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Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

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HA17902 Series

Quad Operational Amplifier



ADE-204-045 (Z)

Rev. 0

Dec. 2000

Description

The HA17902 is an internal phase compensation quad operational amplifier that operates on a single-voltage power supply and is appropriate for use in a wide range of general-purpose control equipment.

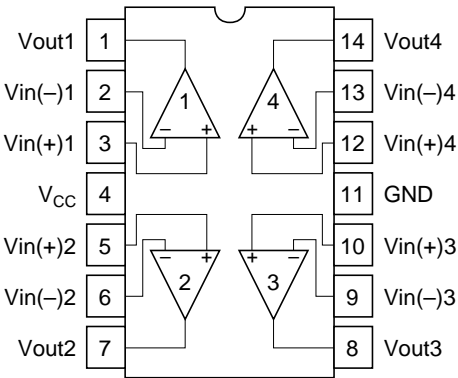
Features

- Wide usable power-supply voltage range and single-voltage supply operation
- Internal phase compensation
- Wide common-mode voltage range and operation for inputs close to the 0 level

Ordering Information

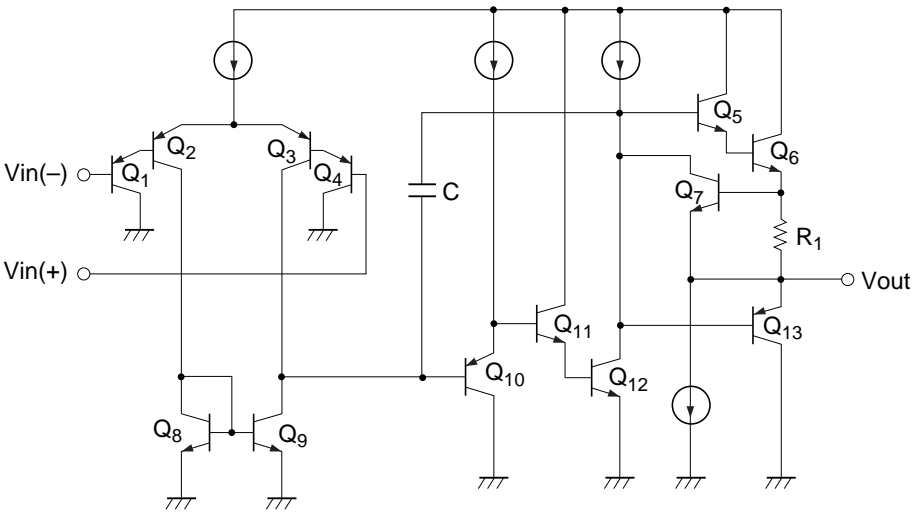
Type No.	Application	Package
HA17902PJ	Car use	DP-14
HA17902FPJ		FP-14DA
HA17902FPK		FP-14DA
HA17902P	Industrial use	DP-14
HA17902FP		FP-14DA
HA17902	Commercial use	DP-14

Pin Arrangement



(Top view)

Circuit Structure (1/4)



Absolute Maximum Ratings ($T_a = 25^{\circ}\text{C}$)

Item	Symbol	HA17902/ P	HA17902 PJ	HA17902 FP	HA17902 FPJ	HA17902 FPK	Unit
Power supply voltage	V_{CC}	28	28	28	28	28	V
Sink current	I_o sink	50	50	50	50	25	mA
Allowable power dissipation	P_T	625^{*1}	625^{*1}	625^{*2}	625^{*2}	625^{*2}	mW
Common-mode input voltage	V_{CM}	-0.3 to V_{CC}	-0.3 to V_{CC}	-0.3 to V_{CC}	-0.3 to V_{CC}	-0.3 to V_{CC}	V
Differential-mode input voltage	$V_{in}(\text{diff})$	$\pm V_{CC}$	$\pm V_{CC}$	$\pm V_{CC}$	$\pm V_{CC}$	$\pm V_{CC}$	V
Operating temperature	T_{opr}	-20 to +75	-40 to +85	-20 to +75	-40 to +85	-40 to +125	$^{\circ}\text{C}$
Storage temperature	T_{stg}	-55 to +125	-55 to +125	-55 to +125	-55 to +125	-55 to +150	$^{\circ}\text{C}$

Notes: 1. These are the allowable values up to $T_a = 50^{\circ}\text{C}$. Derate by $8.3\text{mW}/^{\circ}\text{C}$ above that temperature.

2. See notes on SOP Package Usage in Reliability section.

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

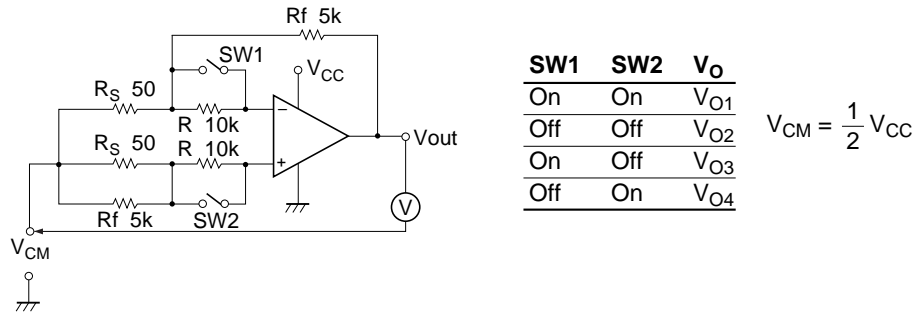
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input offset voltage	V_{IO}	—	3	8	mV	$V_{CM} = 7.5V$, $R_S = 50\Omega$, $R_f = 5k\Omega$
Input offset current	I_{IO}	—	5	50	nA	$I_{IO} = I_1^- - I_1^+ $, $V_{CM} = 7.5V$
Input bias current	I_{IB}	—	30	500	nA	$V_{CM} = 7.5V$
Power-supply rejection ratio	PSRR	—	93	—	dB	$f = 100Hz$, $R_S = 1k\Omega$, $R_f = 100k\Omega$
Voltage gain	A_{VD}	75	90	—	dB	$R_S = 1k\Omega$, $R_f = 100k\Omega$, $R_L = \infty$
Common-mode rejection ratio	CMR	—	80	—	dB	$R_S = 50\Omega$, $R_f = 5k\Omega$
Common-mode input voltage range	V_{CM}	-0.3	—	13.5	V	$R_S = 1k\Omega$, $R_f = 100k\Omega$, $f = 100Hz$
Maximum output voltage amplitude	V_{OP-P}	—	13.6	—	V	$f = 100Hz$, $R_S = 1k\Omega$, $R_f = 100k\Omega$, $R_L = 20k\Omega$
Output voltage	V_{OH1}	13.2	13.6	—	V	$I_{OH} = -1mA$
	V_{OH2}	12	13.3	—	V	$I_{OH} = -10mA$
	V_{OL1}	—	0.8	1	V	$I_{OL} = 1mA$
	V_{OL2}	—	1.1	1.8	V	$I_{OL} = 10mA$
Output source current	$I_{O \text{ source}}$	15	—	—	mA	$V_{OH} = 10V$
Output sink current	$I_{O \text{ sink}}$	3	9	—	mA	$V_{OL} = 1V$
Supply current	I_{CC}	—	0.8	2	mA	$V_{in} = GND$, $R_L = \infty$
Slew rate	SR	—	0.19	—	V/ μs	$f = 1.5kHz$, $V_{CM} = 7.5V$, $R_L = \infty$
Channel separation	CS	—	120	—	dB	$f = 1kHz$

Electrical Characteristics 2 ($V_{CC} = +15V$, $T_a = -40$ to $125^\circ C$)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input offset voltage	V_{IO}	—	—	8	mV	$V_{CM} = 7.5V$, $R_S = 50\Omega$, $R_f = 5k\Omega$
Input offset current	I_{IO}	—	—	200	nA	$V_{CM} = 7.5V$, $I_{IO} = I_1^- - I_1^+ $
Input bias current	I_{IB}	—	—	500	nA	$V_{CM} = 7.5V$
Common-mode input voltage range	V_{CM}	0	—	13.0	V	$R_S = 1k\Omega$, $R_f = 100k\Omega$, $f = 100Hz$
Output voltage	V_{OH}	13.0	—	—	V	$I_{OH} = -1mA$
	V_{OL}	—	—	1.3	V	$I_{OL} = 1mA$
Supply current	I_{CC}	—	—	4	mA	$V_{in} = GND$, $R_L = \infty$

Test Circuits

1. Input offset voltage (V_{IO}), input offset current (I_{IO}), and Input bias current (I_{IB}) test circuit



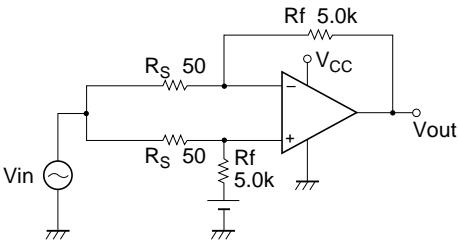
$$V_{IO} = \frac{V_{O1}}{1 + R_f / R_S} \quad (\text{mV})$$

$$I_{IO} = \frac{V_{O2} - V_{O1}}{R(1 + R_f / R_S)} \quad (\text{nA})$$

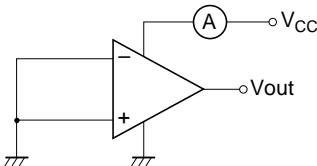
$$I_{IB} = \frac{|V_{O4} - V_{O3}|}{2 \cdot R(1 + R_f / R_S)} \quad (\text{nA})$$

2. Common-mode rejection ratio (CMR) test circuit

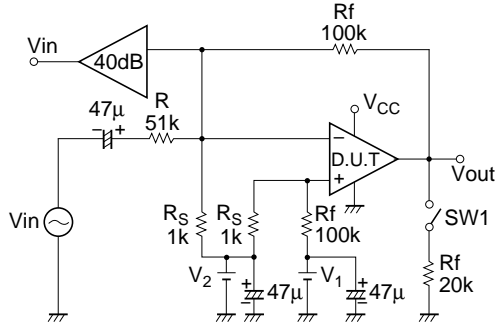
$$\text{CMR} = 20 \log \frac{V_{IN} \cdot R_f}{V_O \cdot R_S} \quad (\text{dB})$$



3. Supply current (I_{CC}) test circuit



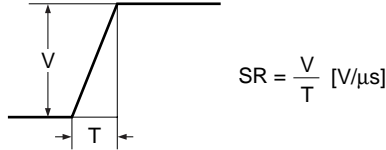
4. Voltage gain (A_{VD}), slew rate (SR), common-mode input voltage range (V_{CM}), and maximum output voltage amplitude (V_{OP-P}) test circuit.



- (1) A_{VD} : $R_S = 1k\Omega$, $R_f = 100k\Omega$, $R_L = \infty$, $V_1 = V_2 = 1/2 V_{CC}$

$$A_{VD} = 20 \log \frac{V_O}{V_{IN}} + 40 \quad (\text{dB})$$

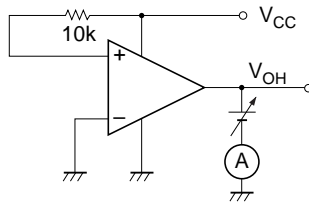
- (2) SR: $f = 1.5kHz$, $R_L = \infty$, $V_1 = V_2 = 1/2 V_{CC}$



- (3) V_{CM} : $R_S = 1k\Omega$, $R_f = 100k\Omega$, $f = 100Hz$, $V_1 = 1/2 V_{CC}$, $R_L = \infty$,
and the value of V_2 just slightly prior to the point where the output waveform changes.
- (4) V_{OP-P} : $R_S = 1k\Omega$, $R_f = 100k\Omega$, $R_L: 20k\Omega$, $f = 100Hz$, $V_{OP-P} = V_{OH} \leftrightarrow V_{OL} [V_{P-P}]$

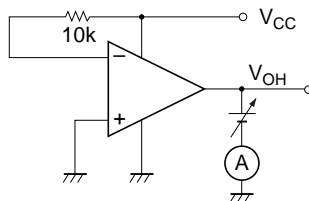
5. Output source current (I_{source}) test circuit

$I_{o \text{ source}}$: $V_{OH} = 10V$



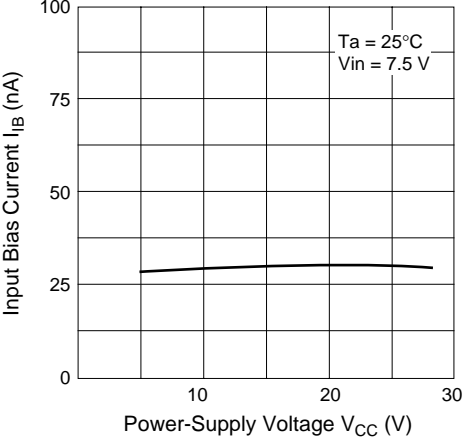
6. Output sink current (I_{sink}) test circuit

$I_{o \text{ sink}}$: $V_{OL} = 1V$

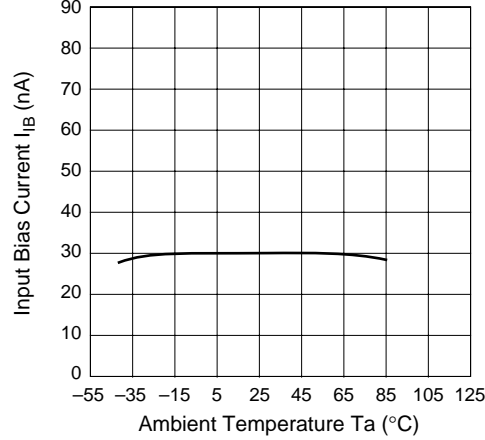


Characteristics Curve

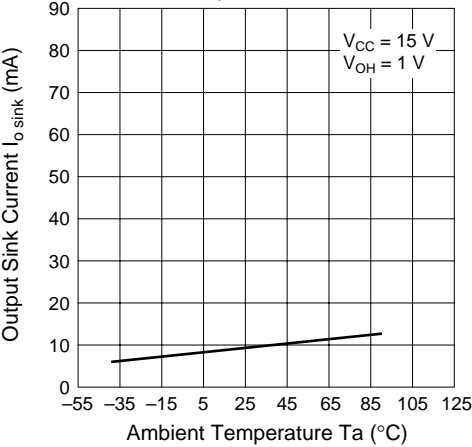
Input Bias Current vs.
Power-Supply
Voltage Characteristics



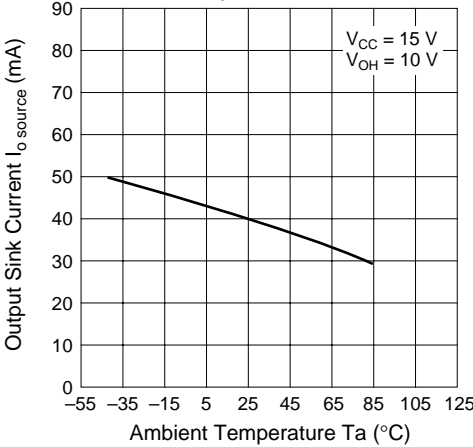
Input Bias Current vs.
Ambient
Temperature Characteristics

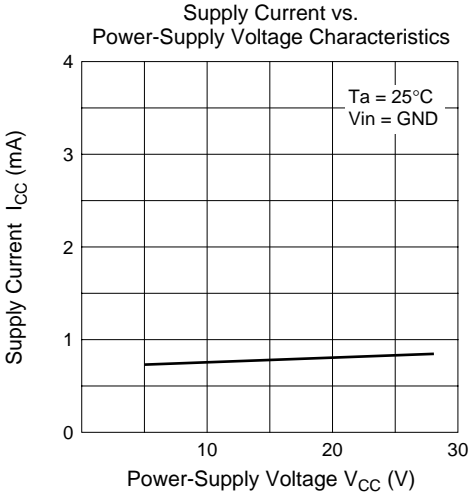
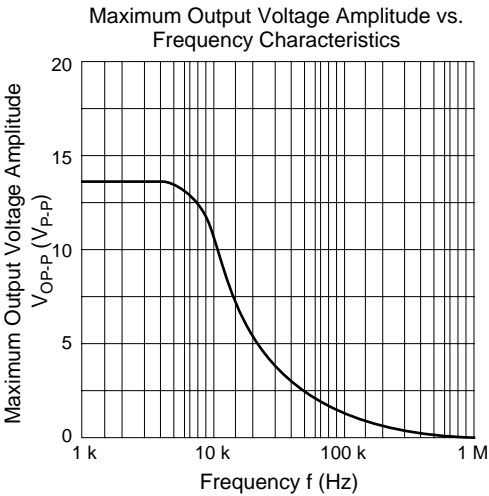
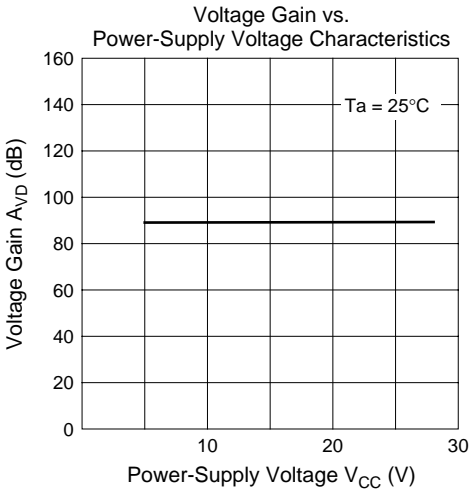
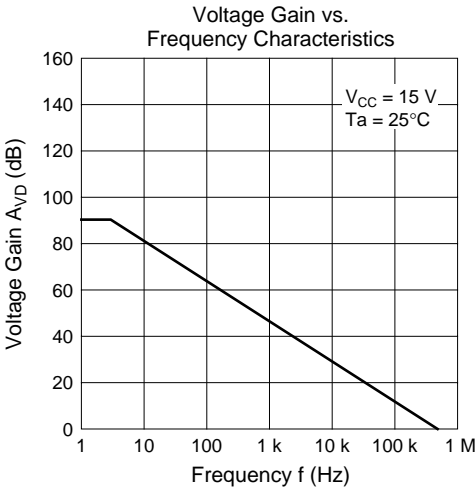


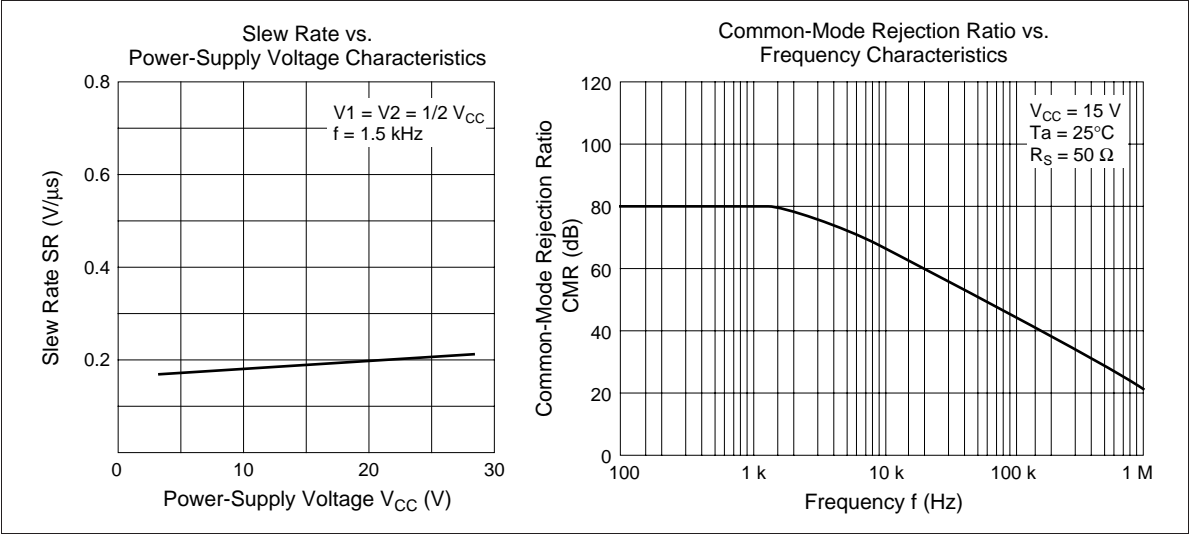
Output Sink Current vs.
Ambient Temperature Characteristics

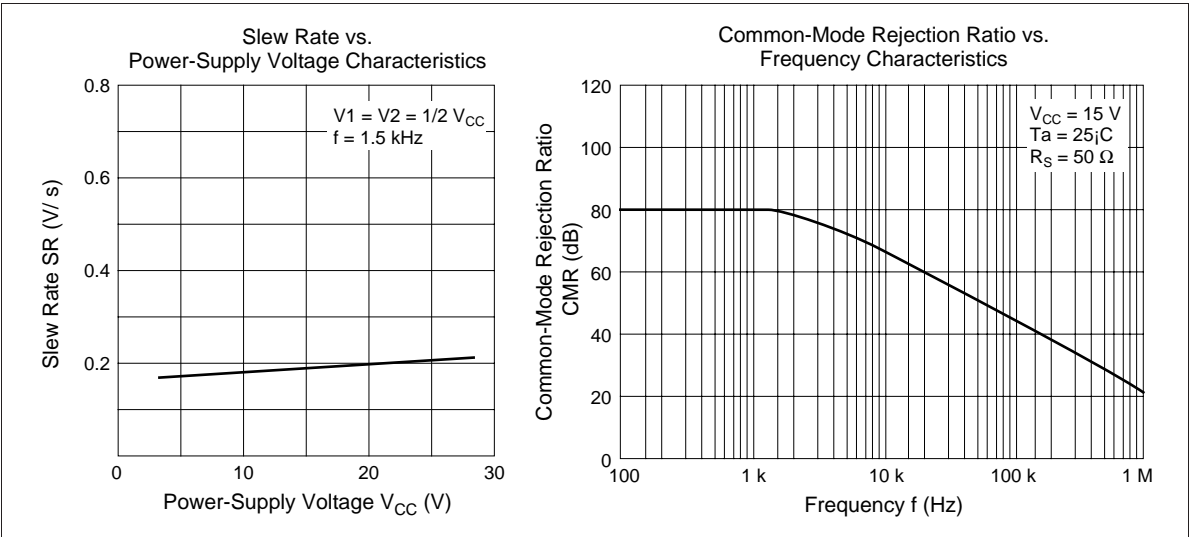


Output Source Current vs.
Ambient Temperature Characteristics









HA17902 Application Examples

The HA17902 is a quad operational amplifier, and consists of four operational amplifier circuits and one bias current circuit. It features single-voltage power supply operation, internal phase compensation, a wide zero-cross bandwidth, a low input bias current, and a high open-loop gain. Thus the HA17902 can be used in a wide range of applications. This section describes several applications using the HA17902.

1. Noninverting Amplifier

Figure 1 shows the circuit diagram for a noninverting amplifier. The voltage gain of this amplifier is given by the following formula.

$$\frac{V_{out}}{V_{in}} = 1 + \frac{R_2}{R_1}$$

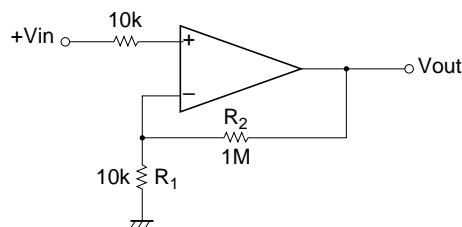


Figure 1 Noninverting Amplifier

2. Summing Amplifier

Since the circuit shown in figure 2 applies $+V_1$ and $+V_2$ to the noninverting input and $+V_3$ and $+V_4$ to the inverting input, the total output will be $V_{out} = V_1 + V_2 - V_3 - V_4$.

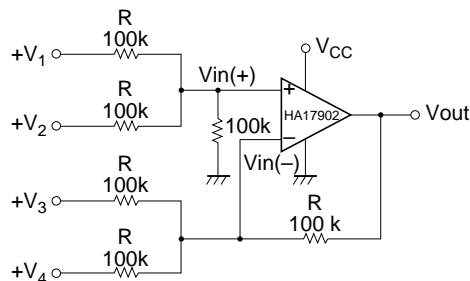


Figure 2 Summing Amplifier

3. High Input Impedance DC Differential Amplifier

The circuit shown in figure 3 is a high input impedance DC differential amplifier. This circuit's common-mode rejection ratio (CMR) depends on the matching between the R_1/R_2 and R_4/R_3 resistance ratios. This amplifier's output is given by the following formula.

$$V_{out} = \left(1 + \frac{R_4}{R_3}\right) (V_2 - V_1)$$

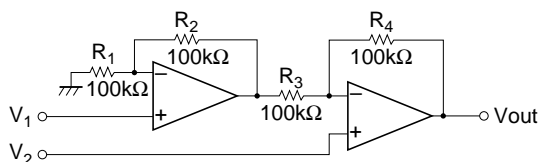


Figure 3 High Input Impedance DC Differential Amplifier

4. Voltage Controlled Oscillator

Figure 4 shows an oscillator circuit in which the amplifier A_1 is an integrator, the amplifier A_2 is a comparator, and transistor Q_1 operates as a switch that controls the oscillator frequency. If the output V_{out1} is at the low level, this will cut off transistor Q_1 and cause the A_1 inverting input to go to a higher potential than the noninverting input. Therefore, A_1 will integrate this negative input state and its output level will decrease. When the A_1 integrator output becomes lower than the A_2 comparator noninverting input level ($V_{CC}/2$) the comparator output goes high. This turns on transistor Q_1 causing the integrator to integrate a positive input state and for its output to increase. This operation generates a square wave on V_{out1} and a triangular wave on V_{out2} .

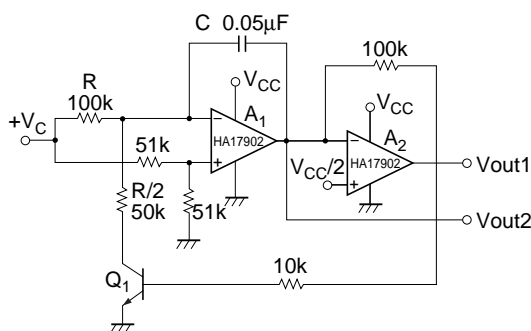
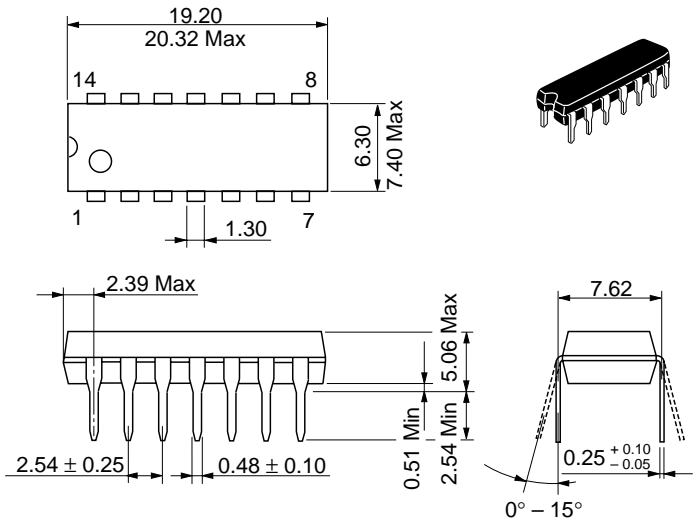


Figure 4 Voltage Controlled Oscillator

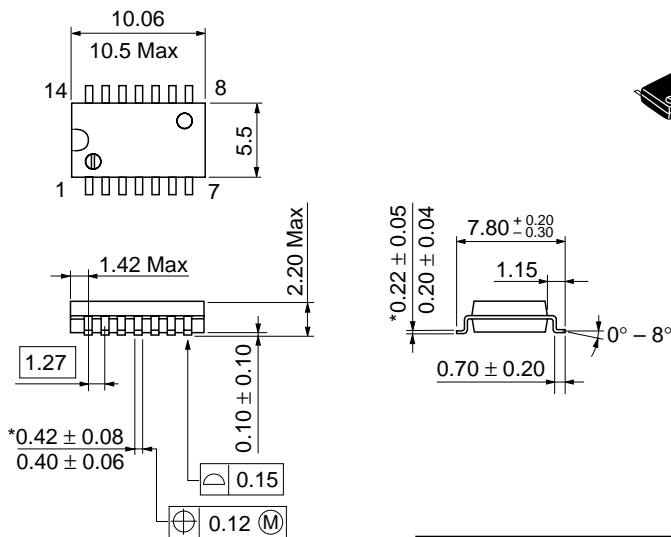
Package Dimensions

Unit: mm



Hitachi Code	DP-14
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	0.97 g

Unit: mm



*Dimension including the plating thickness
Base material dimension

Hitachi Code	FP-14DA
JEDEC	—
EIAJ	Conforms
Mass (reference value)	0.23 g

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