

TL022C, TL022M DUAL LOW-POWER OPERATIONAL AMPLIFIERS

SLOS076 – SEPTEMBER 1973 – REVISED SEPTEMBER 1990

- Very Low Power Consumption
- Power Dissipation With ± 2 -V Supplies
170 μ W Typ
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Input Offset Voltage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- Popular Dual Operational Amplifier Pinout

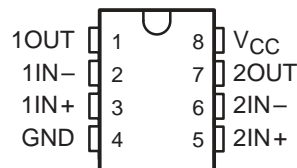
**TL022M IS NOT RECOMMENDED FOR
NEW DESIGNS**

description

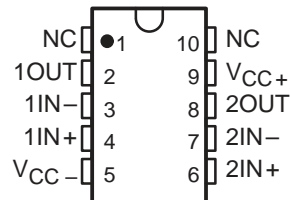
The TL022 is a dual low-power operational amplifier designed to replace higher power devices in many applications without sacrificing system performance. High input impedance, low supply currents, and low equivalent input noise voltage over a wide range of operating supply voltages result in an extremely versatile operational amplifier for use in a variety of analog applications including battery-operated circuits. Internal frequency compensation, absence of latch-up, high slew rate, and output short-circuit protection assure ease of use.

The TL022C is characterized for operation from 0°C to 70°C. The TL022M is characterized for operation over the full military temperature range of -55°C to 125°C.

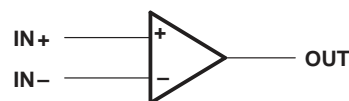
TL022M . . . JG PACKAGE
TL022C . . . D OR P PACKAGE
(TOP VIEW)



TL022M . . . U PACKAGE
(TOP VIEW)



symbol (each amplifier)



AVAILABLE OPTIONS

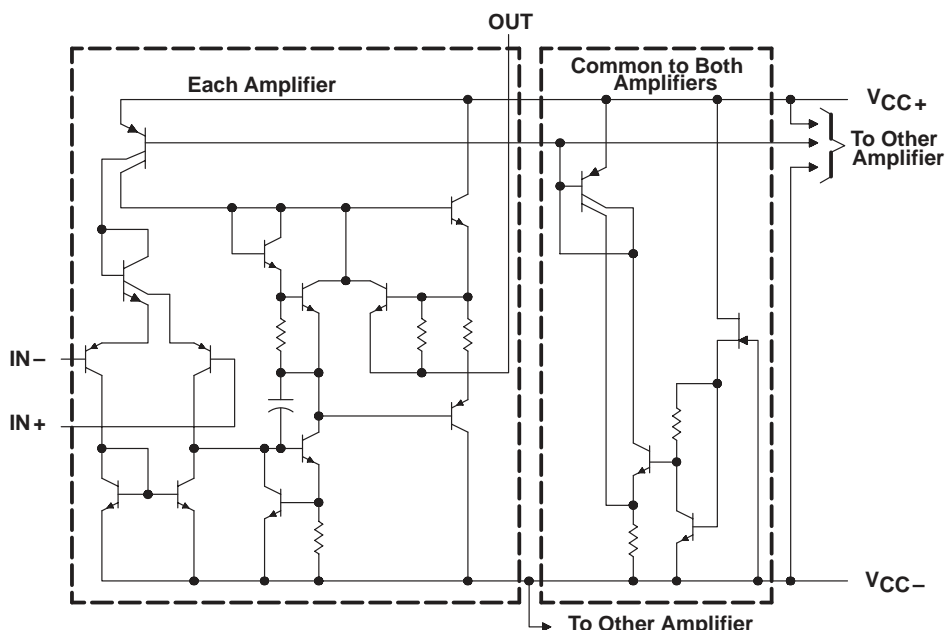
T _A	V _{IO} max AT 25°C	PACKAGE			
		SMALL OUTLINE (D)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLAT PACK (U)
0°C to 70°C	5 mV	TL022CD	—	TL022CP	—
-55°C to 125°C	5 mV	—	TL022MJG	—	TL022MU

The D package is available taped and reeled. Add the suffix R to the device type (i.e. TL022CDR).

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schematic



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	TL022C	TL022M	UNIT
Supply voltage, V_{CC+} (see Note 1)	18	22	V
Supply voltage, V_{CC-} (see Note 1)	-18	-22	V
Differential input voltage (see Note 2)	± 30	± 30	V
Input voltage (any input, see Notes 1 and 3)	± 15	± 15	V
Duration of output short circuit (see Note 4)	unlimited	unlimited	
Continuous total dissipation	See Dissipation Rating Table		
Operating free-air temperature range	0 to 70	-55 to 125	$^{\circ}\text{C}$
Storage temperature range	-65 to 150	-65 to 150	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	JG or U package	300	$^{\circ}\text{C}$
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D or P package	260	$^{\circ}\text{C}$

- NOTES: 1. All voltage values, unless otherwise noted, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. Differential voltages are at IN+ with respect to IN-.
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
 4. The output may be shorted to ground or either power supply. For the TL022M only, the unlimited duration of the short circuit applies at (or below) 125 $^{\circ}\text{C}$ case temperature or 75 $^{\circ}\text{C}$ free-air temperature.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^{\circ}\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70^{\circ}\text{C}$ POWER RATING	$T_A = 125^{\circ}\text{C}$ POWER RATING
D	680 mW	5.8 mW/ $^{\circ}\text{C}$	33 $^{\circ}\text{C}$	464 mW	—
JG	680 mW	8.4 mW/ $^{\circ}\text{C}$	69 $^{\circ}\text{C}$	672 mW	210 mW
P	680 mW	8.0 mW/ $^{\circ}\text{C}$	65 $^{\circ}\text{C}$	640 mW	—
U	675 mW	5.4 mW/ $^{\circ}\text{C}$	25 $^{\circ}\text{C}$	432 mW	135 mW



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recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC+}	5	15	V
Supply voltage, V_{CC-}	-5	-15	V

electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	TL022C			TL022M			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_O = 0$, $R_S = 50 \Omega$	25°C	1	5	1	5	mV	
		Full range		7.5		6		
I_{IO} Input offset current	$V_O = 0$	25°C	15	80	5	40	nA	
		Full range		200		100		
I_{IB} Input bias current	$V_O = 0$	25°C	100	250	50	100	nA	
		Full range		400		250		
V_{ICR} Common-mode input voltage range		25°C	± 12	± 13	± 12	± 13	V	
		Full range	± 12		± 12			
$V_{O(PP)}$ Maximum peak-to-peak output voltage swing	$R_L = 10 \text{ k}\Omega$	25°C	20	26	20	26	V	
	$R_L \geq 10 \text{ k}\Omega$	Full range	20		20			
A_{VD} Large-signal differential voltage amplification	$R_L \geq 10 \text{ k}\Omega$, $V_O = \pm 10 \text{ V}$	25°C	60	80	72	86	dB	
		Full range	60		66			
B_1 Unity-gain bandwidth		25°C	0.5		0.5		MHz	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$, $R_S = 50 \Omega$	25°C	60	72	60	72	dB	
		Full range	60		60			
k_{SVS} Supply voltage sensitivity ($\Delta V_{IO}/\Delta V_{CC}$)	$V_{CC} = \pm 9 \text{ V to } \pm 15 \text{ V}$, $R_S = 50 \Omega$	25°C	30	200	30	150	$\mu\text{V/V}$	
		Full range		200		150		
V_n Equivalent input noise voltage	$A_{VD} = 20 \text{ dB}$, $B = 1 \text{ Hz}$, $f = 1 \text{ kHz}$	25°C	50		50		nV/Hz	
I_{OS} Short-circuit output current		25°C	± 6		± 6		mA	
I_{CC} Supply current (both amplifiers)	$V_O = 0$, No load	25°C	130	250	130	250	μA	
		Full range		250		250		
P_D Total dissipation (both amplifiers)	$V_O = 0$, No load	25°C	3.9	7.5	3.9	6	mW	
		Full range		7.5		6		

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for TL022C is 0°C to 70°C and for TL022M is -55°C to 125°C.

operating characteristics, $V_{CC\pm} = \pm 15$ V, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r Rise time	$V_I = 20 \text{ mV}$, $R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1		0.3		μs
Overshoot factor			5%		
SR Slew rate at unity gain	$V_I = 10 \text{ V}$, $R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1		0.5		V/ μs



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PARAMETER MEASUREMENT INFORMATION

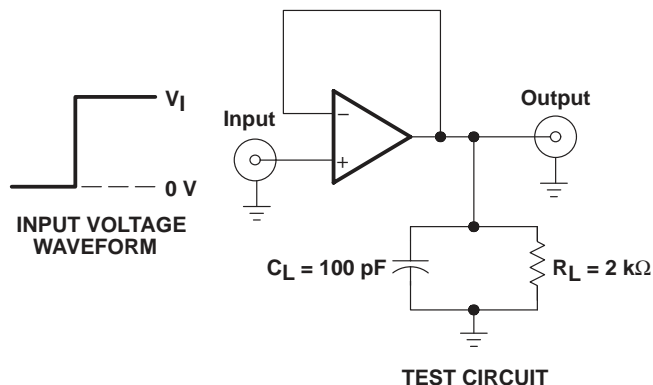


Figure 1. Rise Time, Overshoot Factor, and Slew Rate

TYPICAL CHARACTERISTICS

TOTAL POWER DISSIPATION
vs
SUPPLY RATE

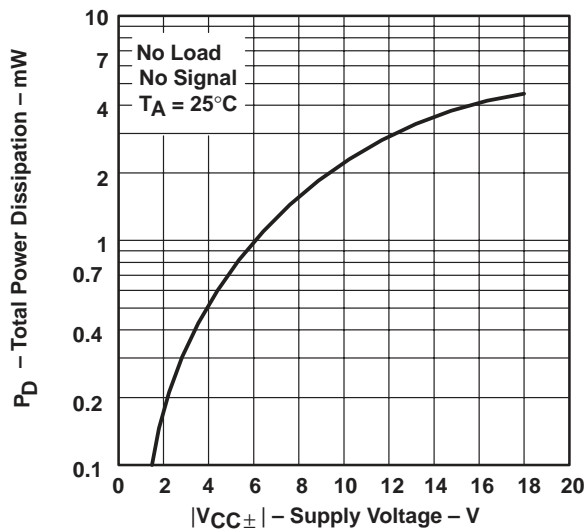


Figure 2

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TL022, Dual Low-Power General-Purpose Operational Amplifier
DEVICE STATUS: ACTIVE

PARAMETER NAME	TL022
Number of Channels	2
Available Channels	D
Shutdown	No
Vs (max) (V)	30
Vs (min) (V)	10
IQ per channel (max) (mA)	0.125
GBW (typ) (MHz)	0.5
Slew Rate (typ) (V/us)	0.5
VIO (25 deg C) (max) (mV)	5
IIB (max) (pA)	250000
CMRR (min) (dB)	60
Vn at 1kHz (typ) (nV/rtHz)	50
Single Supply	No

FEATURES

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170 μ W Typ
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- Output Short-Circuit Protection
- Low Input Offset Voltage
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TL022M IS NOT RECOMMENDED FOR
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DESCRIPTION

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The TL022 is a dual low-power operational amplifier designed to replace higher power devices in many applications without sacrificing system performance. High input impedance, low supply currents, and low equivalent input noise voltage over a wide range of operating supply voltages result in an extremely versatile operational amplifier for use in a variety of analog applications including battery-operated circuits. Internal frequency compensation, absence of latch-up, high slew rate, and output short-circuit protection assure ease of use.

The TL022C is characterized for operation from 0°C to 70°C. The TL022M is characterized for operation over the full military temperature range of -55°C to 125°C.

TECHNICAL DOCUMENTS

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DATASHEET

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Full datasheet in Acrobat PDF: [tl022.pdf](#) (87 KB) (Updated: 09/01/1990)

APPLICATION NOTES

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View Application Notes for [Operational Amplifiers \(Less than equal to 100MHz\)](#)

- [AB-172: Current Feedback Amplifiers: Review, Stability Analysis, and Applications](#) (SBOA081 - Updated: 11/20/2000)
- [Analysis of the Sallen-Key Architecture \(Rev. B\)](#) (SLOA024B - Updated: 09/13/2002)

RELATED DOCUMENTS

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- [Enhanced Plastic Portfolio Brochure](#) (SGZB004, 385 KB - Updated: 08/19/2002)
- [Military Analog Selection Guide](#) (SGLB002, 318 KB - Updated: 11/09/2000)
- [Military Semiconductors Selection Guide 2002 \(Rev. B\)](#) (SGYC003B, 1648 KB - Updated: 04/22/2002)

USER MANUALS

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- [Universal Op Amp Single, Dual, Quad \(SOIC\) Evaluation Module With Shutdown \(Rev. A\)](#) (SLOU061A, 457 KB - Updated: 03/20/2001)
- [Universal Operational Amplifier EVM \(Rev. A\)](#) (SLVU006A, 387 KB - Updated: 03/22/1999)
- [Universal Operational Amplifier Evaluation Module Selection Guide \(Rev. B\)](#) (SLOU060B, 20 KB - Updated: 03/20/2001)
- [Universal Operational Amplifier Single, Dual, Quad \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier Single, Dual, Quad \(PDIP\) \(Rev. A\)](#) (SLOU062A, 513 KB - Updated: 03/20/2001)

SAMPLES

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ORDERABLE DEVICE	PACKAGE INDUSTRY (TI)	PINS	TEMP (°C)	STATUS	PRODUCT CONTENT	SAMPLES
TL022CP	PDIP (P)	8		ACTIVE	View Product Content	Request Samples

PRICING/ AVAILABILITY/ PKG

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DEVICE INFORMATION							TI INVENTORY STATUS AS OF 3:00 PM GMT, 26 Sep 2002			REPORTED DISTRIBUTOR INVENTORY AS OF 3:00 PM GMT, 26 Sep 2002		
ORDERABLE DEVICE	STATUS	PACKAGE TYPE PINS	TEMP (°C)	PRODUCT CONTENT	BUDGETARY PRICING QTY \$US	STD PACK QTY	IN STOCK	IN PROGRESS QTY DATE	LEAD TIME	DISTRIBUTOR COMPANY REGION	IN STOCK	PURCHASE
TL022CD	ACTIVE	SOP (D) 8		View Contents	1KU 0.95	75	N/A*	> 10k 03 Oct	5 WKS			
								> 10k 10 Oct				
TL022CDR	ACTIVE	SOP (D) 8		View Contents	1KU 0.98	2500	N/A*	> 10k 03 Oct	5 WKS			
								> 10k 10 Oct				
TL022CP	ACTIVE	PDIP (P) 8		View Contents	1KU 0.95	50	N/A*	> 10k 01 Oct	5 WKS			
								6300 03 Oct				

								> 10k 08 Oct			
TL022CPSR	ACTIVE	SOP (PS) 8	0 TO 70	View Contents	1KU 0.95	2000	N/A*	763 23 Sep	5 WKS		
								8590 07 Oct			
								> 10k 14 Oct			
								> 10k 21 Oct			

DEVELOPMENT TOOLS

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Tool Part Number	Tool Title	Tool Type
UNIV-OPAMP-GUIDE	Universal EVM Selection Guide	Development Boards/EVMs

RELATED SOFTWARE

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- [FilterPro Filter Design Programs for the UAF42 and Other Op Amps](#) (SBFC001, 105 KB, ZIP - Updated: 10/25/2000)
- [FilterPro MFB and Sallen-Key Design Program \(Rev. A\)](#) (SLVC003A, 4314 KB, ZIP - Updated: 02/27/2002)

Table Data Updated on: 9/26/2002

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