

## Low noise JFET quad operational amplifier

Datasheet — production data

### Features

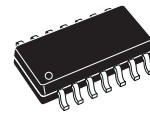
- Wide common-mode (up to  $V_{CC^+}$ ) and differential voltage range
- Low input bias and offset current
- Low noise  $e_n = 15 \text{ nV}/\sqrt{\text{Hz}}$  (typ)
- Output short-circuit protection
- High input impedance JFET input stage
- Low harmonic distortion : 0.01% (typical)
- Internal frequency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

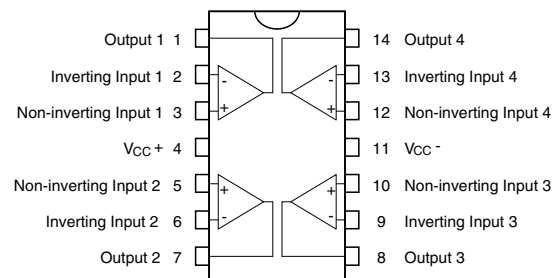
The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

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



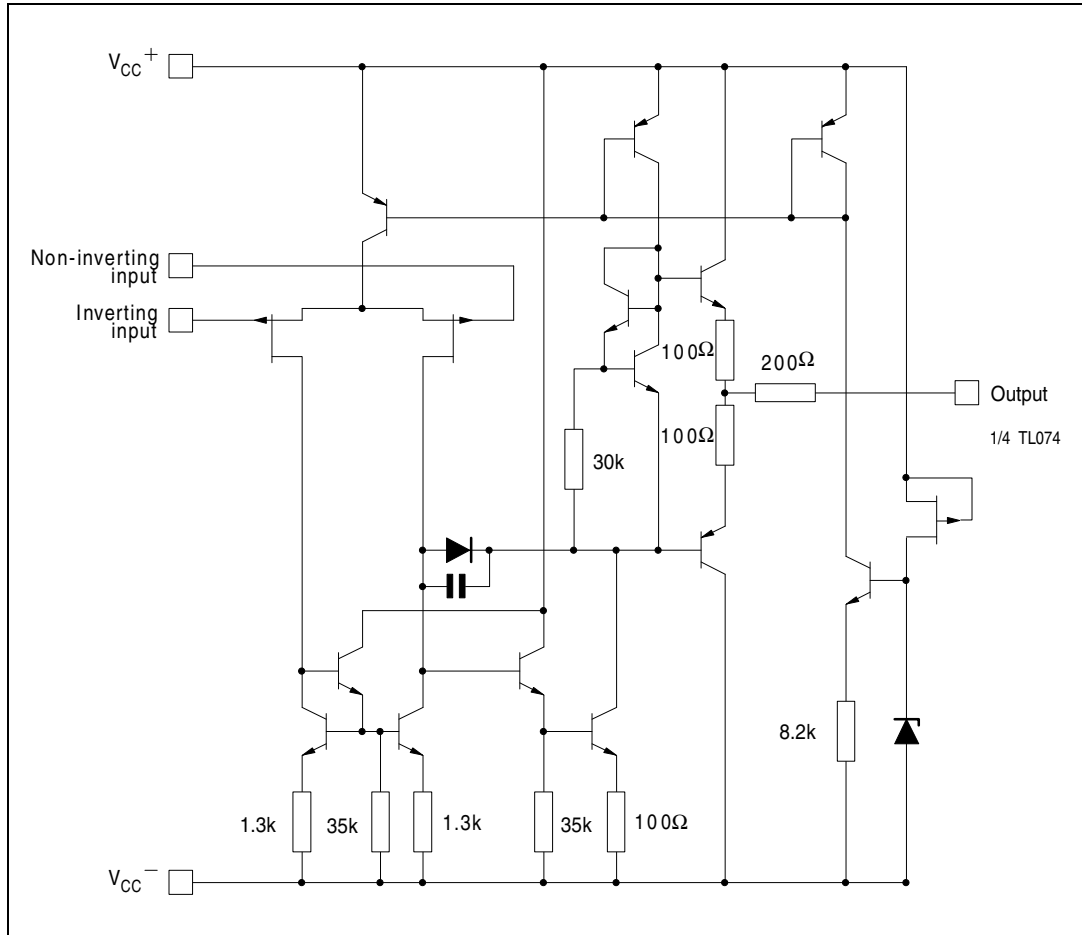
**D**  
**SO-14**  
(Plastic micropackage)

**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	
$V_{CC}$	Supply voltage <sup>(1)</sup>	±18		V
$V_i$	Input voltage <sup>(2)</sup>	±15		V
$V_{id}$	Differential input voltage <sup>(3)</sup>	±30		V
$P_{tot}$	Power dissipation	680		mW
$R_{thja}$	Thermal resistance junction to ambient <sup>(4) (5)</sup>			°C/W
	DIP14	80		
	SO-14	105		
$R_{thjc}$	Thermal resistance junction to case <sup>(4) (5)</sup>			°C/W
	DIP14	33		
	SO-14	31		
	Output short-circuit duration <sup>(6)</sup>	Infinite		
$T_{oper}$	Operating free-air temperature range	-40 to +105	0 to +70	°C
$T_{stg}$	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

- 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  $V_{CC}^-$ .
- The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
- Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.
- $R_{th}$  are typical values.
- 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.
- Human body model: 100pF discharged through a 1.5kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
- 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 < 5Ω), done for all couples of pin combinations with other pins floating.
- 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)**

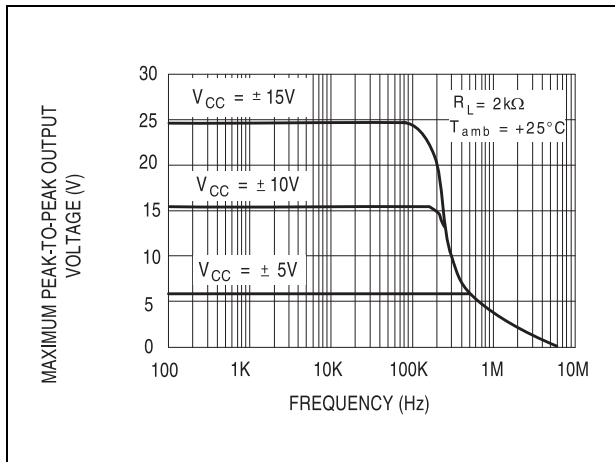
Symbol	Parameter	TL074I,AC,AI, BC,BI			TL074C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$V_{io}$	Input offset voltage ( $R_S = 50\Omega$ )							mV
	$T_{amb} = +25^{\circ}C$ TL074		3	10		3	10	
	TL074A		3	6				
	TL074B		1	3				
	$T_{min} \leq T_{amb} \leq T_{max}$ TL074			13			13	
	TL074A			7				
	TL074B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

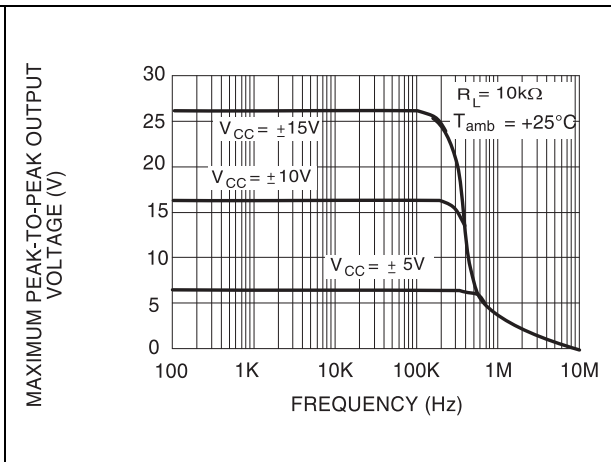
Symbol	Parameter	TL074I,AC,AI, BC,BI			TL074C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$t_r$	Rise time $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain		0.1			0.1		$\mu s$
$K_{ov}$	Overshoot $V_{in} = 20mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , unity gain		10			10		%
GBP	Gain bandwidth product $V_{in} = 10mV$ , $R_L = 2k\Omega$ , $C_L = 100pF$ , = 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

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

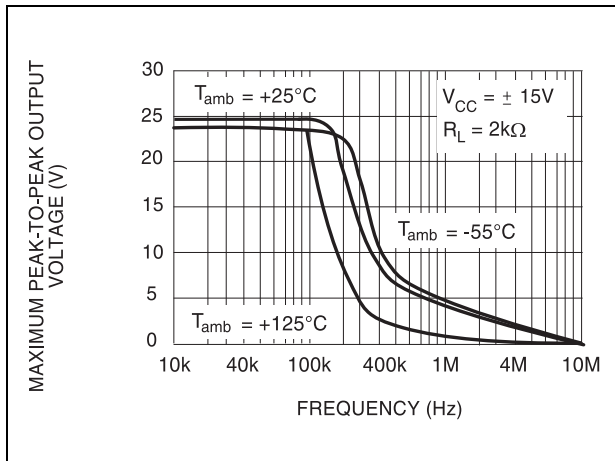
**Figure 2. Maximum peak-to-peak output voltage versus frequency**



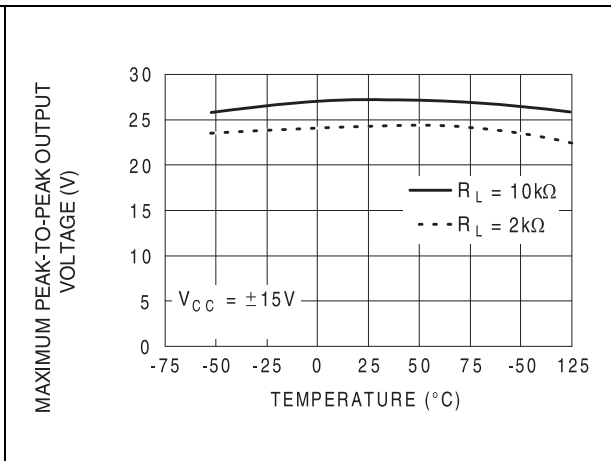
**Figure 3. Maximum peak-to-peak output voltage versus frequency**



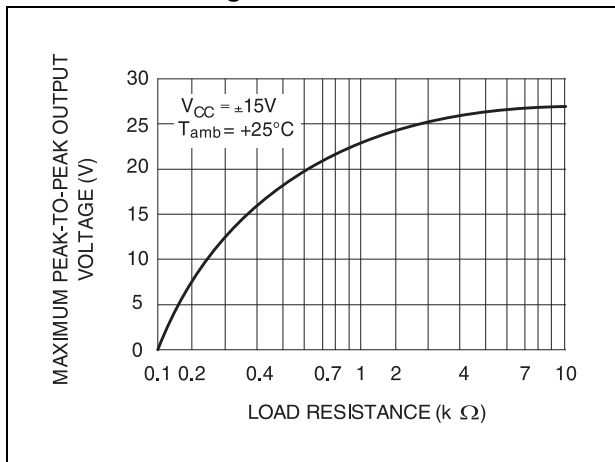
**Figure 4. Maximum peak-to-peak output voltage versus frequency**



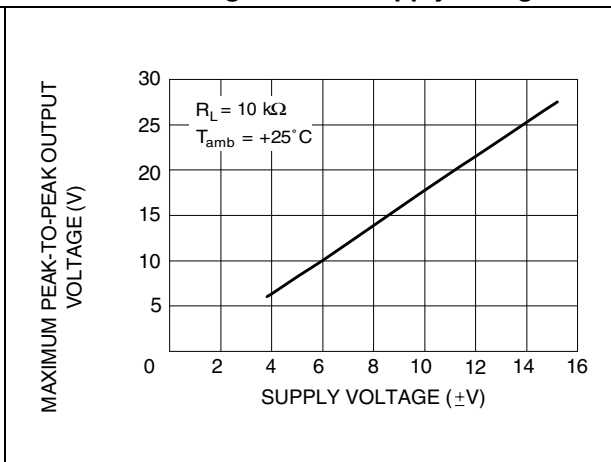
**Figure 5. Maximum peak-to-peak output voltage versus free air temperature**



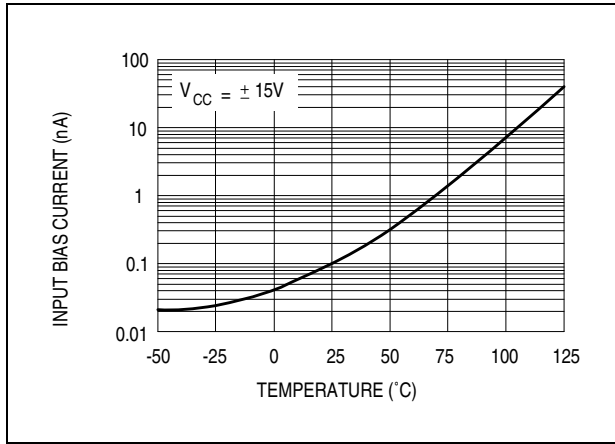
**Figure 6. Maximum peak-to-peak output voltage versus load resistance**



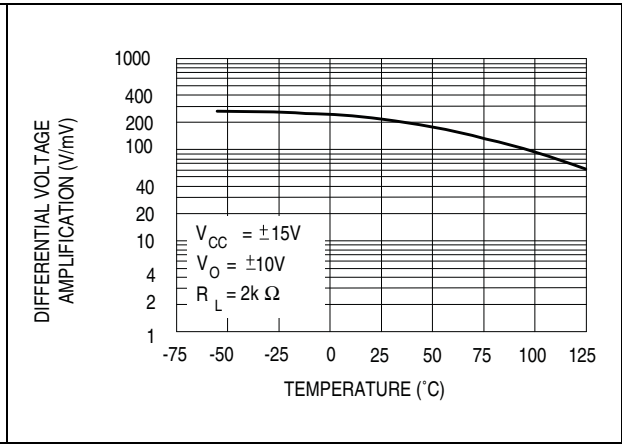
**Figure 7. Maximum peak-to-peak output voltage versus supply voltage**



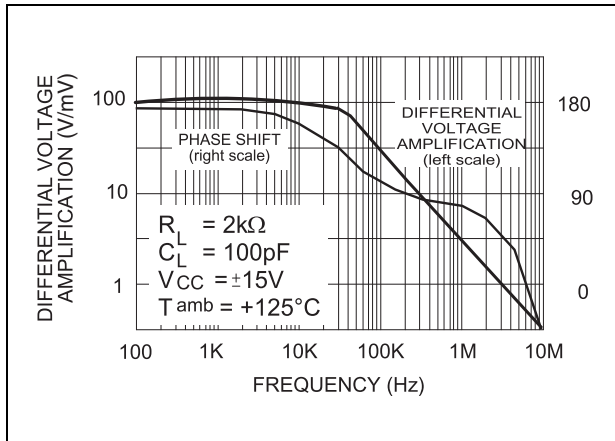
**Figure 8. Input bias current versus free air temperature**



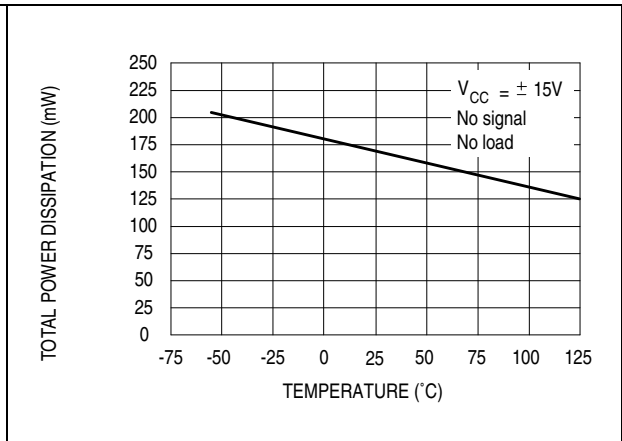
**Figure 9. Large signal differential voltage amplification versus free air temperature**



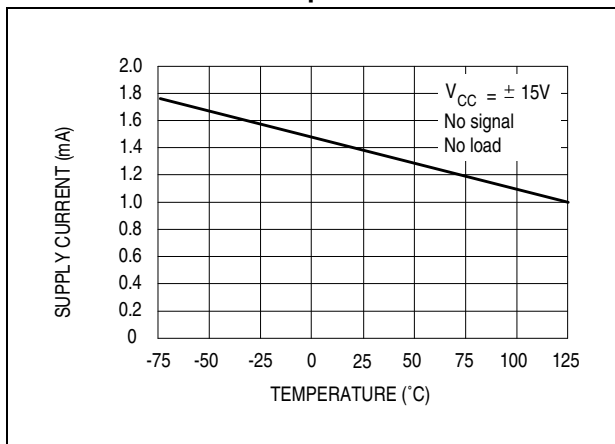
**Figure 10. Large signal differential voltage amplification and phase shift versus frequency**



**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**

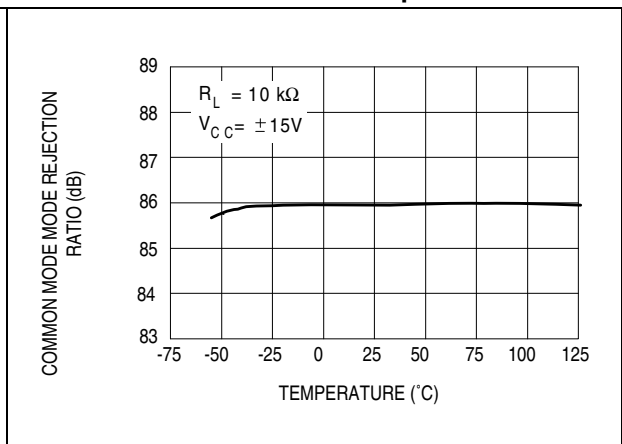


Figure 14. Voltage follower large signal pulse response

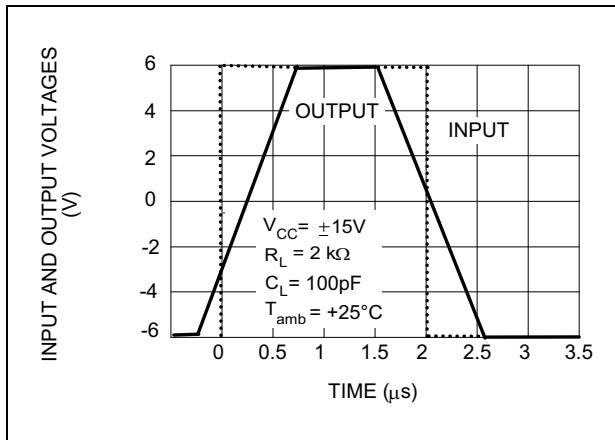


Figure 15. Output voltage versus elapsed time

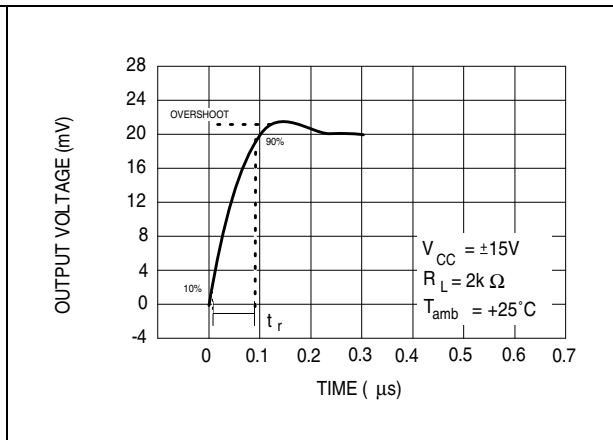


Figure 16. Equivalent input noise voltage versus frequency

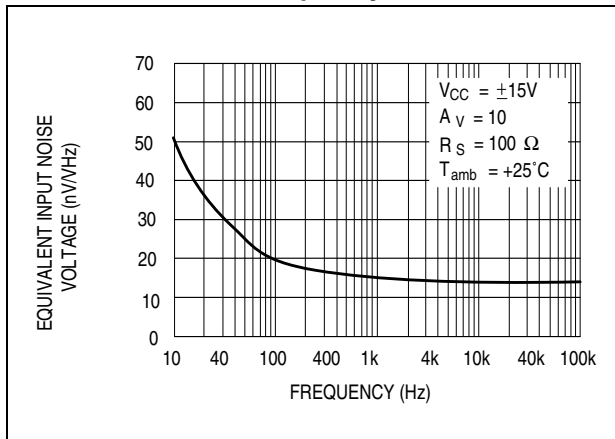
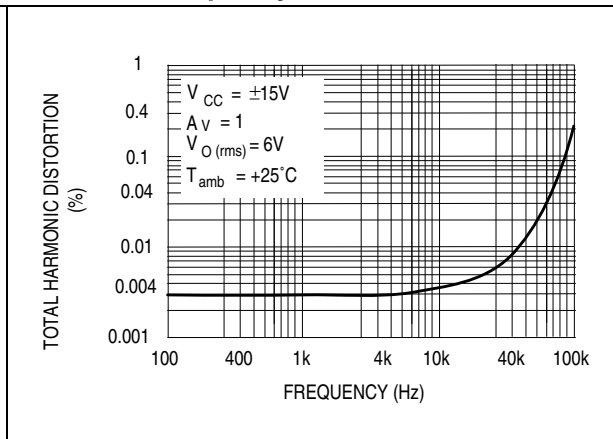


Figure 17. Total harmonic distortion versus frequency





## 4 Parameter measurement information

Figure 18. Voltage follower

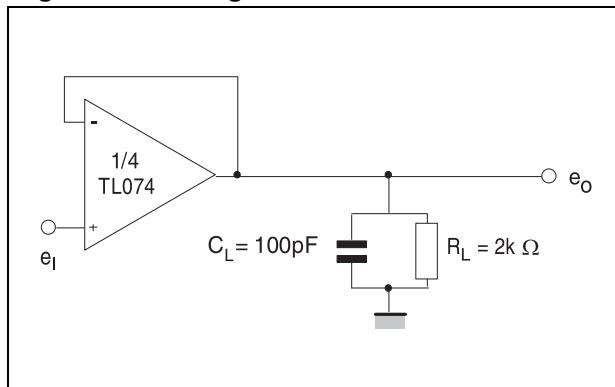
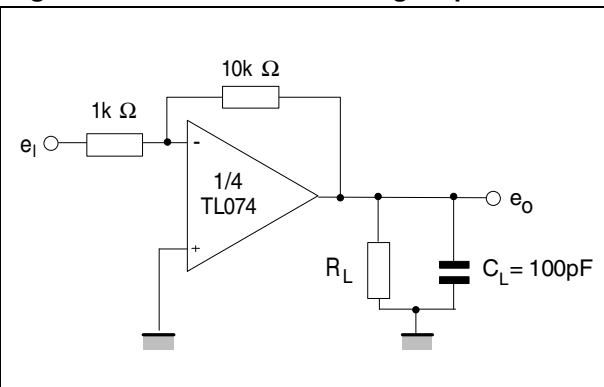


Figure 19. Gain-of-10 inverting amplifier



## 5 Typical applications

Figure 20. Audio distribution amplifier

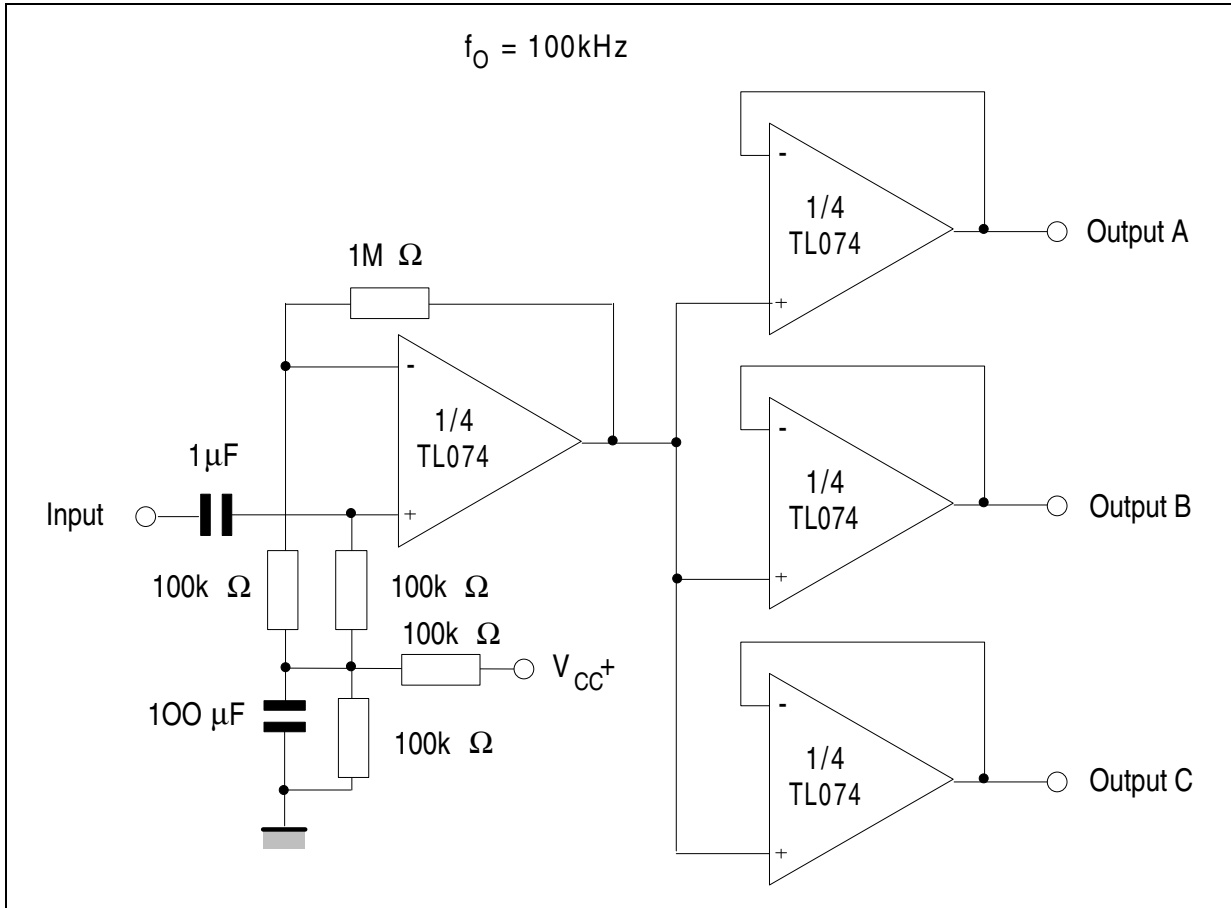


Figure 21. Positive feedback bandpass filter

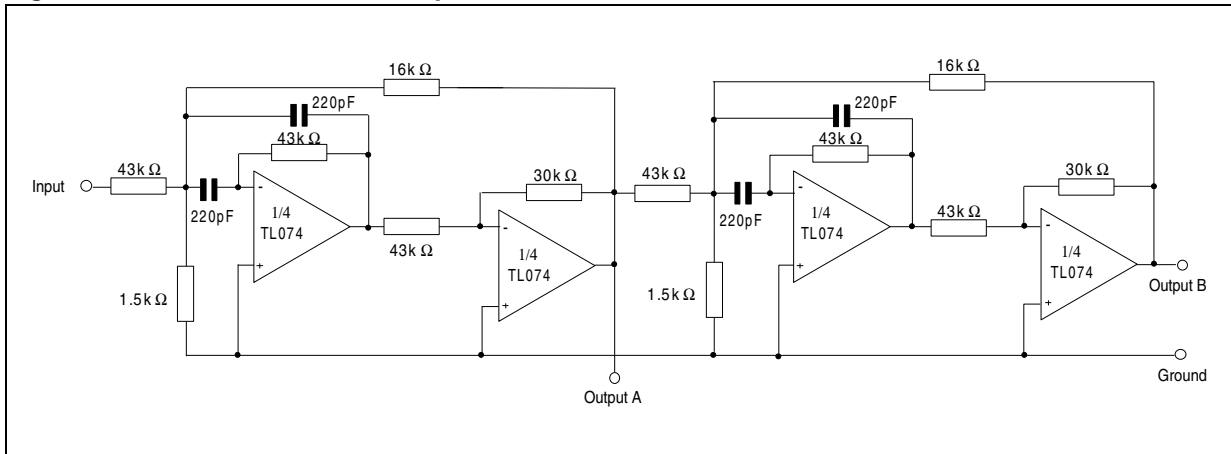
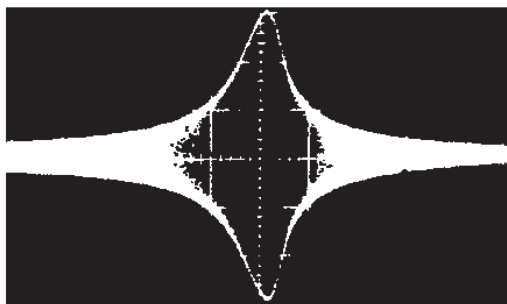
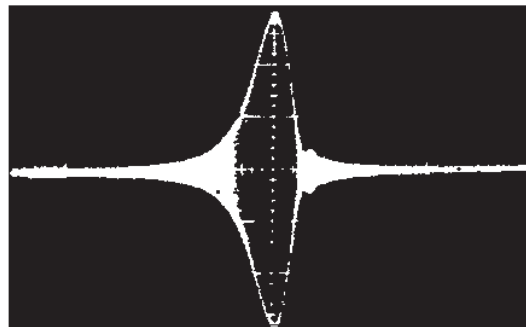


Figure 22. Output A



**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 different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 6.1 DIP14 package information

Figure 24. DIP14 package mechanical drawing

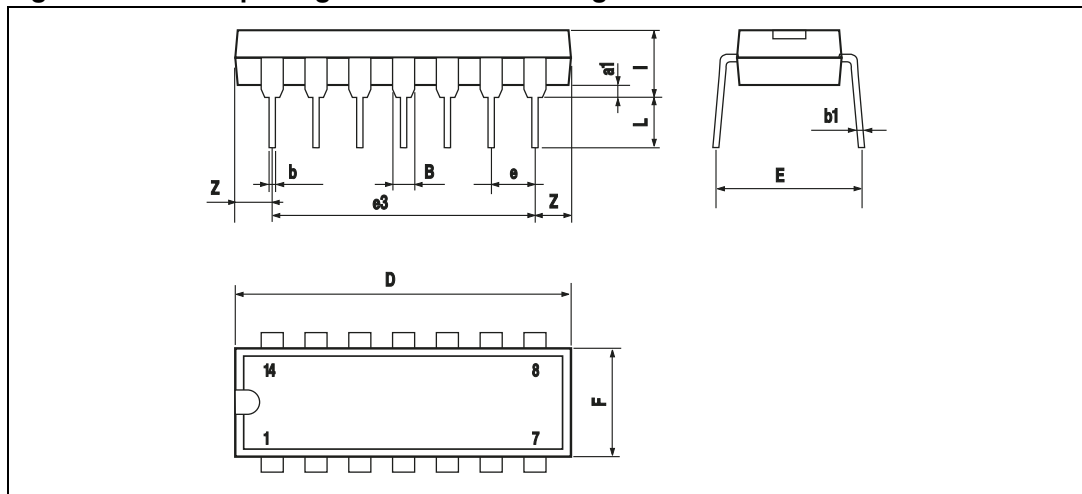


Table 4. DIP14 package mechanical data

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

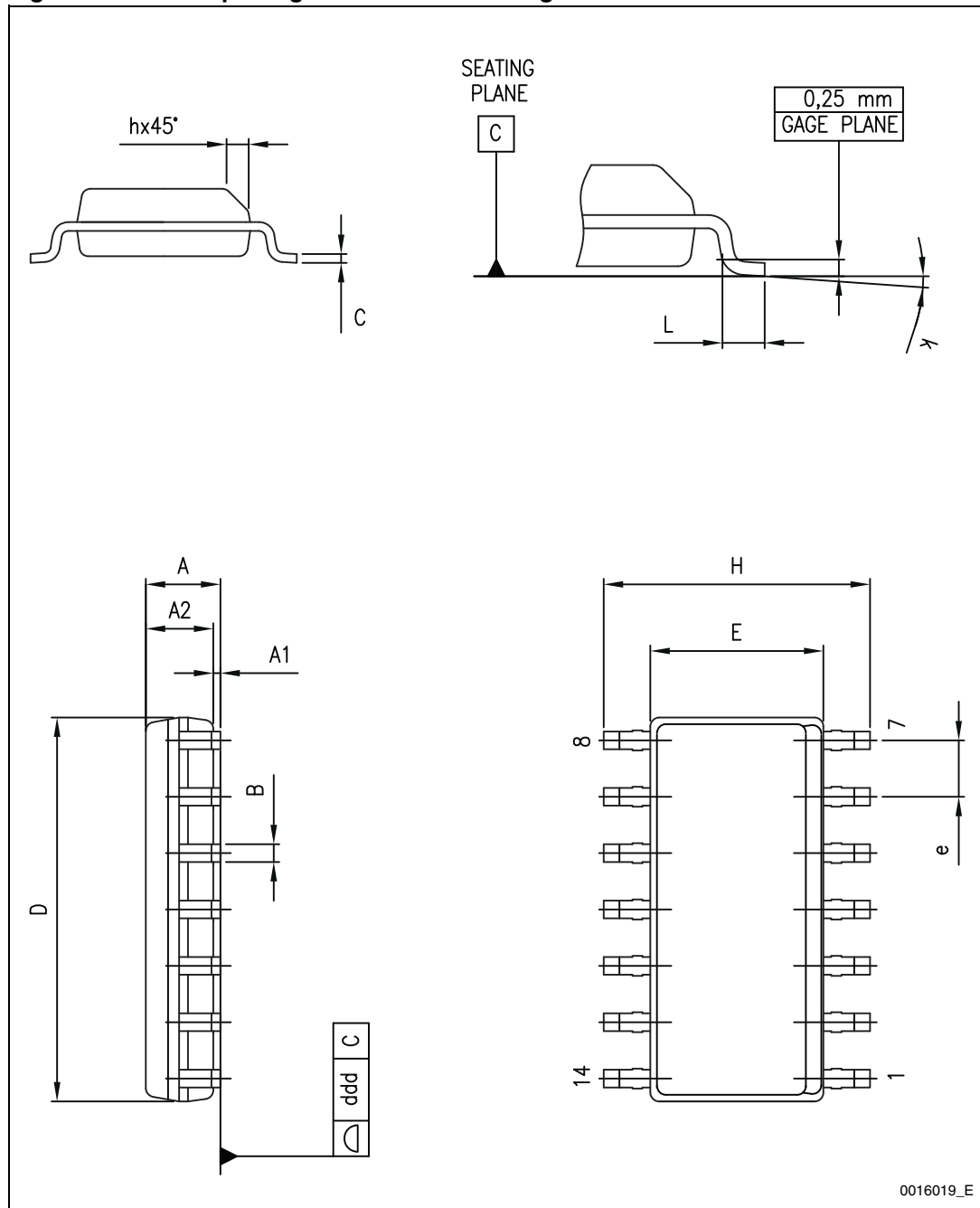


Table 5. SO-14 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	1.35		1.75
A1	0.10		0.25
A2	1.10		1.65
B	0.33		0.51
C	0.19		0.25
D	8.55		8.75
E	3.80		4.00
e		1.27	
H	5.80		6.20
h	0.25		0.50
L	0.40		1.27
K	0		8
e		0.40	
ddd			0.10

## 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
TL074IYDT <sup>(1)</sup> TL074AIYDT <sup>(1)</sup> TL074BIYDT <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> .
04-Jul-2012	4	Removed commercial types TL074IYD, TL074AIYD, TL074BIYD. Updated <a href="#">Table 6: Order codes</a> .

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