TL074

Low-noise JFET quad operational amplifier

Description

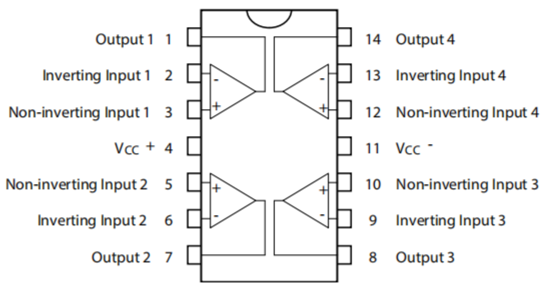
The TL074 is high-speed JFET input single operational amplifiers. Each of these JFET input operational amplifiers
incorporates well matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit.

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

Features

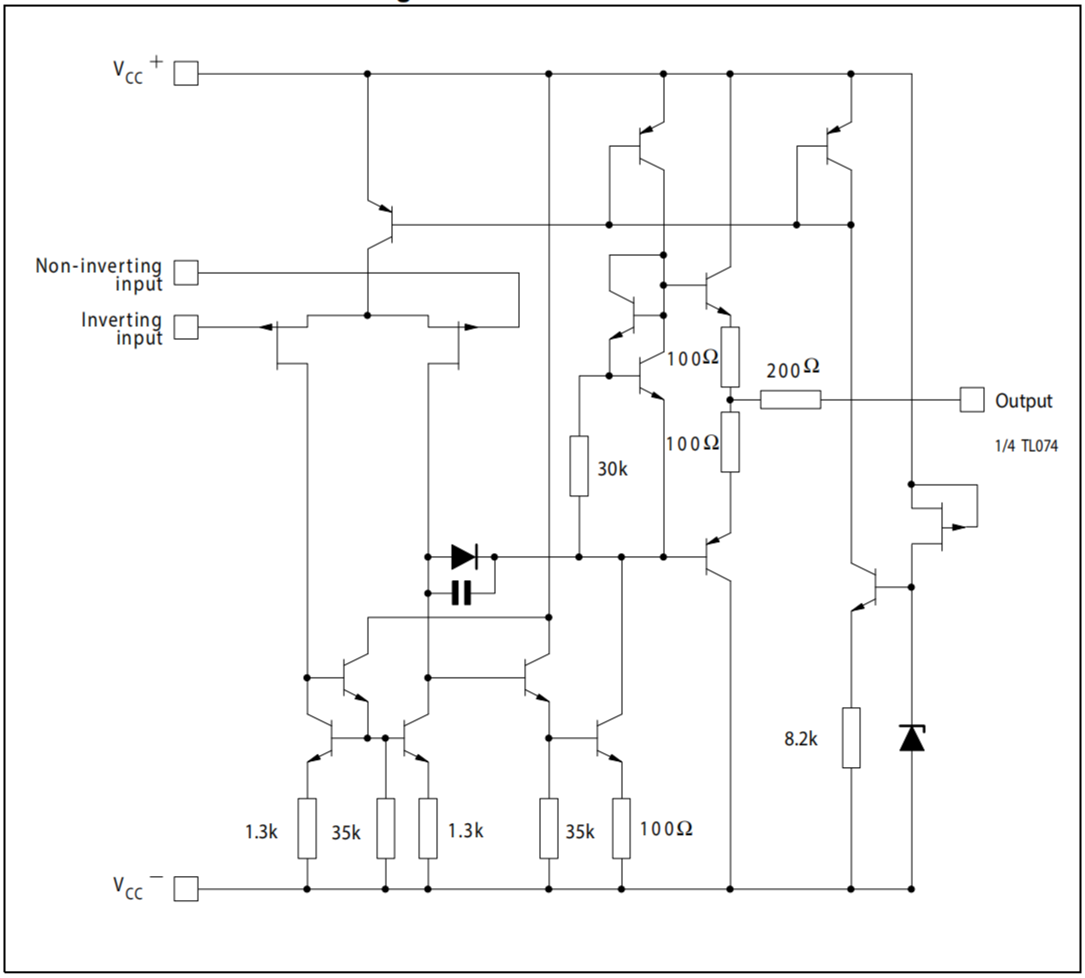
- Wide common-mode (up to V_{CC}^+) and differential voltage range
- Low input bias and offset current
- Low noise e_n = 15 nV/ √Hz (typ)
- Output short-circuit protection
- High input impedance JFET input stage
- Low harmonic distortion: 0.01% (typical)
- Internal frequency compensation
- Latch up free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

Pin connections



Schematic diagram

Figure 1. Circuit schematic



Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18	V
V_i	Input voltage	±15	
V_{id}	Differential input voltage	±30	
P_{tot}	Power dissipation	680	mW
R_{thja}	Thermal resistance junction to ambient SO14	105	°C/W
R_{thjc}	Thermal resistance junction to case SO14	31	
	Output short-circuit duration	Infinite	
T_{oper}	Operating free-air temperature range	0 to +70	°C
T_{stg}	Storage temperature range	-65 to +150	
ESD	HBM: human body model	1	kV
	MM: machine model	200	V
	CDM: charged device model	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	TL074		Unit
V_{CC}	Supply voltage	6 to 36		V
T_{oper}	Operating free-air temperature range	-40 to +125	0 to +70	°C

Electrical characteristics

Table 3. V_{CC} = ±15 V, T_{amb} = +25 °C (unless otherwise specified)

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

Table 3. V_{CC} = ±15 V, T_{amb} = +25 °C (unless otherwise specified) (continued)

Symbol	Parameter	TL074			Unit
		Min.	Typ.	Max.	
t_r	Rise time V_{in} = 20mV, R_L = 2kΩ, C_L = 100pF, unity gain		0.1		μs
K_{ov}	Overshoot V_{in} = 20mV, R_L = 2kΩ, C_L = 100pF, unity gain		10		%
GBP	Gain bandwidth product V_{in}= 10mV, R_L= 2kΩ, C_L = 100pF, = 100kHz	2	3		MHz
R_i	Input resistance		10^{12}		Ω
THD	Total harmonic distortion f= 1kHz, R_L = 2kΩ,C_L = 100pF, A_v = 20dB, V_o = $2V_{pp}$)		0.01		%
e_n	Equivalent input noise voltage R_S = 100Ω, f = 1kHz		15		$\frac{nV}{\sqrt{Hz}}$
∅m	Phase margin		45		degrees
V_{o1}/V_{o2}	Channel separation A_v = 100		120		dB

1. The input bias currents are junction leakage currents which approximately double for every 10° C increase in the junction

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

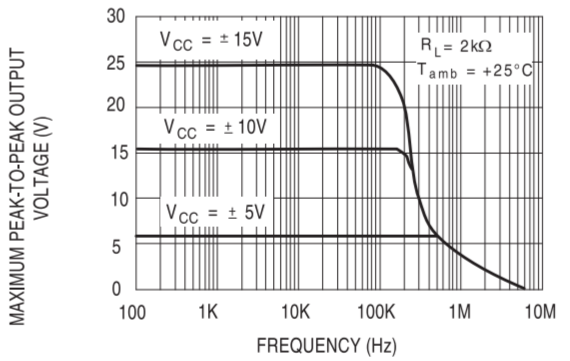


Figure 3. Maximum peak-to-peak output voltage versus frequency

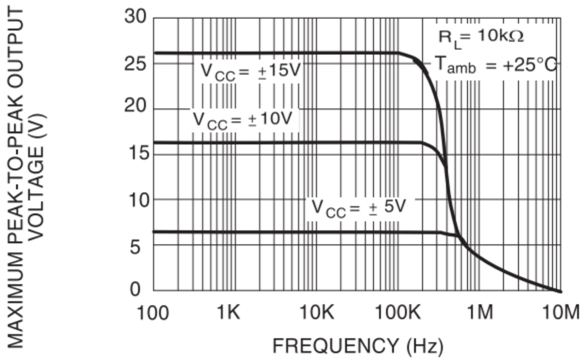


Figure 4. Maximum peak-to-peak output voltage versus frequency

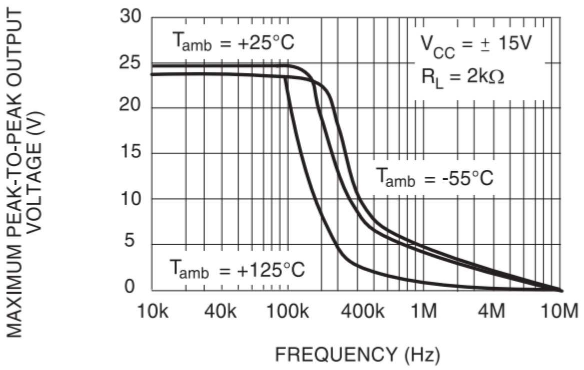


Figure 5. Maximum peak-to-peak output voltage versus free air temperature

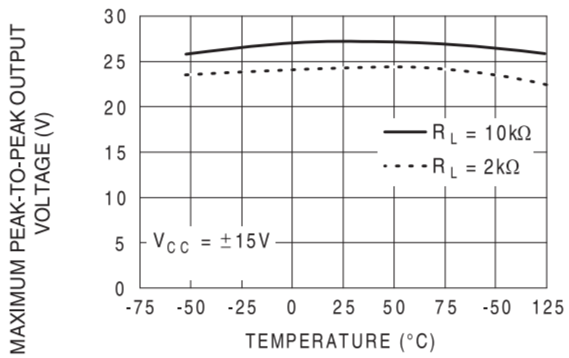


Figure 6. Maximum peak-to-peak output voltage versus load resistance

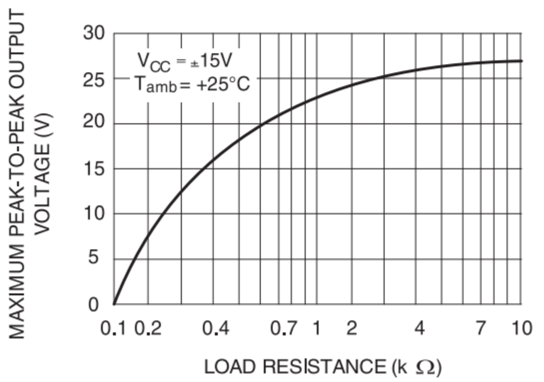


Figure 7. Maximum peak-to-peak output voltage versus supply voltage

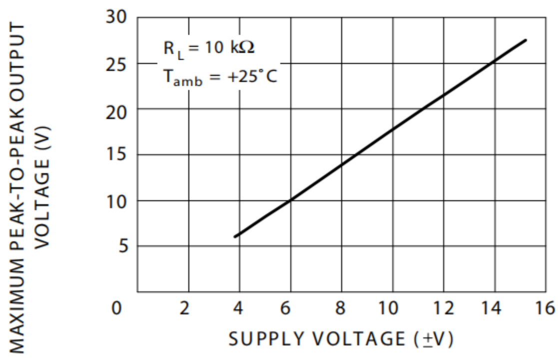


Figure 8. Input bias current versus free air temperature

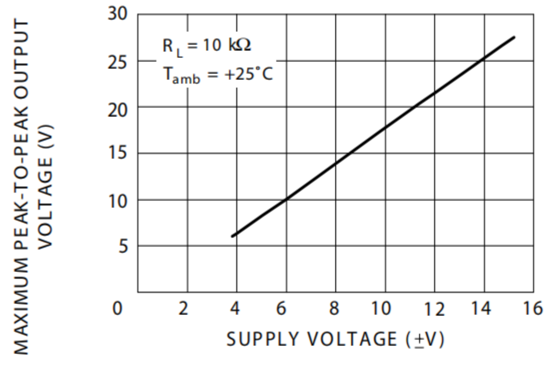


Figure 9. Large signal differential voltage amplification versus free air temperature

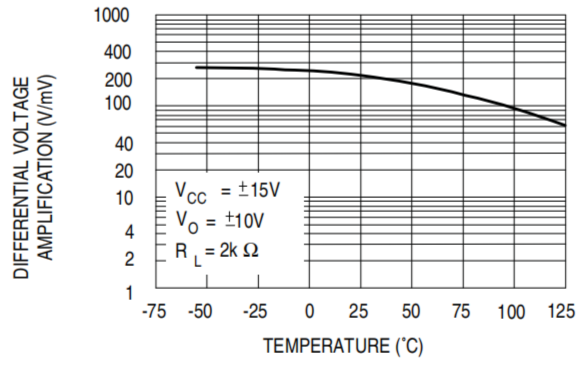


Figure 10. Large signal differential voltage amplification and phase shift versus frequency

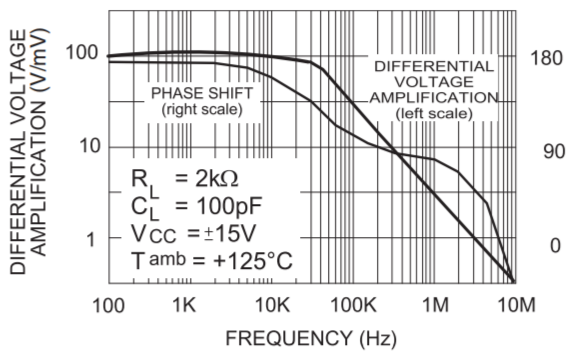


Figure 11. Total power dissipation versus free air temperature

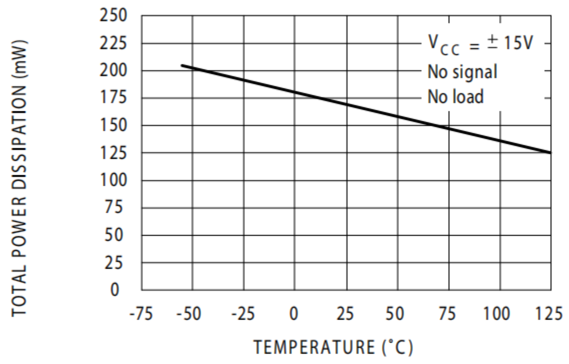


Figure 12. Supply current per amplifier versus free air temperature

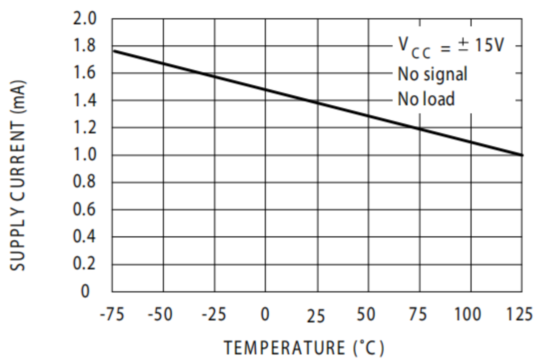


Figure 13. Common mode rejection ratio versus free air temperature

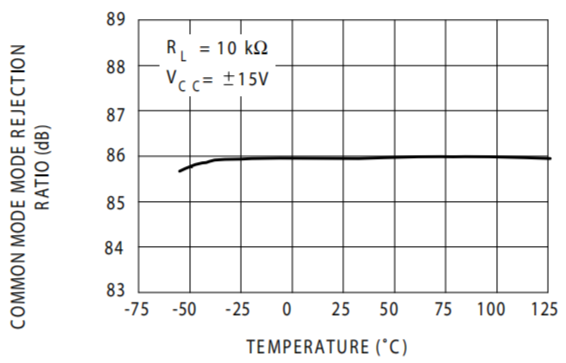


Figure 14. Voltage follower large signal pulse response

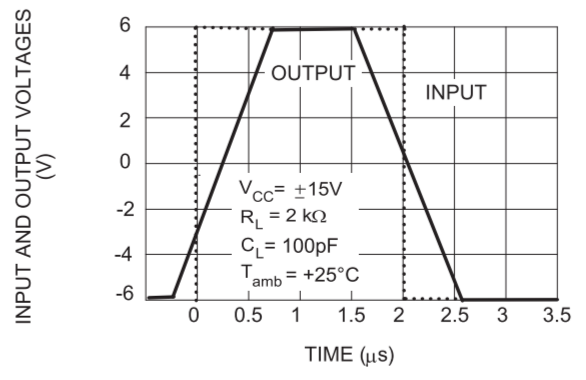


Figure 15. Output voltage versus elapsed time

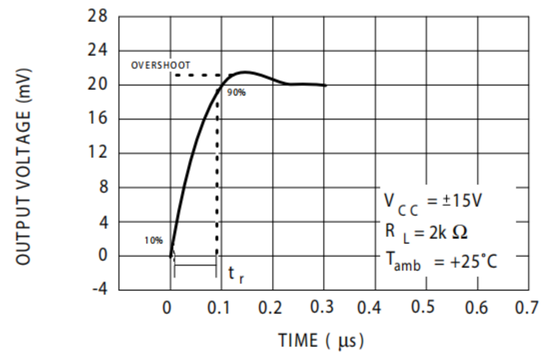


Figure 16. Equivalent input noise voltage versus frequency

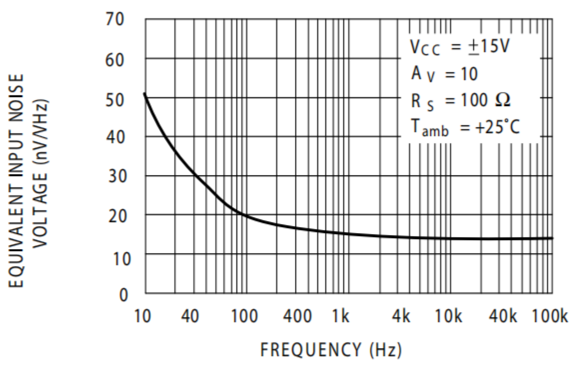
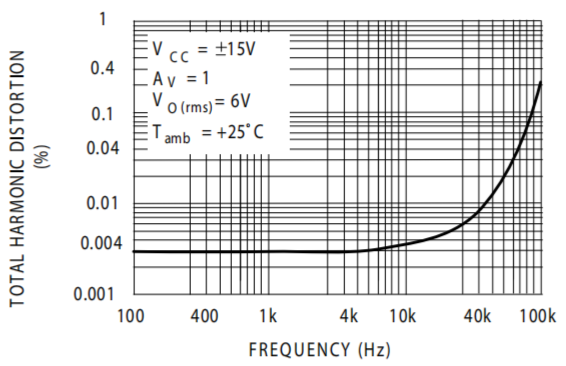


Figure 17. Total harmonic distortion versus frequency



Parameter measurement information

Figure 18. Voltage follower

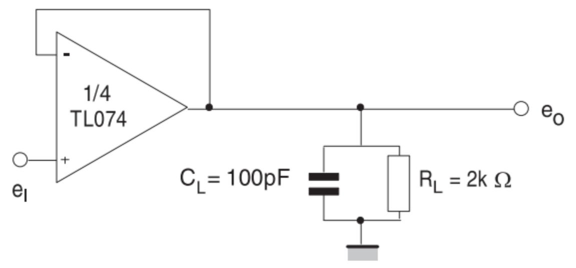
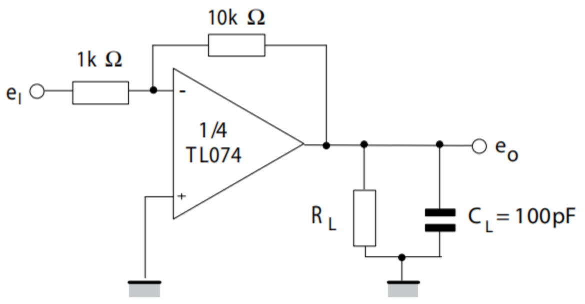


Figure 19. Gain-of-10 inverting amplifier



Typical applications

Figure 20. Audio distribution amplifier

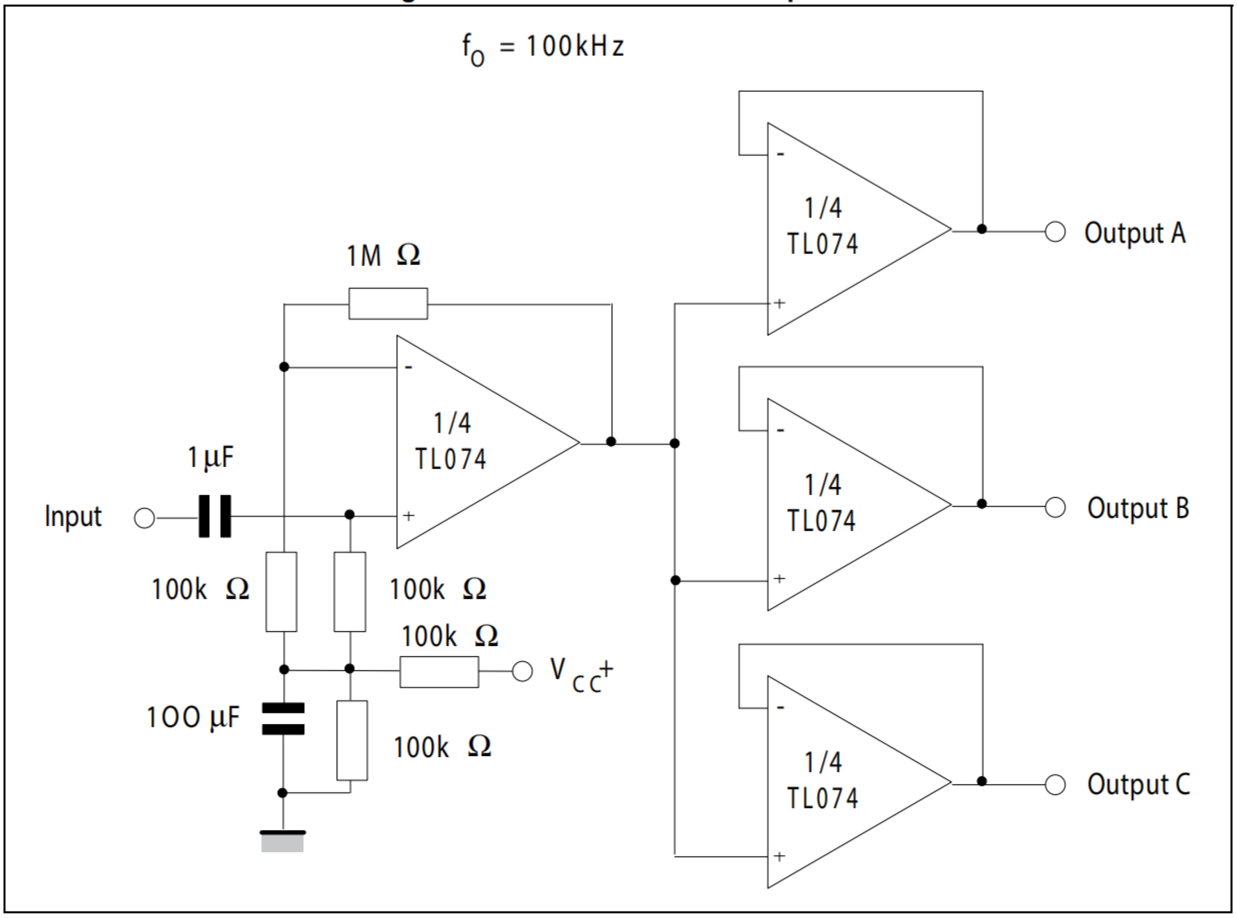


Figure 21. Positive feeback bandpass filter

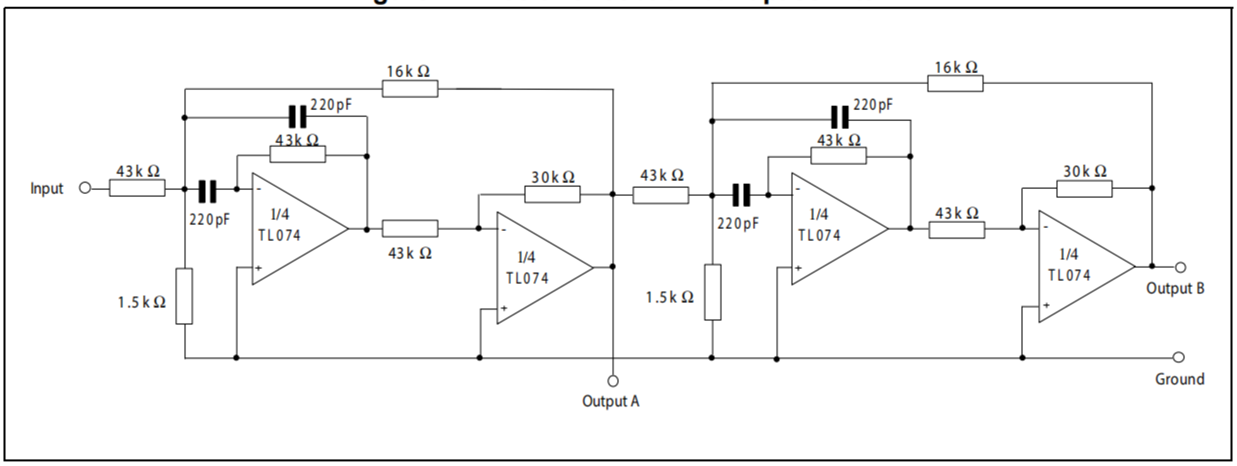
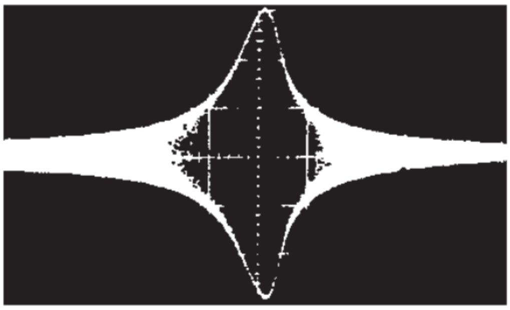
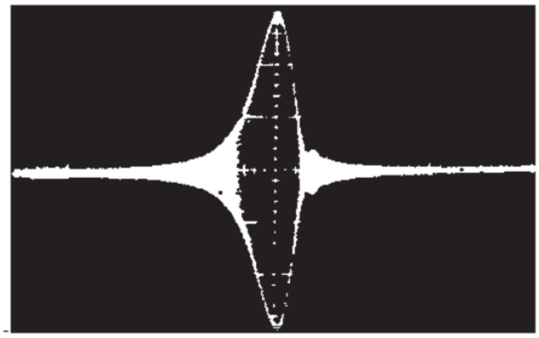


Figure 22. Output A	Figure 23. Output B
 SECOND ORDER BANDPASS FILTER fo = 100 kHz; Q = 30; Gain = 16	 CASCADED BANDPASS FILTER fo = 100 kHz; Q = 69; Gain = 16