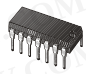
TL084

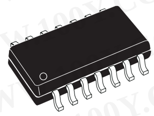
General purpose JFET quad operational amplifier

Features

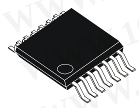
- Wide common-mode (up to V_{CC}^+) and differential voltage range
- Low input bias and offset current
- Output short-circuit protection
- High input impedance JFET input stage
- Internal frequency compensation
- Latch up free operation
- High slew rate: 16V/µs (typ)



N
DIP14
(Plastic package)

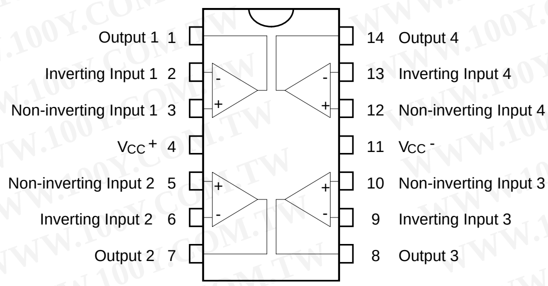


D
TSSOP-14
(Thin shrink small outline package)



D
SO-14
(Plastic micropackage)

Pin connections
(Top view)



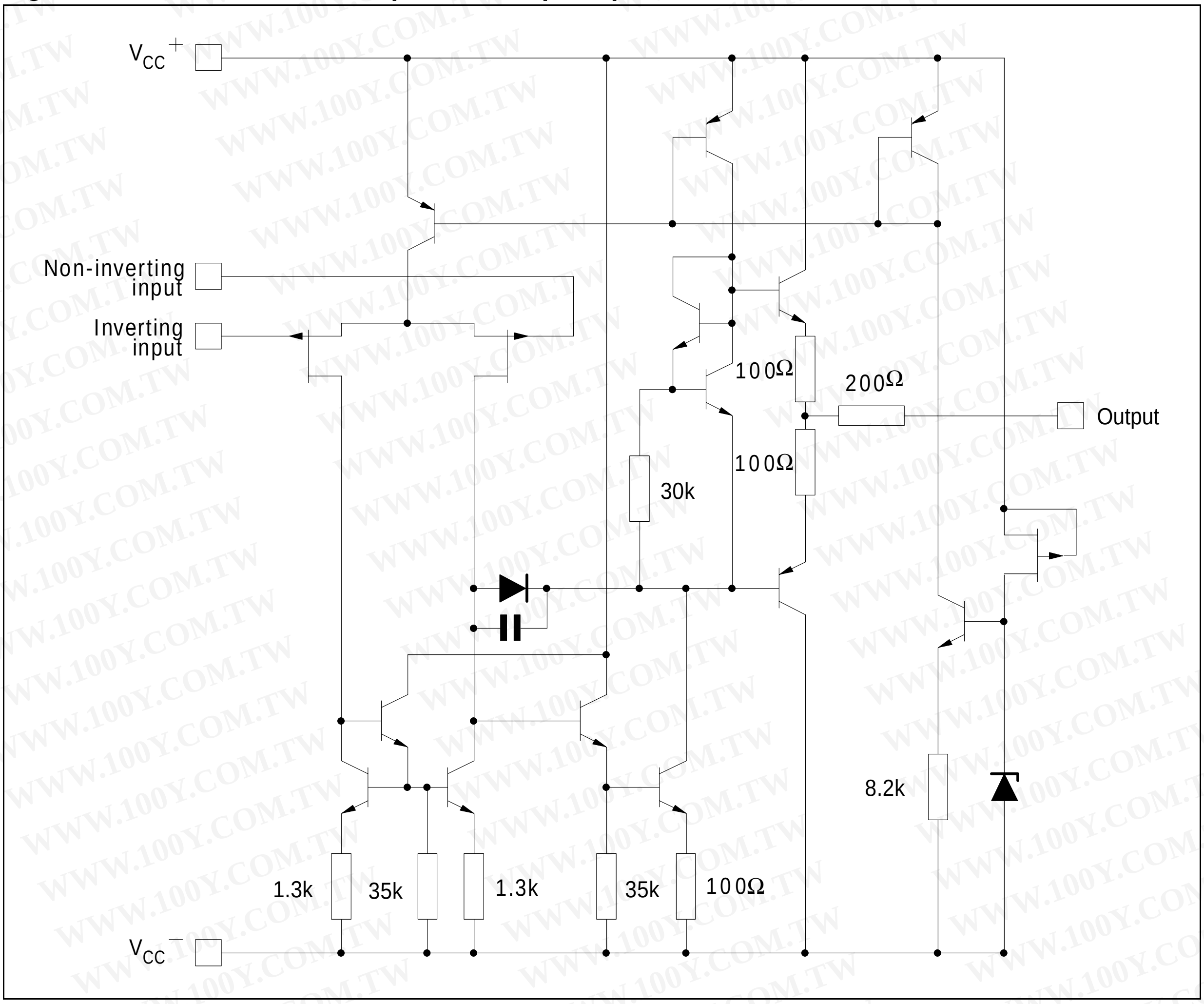
Description

The TL084, TL084A and TL084B are high-speed JFET input quad operational amplifiers incorporating 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 (for each amplifier)



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TL084M, AM, BM	TL084I, AI, BI	TL084C, AC, BC	
V_{CC}	Supply voltage [1]	±18			V
V_i	Input voltage [2]	±15			V
V_{id}	Differential input voltage [3]	±30			V
R_{thja}	Thermal resistance junction to ambient[4] [5] SO-14 DIP14 TSSOP14	 105 80 100			°C/W
R_{thjc}	Thermal resistance junction to case[4] [5] SO-14 DIP14 TSSOP14	 31 33 32			°C/W
P_{tot}	Power dissipation	680			mW
	Output short-circuit duration [6]	Infinite			
T_{oper}	Operating free-air temperature range	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	Storage temperature range	-65 to +150			°C
ESD	HBM: human body model[7]	1000			V
	MM: machine model[8]	150			
	CDM: charged device model[9]	1500			

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 and destructive dissipation.
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	TL084M, AM, BM	TL084I, AI, BI	TL084C, AC, BC	Unit
V_{CC}	Supply voltage range	6 to 36			V
T_{oper}	Operating free-air temperature range	-55 to +125	-40 to +105	0 to +70	°C

3 Electrical characteristics

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

Symbol	Parameter	TL084I,M,AC,AI,AM, BC,BI,BM			TL084C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input offset voltage (R_s = 50Ω) T_{amb} = +25°C TL084 TL084A TL084B $T_{min} \le T_{amb} \le T_{max}$ TL084 TL084A TL084B		 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 $T_{min} \le T_{amb} \le T_{max}$		 5	 100 4		 5	 100 4	 pA nA
I_{ib}	Input bias current [1] T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		 20	 200 20		 30	 200 20	 pA nA
A_{vd}	Large signal voltage gain (R_L = 2kΩ, V_o =±10V) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 50 25	 200		 25 15	 200		V/mV
SVR	Supply voltage rejection ratio (R_S = 50Ω) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 80 80	 86		 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		 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 = 50Ω) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 80 80	 86		 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	 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		 10 12 10 12	 12 13.5		V
SR	Slew rate (T_{amb} = +25°C) V_{in} = 10V, R_L = 2kΩ, C_L = 100pF, unity gain	8	16		8	16		V/µs

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

Symbol	Parameter	TL084I,M,AC,AI,AM, BC,BI,BM			TL084C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
t_r	Rise time (T_{amb} = +25°C) V_{in} = 20mV, R_L = 2kΩ, C_L = 100pF, unity gain		0.1			0.1		µs
K_{ov}	Overshoot (T_{amb} = +25°C) V_{in} = 20mV, R_L = 2kΩ, C_L = 100pF, unity gain		10			10		%
GBP	Gain bandwidth product (T_{amb} = +25°C) V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF, f= 100kHz	2.5	4		2.5	4		MHz
R_i	Input resistance		10^{12}			10^{12}		Ω
THD	Total harmonic distortion (T_{amb} = +25°C, f= 1kHz, R_L = 2kΩC_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

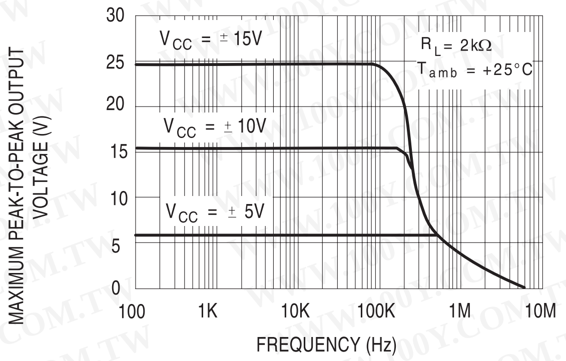


Figure 3. Maximum peak-to-peak output voltage versus frequency

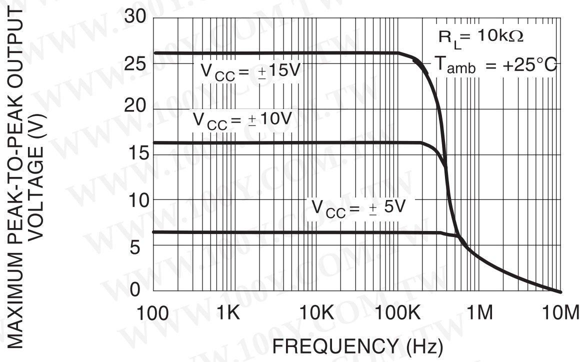


Figure 4. Maximum peak-to-peak output voltage versus frequency

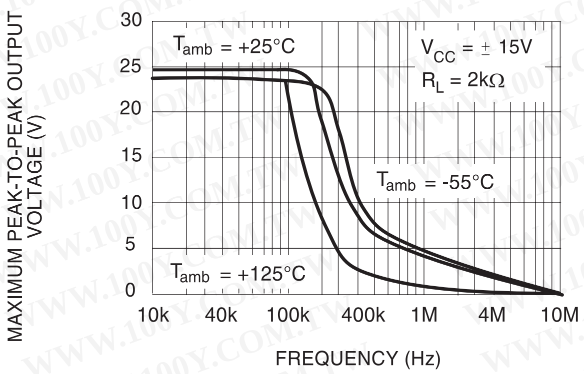


Figure 5. Maximum peak-to-peak output voltage versus free air temperature

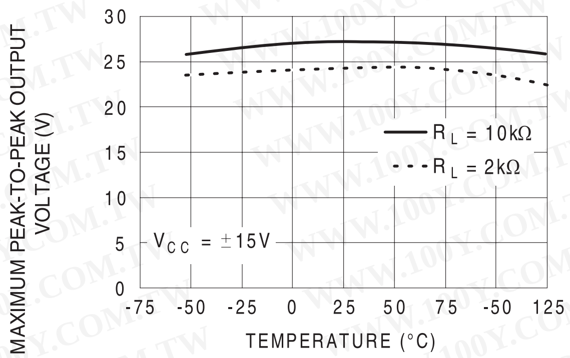


Figure 6. Maximum peak-to-peak output voltage versus load resistance

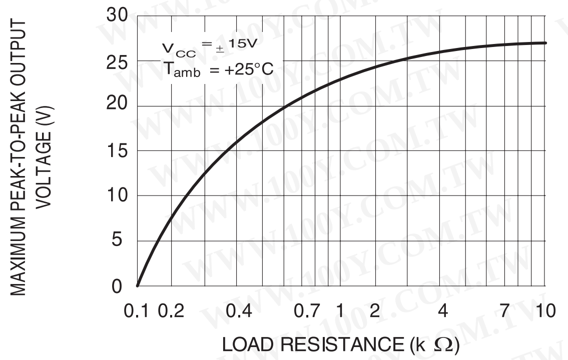


Figure 7. Maximum peak-to-peak output voltage versus supply voltage

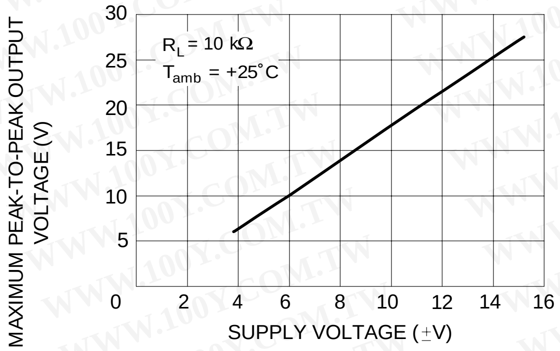


Figure 8. Input bias current versus free air temperature

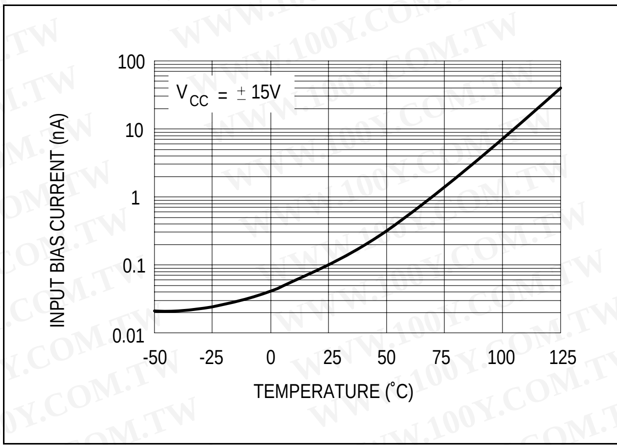


Figure 9. Large signal differential voltage amplification versus free air temperature

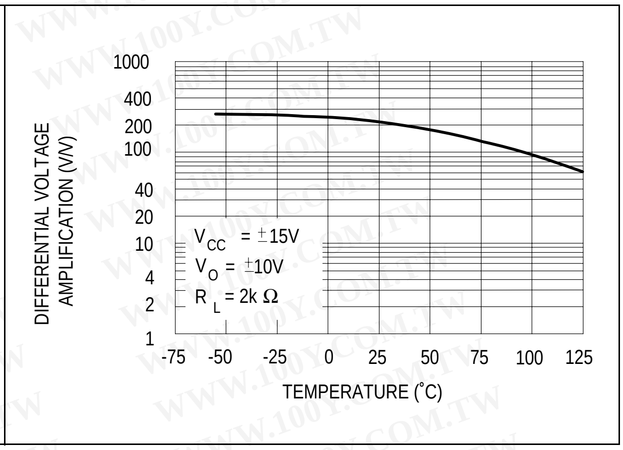


Figure 10. Large signal differential voltage amplification and phase shift versus frequency

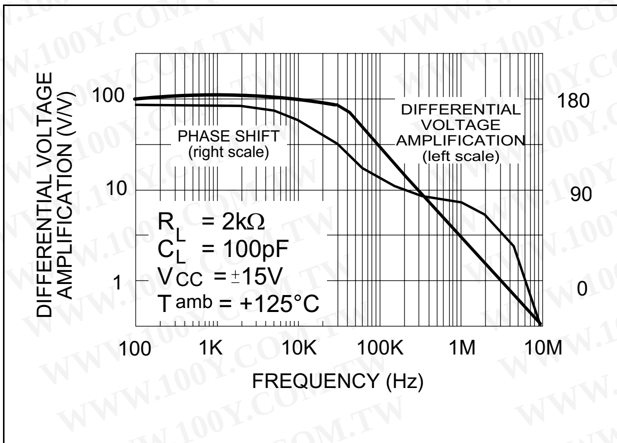


Figure 11. Total power dissipation versus free air temperature

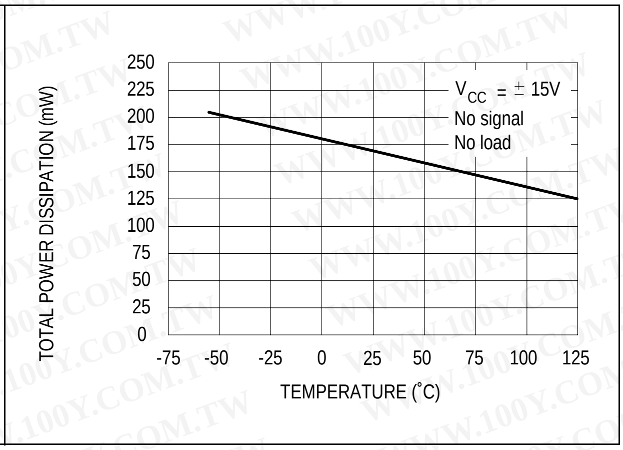


Figure 12. Supply current per amplifier versus free air temperature

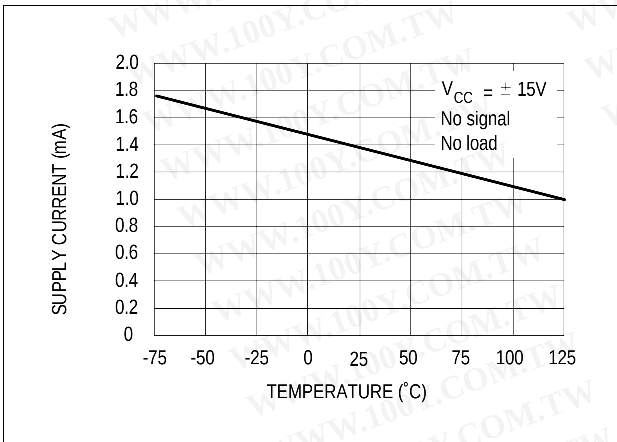


Figure 13. Supply current per amplifier versus supply voltage

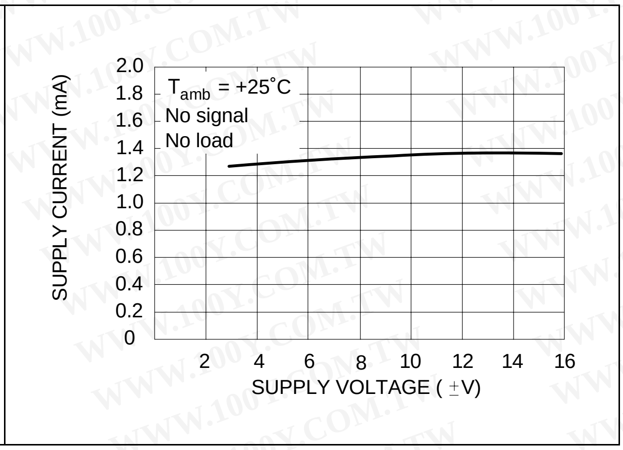


Figure 14. Common mode rejection ratio versus free air temperature

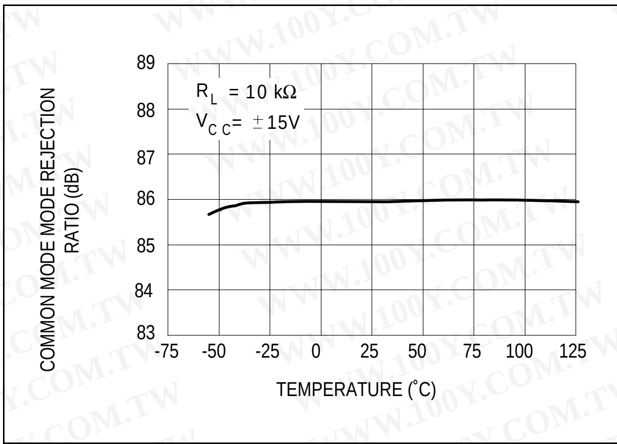


Figure 15. Voltage follower large signal pulse response

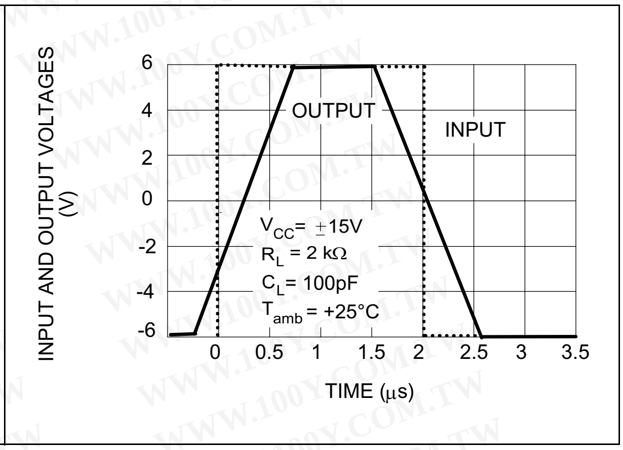


Figure 16. Output voltage versus elapsed time

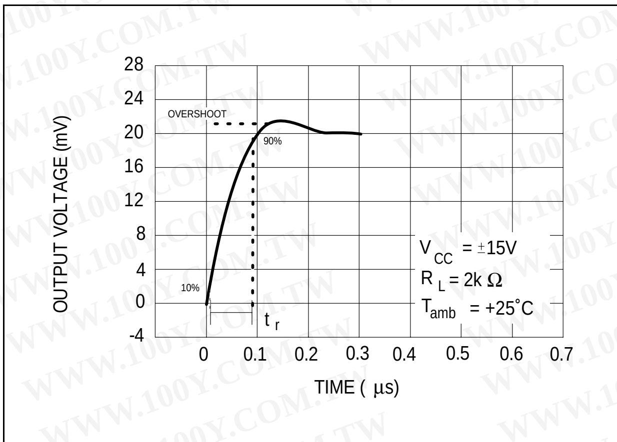


Figure 17. Equivalent input noise voltage versus frequency

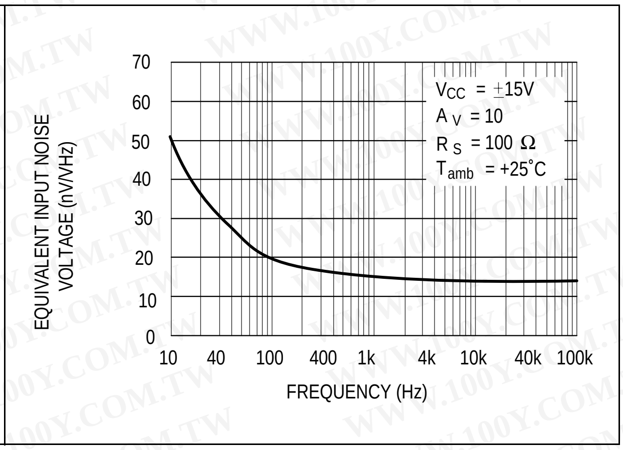
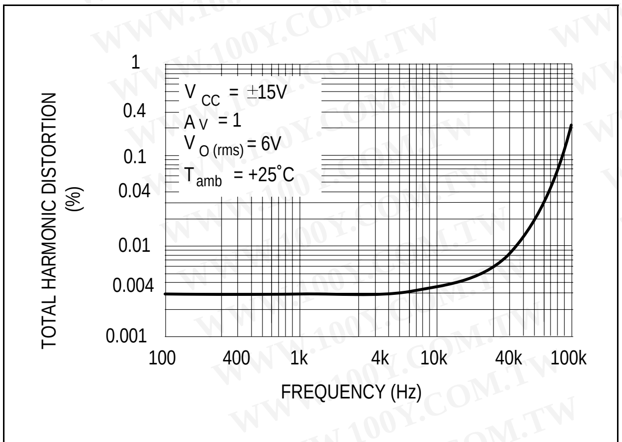


Figure 18. Total harmonic distortion versus frequency



Parameter measurement information

Figure 19. Voltage follower

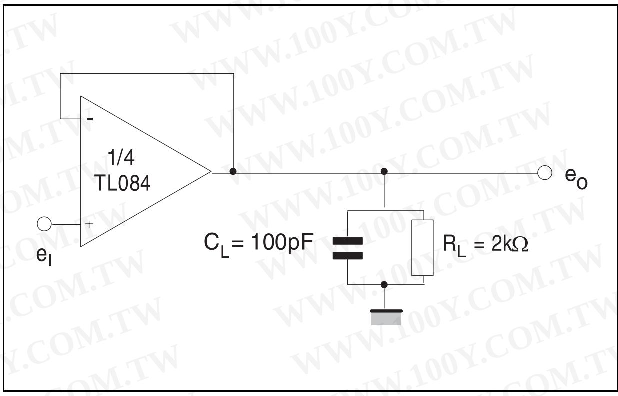
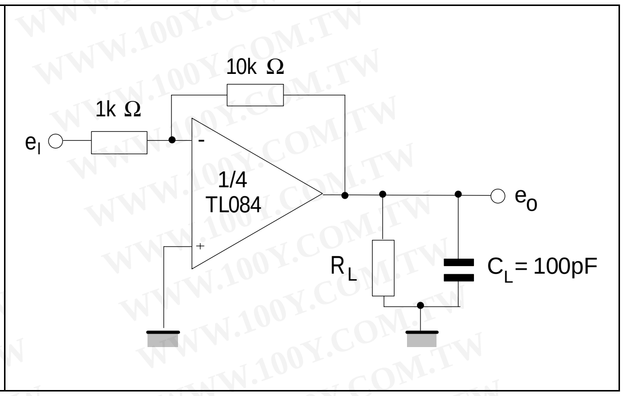


Figure 20. Gain-of-10 inverting amplifier



4 Typical applications

Figure 21. Audio distribution amplifier

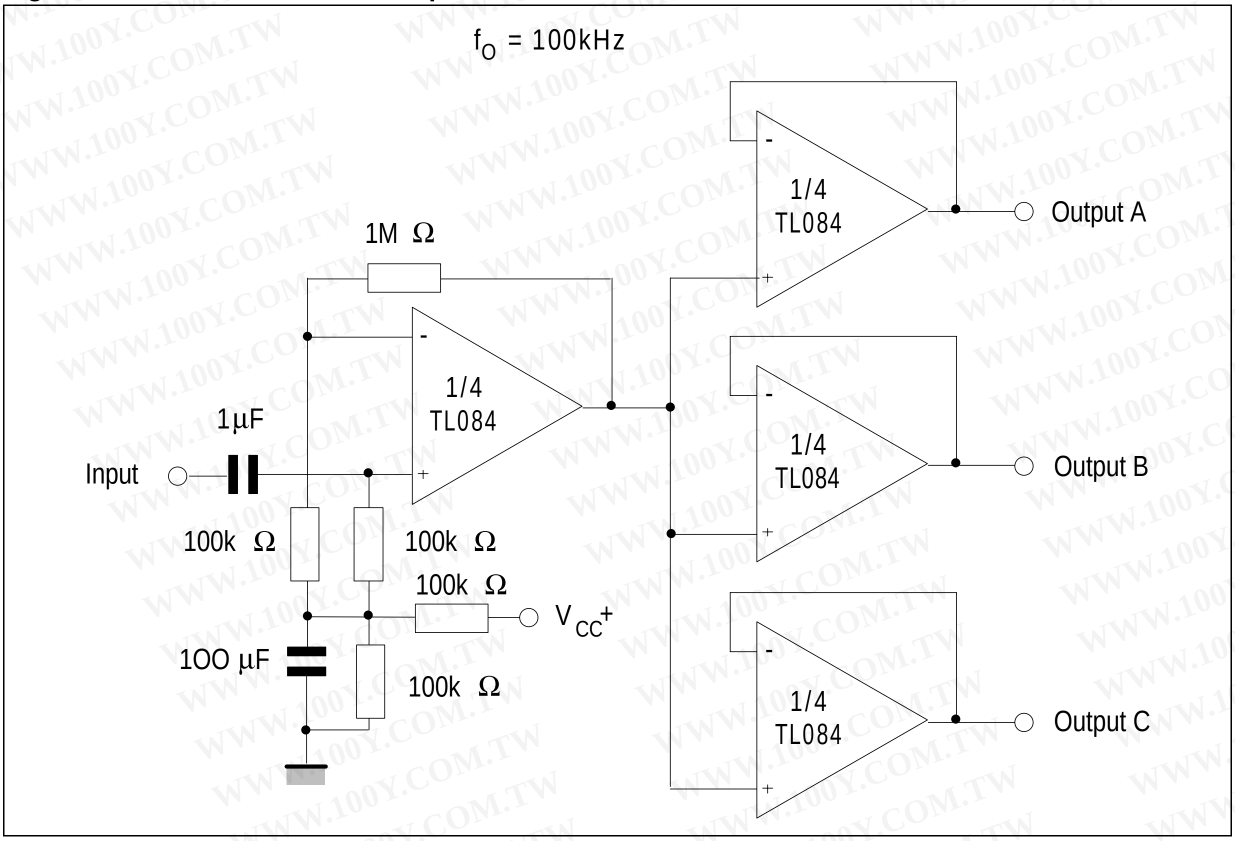


Figure 22. Positive feeback bandpass filter

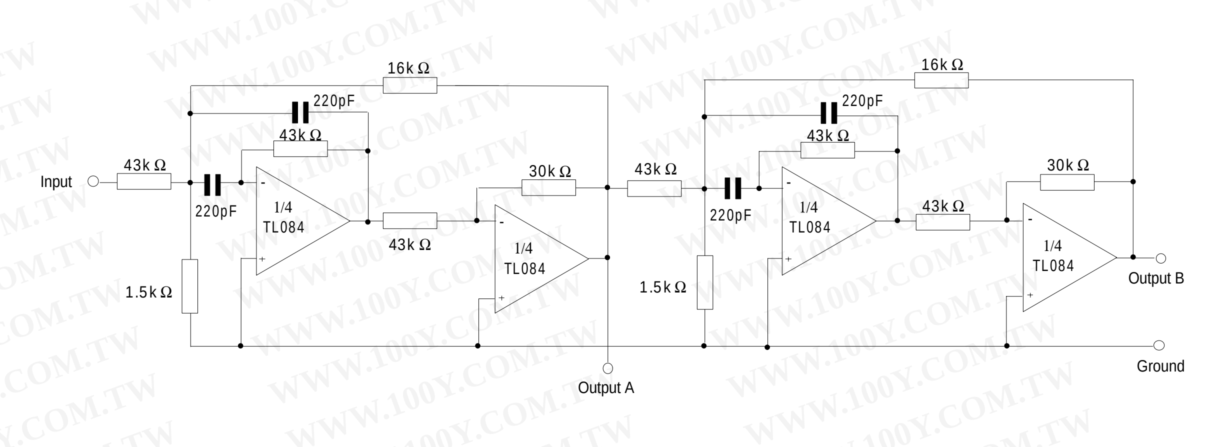
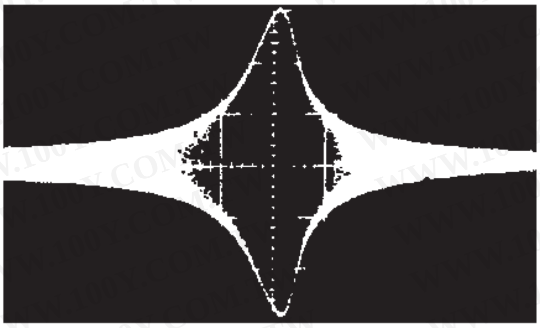
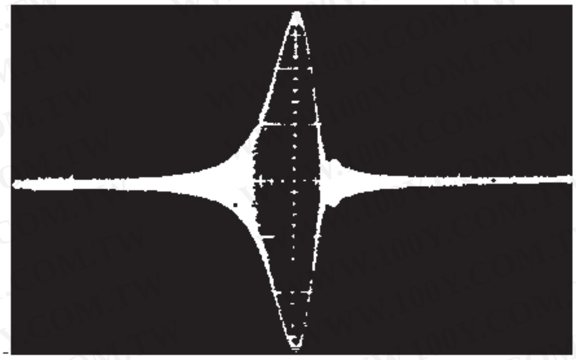


Figure 23. Output A



Second order bandpass filter
fo = 100kHz; Q = 30; Gain = 4

Figure 24. Output B



Cascaded bandpass filter
fo = 100kHz; Q = 69; Gain = 16

5 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.

Figure 25. TSSOP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030

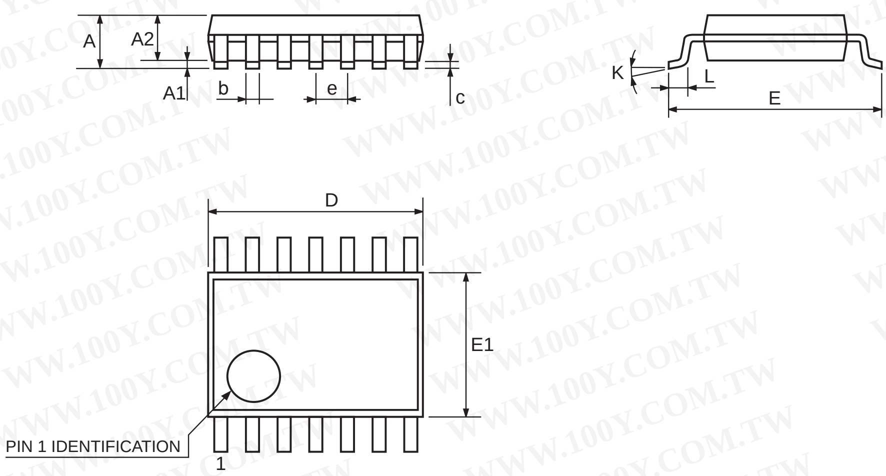


Figure 26. DIP14 package mechanical data

Ref.	Dimensions					
	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

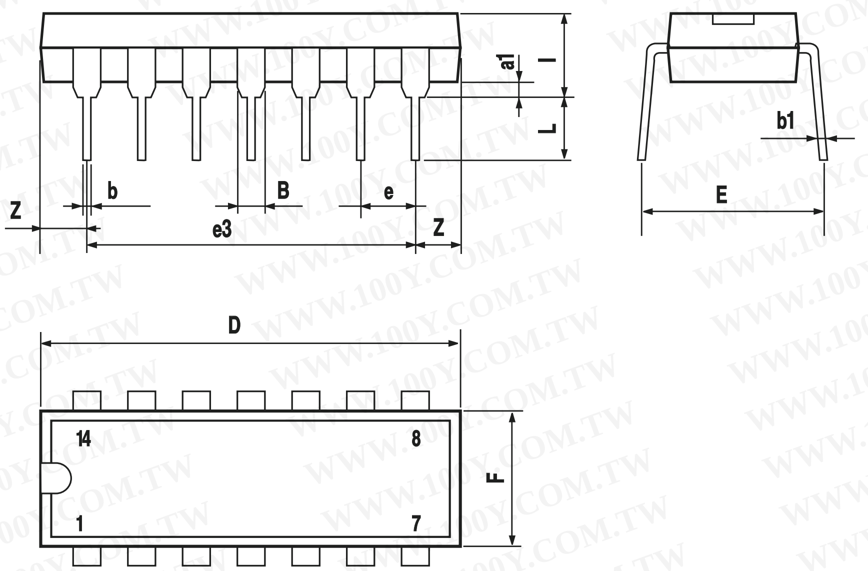
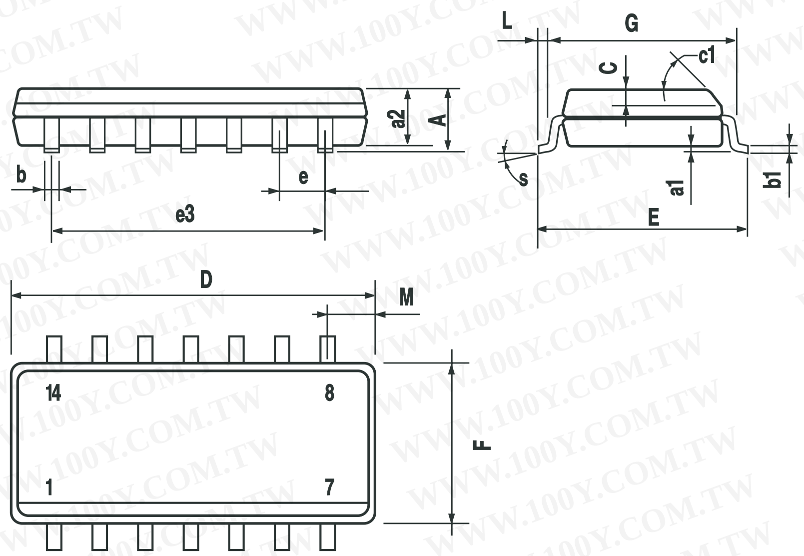


Figure 27. SO-14 package mechanical data

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.)					



6 Ordering information

Table 4. Order codes

Part number	Temperature range	Package	Packing	Marking
TL084MN TL084AMN TL084BMN		DIP14	Tube	TL084MN TL084AMN TL084BMN
TL084MD/MDT TL084AMD/AMDT TL084BMD/BMDT	-55°C, +125°C	SO-14	Tube or tape & reel	084M 084AM 084BM
TL084MP/MPT TL084AMP/AMPT TL084BMP/BMPT		TSSOP14	Tube or tape & reel	084M 084AM 084BM
TL084IN TL084AIN TL084BIN		DIP14	Tube	TL084IN TL084AIN TL084BIN
TL084ID/IDT TL084AID/AIDT TL084BID/BIDT	-40°C, +105°C	SO-14	Tube or tape & reel	084I 084AI 084BI
TL084IP/IPT TL084AIP/AIPT TL084BIP/BIPT		TSSOP14	Tube or tape & reel	084I 084AI 084BI
TL084CN TL084ACN TL084BCN		DIP14	Tube	TL084CN TL084ACN TL084BCN
TL084CD/CDT TL084ACD/ACDT TL084BCD/BCDT	0°C, +70°C	SO-14	Tube or tape & reel	084C 084AC 084BC
TL084CP/CPT TL084ACP/ACPT TL084BCP/BCPT		TSSOP14	Tube or tape & reel	084C 084AC 084BC

7 Revision history

Table 5. 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 4: Order codes*. Template update.

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