HA17741/PS

General-Purpose Operational Amplifier
(Frequency Compensated)

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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.

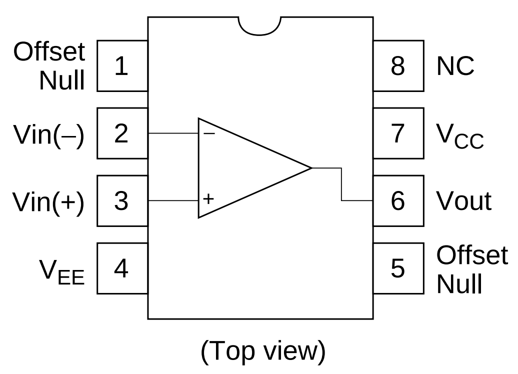
Features

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

Ordering Information

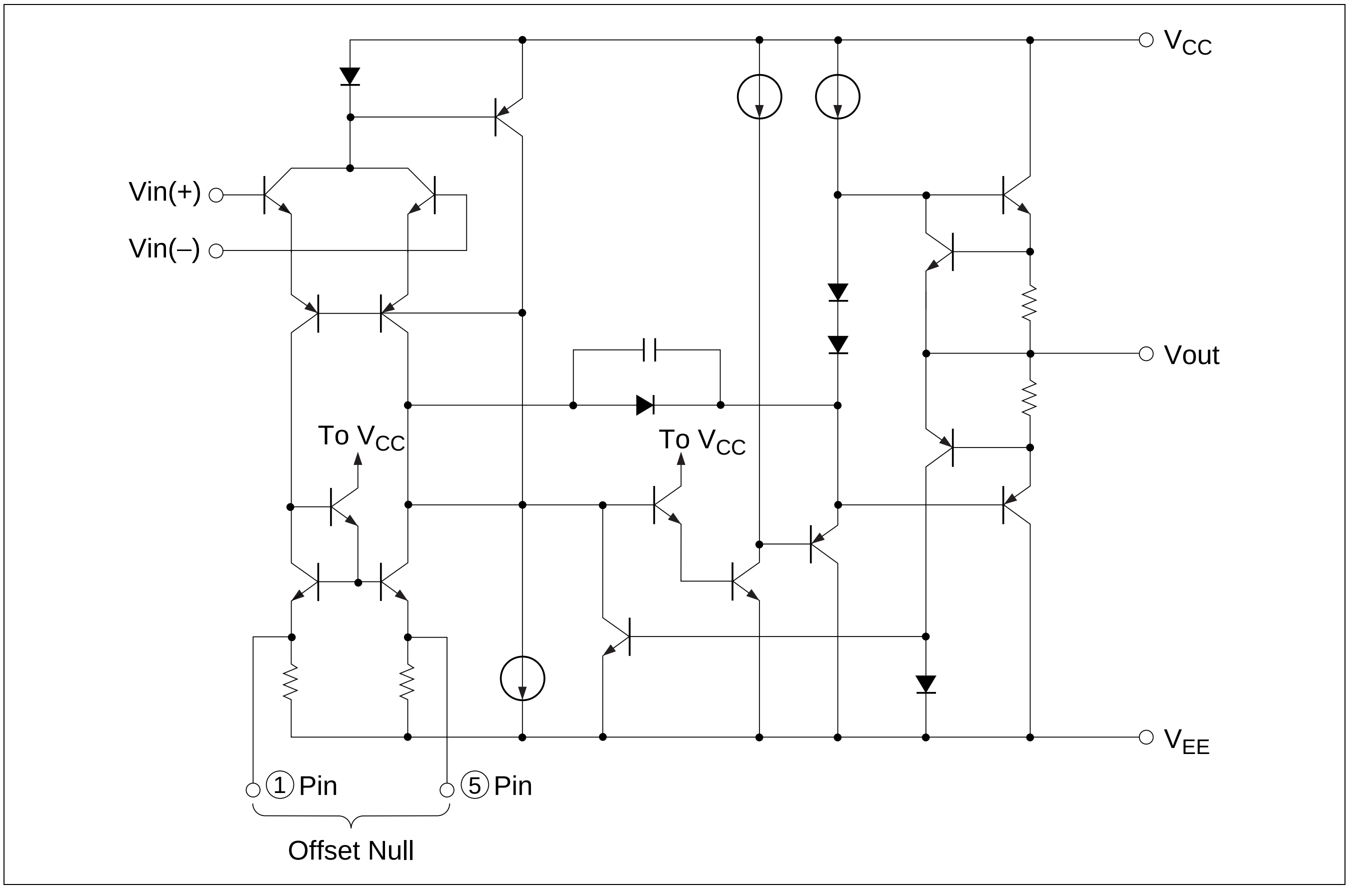
Application	Type No.	Package
Industrial use	HA17741PS	DP-8
Commercial use	HA17741	

Pin Arrangement



Hitachi semiconductor

Circuit Structure



Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Ratings HA17741PS	Ratings HA17741	Unit
Power-supply voltage	V_{CC}	+18	+18	V
	V_{EE}	–18	–18	V
Input voltage	Vin	±15	±15	V
Differential input voltage	Vin(diff)	±30	±30	V
Allowable power dissipation	P_T	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 V, Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Input offset voltage	V_{IO}	—	1.0	6.0	mV	$R_S \le 10$ kΩ
Input offset current	I_{IO}	—	18	200	nA	
Input bias current	I_{IB}	—	75	500	nA	
Power-supply	$\Delta V_{IO}/\Delta V_{CC}$	—	30	150	µV/V	$R_S \le 10$ kΩ
rejection ratio	$\Delta V_{IO}/\Delta V_{EE}$	—	30	150	µV/V	$R_S \le 10$ kΩ
Voltage gain	A_{VD}	86	106	—	dB	$R_L \ge 2$ kΩ, Vout = ±10 V
Common-mode rejection ratio	CMR	70	90	—	dB	$R_S \le 10$ kΩ
Common-mode input voltage range	V_{CM}	±12	±13	—	V	$R_S \le 10$ kΩ
Maximum output	V_{OP-P}	±12	±14	—	V	$R_L \ge 10$ kΩ
voltage amplitude		±10	±13	—	V	$R_L \ge 2$ kΩ
Power dissipation	Pd	—	65	100	mW	No load
Slew rate	SR	—	1.0	—	V/µs	$R_L \ge 2$ kΩ
Rise time	t_r	—	0.3	—	µs	Vin = 20 mV, R_L = 2 kΩ,
Overshoot	Vover	—	5.0	—	%	C_L = 100 pF
Input resistance	Rin	0.3	1.0	—	MΩ	

Electrical Characteristics-2 (V_{CC} = –V_{EE} = 15 V, Ta = –20 to +75°C)

Item	Symbol	Min	Typ	Max	Unit	Test Condition
Input offset voltage	V_{IO}	—	—	9.0	mV	$R_S \le 10$ kΩ
Input offset current	I_{IO}	—	—	400	nA	
Input bias current	I_{IB}	—	—	1,100	nA	
Voltage gain	A_{VD}	80	—	—	dB	$R_L \ge 2$ kΩ, Vout = ±10 V
Maximum output voltage amplitude	V_{OP-P}	±10	—	—	V	$R_L \ge 2$ kΩ

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

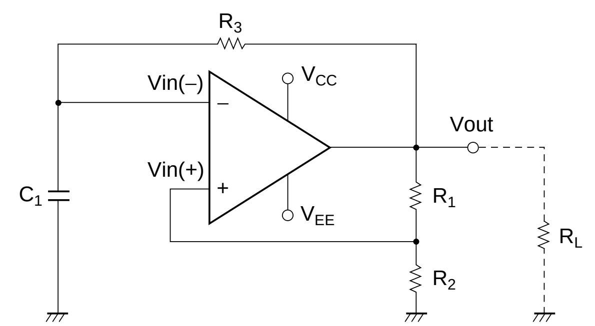


Figure 1 Astable Multivibrator Operating Circuit

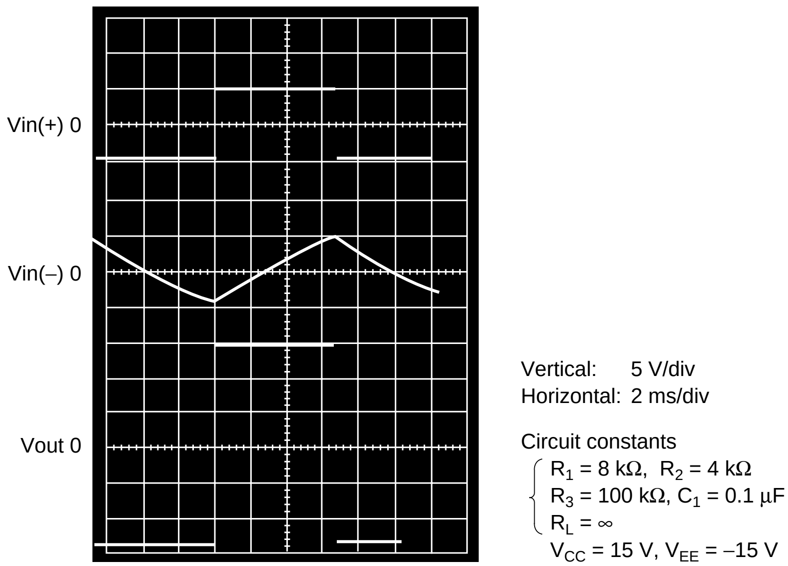


Figure 2 HA17741 Astable Multivibrator Operating Waveform

2. Monostable Multivibrator

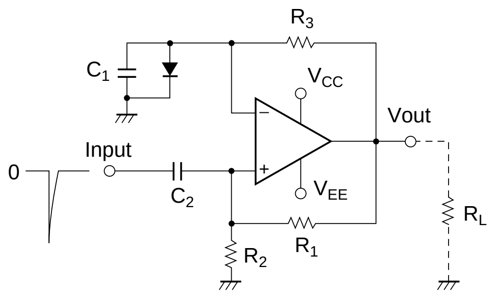


Figure 3 Monostable Multivibrator Operating Circuit

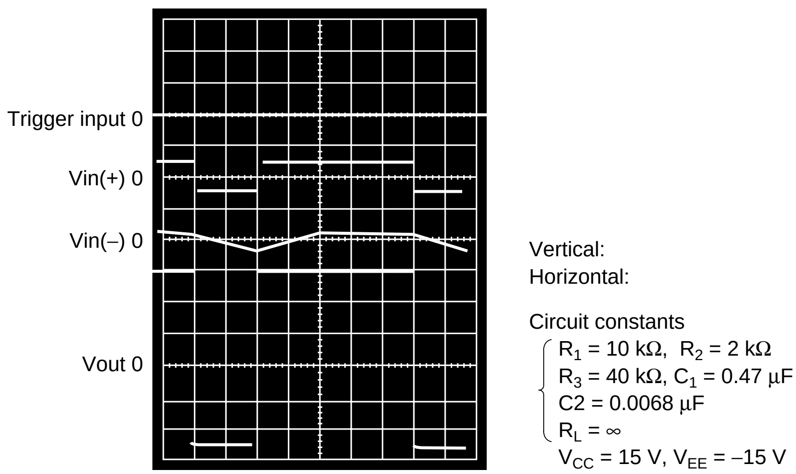


Figure 4 HA17741 Monostable Multivibrator Operating Waveform

3. Bistable Multivibrator

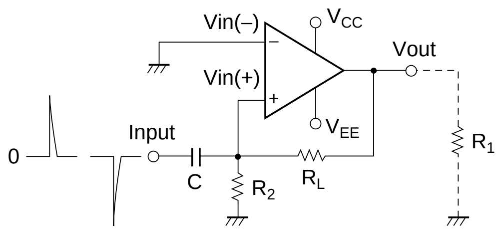


Figure 5 Bistable Multivibrator Operating Circuit

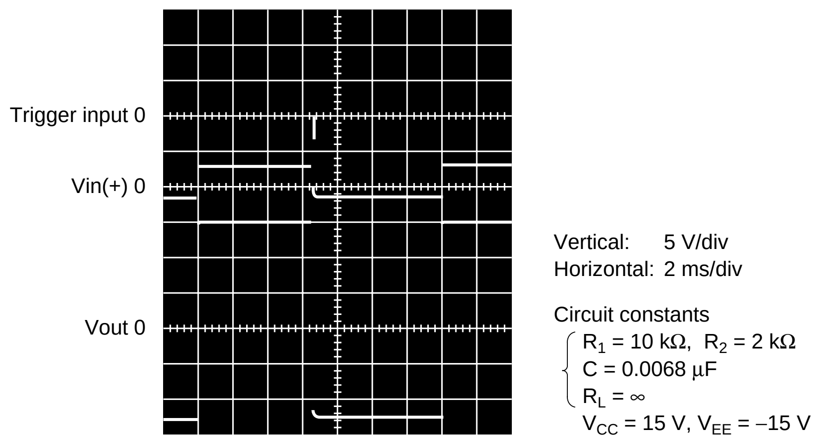


Figure 6 HA17741 Bistable Multivibrator Operating Waveform

Wien Bridge Sine Wave Oscillator

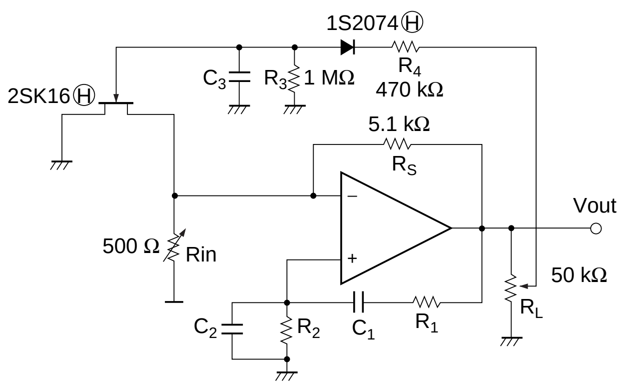


Figure 7 Wien Bridge Sine Wave Oscillator

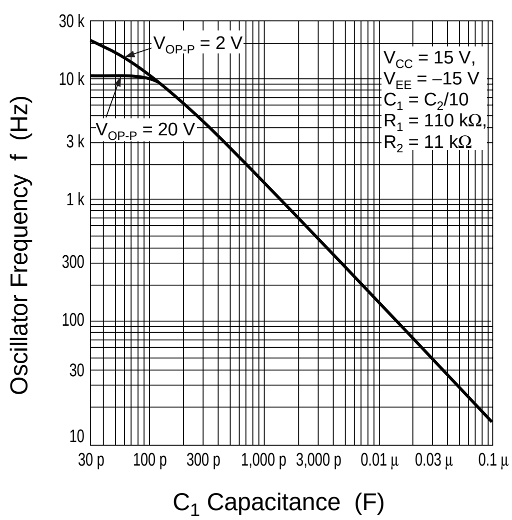


Figure 8 HA17741 Wien Bridge Sine Wave Oscillator f–C Characteristics

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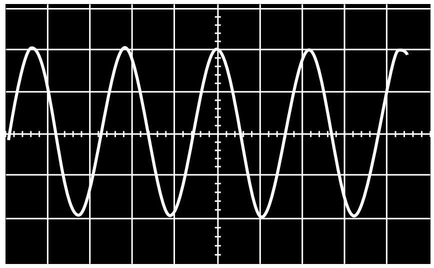


Vertical: 5 V/div
Horizontal: 0.5 ms/div

Test circuit condition
V_{CC} = 15 V, V_{EE} = –15 V
R_1 = 110 kΩ, R_2 = 11 kΩ
C_1 = 0.0015 µF, C_2 = 0.015 µF
Test results
f = 929.7 Hz, T.H.P = 0.06%

Figure 9 HA17741 Wien Bridge Sine Wave Oscillator Operating Waveform

Quadrature Oscillator

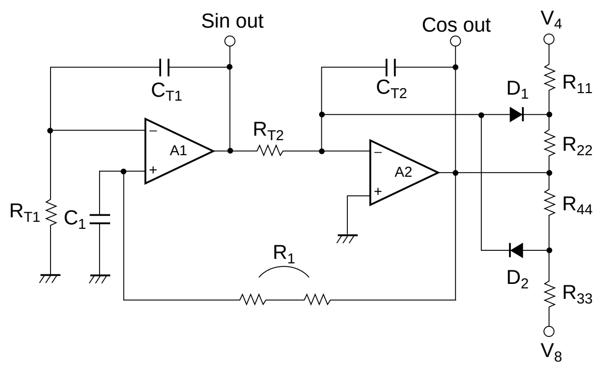


Figure 10 Quadrature Sine Wave Oscillator

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°. The output amplitude is essentially determined by the limiter circuit.

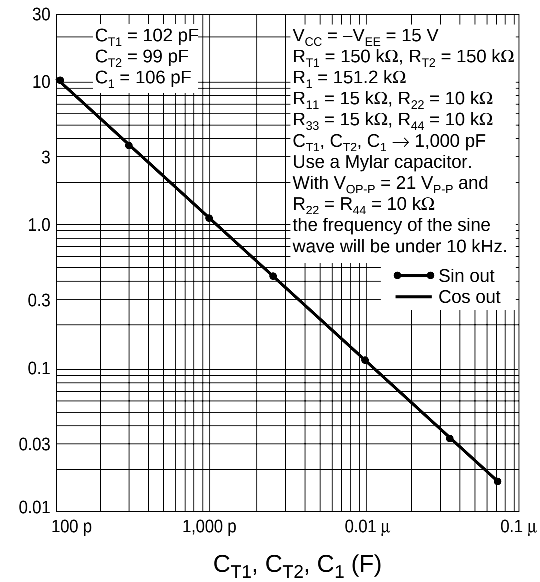
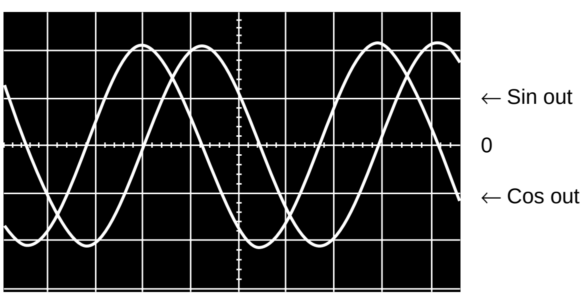


Figure 11 HA17741 Quadrature Sine Wave Oscillator

f–C_{T1}, C_{T2}, C_1 Characteristics



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

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

Figure 12 Sine and Cosine Output Waveforms

Triangular Wave Generator

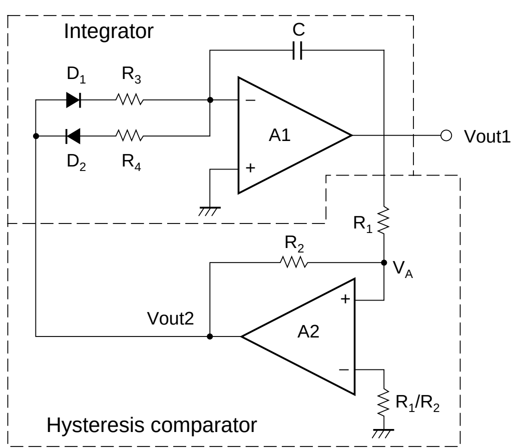


Figure 13 Triangular Wave Generator Operating Circuit

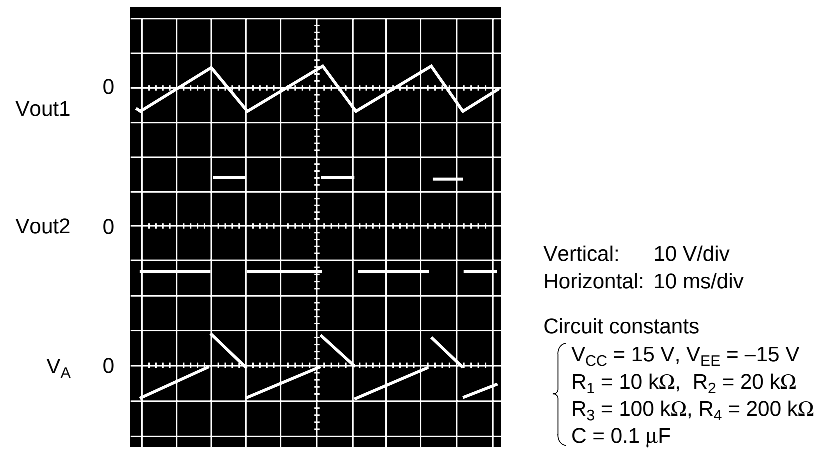


Figure 14 HA17741 Triangular Wave Generator Operating Waveform

Sawtooth Waveform Generator

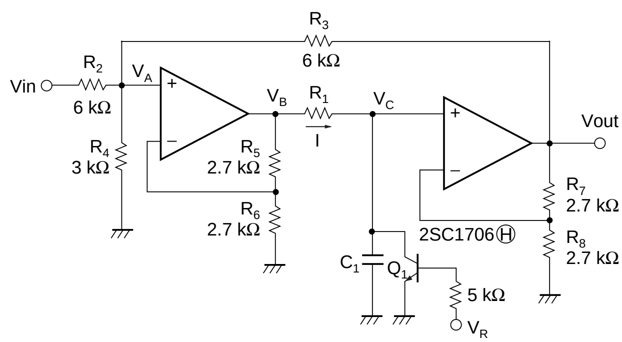


Figure 15 Sawtooth Waveform Generator

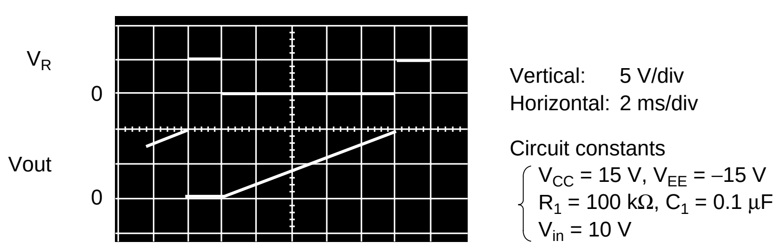
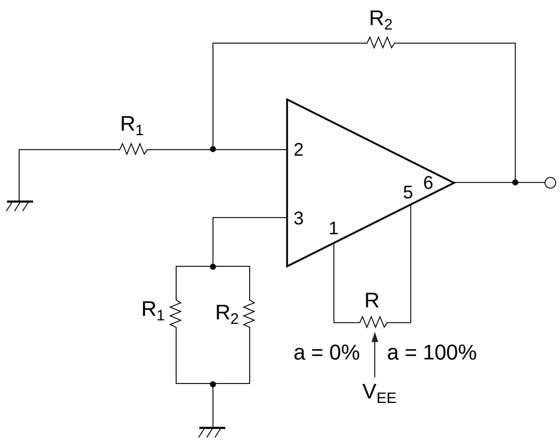


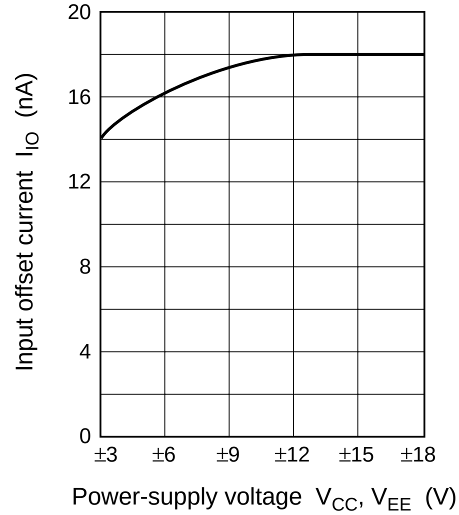
Figure 16 HA17741 Sawtooth Waveform Generator Operating Waveform

Characteristic Curves

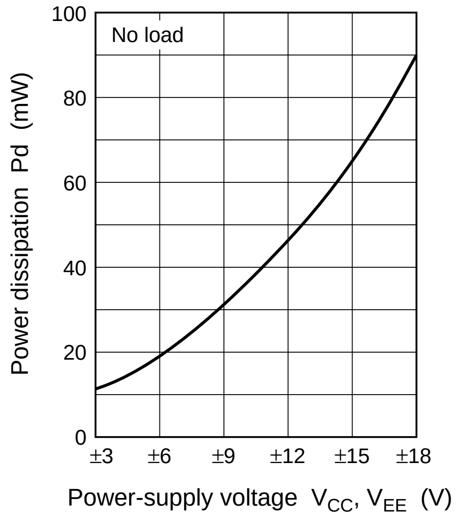
Voltage Offset Adjustment Circuit



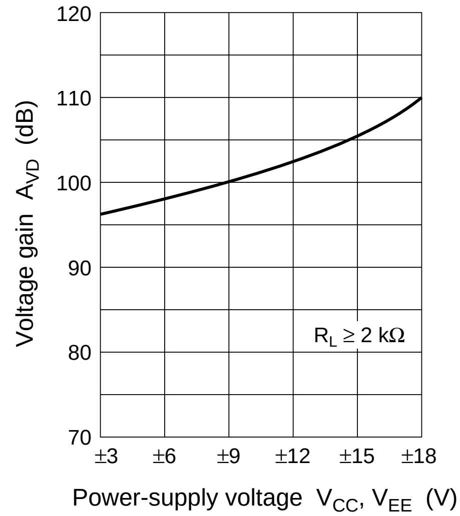
Input Offset Current vs. Power-Supply Voltage Characteristics



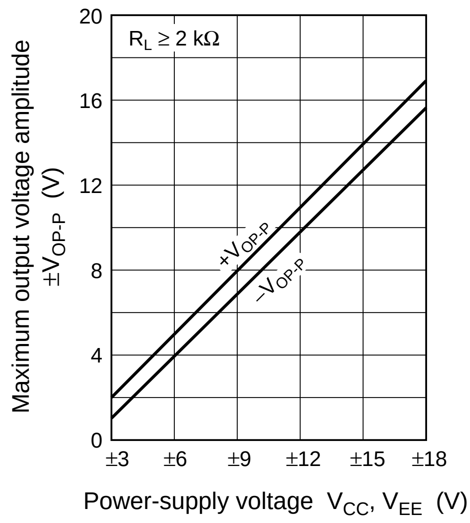
Power Dissipation vs. Power-Supply Voltage Characteristics



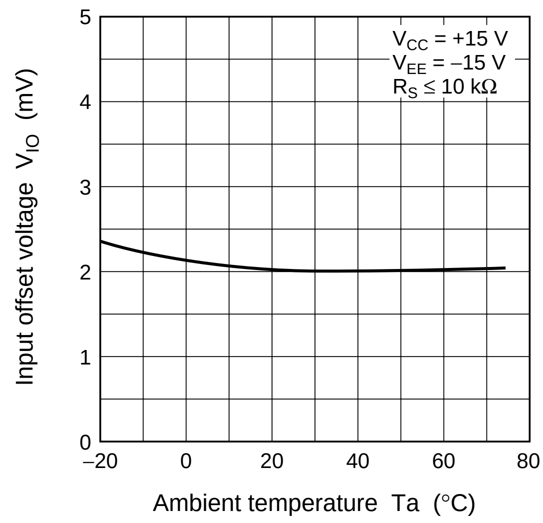
Voltage Gain vs. Power-Supply Voltage Characteristics



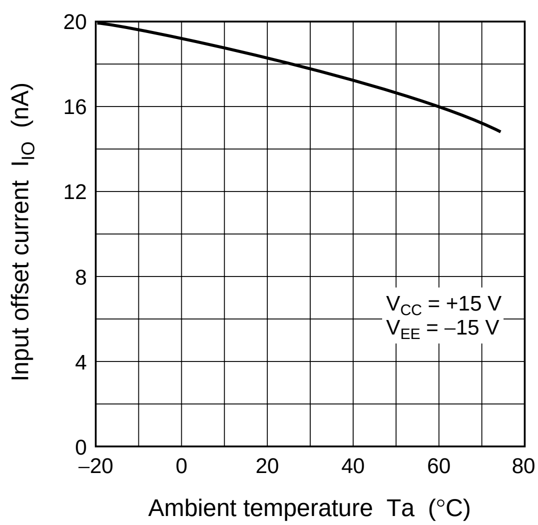
Maximum Output Voltage Amplitude vs. Power-Supply Voltage Characteristics



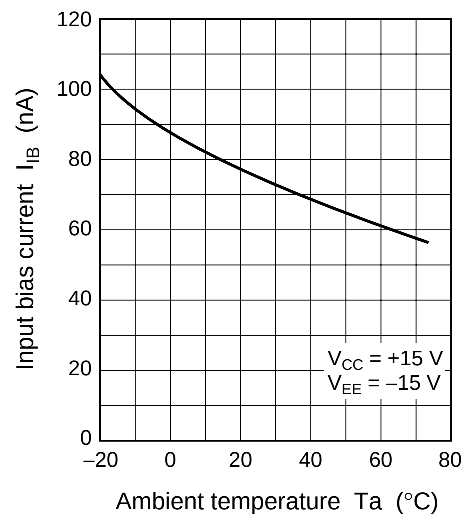
Input Offset Voltage vs. Ambient Temperature Characteristics



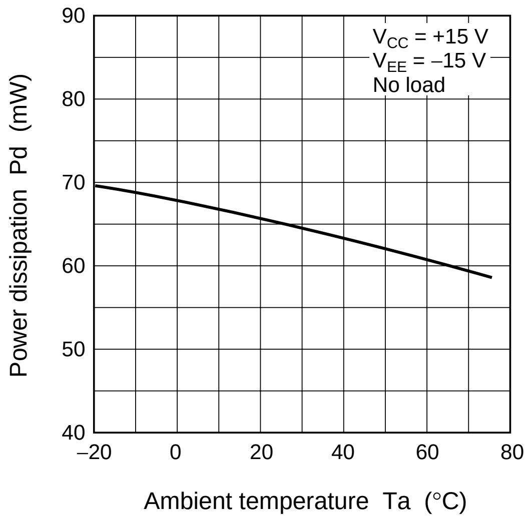
Input Offset Current vs. Ambient Temperature Characteristics



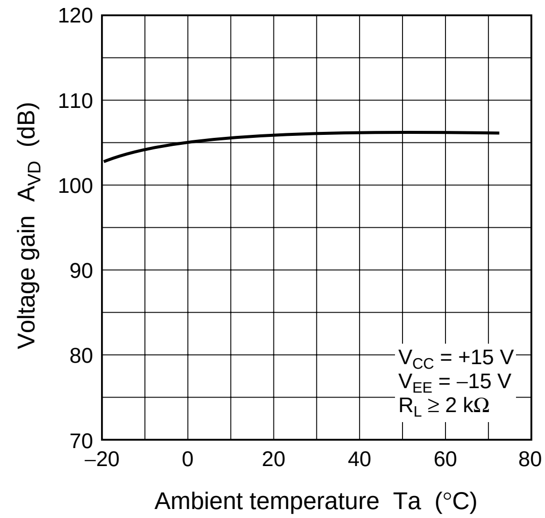
Input Bias Current vs. Ambient Temperature Characteristics



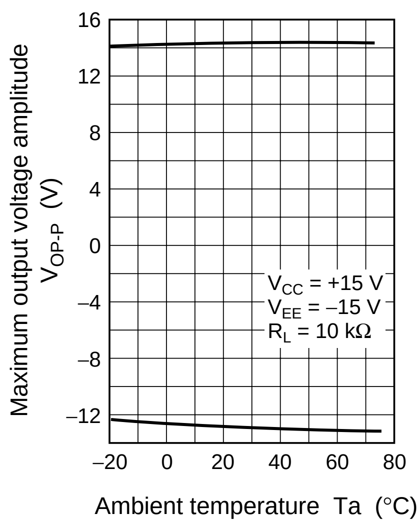
**Power Dissipation vs.
Ambient Temperature Characteristics**



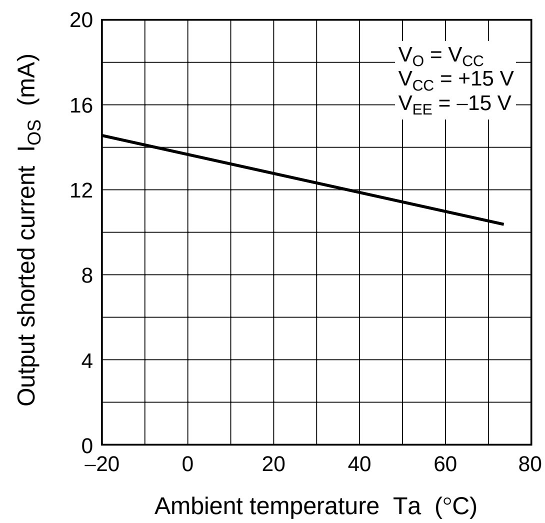
**Voltage Gain vs.
Ambient Temperature Characteristics**



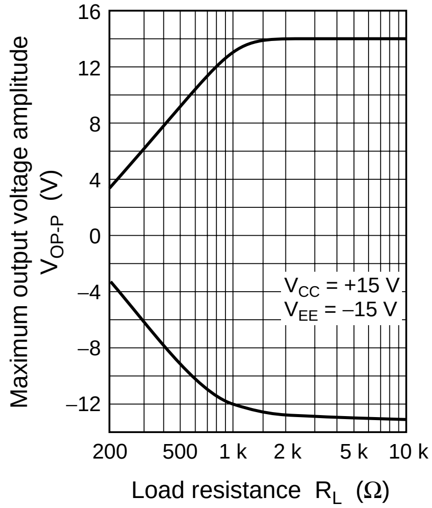
**Maximum Output Voltage Amplitude vs.
Ambient Temperature Characteristics**



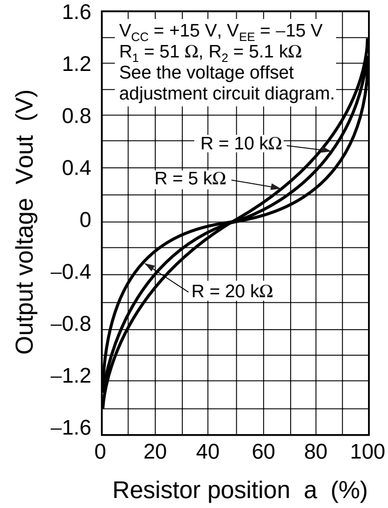
**Output Shorted Current vs.
Ambient Temperature Characteristics**



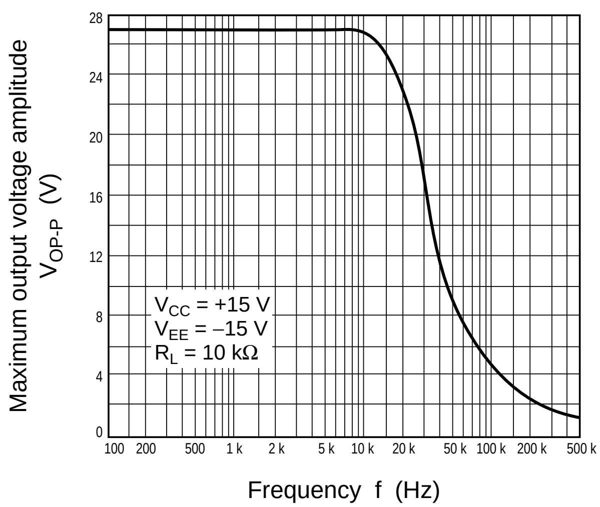
Maximum Output Voltage Amplitude vs. Load Resistance Characteristics



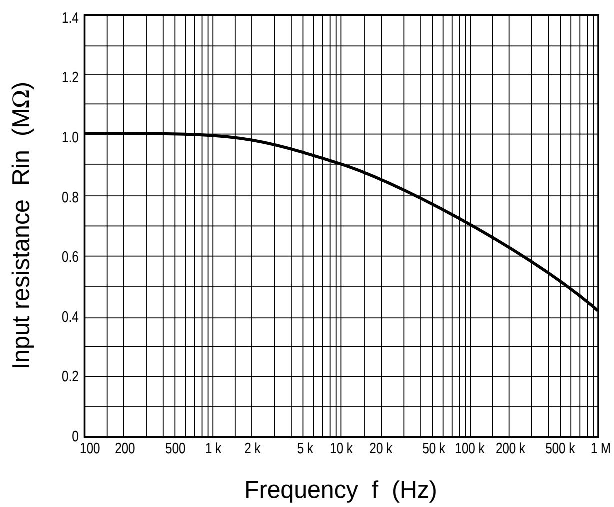
Offset Adjustment Characteristics



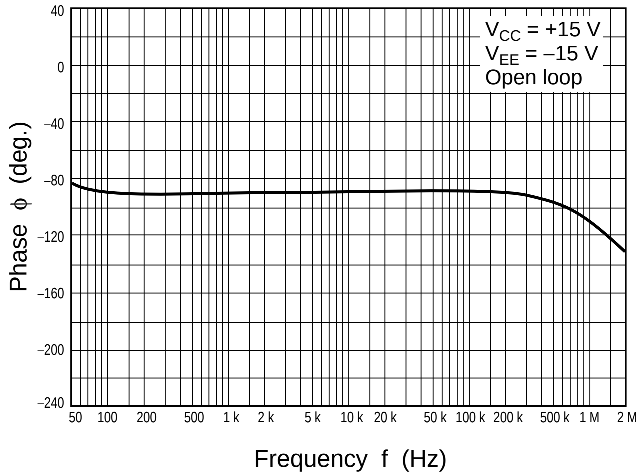
Maximum Output Voltage Amplitude vs. Frequency Characteristics



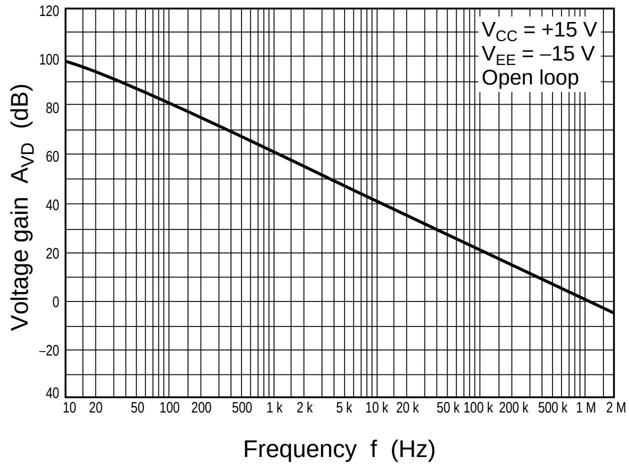
Input Resistance vs. Frequency Characteristics



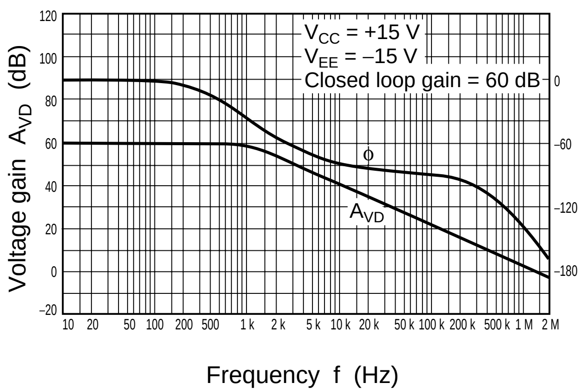
**Phase vs.
Frequency Characteristics**



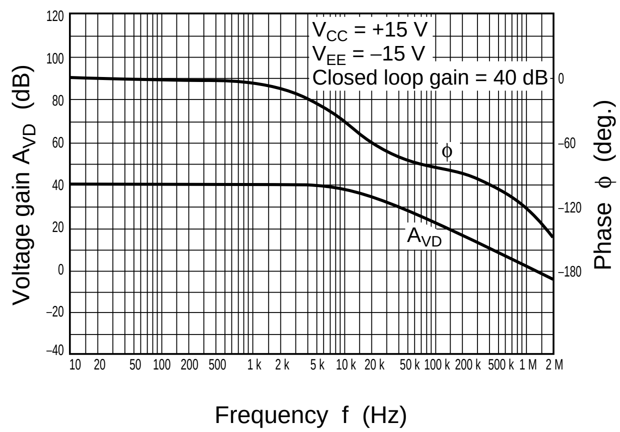
**Voltage Gain vs
Frequency Characteristics**



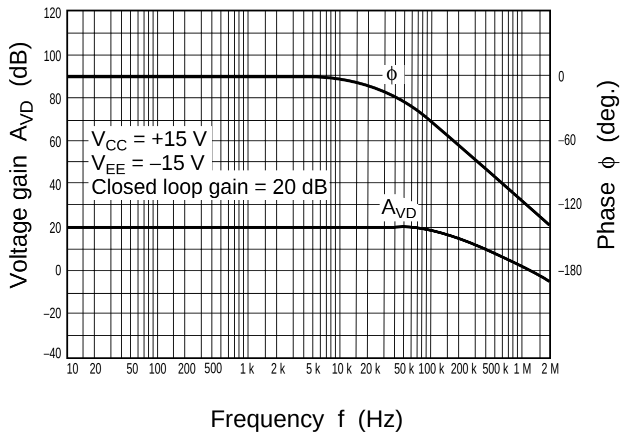
**Voltage Gain and Phase vs.
Frequency Characteristics (1)**



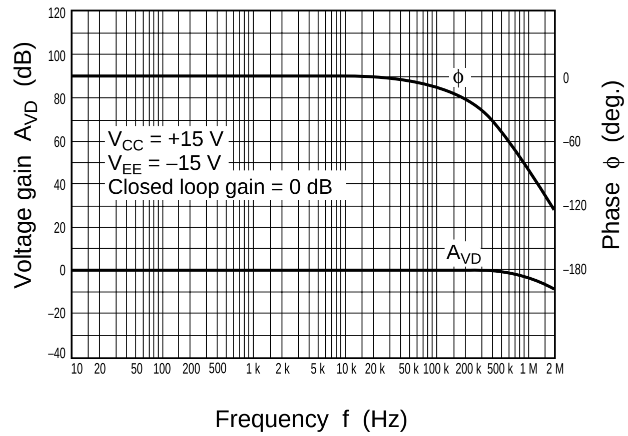
**Voltage Gain and Phase vs.
Frequency Characteristics (2)**



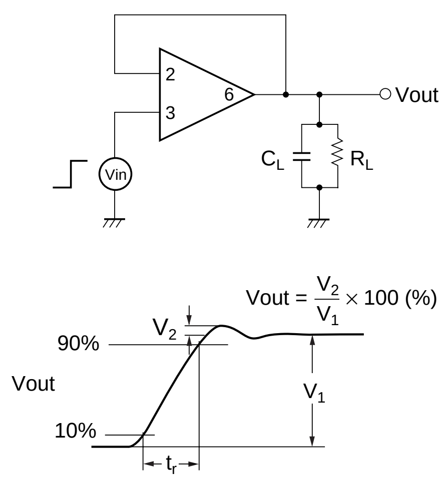
Voltage Gain and Phase vs. Frequency Characteristics (3)



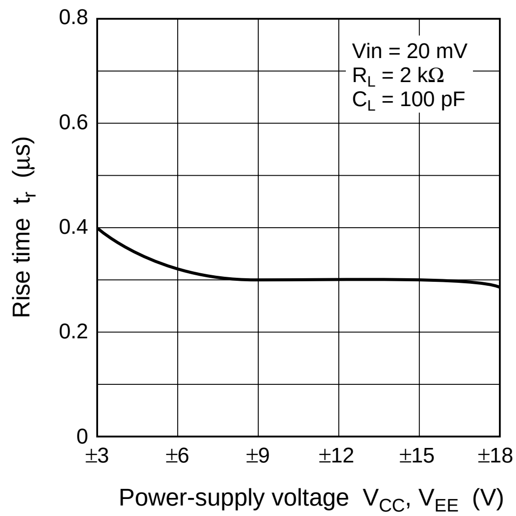
Voltage Gain and Phase vs. Frequency Characteristics (4)



Impulse Response Characteristics Test Circuit



Rise time vs. Power-Supply Voltage Characteristics



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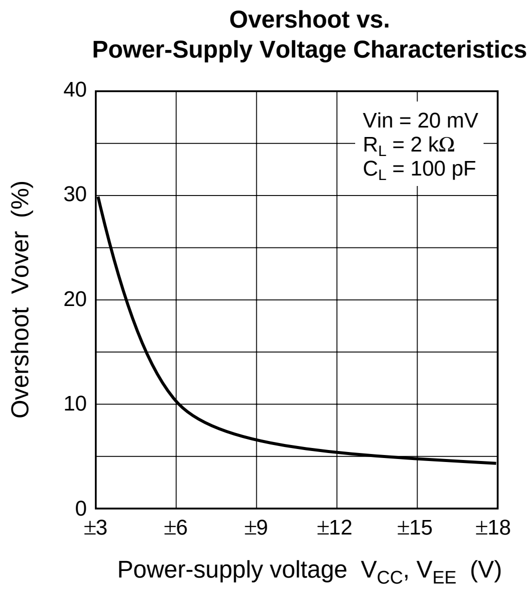
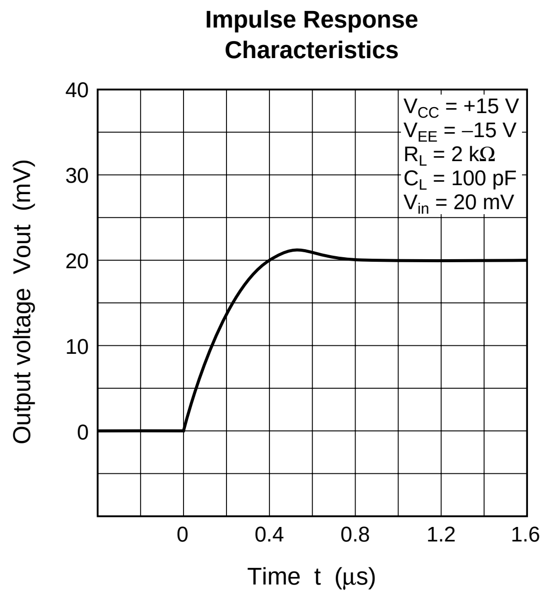
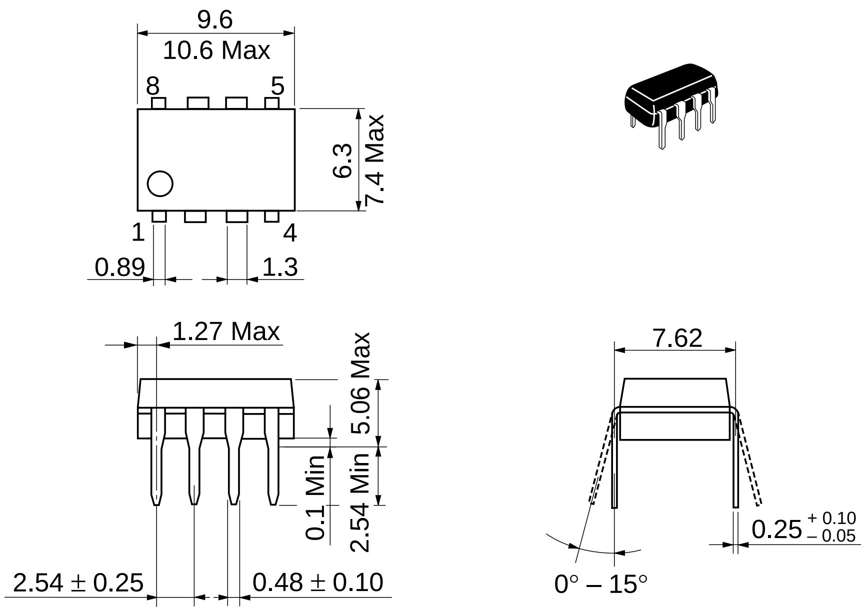

Overshoot vs.
Power-Supply Voltage Characteristics
Vin = 20 mV
R_L = 2 kΩ
C_L = 100 pF
Overshoot Vover (%)
40
30
20
10
0
±3
±6
±9
±12
±15
±18
Power-supply voltage V_{CC}, V_{EE} (V)


Impulse Response
Characteristics
V_{CC} = +15 V
V_{EE} = –15 V
R_L = 2 kΩ
C_L = 100 pF
V_{in} = 20 mV
Output voltage Vout (mV)
40
30
20
10
0
0
0.4
0.8
1.2
1.6
Time t (µs)

Package Dimensions

Unit: mm



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

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