

## Low noise JFET quad operational amplifier

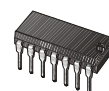
### Features

- Wide common-mode (up to  $V_{CC}^+$ ) and differential voltage range
- Low input bias and offset current
- Low noise  $e_n = 15 \text{ nV}/\sqrt{\text{Hz}}$  (typ)
- Output short-circuit protection
- High input impedance JFET input stage
- Low harmonic distortion : 0.01% (typical)
- Internal frequency compensation
- Latch up free operation
- High slew rate: 16 V/ $\mu\text{s}$  (typical)

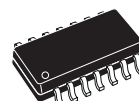
### Description

The TL074, TL074A and TL074B are high-speed JFET input single operational amplifiers. Each of these JFET input operational amplifiers incorporates well matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit.

The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

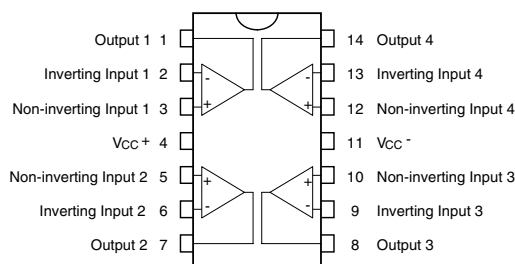


**N**  
**DIP14**  
(Plastic package)



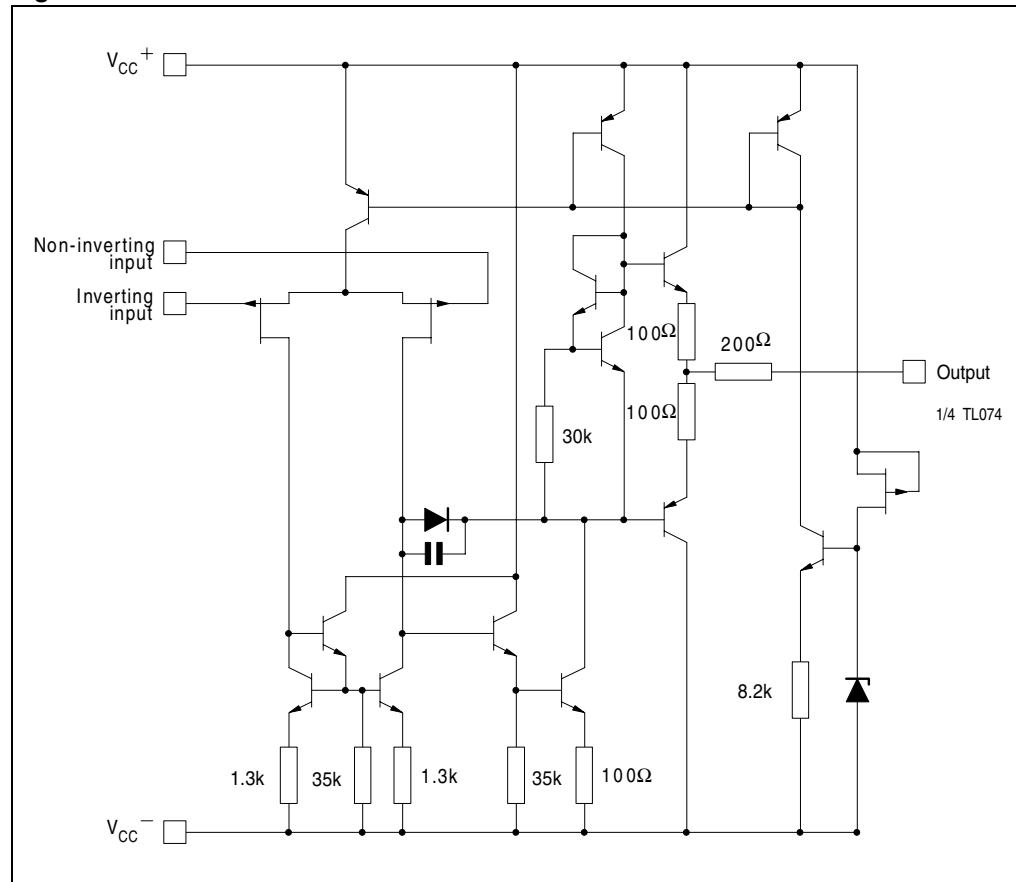
**D**  
**SO-14**  
(Plastic micropackage)

### Pin connections (Top view)



# 1 Schematic diagram

Figure 1. Circuit schematics



## 2 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TL074I, AI, BI	TL074C, AC, BC	
V <sub>CC</sub>	Supply voltage <sup>(1)</sup>	±18		V
V <sub>i</sub>	Input voltage <sup>(2)</sup>	±15		V
V <sub>id</sub>	Differential input voltage <sup>(3)</sup>	±30		V
P <sub>tot</sub>	Power dissipation	680		mW
R <sub>thja</sub>	Thermal resistance junction to ambient <sup>(4) (5)</sup>			°C/W
	DIP14 SO-14	80 105		
R <sub>thjc</sub>	Thermal resistance junction to case <sup>(4) (5)</sup>			°C/W
	DIP14 SO-14	33 31		
	Output short-circuit duration <sup>(6)</sup>	Infinite		
T <sub>oper</sub>	Operating free-air temperature range	-40 to +105	0 to +70	°C
T <sub>stg</sub>	Storage temperature range	-65 to +150		°C
ESD	HBM: human body model <sup>(7)</sup>	1		kV
	MM: machine model <sup>(8)</sup>	200		V
	CDM: charged device model <sup>(9)</sup>	1.5		kV

1. All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between  $V_{CC}^+$  and  $V_{CC}^-$ .
2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
3. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
4. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.
5.  $R_{th}$  are typical values.
6. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.
7. Human body model: 100pF discharged through a 1.5k $\Omega$  resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
8. Machine model: a 200pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 $\Omega$ ), done for all couples of pin combinations with other pins floating.
9. Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to the ground.

**Table 2. Operating conditions**

Symbol	Parameter	TL074I, AI, BI	TL074C, AC, BC	Unit
$V_{CC}$	Supply voltage	6 to 36		V
$T_{oper}$	Operating free-air temperature range	-40 to +105	0 to +70	°C

### 3 Electrical characteristics

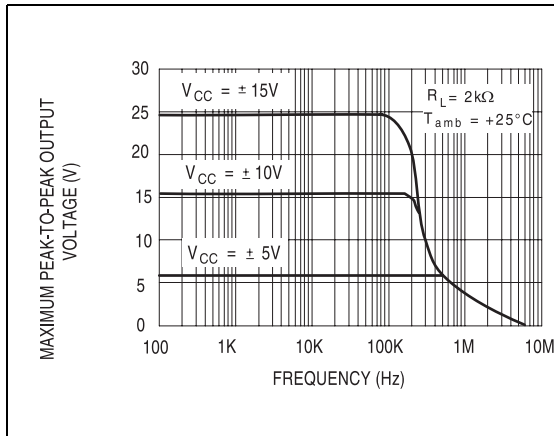
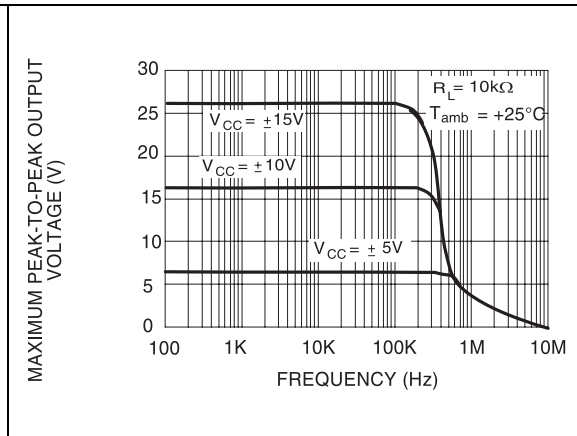
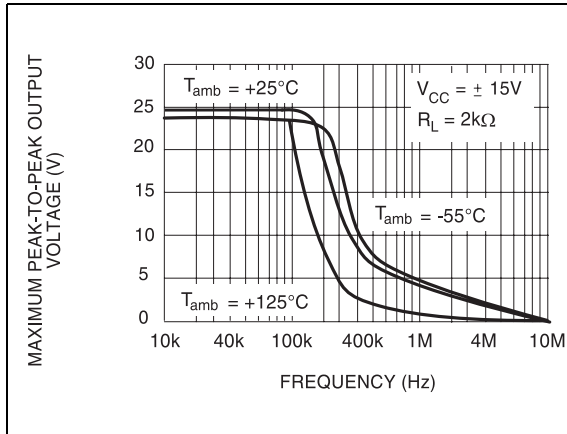
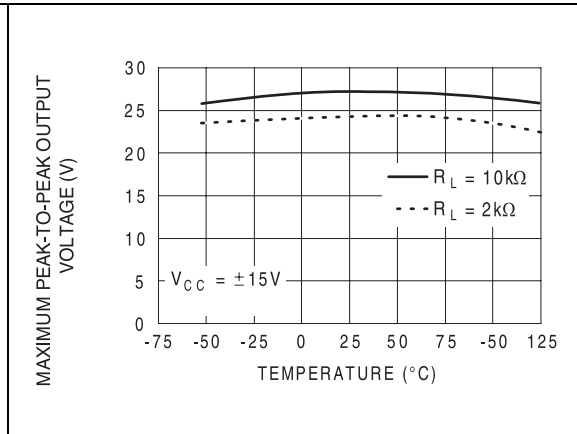
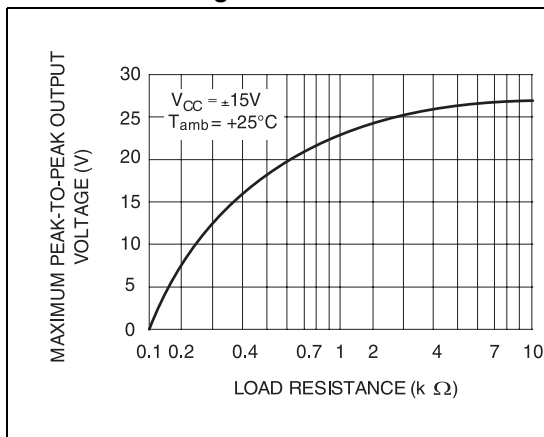
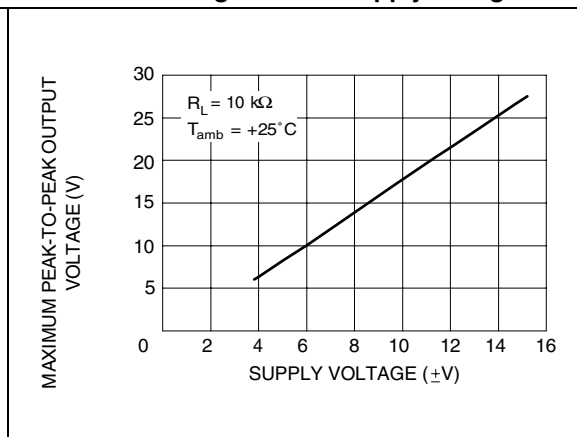
Table 3.  $V_{CC} = \pm 15V$ ,  $T_{amb} = +25^{\circ}C$  (unless otherwise specified)

Symbol	Parameter	TL074I,AC,AI, BC,BI			TL074C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$V_{io}$	Input offset voltage ( $R_S = 50\Omega$ )							
	$T_{amb} = +25^{\circ}C$ TL074		3	10		3	10	
	TL074A		3	6				
	TL074B		1	3				
	$T_{min} \leq T_{amb} \leq T_{max}$ TL074			13			13	mV
	TL074A			7				
	TL074B			5				
$DV_{io}$	Input offset voltage drift		10			10		$\mu V/^{\circ}C$
$I_{io}$	Input offset current							
	$T_{amb} = +25^{\circ}C$		5	100		5	100	pA
	$T_{min} \leq T_{amb} \leq T_{max}$			4			10	nA
$I_{ib}$	Input bias current -note <sup>(1)</sup>							
	$T_{amb} = +25^{\circ}C$		20	200		30	200	pA
	$T_{min} \leq T_{amb} \leq T_{max}$			20			20	nA
$A_{vd}$	Large signal voltage gain $R_L = 2k\Omega$ , $V_o = \pm 10V$							
	$T_{amb} = +25^{\circ}C$	50	200		25	200		V/mV
	$T_{min} \leq T_{amb} \leq T_{max}$	25			15			
SVR	Supply voltage rejection ratio ( $R_S = 50\Omega$ )							
	$T_{amb} = +25^{\circ}C$	80	86		70	86		dB
	$T_{min} \leq T_{amb} \leq T_{max}$	80			70			
$I_{CC}$	Supply current, no load							
	$T_{amb} = +25^{\circ}C$		1.4	2.5		1.4	2.5	mA
	$T_{min} \leq T_{amb} \leq T_{max}$			2.5			2.5	
$V_{icm}$	Input common mode voltage range	$\pm 11$	+15 -12		$\pm 11$	+15 -12		V
CMR	Common mode rejection ratio ( $R_S = 50\Omega$ )							
	$T_{amb} = +25^{\circ}C$	80	86		70	86		dB
	$T_{min} \leq T_{amb} \leq T_{max}$	80			70			
$I_{os}$	Output short-circuit current							
	$T_{amb} = +25^{\circ}C$	10	40	60	10	40	60	mA
	$T_{min} \leq T_{amb} \leq T_{max}$	10		60	10		60	
$\pm V_{opp}$	Output voltage swing							
	$T_{amb} = +25^{\circ}C$ $R_L = 2k\Omega$	10	12		10	12		V
	$R_L = 10k\Omega$	12	13.5		12	13.5		
	$T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 2k\Omega$	10			10			
	$R_L = 10k\Omega$	12			12			
SR	Slew rate $V_{in} = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain	8	13		8	13		V/ $\mu s$

**Table 3.**  $V_{CC} = \pm 15V$ ,  $T_{amb} = +25^{\circ}C$  (unless otherwise specified) (continued)

Symbol	Parameter	TL074I,AC,AI, BC,BI			TL074C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$t_r$	Rise time $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain		0.1			0.1		$\mu s$
$K_{ov}$	Overshoot $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain		10			10		%
GBP	Gain bandwidth product $V_{in} = 10mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , = 100kHz	2	3		2	3		MHz
$R_i$	Input resistance		$10^{12}$			$10^{12}$		$\Omega$
THD	Total harmonic distortion $f = 1kHz$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , $A_v = 20dB$ , $V_o = 2V_{pp}$		0.01			0.01		%
$e_n$	Equivalent input noise voltage $R_S = 100\Omega$ , $f = 1kHz$		15			15		$\frac{nV}{\sqrt{Hz}}$
$\phi_m$	Phase margin		45			45		degrees
$V_{o1}/V_{o2}$	Channel separation $A_v = 100$		120			120		dB

1. The input bias currents are junction leakage currents which approximately double for every  $10^{\circ}C$  increase in the junction temperature.

**Figure 2. Maximum peak-to-peak output voltage versus frequency****Figure 3. Maximum peak-to-peak output voltage versus frequency****Figure 4. Maximum peak-to-peak output voltage versus frequency****Figure 5. Maximum peak-to-peak output voltage versus free air temperature****Figure 6. Maximum peak-to-peak output voltage versus load resistance****Figure 7. Maximum peak-to-peak output voltage versus supply voltage**

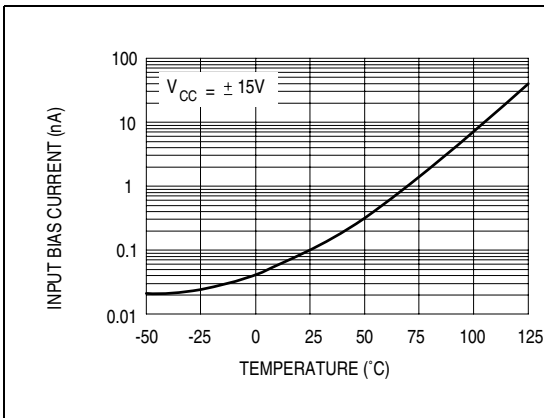
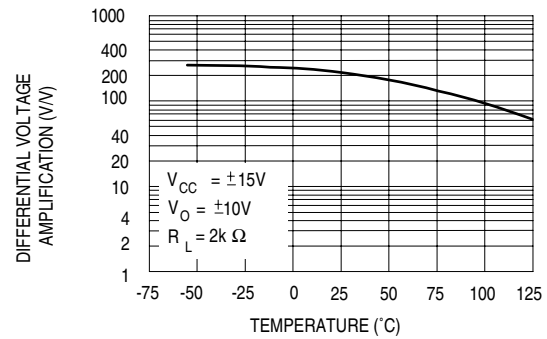
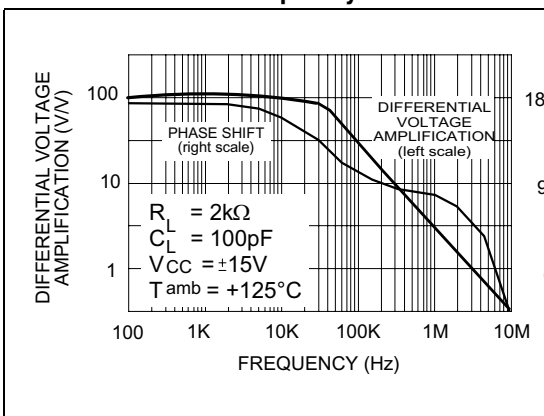
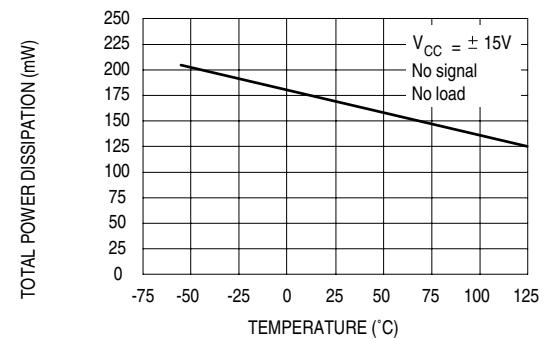
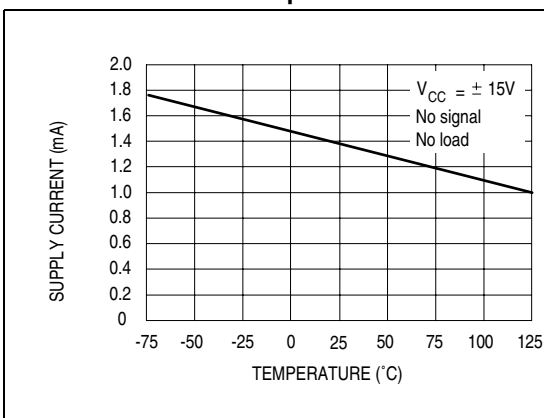
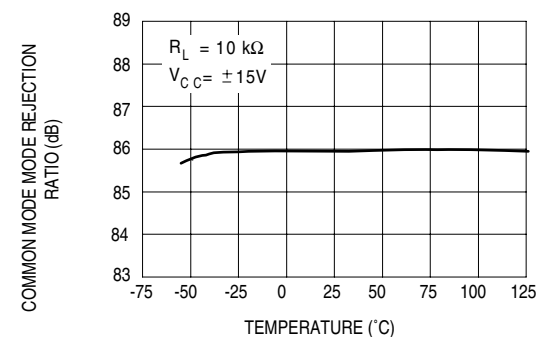
**Figure 8. Input bias current versus free air temperature****Figure 9. Large signal differential voltage amplification versus free air temperature****Figure 10. Large signal differential voltage amplification and phase shift versus frequency****Figure 11. Total power dissipation versus free air temperature****Figure 12. Supply current per amplifier versus free air temperature****Figure 13. Common mode rejection ratio versus free air temperature**

Figure 14. Voltage follower large signal pulse response      Figure 15. Output voltage versus elapsed time

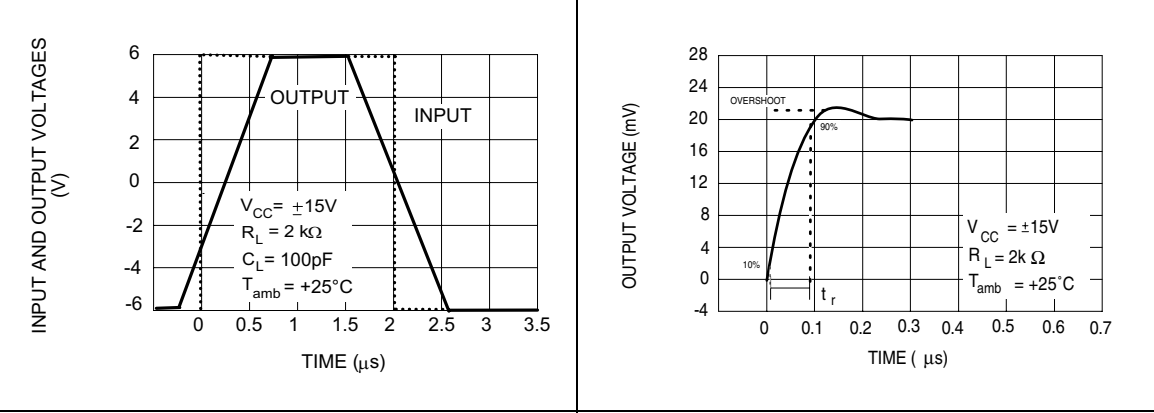
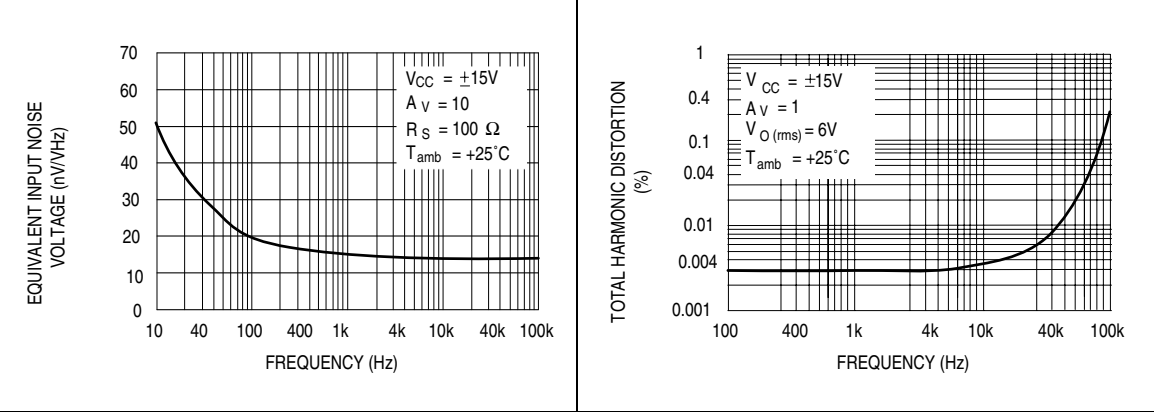
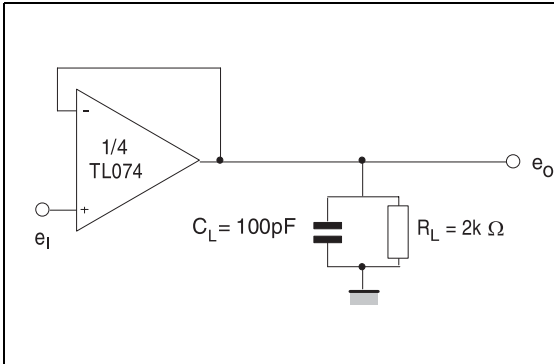
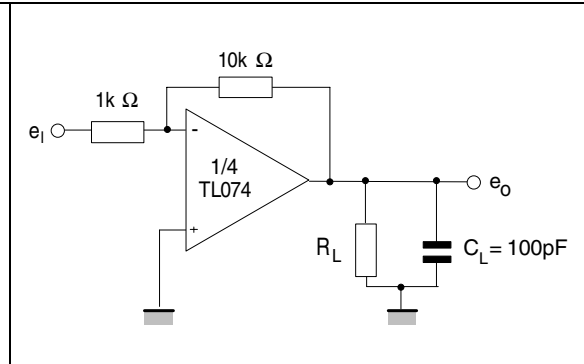


Figure 16. Equivalent input noise voltage versus frequency      Figure 17. Total harmonic distortion versus frequency





## 4 Parameter measurement information

**Figure 18. Voltage follower****Figure 19. Gain-of-10 inverting amplifier**

## 5 Typical applications

Figure 20. Audio distribution amplifier

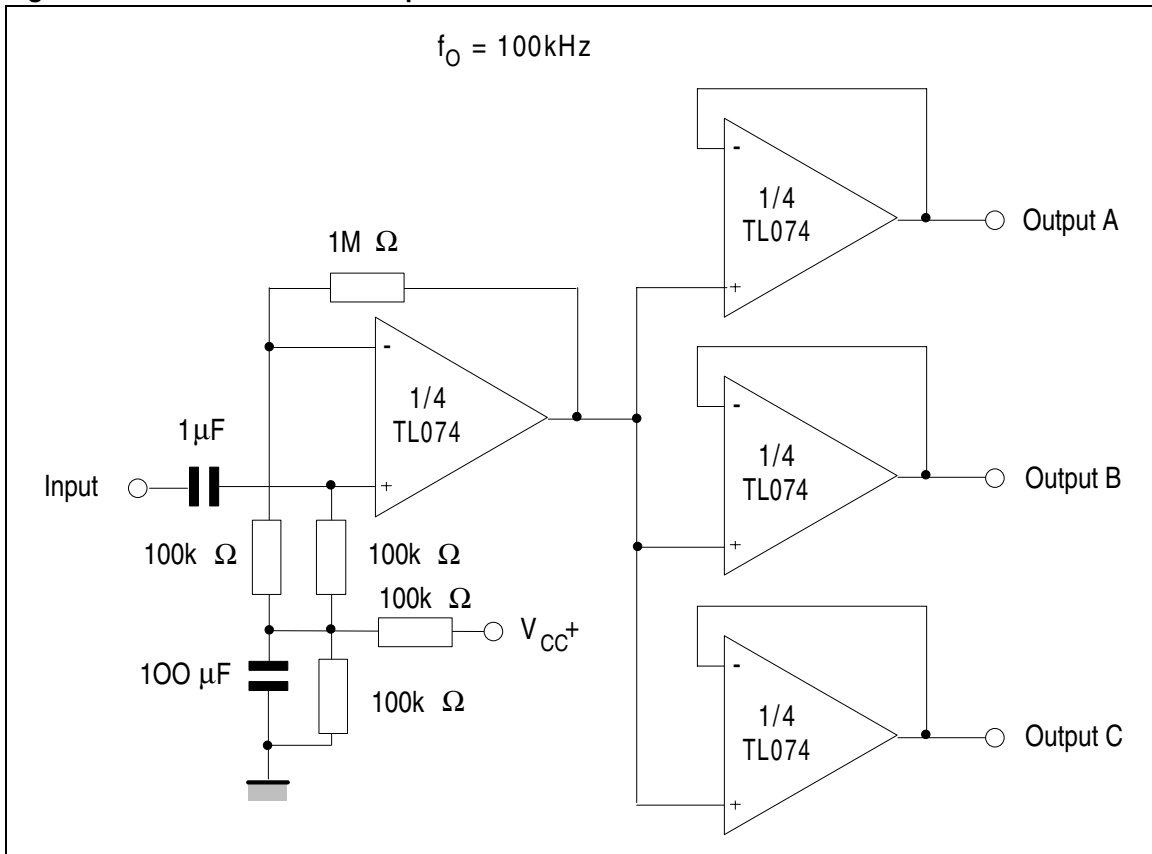


Figure 21. Positive feedback bandpass filter

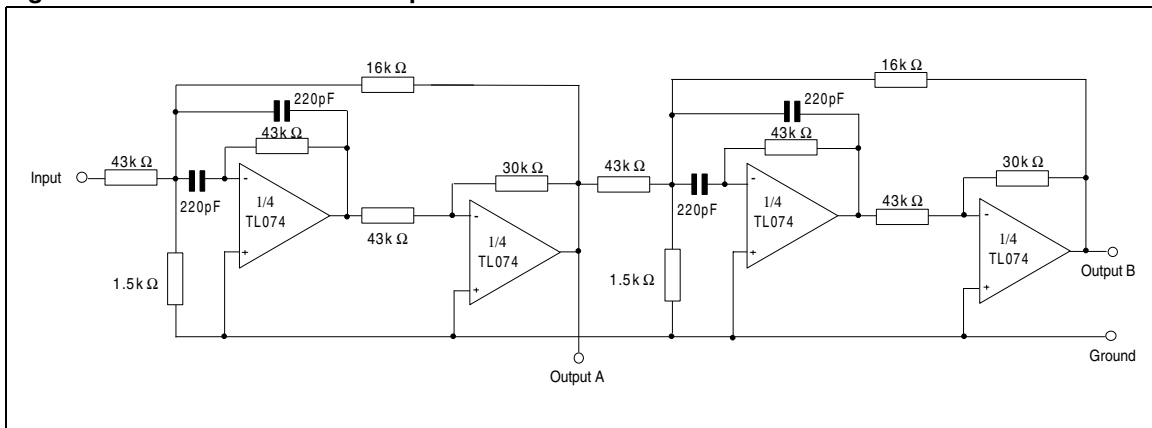
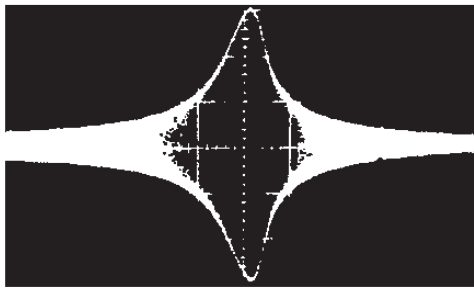
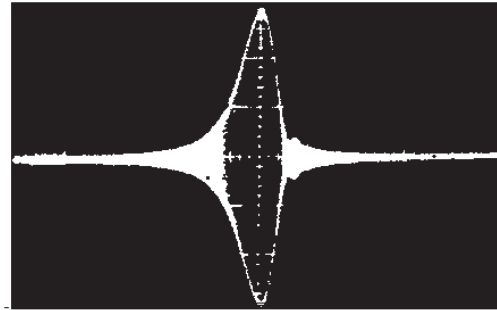


Figure 22. Output A



**SECOND ORDER BANDPASS FILTER**  
fo = 100 kHz; Q = 30; Gain = 16

Figure 23. Output B



**CASCADED BANDPASS FILTER**  
fo = 100 kHz; Q = 69; Gain = 16

# 6 Package information

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

## 6.1 DIP14 package information

Figure 24. DIP14 package mechanical drawing

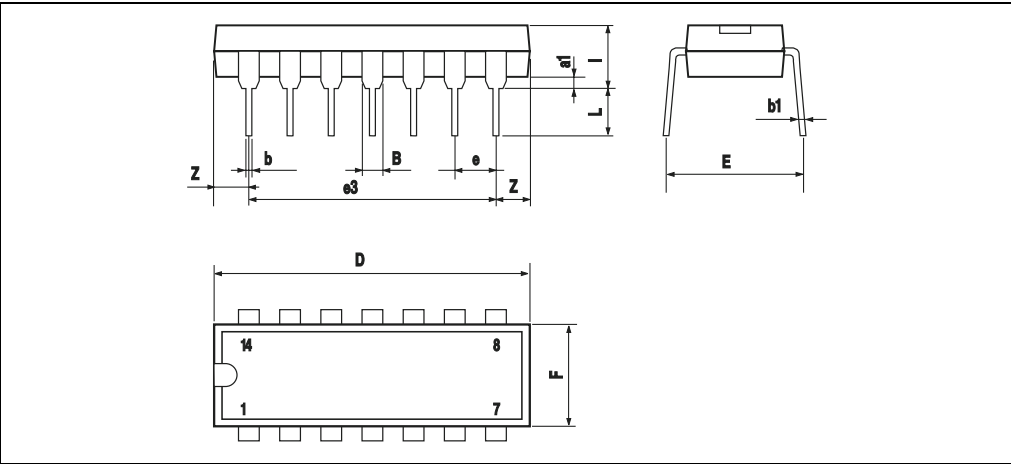


Table 4. DIP14 package mechanical data

Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
l			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

## 6.2 SO-14 package information

Figure 25. SO-14 package mechanical drawing

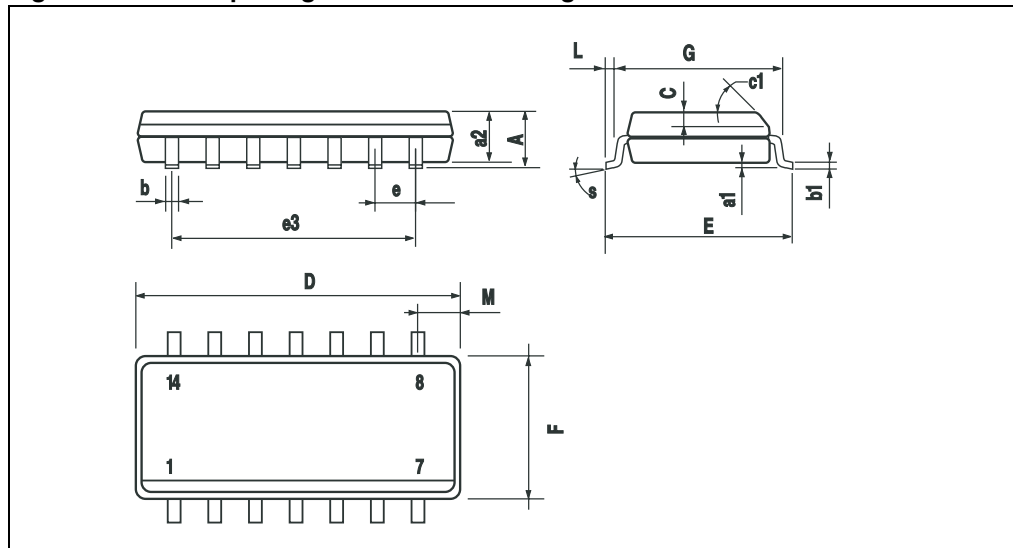


Table 5. SO-14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					

## 7 Ordering information

Table 6. Order codes

Order code	Temperature range	Package	Packing	Marking
TL074IN TL074AIN TL074BIN	-40°C, +105°C	DIP14	Tube	TL074IN TL074AIN TL074BIN
TL074ID/IDT TL074AID/AIDT TL074BID/BIDT		SO-14	Tube or tape & reel	074I 074AI 074BI
TL074IYD/IYDT <sup>(1)</sup> TL074AIYD/AIYDT <sup>(1)</sup> TL074BIYD/BIYDT <sup>(1)</sup>		SO-14	Tube or tape & reel	074IY 074AIY 074BIY
TL074CN TL074ACN TL074BCN	0°C, +70°C	DIP14	Tube	TL074CN TL074ACN TL074BCN
TL074CD/CDT TL074ACD/ACDT TL074BCD/BCDT		SO-14	Tube or tape & reel	074C 074AC 074BC

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

## 8 Revision history

Table 7. Document revision history

Date	Revision	Changes
28-Mar-2001	1	Initial release.
30-Jul-2007	2	Added values for $R_{thja}$ , $R_{thjc}$ and ESD in <a href="#">Table 1: Absolute maximum ratings</a> . Added <a href="#">Table 2: Operating conditions</a> . Expanded <a href="#">Table 6: Order codes</a> . Format update.
07-Jul-2008	3	Removed information concerning military temperature ranges (TL074Mx, TL074AMx, TL074BMx). Added automotive grade order codes in <a href="#">Table 6: Order codes</a> .

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