

# HA17741/PS

## General-Purpose Operational Amplifier (Frequency Compensated)

# HITACHI

ADE-204-043 (Z)

Rev. 0

Dec. 2000

### Description

The HA17741/PS is an internal phase compensation high-performance operational amplifier, that is appropriate for use in a wide range of applications in the test and control fields.

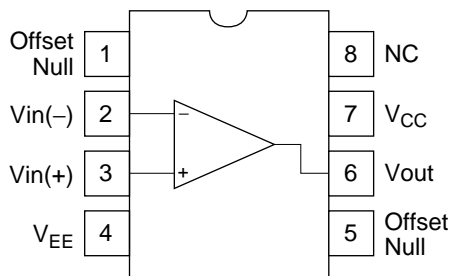
### Features

- High voltage gain : 106 dB (Typ)
- Wide output amplitude :  $\pm 13$  V (Typ) (at  $R_L \geq 2$  k $\Omega$ )
- Shorted output protection
- Adjustable offset voltage
- Internal phase compensation

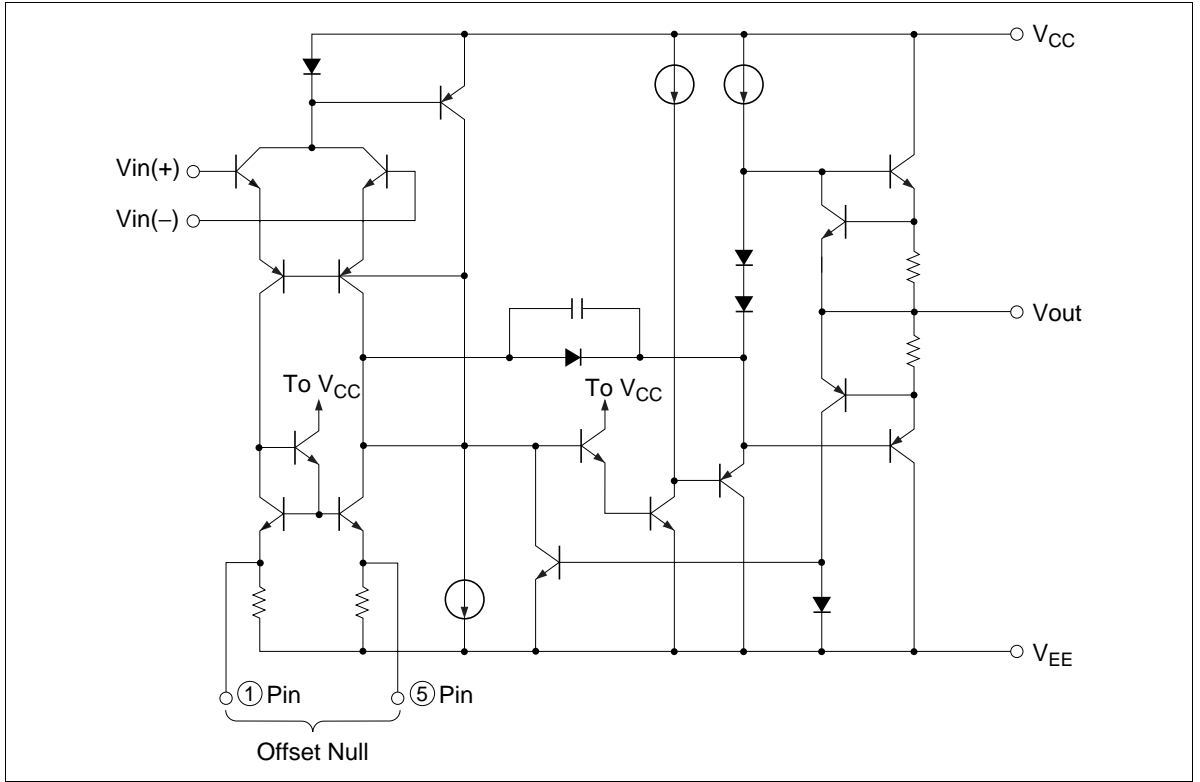
### Ordering Information

Application	Type No.	Package
Industrial use	HA17741PS	DP-8
Commercial use	HA17741	

### Pin Arrangement



## Circuit Structure



## Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Ratings		Unit
		HA17741PS	HA17741	
Power-supply voltage	V <sub>CC</sub>	+18	+18	V
	V <sub>EE</sub>	-18	-18	V
Input voltage	V <sub>in</sub>	±15	±15	V
Differential input voltage	V <sub>in(diff)</sub>	±30	±30	V
Allowable power dissipation	P <sub>T</sub>	670 *	670 *	mW
Operating temperature	Topr	-20 to +75	-20 to +75	°C
Storage temperature	Tstg	-55 to +125	-55 to +125	°C

Note: These are the allowable values up to Ta = 45°C. Derate by 8.3 mW/°C above that temperature.

## Electrical Characteristics

### Electrical Characteristics-1 ( $V_{CC} = -V_{EE} = 15\text{ V}$ , $T_a = 25^\circ\text{C}$ )

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Input offset voltage	$V_{IO}$	—	1.0	6.0	mV	$R_s \leq 10\text{ k}\Omega$
Input offset current	$I_{IO}$	—	18	200	nA	
Input bias current	$I_{IB}$	—	75	500	nA	
Power-supply rejection ratio	$\Delta V_{IO}/\Delta V_{CC}$	—	30	150	$\mu\text{V/V}$	$R_s \leq 10\text{ k}\Omega$
	$\Delta V_{IO}/\Delta V_{EE}$	—	30	150	$\mu\text{V/V}$	$R_s \leq 10\text{ k}\Omega$
Voltage gain	$A_{VD}$	86	106	—	dB	$R_L \geq 2\text{ k}\Omega$ , $V_{out} = \pm 10\text{ V}$
Common-mode rejection ratio	CMR	70	90	—	dB	$R_s \leq 10\text{ k}\Omega$
Common-mode input voltage range	$V_{CM}$	$\pm 12$	$\pm 13$	—	V	$R_s \leq 10\text{ k}\Omega$
Maximum output voltage amplitude	$V_{OP-P}$	$\pm 12$	$\pm 14$	—	V	$R_L \geq 10\text{ k}\Omega$
		$\pm 10$	$\pm 13$	—	V	$R_L \geq 2\text{ k}\Omega$
Power dissipation	$P_d$	—	65	100	mW	No load
Slew rate	SR	—	1.0	—	V/ $\mu\text{s}$	$R_L \geq 2\text{ k}\Omega$
Rise time	$t_r$	—	0.3	—	$\mu\text{s}$	$V_{in} = 20\text{ mV}$ , $R_L = 2\text{ k}\Omega$ ,
Overshoot	$V_{over}$	—	5.0	—	%	$C_L = 100\text{ pF}$
Input resistance	$R_{in}$	0.3	1.0	—	M $\Omega$	

### Electrical Characteristics-2 ( $V_{CC} = -V_{EE} = 15\text{ V}$ , $T_a = -20\text{ to }+75^\circ\text{C}$ )

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Input offset voltage	$V_{IO}$	—	—	9.0	mV	$R_s \leq 10\text{ k}\Omega$
Input offset current	$I_{IO}$	—	—	400	nA	
Input bias current	$I_{IB}$	—	—	1,100	nA	
Voltage gain	$A_{VD}$	80	—	—	dB	$R_L \geq 2\text{ k}\Omega$ , $V_{out} = \pm 10\text{ V}$
Maximum output voltage amplitude	$V_{OP-P}$	$\pm 10$	—	—	V	$R_L \geq 2\text{ k}\Omega$

IC Operational Amplifier Application Examples

Multivibrator

A multivibrator is a square wave generator that uses an RC circuit charge/discharge operation to generate the waveform. Multivibrators are widely used as the square wave source in such applications as power supplies and electronic switches.

Multivibrators are classified into three types, astable multivibrators, which have no stable states, monostable multivibrators, which have one stable state, and bistable multivibrators, which have two stable states.

1. Astable Multivibrator

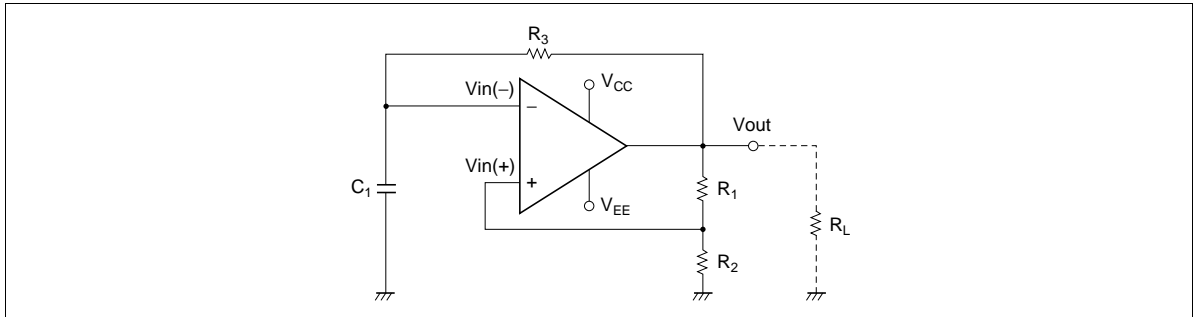


Figure 1 Astable Multivibrator Operating Circuit

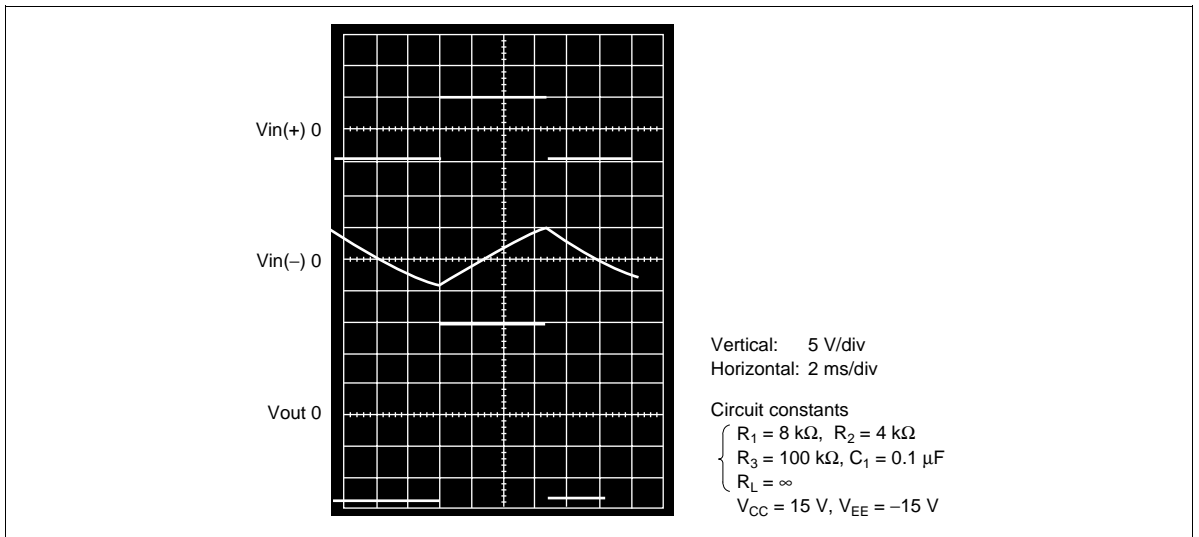


Figure 2 HA17741 Astable Multivibrator Operating Waveform

2. Monostable Multivibrator

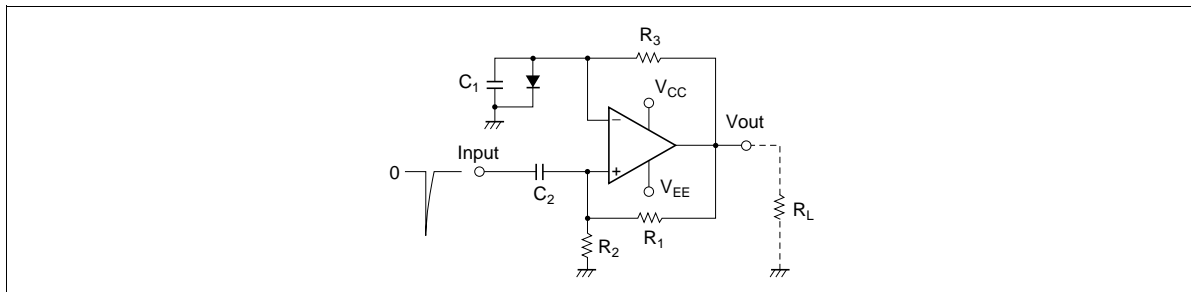


Figure 3 Monostable Multivibrator Operating Circuit

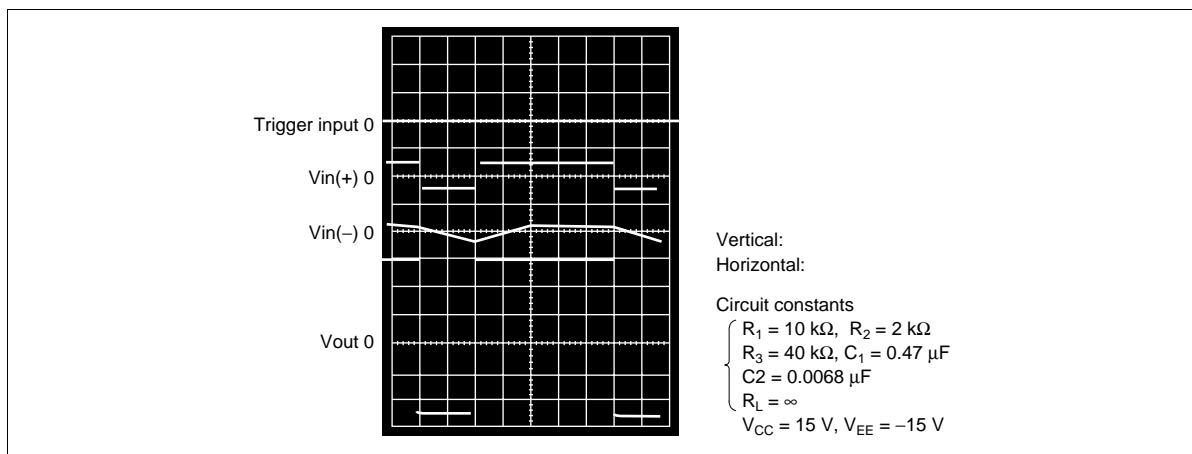


Figure 4 HA17741 Monostable Multivibrator Operating Waveform

3. Bistable Multivibrator

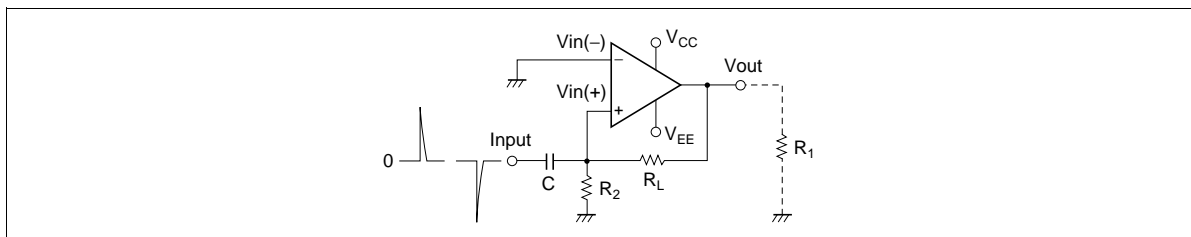


Figure 5 Bistable Multivibrator Operating Circuit

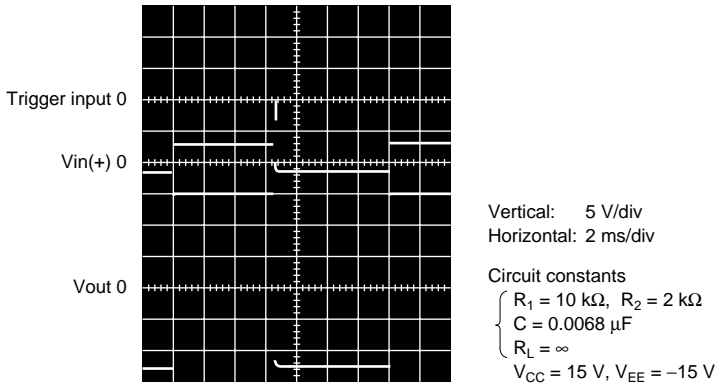


Figure 6 HA17741 Bistable Multivibrator Operating Waveform

Wien Bridge Sine Wave Oscillator

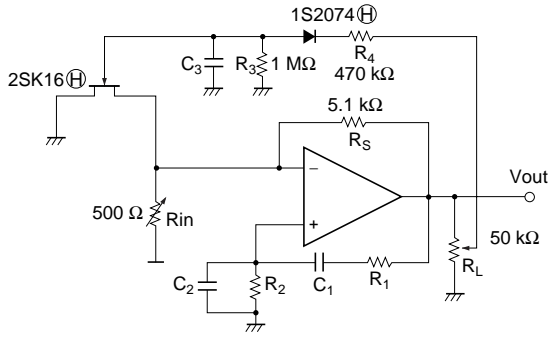


Figure 7 Wien Bridge Sine Wave Oscillator

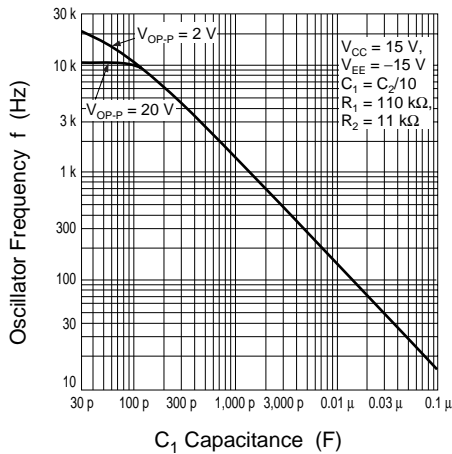
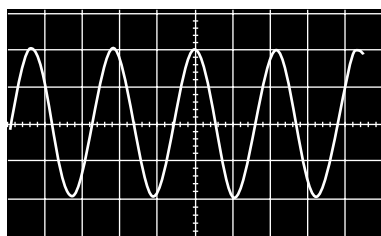


Figure 8 HA17741 Wien Bridge Sine Wave Oscillator  $f$ - $C$  Characteristics



Vertical: 5 V/div  
Horizontal: 0.5 ms/div

Test circuit condition

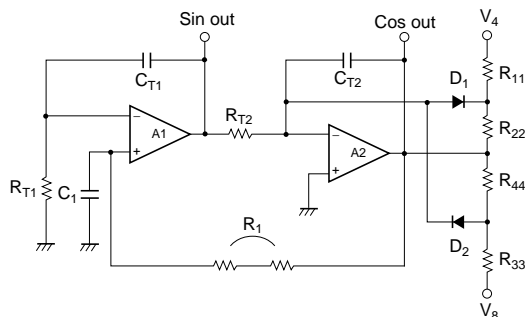
$$\begin{cases} V_{CC} = 15 \text{ V}, V_{EE} = -15 \text{ V} \\ R_1 = 110 \text{ k}\Omega, R_2 = 11 \text{ k}\Omega \\ C_1 = 0.0015 \text{ }\mu\text{F}, C_2 = 0.015 \text{ }\mu\text{F} \end{cases}$$

Test results

$$f = 929.7 \text{ Hz}, \text{ T.H.P} = 0.06\%$$

**Figure 9 HA17741 Wien Bridge Sine Wave Oscillator Operating Waveform**

## Quadrature Oscillator



**Figure 10 Quadrature Sine Wave Oscillator**

Figure 10 shows the circuit diagram for a quadrature sine wave oscillator. This circuit consists of two integrators and a limiter circuit, and provides not only a sine wave output, but also a cosine output, that is, it also supplies the waveform delayed by  $90^\circ$ . The output amplitude is essentially determined by the limiter circuit.

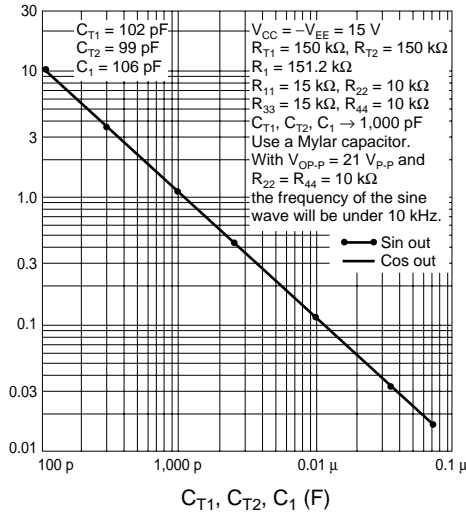
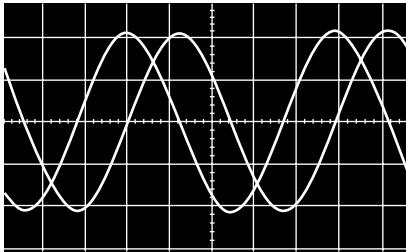


Figure 11 HA17741 Quadrature Sine Wave Oscillator

f-C<sub>T1</sub>, C<sub>T2</sub>, C<sub>1</sub> Characteristics



Vertical: 5 V/div  
 Horizontal: 0.2 ms/div  
 Circuit constants

$C_{T1} = 1000 \text{ pF (990)}, C_{T2} = 1000 \text{ pF (990)}$   
 $R_{T1} = 150 \text{ k}\Omega, R_{T2} = 150 \text{ k}\Omega$   
 $C_1 = 1000 \text{ pF (990)}, R_1 = 160 \text{ k}\Omega$   
 $R_{11} = 15 \text{ k}\Omega, R_{22} = 10 \text{ k}\Omega$   
 $R_{33} = 16 \text{ V}, R_{44} = 10 \text{ k}\Omega$   
 $V_{CC} = 15 \text{ V}, V_{EE} = -15 \text{ V}$

Figure 12 Sine and Cosine Output Waveforms

Triangular Wave Generator

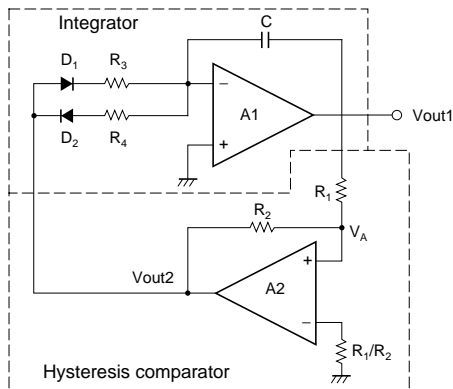


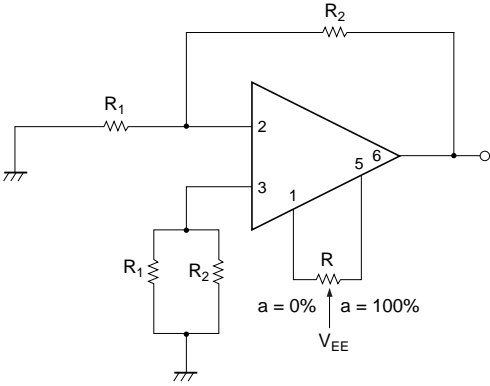
Figure 13 Triangular Wave Generator Operating Circuit



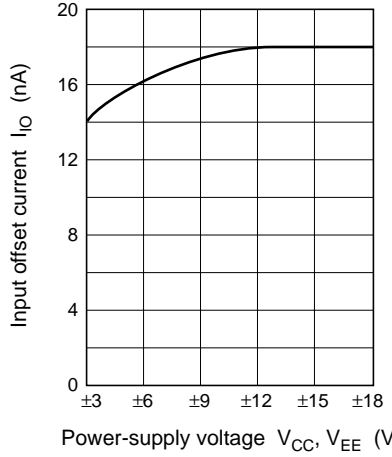


Characteristic Curves

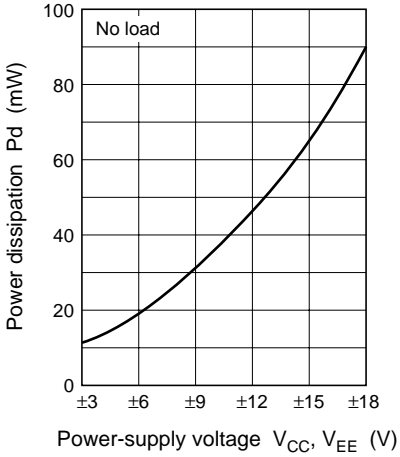
Voltage Offset Adjustment Circuit



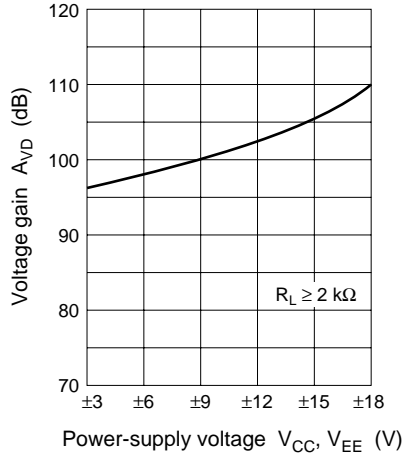
Input Offset Current vs. Power-Supply Voltage Characteristics



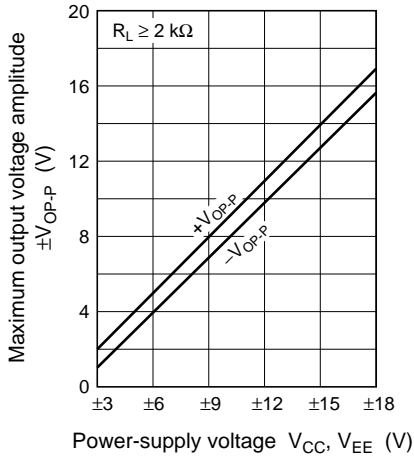
Power Dissipation vs. Power-Supply Voltage Characteristics



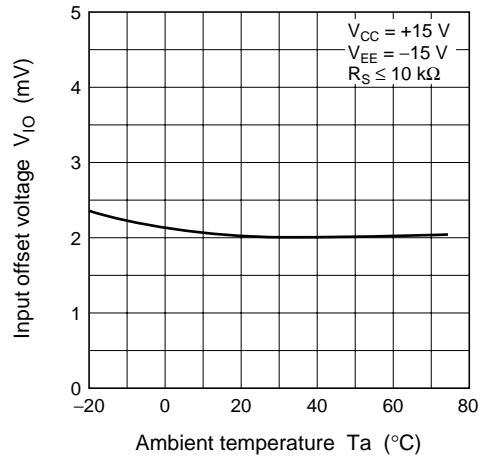
Voltage Gain vs. Power-Supply Voltage Characteristics



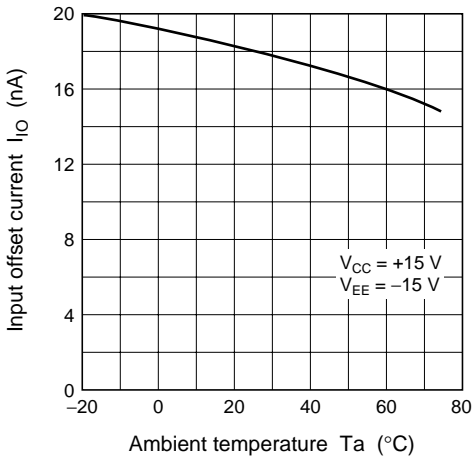
**Maximum Output Voltage Amplitude vs. Power-Supply Voltage Characteristics**



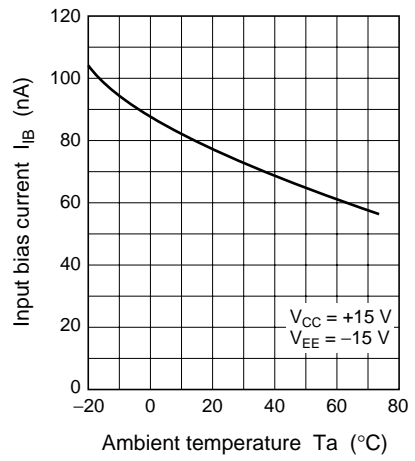
**Input Offset Voltage vs. Ambient Temperature Characteristics**



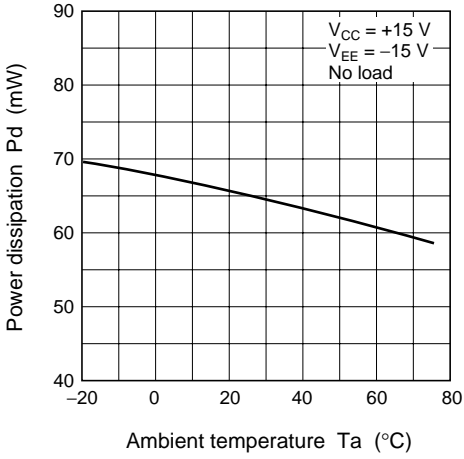
**Input Offset Current vs. Ambient Temperature Characteristics**



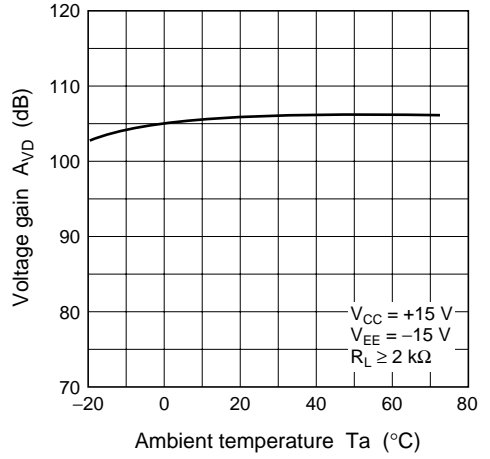
**Input Bias Current vs. Ambient Temperature Characteristics**



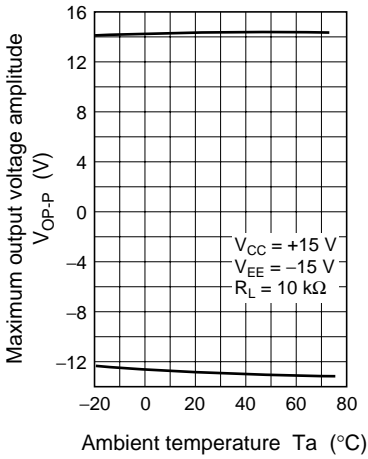
**Power Dissipation vs. Ambient Temperature Characteristics**



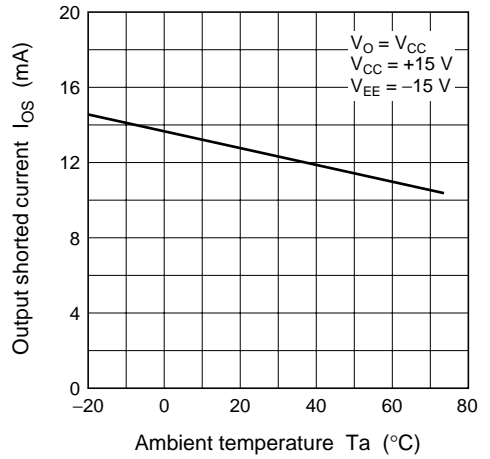
**Voltage Gain vs. Ambient Temperature Characteristics**



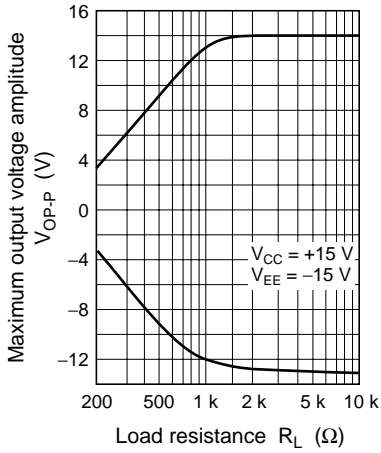
**Maximum Output Voltage Amplitude vs. Ambient Temperature Characteristics**



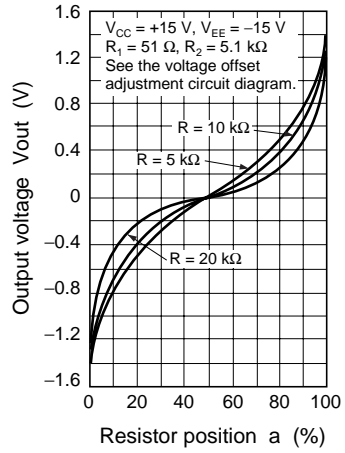
**Output Shorted Current vs. Ambient Temperature Characteristics**



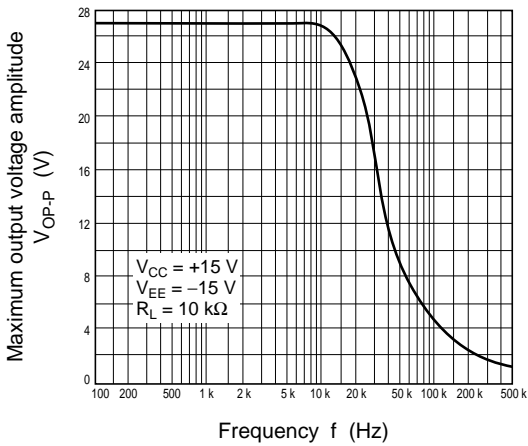
**Maximum Output Voltage Amplitude vs. Load Resistance Characteristics**



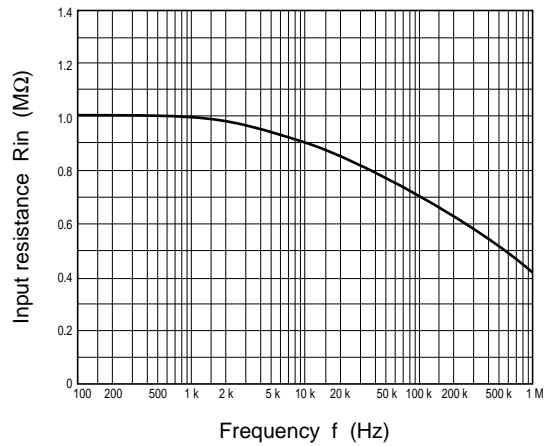
**Offset Adjustment Characteristics**



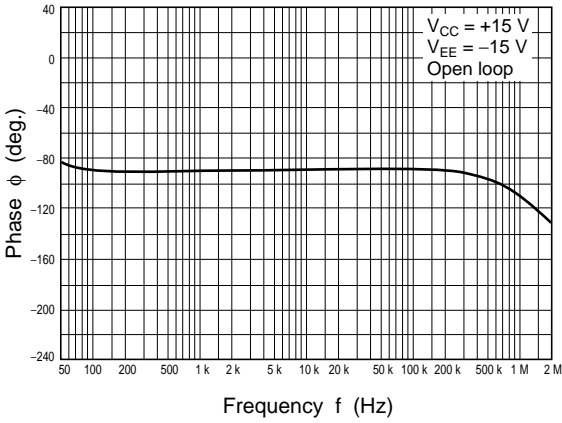
**Maximum Output Voltage Amplitude vs. Frequency Characteristics**



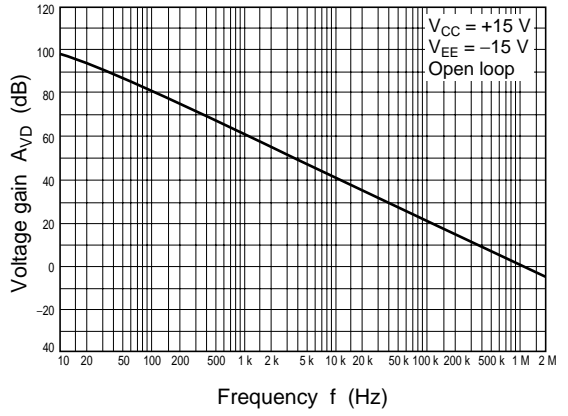
**Input Resistance vs. Frequency Characteristics**



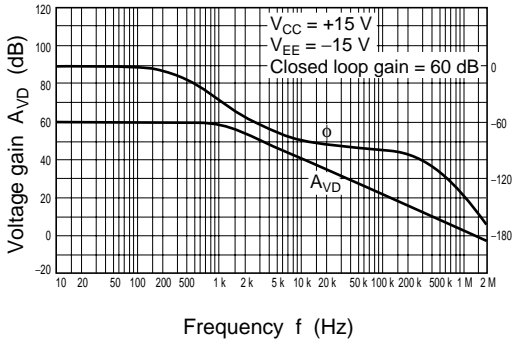
Phase vs. Frequency Characteristics



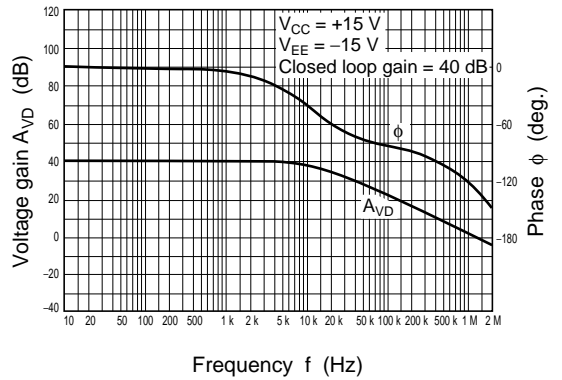
Voltage Gain vs Frequency Characteristics



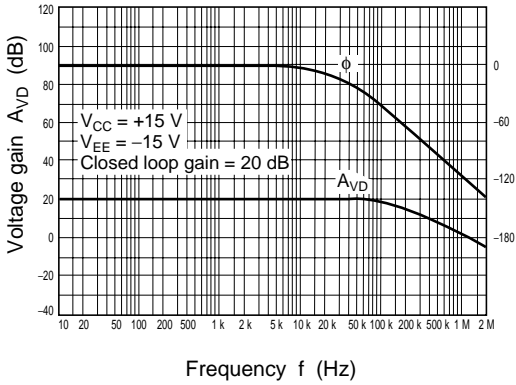
Voltage Gain and Phase vs. Frequency Characteristics (1)



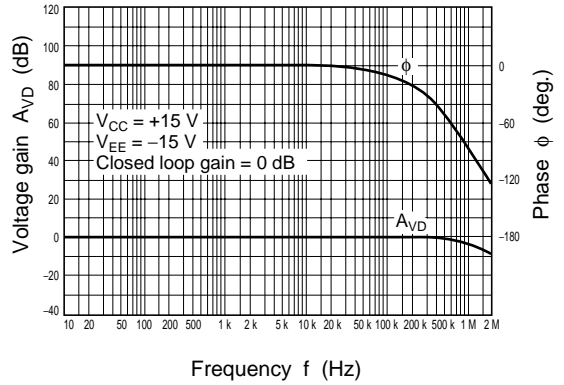
Voltage Gain and Phase vs. Frequency Characteristics (2)



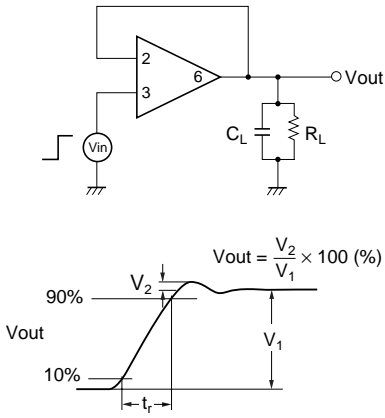
Voltage Gain and Phase vs. Frequency Characteristics (3)



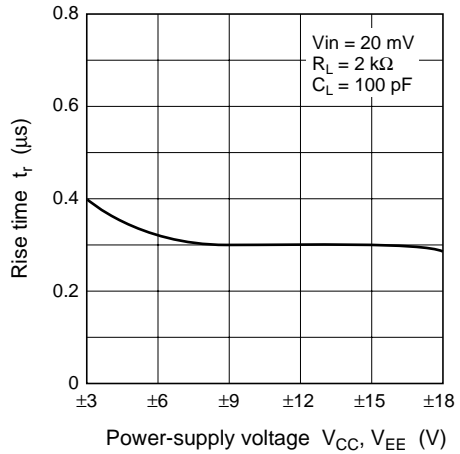
Voltage Gain and Phase vs. Frequency Characteristics (4)



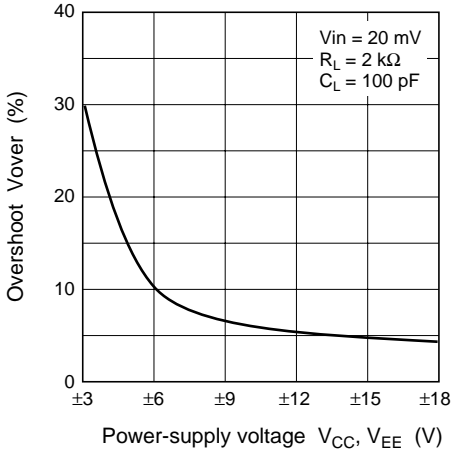
Impulse Response Characteristics Test Circuit



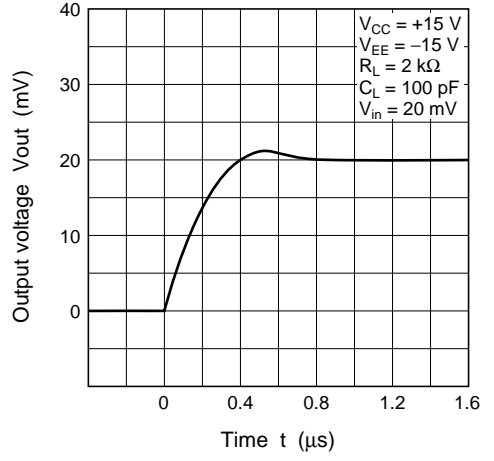
Rise time vs. Power-Supply Voltage Characteristics



**Overshoot vs.  
Power-Supply Voltage Characteristics**



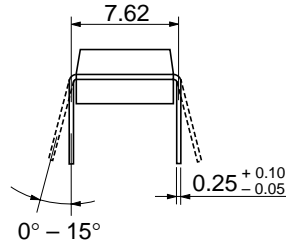
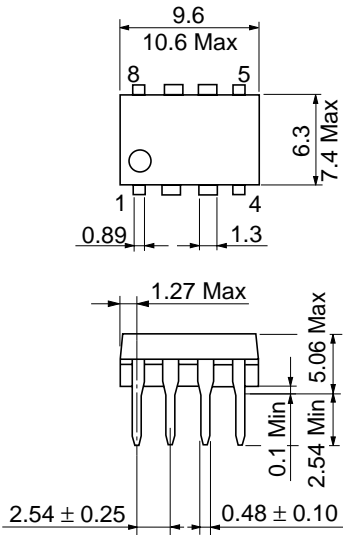
**Impulse Response  
Characteristics**





Package Dimensions

Unit: mm



Hitachi Code	DP-8
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	0.54 g

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