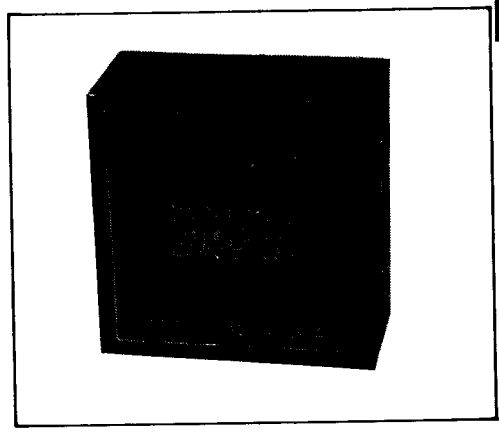
TELEDYNE PHILBRICK

Ultra Low Offset Drift Operational Amplifiers

1020

The 1020 and 1020-01 are extremely low offset drift operational amplifiers that do not use chopper stabilization. Low offset temperature coefficients are achieved with a precise electrical and thermal design and most importantly, the careful selecting and matching of components—including an external metal-film trim resistor selected by the manufacturer and supplied with each unit. The 1020 and 1020-01 have respective initial offset errors of ± 3mV and ± 0.5mV maximum. Maximum offset drifts are ± 5μV/°C and ± 1.5μV/°C.

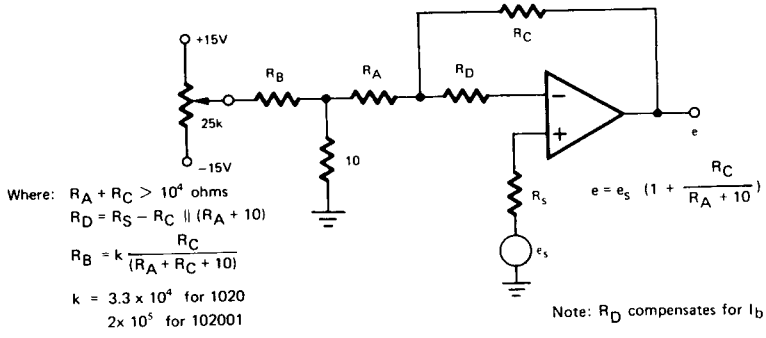


Offset Drift Considerations

The 1020 and 1020-01 are guaranteed to meet or exceed their published specifications only when the metal-film trim resistor selected for and supplied with each unit (the value is indicated on the amplifier case) is connected between the + 15 volt supply and the trim terminal. If it is necessary to trim the offset voltage closer to zero, the adjustment is made by replacing the selected trim resistor with a rheostat, or by adding an external biasing network. Trimming the offset voltage with a rheostat (typically 100kΩ) will introduce a small error into the offset voltage temperature coefficient. Equations relating the change in trim resistance to changes in the initial value and offset voltage temperature coefficient are:

1. $\triangle e_{os}(@25°C)/\triangle R_{Trim} \approx +45\mu V/k\Omega$
2. $\triangle e_{os}TC(-25°C \text{ to } +85°C)/\triangle R_{Trim} \approx +0.13\mu V/°C/k\Omega$

Many applications require a method to trim offset voltage without degrading the temperature drift specification. This is done with an external network which sums an external dc to null the effects of offset voltage.



Biasing Circuit (Follower)

FEATURES

- Low Offset TC
  1020 ± 5μV/°C Max
  1020-01 ± 1.5μV/°C Max
- Low Initial Offset
  1020 ± 3mV Max
  1020-01 ± 0.5mV Max
- Low Flicker Noise
- 100dB CMRR
- 120dB Open Loop Gain
- − 25°C to + 85°C Operation

APPLICATIONS

- Microvolt Signal Conditioners
- Bridge Amplifiers
- Instrumentation Amplifiers

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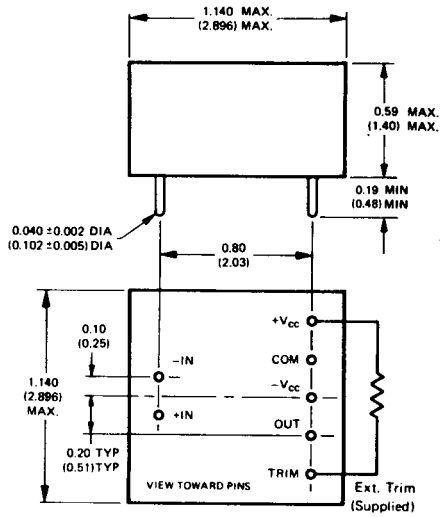
SPECIFICATIONS @ 25 °C, V_{CC} = ±15 V, unless otherwise indicated

	Typical	Guaranteed
		1020/1020-01
OUTPUT RANGE ①		
Voltage (Peak)	---	±10 V
Current	---	±5 mA
VOLTAGE GAIN (dc Open Loop) ①		
Rated Load	---	106 dB
10 k Load	120 dB	---
FREQUENCY RESPONSE (Inverting) ①		
Small Signal (Unity Gain, Open Loop)	---	0.5 MHz
Large Signal Full Output (Undistorted	---	5 kHz
Large Signal Full Output (Peak-to-Peak)	10 kHz	---
Slew Rate	0.6 V/μsec	0.3 V/μsec
Settling Time to 0.1% (10 V Step Input)	40 μsec	---
Overload Recovery Time (Step Input)	600 μsec	---
Max. Capacitive Load Without Instability	---	0.01 μF
INPUT VOLTAGE RANGE		
Common Mode dc Linear Operation	---	±10 V
Common Mode Fault	---	±15 V Abs. Max.
Differential (Between Inputs)	---	30 V Abs. Max.
Common Mode Rejection Ratio	100 dB	86 dB
INPUT VOLTAGE OFFSET		
Initial (with supplied trim) @ 25 °C	---	±3/0.5 mV
Zero Adjustment	see text	
Vs. Temperature (Avg. -25 °C to +85 °C)	---	±5/1.5 μV/°C
Vs. Time (per 24 hours)	±5 μV	---
Vs. Power Supply	±50 μV/V	---
INPUT BIAS CURRENT		
Initial @ 25 °C	---	±25 nA
Vs. Temperature (Avg. -25 °C to +85 °C)	±500 pA/°C	---
Vs. Time (per 24 hours)	---	---
Vs. Power Supply	±0.7 nA/V	---
Offset Current	---	±5 nA
Offset Current Vs. Temp	±50 pA/°C	---
INPUT IMPEDANCE @ dc		
Differential	4 MΩ ‖ 8 pF	---
Common Mode (either Input to Common)	1000 MΩ ‖ 8 pF	---
NOISE (Referred to Input) ②		
Flicker (0.016 to 1.6 Hz)		
Voltage (Peak-to-Peak)	---	1 μV
Current (Peak-to-Peak)	50 pA	---
Midband (1.6 to 160 Hz)		
Voltage (rms)	---	2 μV
Current (rms)	6 pA	---
Highband (160 Hz to 16 kHz)		
Voltage (rms)	---	4 μV Max.
Current (rms)	6 pA	---
Broadband (15 Hz to 50 kHz)		
Voltage (rms)	4 μV	---
POWER REQUIREMENTS		
Voltage Range	---	±12 V to ±18 V
Current (Quiescent)	---	±12 mA
TEMPERATURE RANGE (Degrees C)		
Operating	---	-25 °C to +85 °C
Storage	---	-55 °C to +125 °C

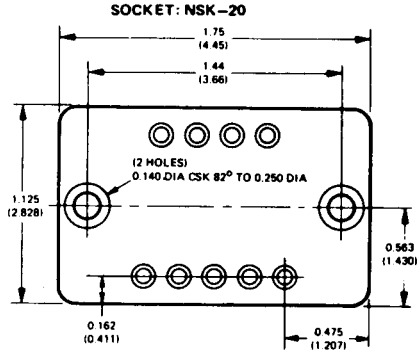
① R_{LL} = 2 kΩ
② e_n = 4 μV rms (5 Hz to 50 kHz)



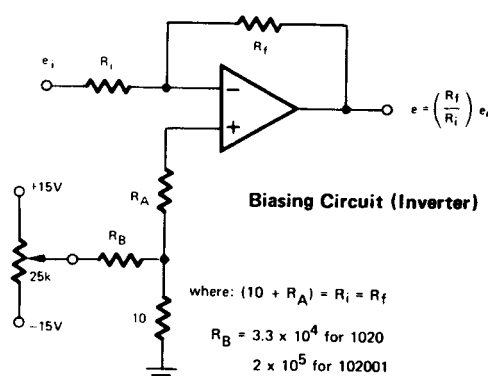
±0.01 Non-cumulative tolerance between pins
±0.02 Tolerance from case edge to center of pins

DIMENSIONS IN PARENTHESES ARE EXPRESSED IN CENTIMETERS

SOCKET: NSK-20



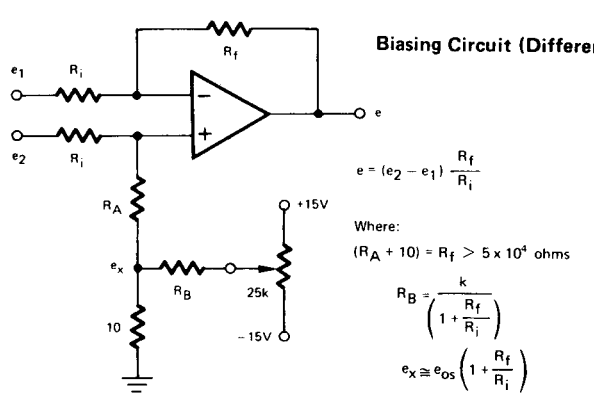
Board Thickness 0.094 (0.238)



Biasing Circuit (Inverter)

where: $(10 + R_A) = R_i = R_f$

R_B = 3.3 x 10^4 for 1020
2 x 10^5 for 102001



Biasing Circuit (Differential)

$$e = (e_2 - e_1)\frac{R_f}{R_i}$$

Where:

$(R_A + 10) = R_f > 5 \times 10^4$ ohms

$$R_B = \frac{k}{\left(1 + \frac{R_f}{R_i}\right)}$$

$$e_x \cong e_{os}\left(1 + \frac{R_f}{R_i}\right)$$

k = 3.3 x 10^4 for 1020
2 x 10^5 for 102001

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