
HA17902 Series

Quad Operational Amplifier

HITACHI

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.

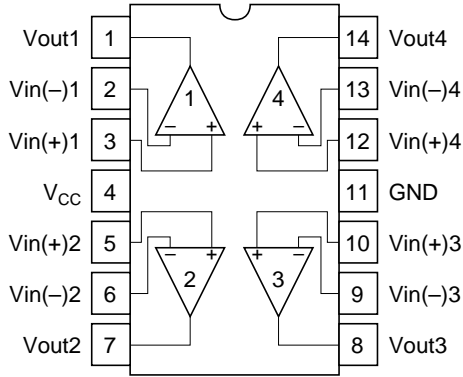
Features

- 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

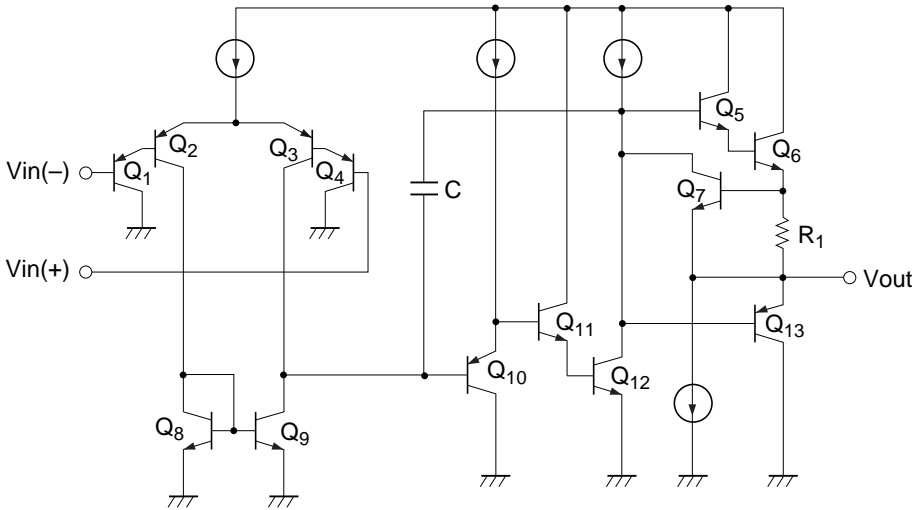
Type No.	Application	Package
HA17902PJ	Car use	DP-14
HA17902FPJ		FP-14DA
HA17902FPK		FP-14DA
HA17902P	Industrial use	DP-14
HA17902FP		FP-14DA
HA17902	Commercial use	DP-14

Pin Arrangement



(Top view)

Circuit Structure (1/4)



Absolute Maximum Ratings (Ta = 25°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(diff)}	±V _{CC}	±V _{CC}	±V _{CC}	±V _{CC}	±V _{CC}	V
Operating temperature	T _{opr}	-20 to +75	-40 to +85	-20 to +75	-40 to +85	-40 to +125	°C
Storage temperature	T _{stg}	-55 to +125	-55 to +125	-55 to +125	-55 to +125	-55 to +150	°C

- Notes: 1. These are the allowable values up to Ta = 50°C. Derate by 8.3mW/°C above that temperature.
 2. See notes on SOP Package Usage in Reliability section.

HA17902 Series

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

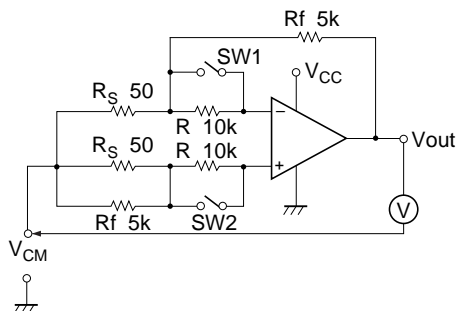
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input offset voltage	V_{IO}	—	3	8	mV	$V_{CM} = 7.5V$, $R_S = 50\Omega$, $R_f = 5k\Omega$
Input offset current	I_{IO}	—	5	50	nA	$I_{IO} = I_1^- - I_1^+ $, $V_{CM} = 7.5V$
Input bias current	I_{IB}	—	30	500	nA	$V_{CM} = 7.5V$
Power-supply rejection ratio	PSRR	—	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	Io source	15	—	—	mA	$V_{OH} = 10V$
Output sink current	Io 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



SW1	SW2	V_O
On	On	V_{O1}
Off	Off	V_{O2}
On	Off	V_{O3}
Off	On	V_{O4}

$$V_{CM} = \frac{1}{2} V_{CC}$$

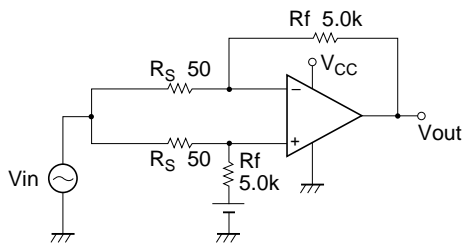
$$V_{IO} = \frac{V_{O1}}{1 + R_f / R_S} \quad (\text{mV})$$

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

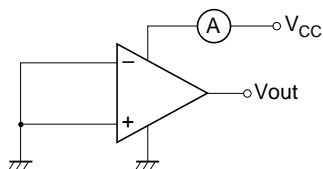
$$I_{IB} = \frac{|V_{O4} - V_{O3}|}{2 \cdot R(1 + R_f / R_S)} \quad (\text{nA})$$

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

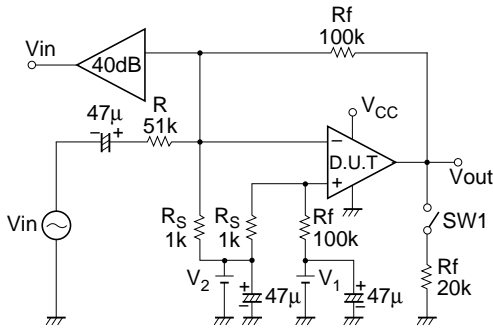
$$\text{CMR} = 20 \log \frac{V_{IN} \cdot R_f}{V_O \cdot R_S} \quad (\text{dB})$$



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



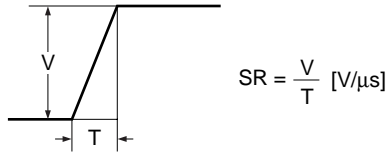
4. Voltage gain (A_{VD}), slew rate (SR), common-mode input voltage range (V_{CM}), and maximum output voltage amplitude (V_{OP-P}) test circuit.



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

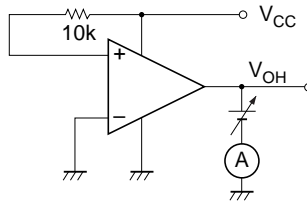


- (3) V_{CM} : $R_S = 1k\Omega$, $R_f = 100k\Omega$, $f = 100\text{Hz}$, $V_1 = 1/2 V_{CC}$, $R_L = \infty$, and the value of V_2 just slightly prior to the point where the output waveform changes.

- (4) V_{OP-P} : $R_S = 1k\Omega$, $R_f = 100k\Omega$, $R_L = 20k\Omega$, $f = 100\text{Hz}$, $V_{OP-P} = V_{OH} \leftrightarrow V_{OL} [V_{P-P}]$

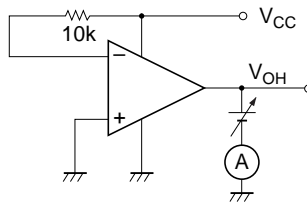
5. Output source current ($I_{osource}$) test circuit

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



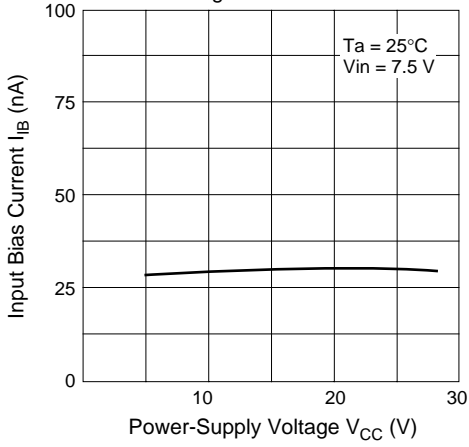
6. Output sink current (I_{osink}) test circuit

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

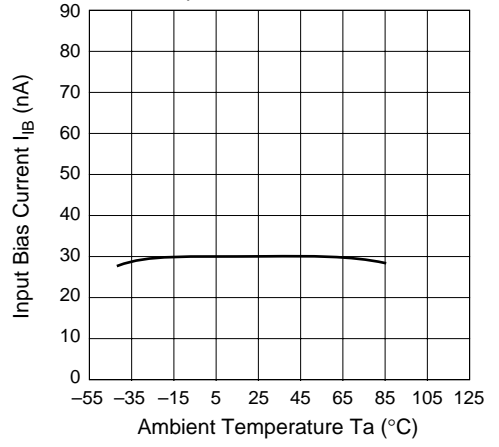


Characteristics Curve

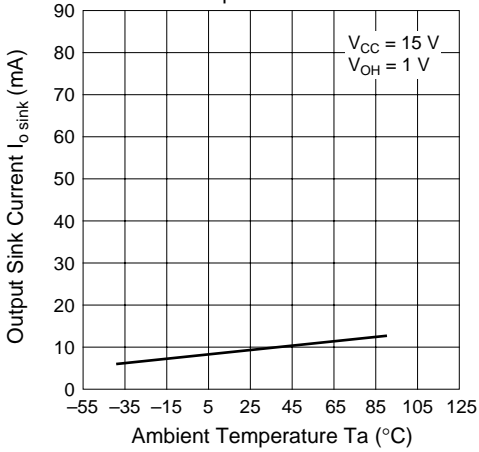
Input Bias Current vs. Power-Supply Voltage Characteristics



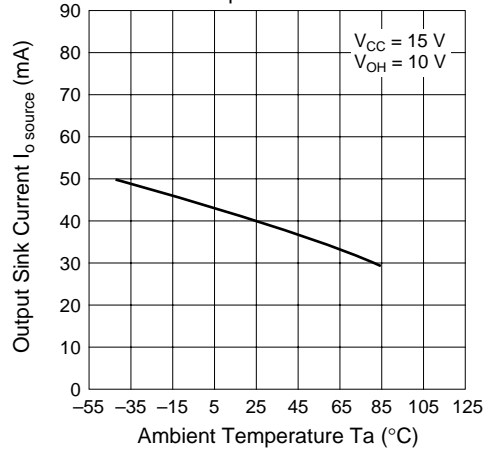
Input Bias Current vs. Ambient Temperature Characteristics

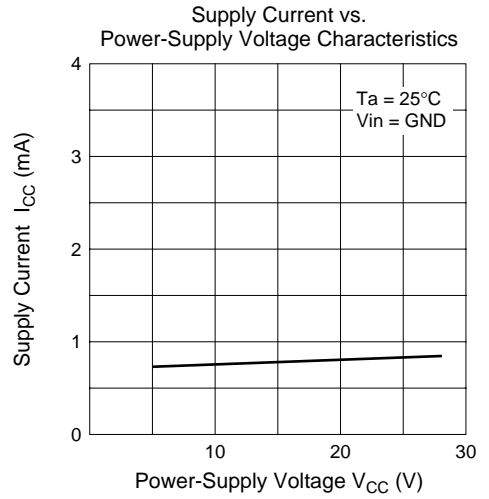
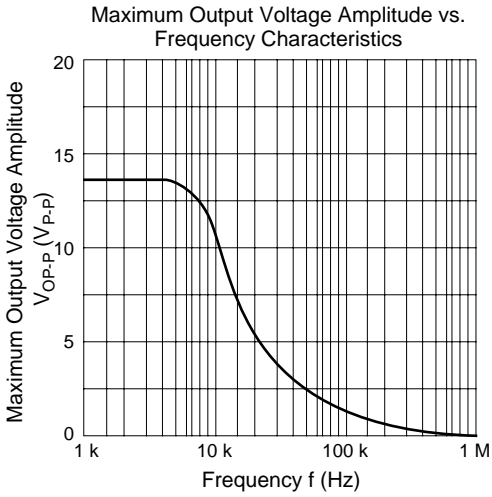
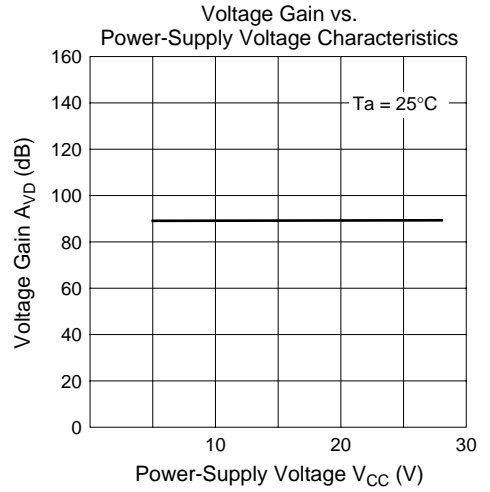
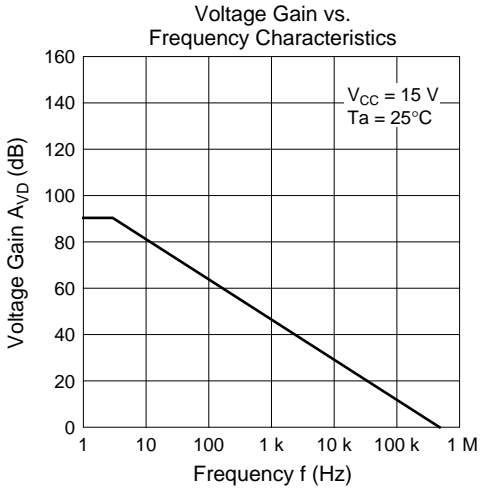


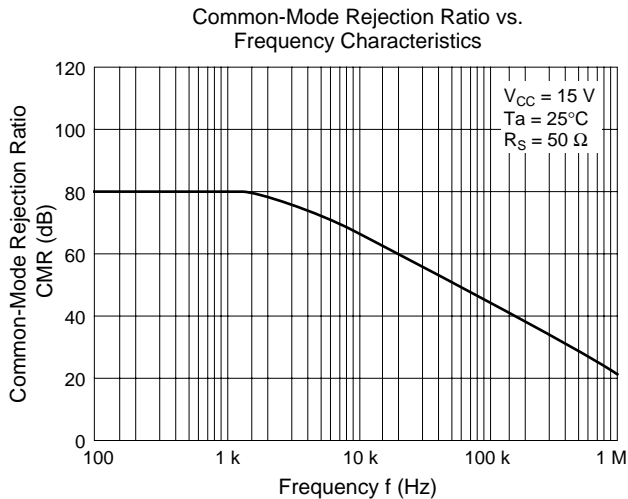
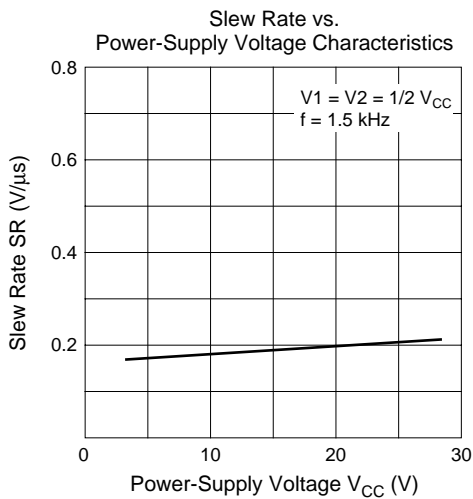
Output Sink Current vs. Ambient Temperature Characteristics

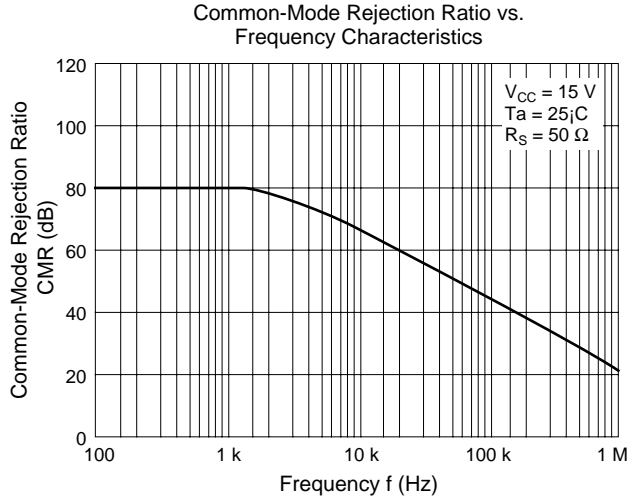
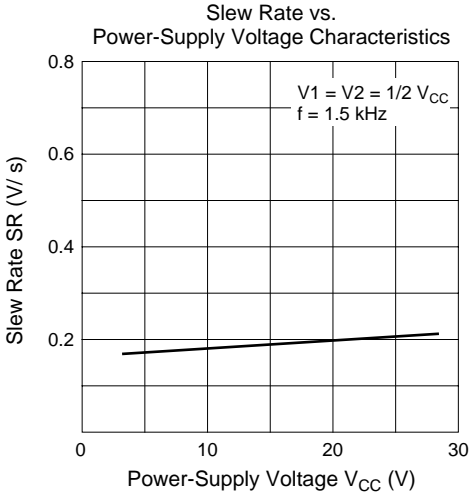


Output Source Current vs. Ambient Temperature Characteristics









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.

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

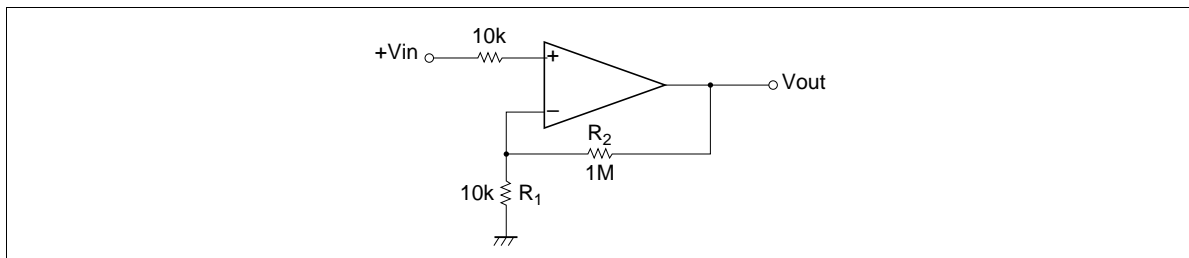


Figure 1 Noninverting Amplifier

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 $V_{out} = V_1 + V_2 - V_3 - V_4$.

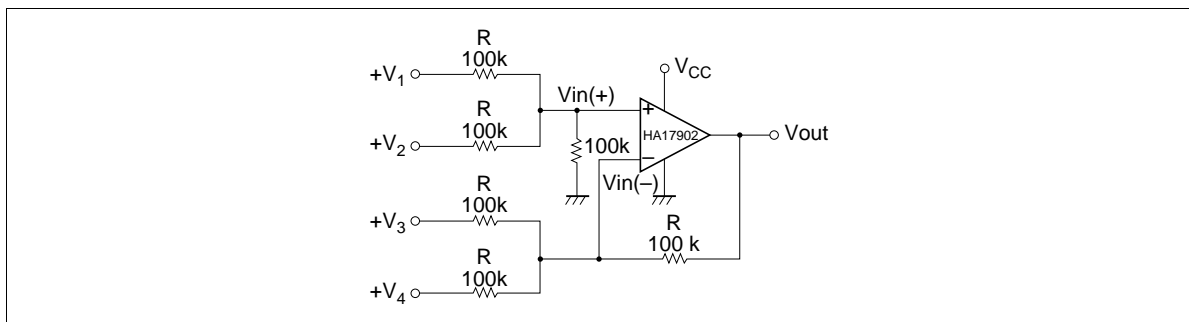


Figure 2 Summing Amplifier

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.

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

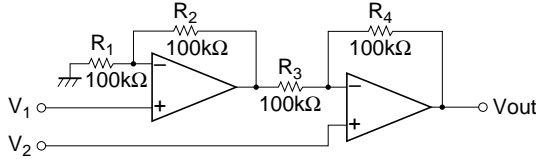


Figure 3 High Input Impedance DC Differential Amplifier

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} .

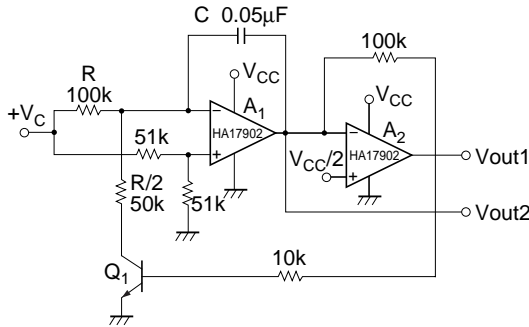
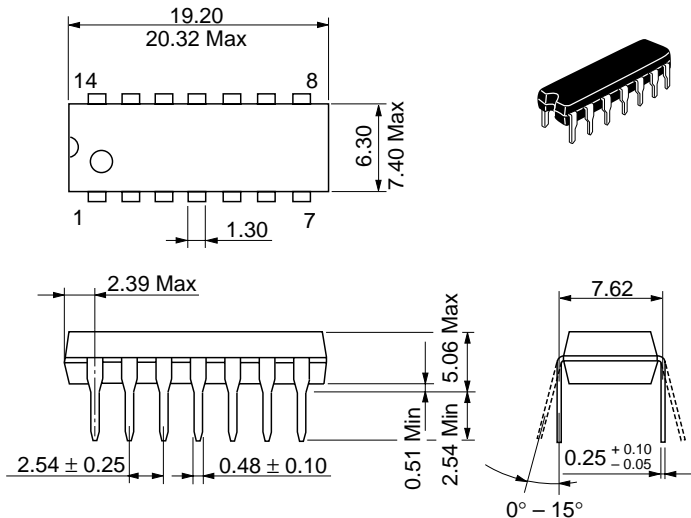


Figure 4 Voltage Controlled Oscillator

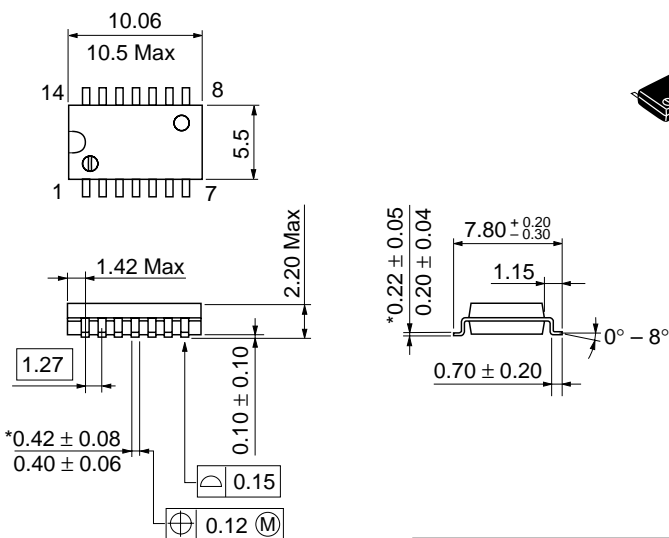
Package Dimensions

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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Hitachi, Ltd.

Semiconductor & Integrated Circuits.

Nippon Bldg., 2-6-2, Ohite-machi, Chiyoda-ku, Tokyo 100-0004, Japan

Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL NorthAmerica : <http://semiconductor.hitachi.com/>
 Europe : <http://www.hitachi-eu.com/hel/ecg>
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For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose, CA 95134
Tel: <1> (408) 433-1990
Fax: <1> (408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building, No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
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