

1024/1028/1034 HIGH PERFORMANCE OPERATIONAL AMPLIFIERS

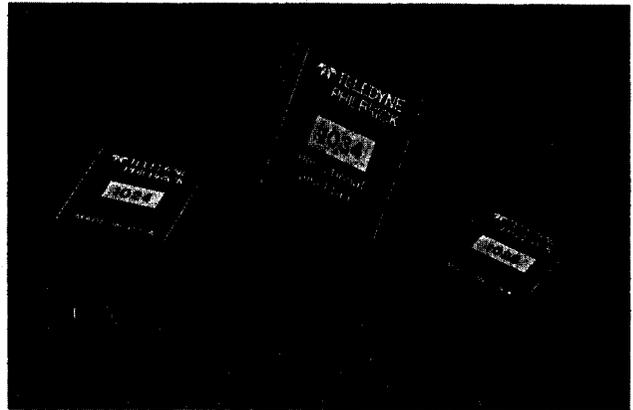
The Teledyne Philbrick models 1024, 1028, and 1034 modular operational amplifiers provide price/performance trade-offs not available from integrated circuits.

Model 1034's output will swing ± 30 V into a 1.5 k Ω load and provide an $E_{OS}TC$ of 15 $\mu V/^\circ C$. This device in particular is designed for high compliance 4 to 20 mA current loops as used in process control instrumentation. However, the low (4 mA) quiescent current and 50 kHz full power make it ideal for use in portable high frequency galvanometer drivers.

The 1028 has typical open loop gains of 110 dB, coupled with low I_{BIAS} and E_{OS} temperature coefficients. It is ideal for low cost, gain and drift stable differential amplifiers operating from source resistances as high as 10 k Ω .

The 1024 has characteristics similar to the 1028 and will drive a 500 Ω load with a 10 V p-p sine wave at 250 kHz.

The initial input offset voltage of the three amplifiers may be trimmed to zero with an external variable resistor as shown in the outline and base drawing. Note: If an external Zero Trim adjust is not used, the trim pin MUST be connected to $+V_{CC}$ as defined in the specifications.



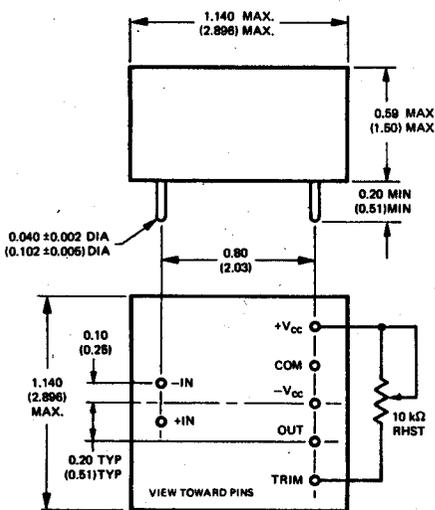
FEATURES

- Output ± 30 V @ ± 22 mA (1034)
- 15 $\mu V/^\circ C$ E_{OS} vs. Temperature (1034)
- 50 kHz Full Power (1034)
- I_{CC} 4 mA Max. (1034)
- Output ± 20 mA @ ± 10 V (1024)
- 250 kHz Full Power (1024)
- Open Loop Gain 110 dB (1034)
- 6 V/ μ sec Slew Rate

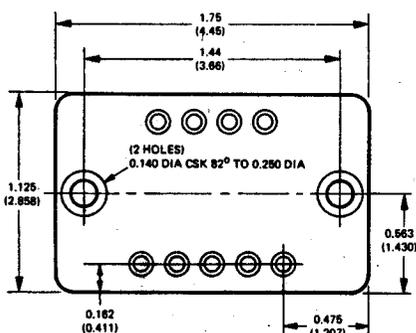
APPLICATIONS

- 4 to 20 mA Control Loops
- Wideband Galvanometer Drivers
- Power Instrumentation Amps
- Power Digital to Analog Converters

MODEL 1024

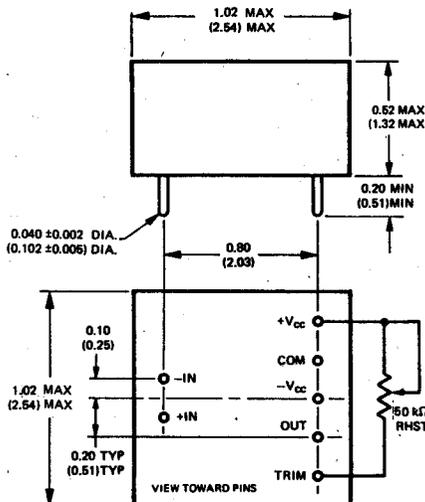


Optional Socket: Model NSK-20

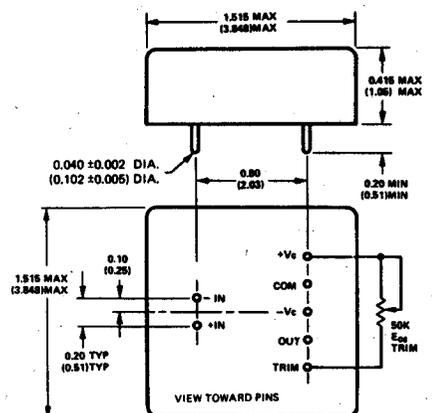


Board Thickness: 0.094 (0.238) Overall Height: 0.826 (1.50)

MODEL 1028



MODEL 1034



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

DIMENSIONS IN PARENTHESES ARE EXPRESSED IN CENTIMETERS

SPECIFICATIONS @ 25°C, Rated Load, $V_{CC} = \pm 15\text{ V}$ ($\pm 26\text{ V}$ for 1034), unless otherwise specified

	1024		1028		1034	
	Typical	Guaranteed	Typical	Guaranteed	Typical	Guaranteed
OUTPUT RANGE						
Voltage (Peak)	$\pm 12\text{ V}$	$\pm 10\text{ V}$	$\pm 11\text{ V}$	$\pm 10\text{ V}$	$\pm 22\text{ V}$ $\pm 36\text{ V } V_{CC} = \pm 35\text{ V}$	$\pm 20\text{ V}$
Current	25 mA	$\pm 20\text{ mA}$	---	$\pm 5\text{ mA}$	$\pm 25\text{ mA}$	$\pm 22\text{ mA}$
VOLTAGE GAIN						
Rated Load	100 dB	94 dB	114 dB	108 dB	110 dB	100 dB
FREQUENCY-TIME-RESPONSE						
Small Signal (Unity Gain Open Loop)	2 MHz	---	2 MHz	1 MHz	2 MHz	1 MHz
Max Sine Power Out (3 to 5% distortion) Inverting	150 kHz	100 kHz	100 kHz	---	50 kHz	---
Max Sine Power Out (3 to 5% distortion) Non-Inv.	100 kHz	---	20 kHz	---	10 kHz	---
Max Peak to Peak Out (Triangle Wave) Inverting	250 kHz	---	150 kHz	100 kHz	75 kHz	50 kHz
Max Peak to Peak Out (Triangle Wave) Non-Inv.	200 kHz	---	30 kHz	---	10 kHz	---
Slew Rate (Inverting)	---	6 V/ μsec	10 V/ μsec	6 V/ μsec	1.2 (non-inv.)	6 V/ μsec
Settling Time to 0.1% (Step Input)	5 μsec	---	---	---	---	---
Overload Recovery Time (Step Input)	2 μsec	---	500 μsec	---	500 μsec	---
Capacitive Load Without Instability	---	0.001 μF	0.001 μF	---	0.01 μF	---
INPUT VOLTAGE RANGE						
Common Mode for Linear Operation	---	$\pm 10\text{ V}$	---	$\pm 10\text{ V}$	---	$\pm 20\text{ V}$
Common Mode Fault, Abs. max.	$\pm V_{CC}$	$\pm 15\text{ V}$	$\pm V_{CC}$	$\pm 15\text{ V}$	$\pm V_{CC}$	$\pm 26\text{ V}$
Differential (Between Inputs) Abs. max.	---	5 V	$+V_{CC} - (-V_{CC})$	$\pm 15\text{ V}$	$+V_{CC} - (-V_{CC})$	52 V
Common Mode Rejection Ratio	90 dB	---	90 dB	80 dB	102 dB	80 dB
INPUT OFFSET VOLTAGE						
Initial (without external trim)	$\pm 10\text{ mV}$	---	$\pm 3\text{ mV}$ (req. 24k Ω trim to $+V_{CC}$)	---	$\pm 10\text{ mV}$ (req. short trim to $+V_{CC}$)	---
Zero Adjustment Required	10 k Ω rht	---	50 k Ω rht	---	50 k Ω rht	---
Vs. Temperature (Avg. -25 to +85°C)	---	$\pm 20\text{ }\mu\text{V}/^\circ\text{C}$	---	$\pm 20\text{ }\mu\text{V}/^\circ\text{C}$	---	$\pm 15\text{ }\mu\text{V}/^\circ\text{C}$
Vs. Time (per 24 hours)	$\pm 50\text{ }\mu\text{V}$	---	---	---	50 μV	---
Vs. Time (per month)	---	---	$\pm 100\text{ }\mu\text{V}$	---	---	---
Vs. Power Supply	$\pm 100\text{ }\mu\text{V}/\text{V}$	---	100 $\mu\text{V}/\text{V}$	---	60 $\mu\text{V}/\text{V}$	---
INPUT BIAS CURRENT						
Initial @ 25°C	$\pm 30\text{ nA}$	$\pm 50\text{ nA}$	+20 nA	+35 nA	+25 nA	+50 nA
Vs. Temperature (Avg. -25 to +85°C)	---	$\pm 1\text{ nA}/^\circ\text{C}$	---	$\pm 0.5\text{ nA}/^\circ\text{C}$	---	$\pm 0.4\text{ nA}/^\circ\text{C}$
Vs. Time (per 24 hours)	$\pm 0.5\text{ nA}$	---	$\pm 3\text{ nA}$	---	$\pm 2\text{ nA}$	---
Vs. Power Supply	$\pm 3\text{ nA}/\text{V}$	---	3 nA/V	---	$\pm 3\text{ nA}/\text{V}$	---
Offset (tracking)	$\pm 25\text{ nA}$	---	$\pm 3\text{ nA}$	---	$\pm 3\text{ nA}$	---
INPUT IMPEDANCE						
Differential	1 M Ω 6 pF	---	1 M Ω	---	1 M Ω	---
Common Mode (either input to common)	50 M Ω 6 pF	---	1000 M Ω	---	1000 M Ω	---
NOISE (Referred to Input)						
Flicker (0.016 to 1.6 Hz)	---	---	---	---	---	---
Voltage (Peak to Peak)	7 μV	---	---	---	1 μV	---
Current (Peak to Peak)	34 pA	---	---	---	20 pA	---
Voltage (0.01 to 1 Hz) Peak-to-Peak	---	---	1 μV	---	---	---
Current (0.01 to 1 Hz) Peak-to-Peak	---	---	20 pA	---	---	---
Midband (1.6 to 100 Hz)	---	---	---	---	---	---
Voltage (rms)	2 μV	---	---	---	2 μV	---
Current (rms)	7 pA	---	---	---	10 pA	---
Wideband (10 Hz to 10 kHz)	---	---	2 μV	---	---	---
Voltage (rms)	---	---	---	---	---	---
POWER REQUIREMENTS						
Voltage Range	± 12 to $\pm 18\text{ V}$	---	± 12 to $\pm 18\text{ V}$	---	± 15 to $\pm 35\text{ V}$	---
Current: Quiescent	---	$\pm 9\text{ mA}$	---	$\pm 5\text{ mA}$	---	$\pm 4\text{ mA}$
TEMPERATURE RANGE						
Operating	---	-25 to +85°C	---	-25 to +85°C	---	-25 to +85°C
Storage	---	-55 to +125°C	---	-55 to +125°C	---	-55 to +125°C

The input circuits of these units are protected to $\pm V_{CC}$. Output circuits are short-circuit protected to ground.

Recommended Power Supply: Models 1024 & 1028 — TP Model 2211
Model 1034 — TP Model 2216

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 **TELEDYNE PHILBRICK**

Allied Drive at Route 128, Dedham, Massachusetts 02026
Tel: (617) 329-1600 TWX: (710) 348-6726 Telex: 92-4439