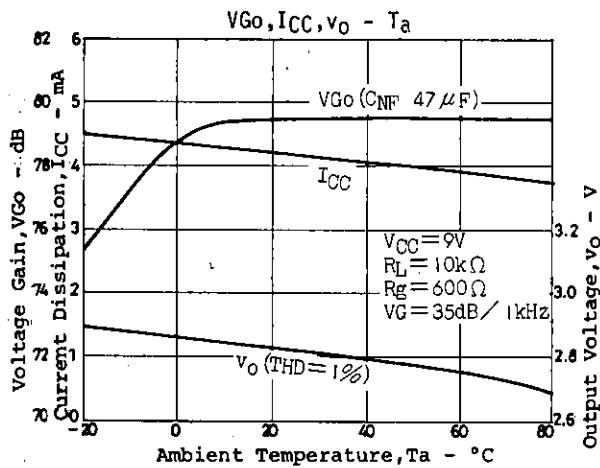
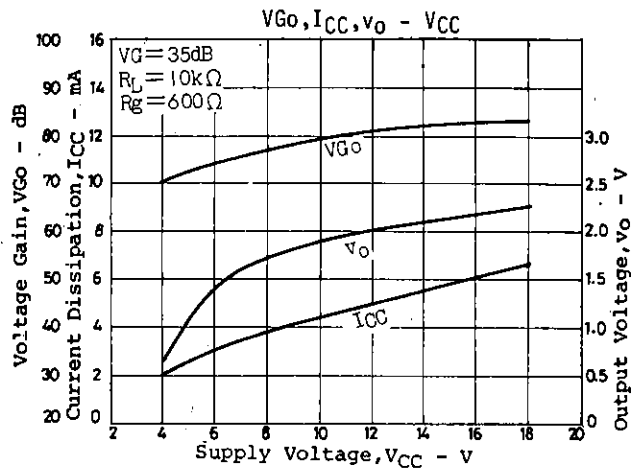
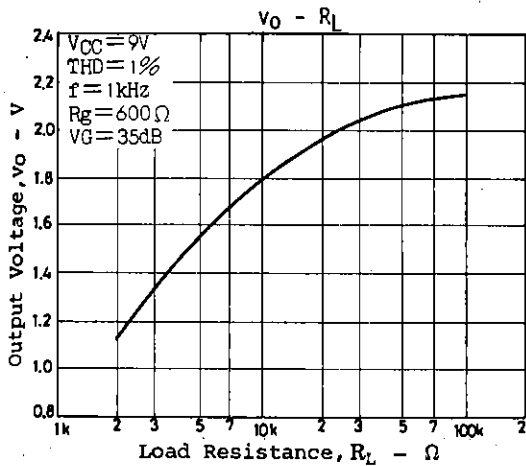


VG	30	35	40	dB
R <sub>NF</sub>	3.2k	1.8k	1k	ohm





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 100kohms.
- Determine the gain by changing  $R_{NF}$  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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