TL074

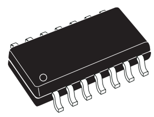
Low noise JFET quad operational amplifier

Datasheet — production data

Features

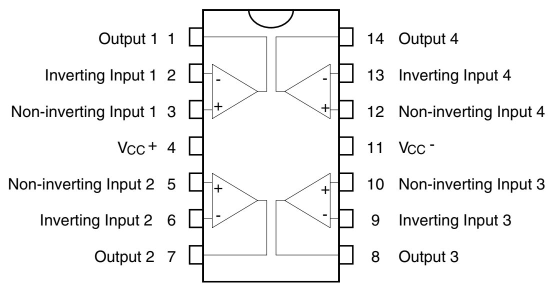
- Wide common-mode (up to V_{CC}^{+}) and differential voltage range
- Low input bias and offset current
- Low noise e_n = 15 nV/ √Hz (typ)
- Output short-circuit protection
- High input impedance JFET input stage
- Low harmonic distortion : 0.01% (typical)
- Internal frequency compensation
- Latch up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

N
DIP14
(Plastic package)



D
SO-14
(Plastic micropackage)

Pin connections
(Top view)



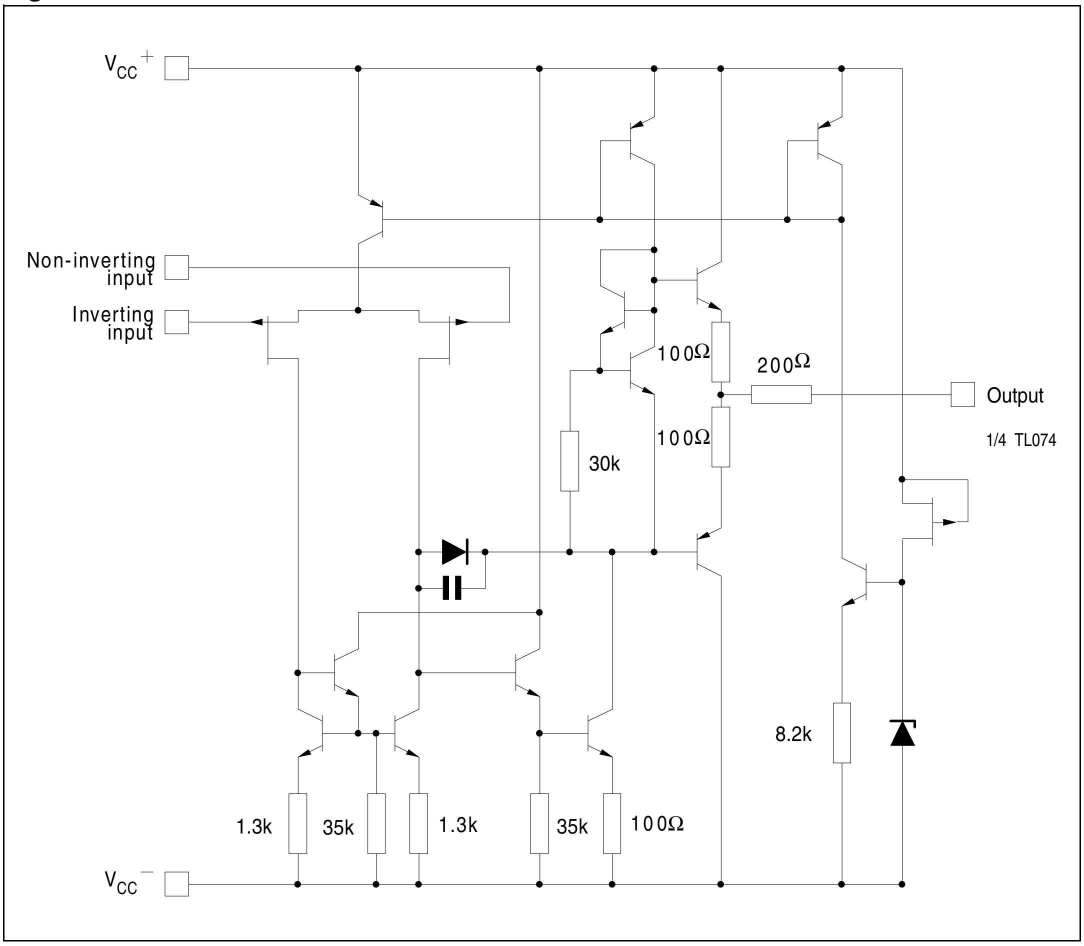
Description

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.

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 (1)	±18		V
V_i	Input voltage(2)	±15		V
V_{id}	Differential input voltage(3)	±30		V
P_{tot}	Power dissipation	680		mW
R_{thja}	Thermal resistance junction to ambient (4) (5) DIP14 SO-14	 80 105		°C/W
R_{thjc}	Thermal resistance junction to case (4) (5) DIP14 SO-14	 33 31		°C/W
	Output short-circuit duration(6)	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(7)	1		kV
	MM: machine model(8)	200		V
	CDM: charged device model(9)	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. Rth 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 1.5kΩ 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 < 5Ω), 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. $V_{CC} = \pm 15V$, $T_{amb} = +25°C$ (unless otherwise specified)

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

Table 3. V_{CC} = ±15V, T_{amb} = +25°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 = 2kΩ, C_L = 100pF, unity gain		0.1			0.1		µs
K_{ov}	Overshoot V_{in} = 20mV, R_L = 2kΩ, C_L = 100pF, unity gain		10			10		%
GBP	Gain bandwidth product V_{in}= 10mV, R_L= 2kΩ, C_L = 100pF, = 100kHz	2	3		2	3		MHz
R_i	Input resistance		10^{12}			10^{12}		Ω
THD	Total harmonic distortion f= 1kHz, R_L = 2kΩ,C_L = 100pF, A_v = 20dB, V_o = $2V_{pp}$)		0.01			0.01		%
e_n	Equivalent input noise voltage R_S = 100Ω, f = 1kHz		15			15		$\frac{nV}{\sqrt{Hz}}$
∅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° C increase in the junction temperature.

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

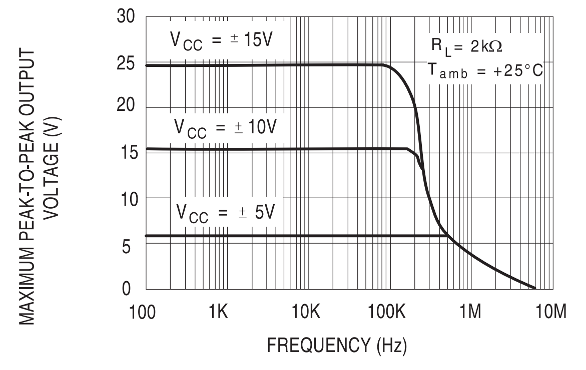


Figure 3. Maximum peak-to-peak output voltage versus frequency

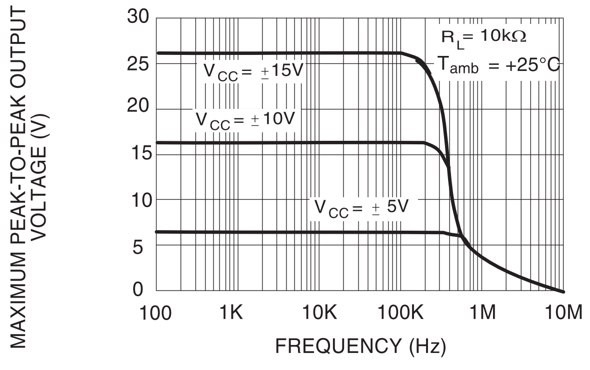


Figure 4. Maximum peak-to-peak output voltage versus frequency

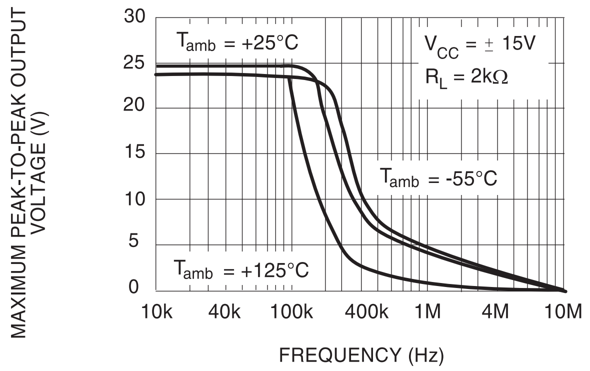


Figure 5. Maximum peak-to-peak output voltage versus free air temperature

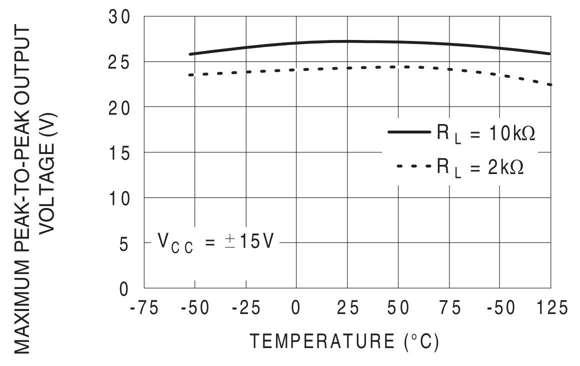


Figure 6. Maximum peak-to-peak output voltage versus load resistance

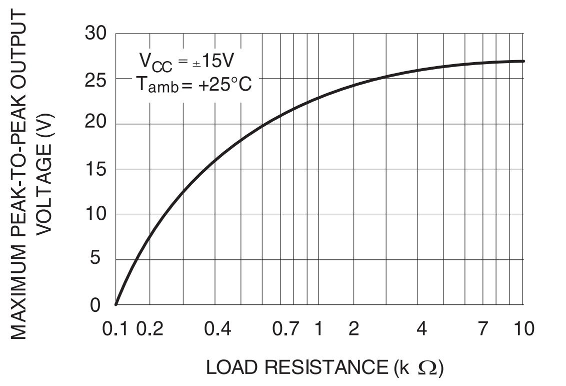


Figure 7. Maximum peak-to-peak output voltage versus supply voltage

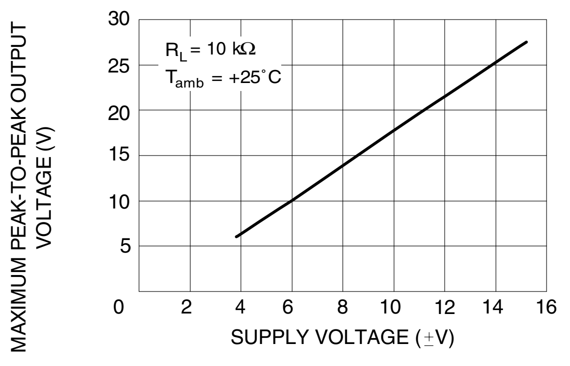


Figure 8. Input bias current versus free air temperature

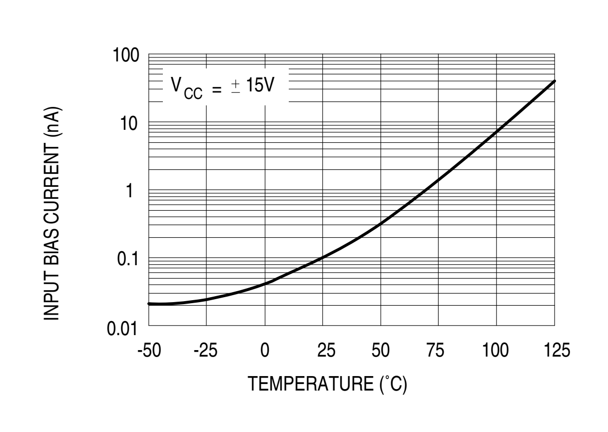


Figure 9. Large signal differential voltage amplification versus free air temperature

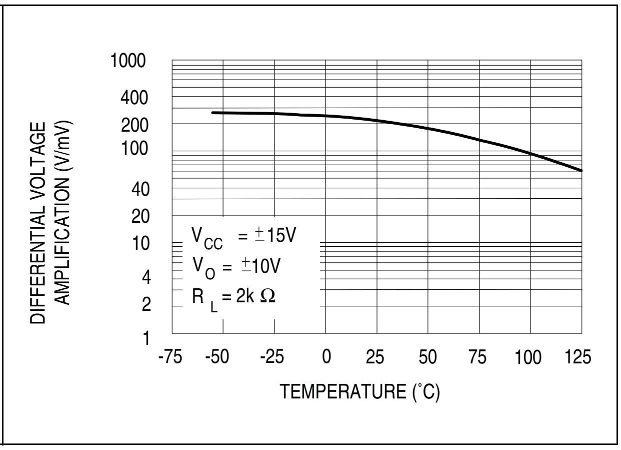


Figure 10. Large signal differential voltage amplification and phase shift versus frequency

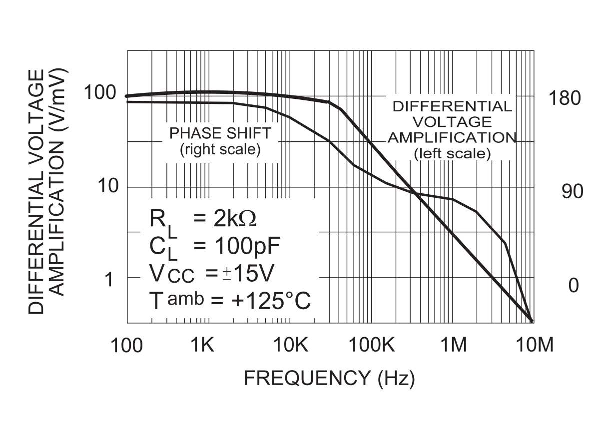


Figure 11. Total power dissipation versus free air temperature

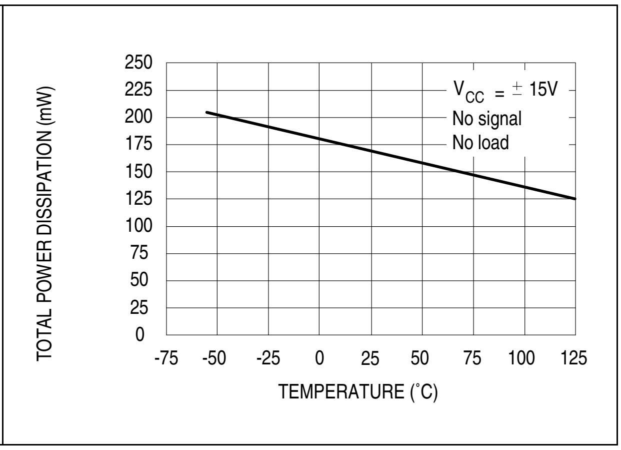


Figure 12. Supply current per amplifier versus free air temperature

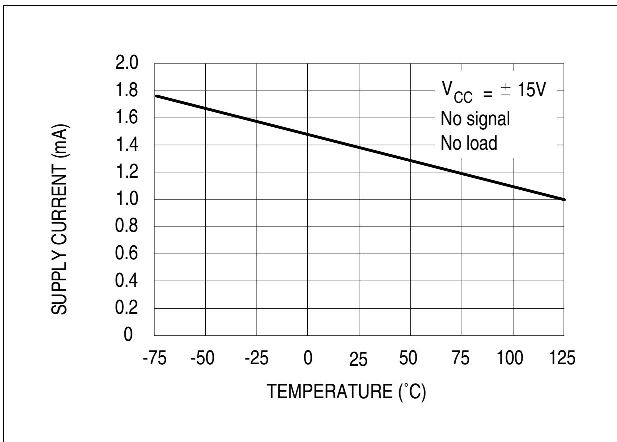


Figure 13. Common mode rejection ratio versus free air temperature

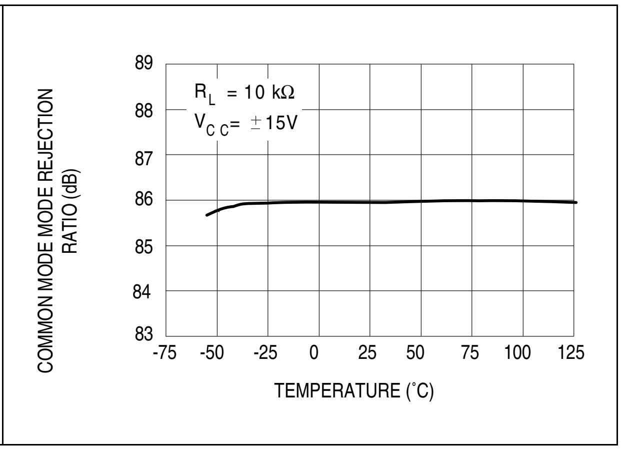


Figure 14. Voltage follower large signal pulse response

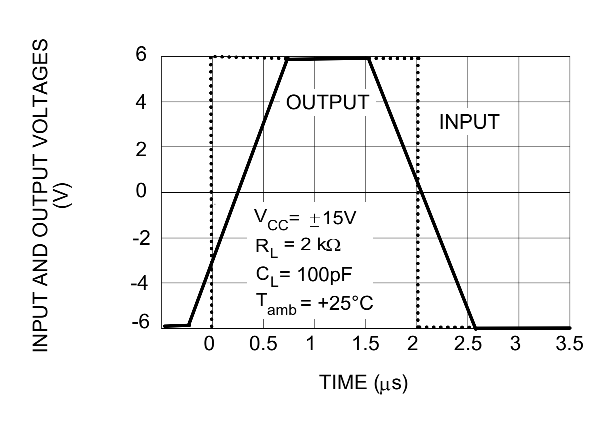


Figure 15. Output voltage versus elapsed time

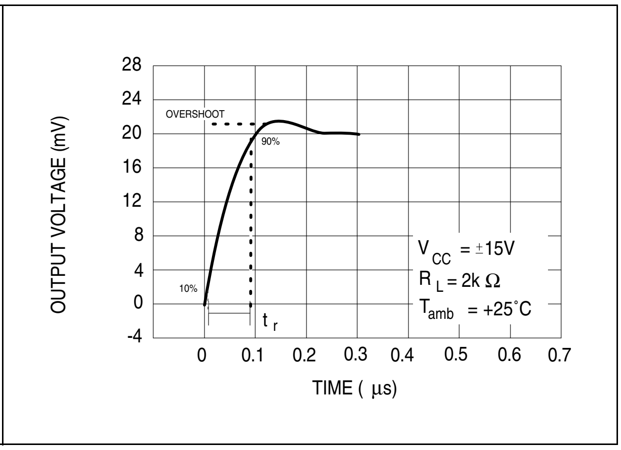


Figure 16. Equivalent input noise voltage versus frequency

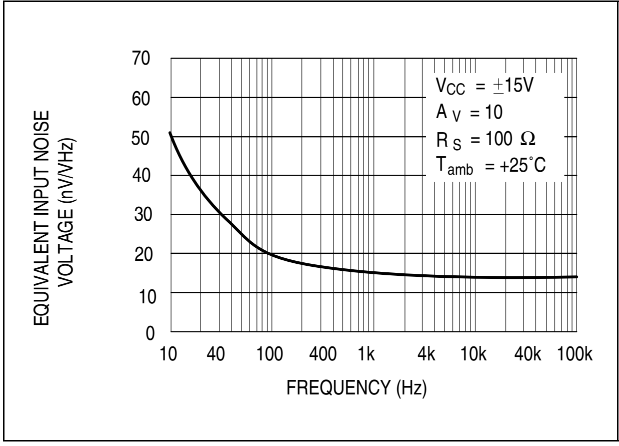
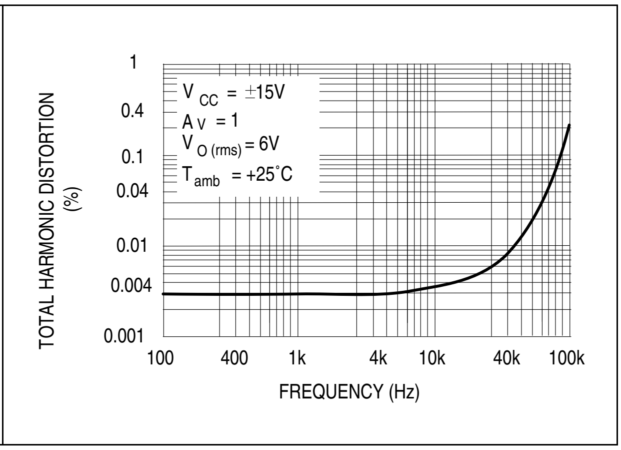


Figure 17. Total harmonic distortion versus frequency



4 Parameter measurement information

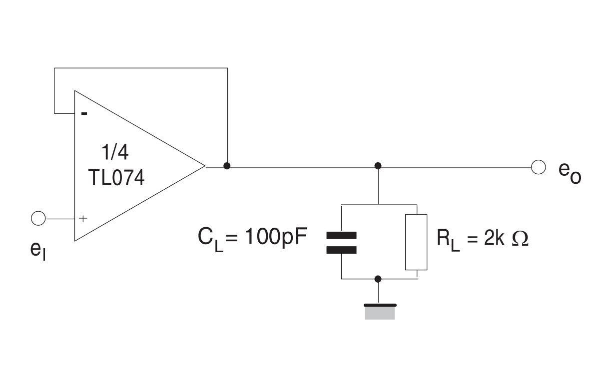


Figure 18. Voltage follower

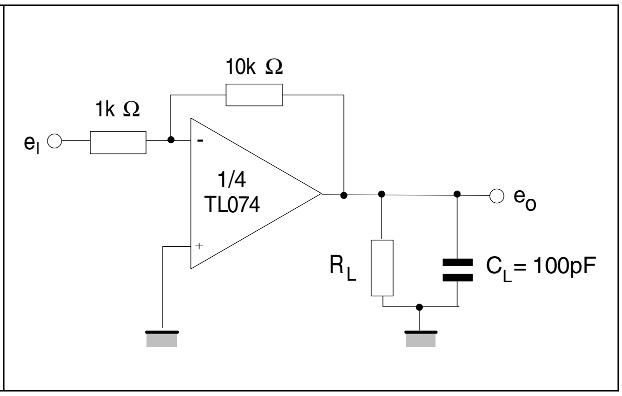


Figure 19. Gain-of-10 inverting amplifier

5 Typical applications

Figure 20. Audio distribution amplifier

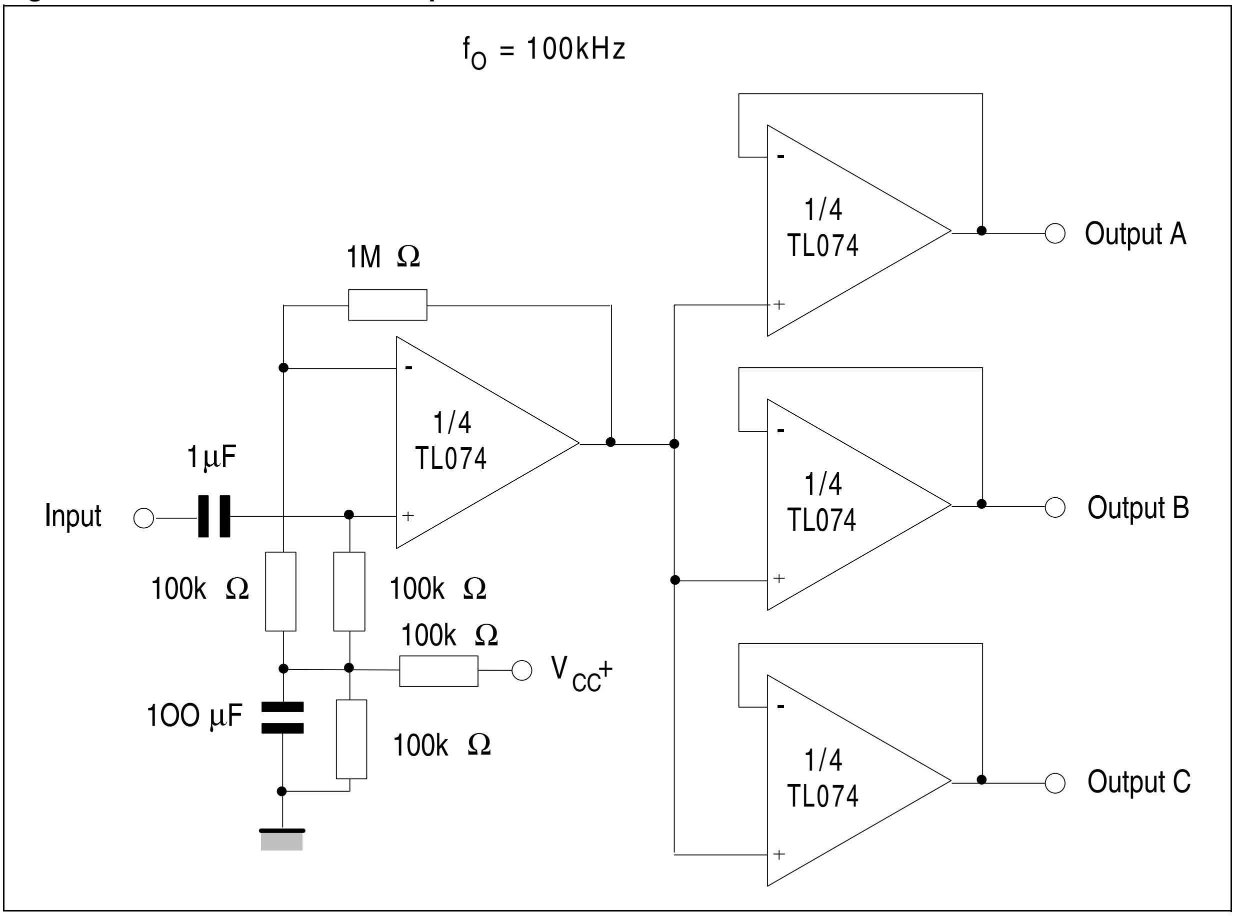


Figure 21. Positive feeback bandpass filter

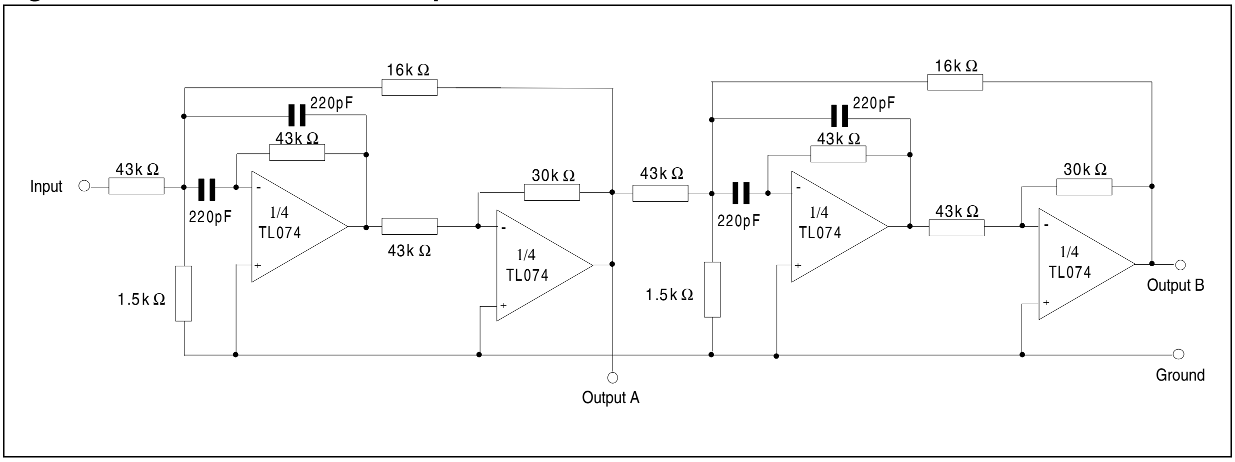
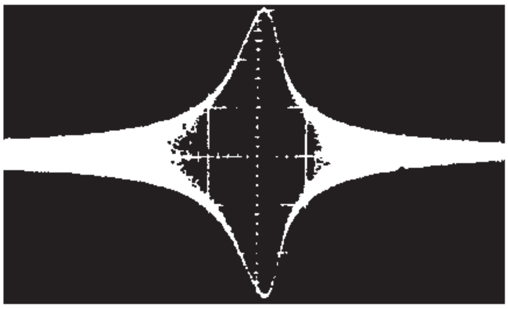
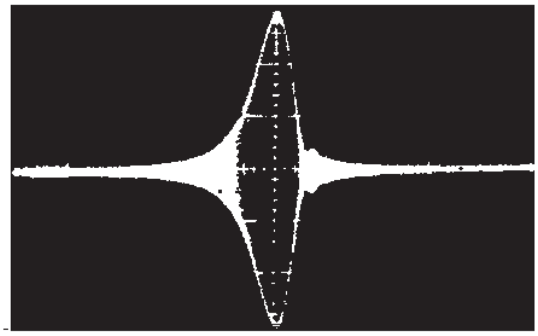


Figure 22. Output A



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. ECOPACK is an ST trademark.

6.1 DIP14 package information

Figure 24. DIP14 package mechanical drawing

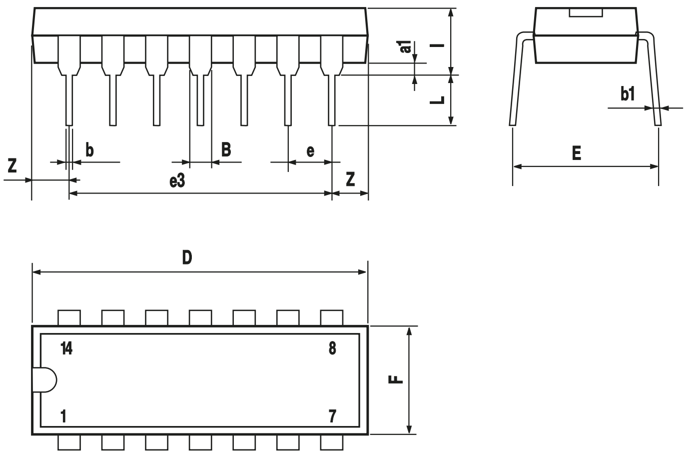


Table 4. DIP14 package mechanical data

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
I			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

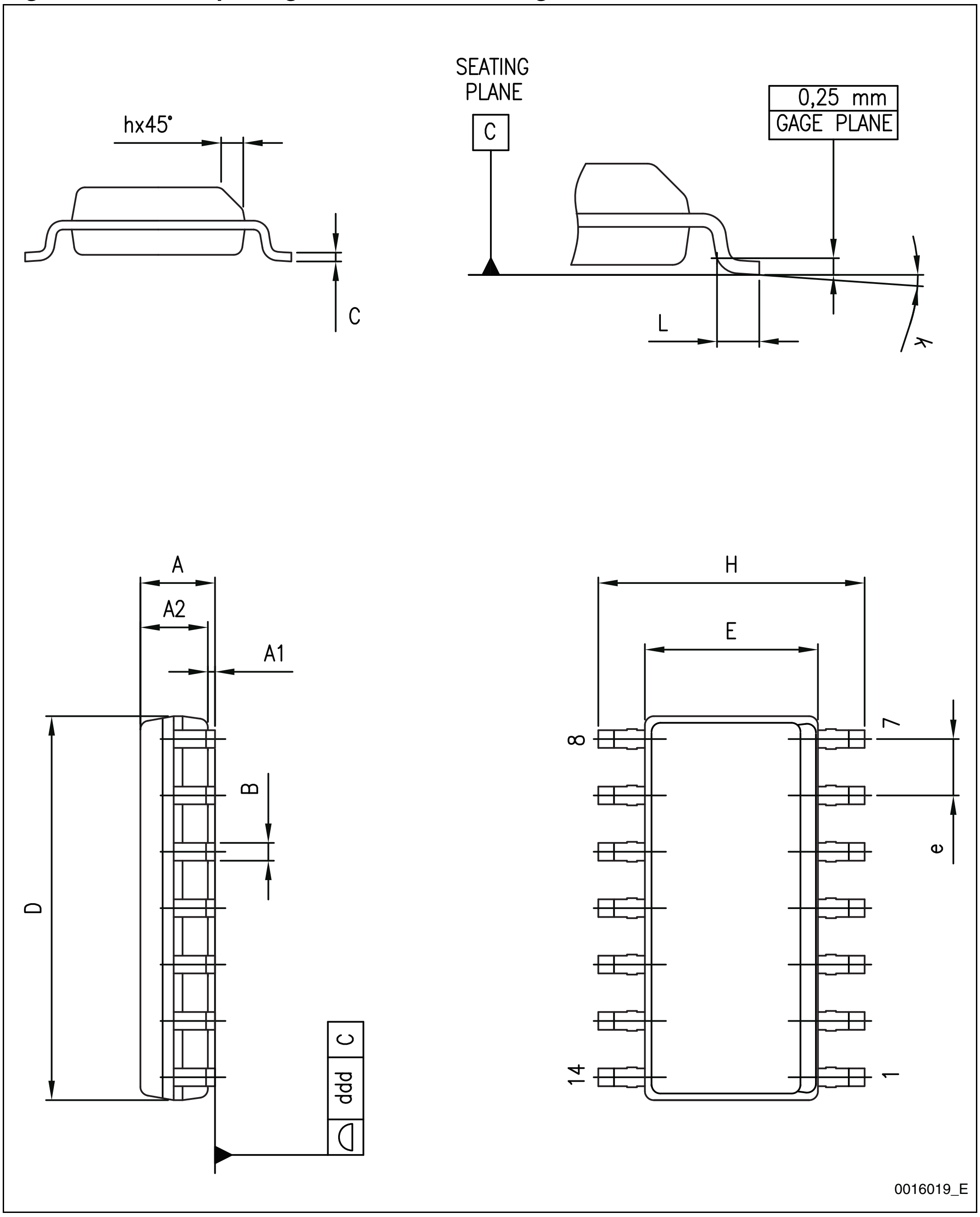


Table 5. SO-14 mechanical data

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(1) TL074AIYDT(1) TL074BIYDT(1)		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 *Table 1: Absolute maximum ratings*. Added *Table 2: Operating conditions*. Expanded *Table 6: Order codes*. Format update.
07-Jul-2008	3	Removed information concerning military temperature ranges (TL074Mx, TL074AMx, TL074BMx). Added automotive grade order codes in *Table 6: Order codes*.
04-Jul-2012	4	Removed commercial types TL074IYD, TL074AIYD, TL074BIYD. Updated *Table 6: Order codes*.