TL084, TL084A, TL084B

General purpose JFET quad operational amplifiers

Datasheet — production data

Features

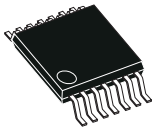
- Wide common-mode (up to V_{CC}^+) and differential voltage range
- Low input bias and offset current
- Output short-circuit protection
- High input impedance JFET input stage
- Internal frequency compensation
- Latch up free operation
- High slew rate: 16 V/µs (typical)

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.

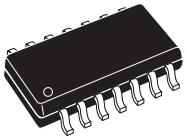
The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

N
DIP14
(Plastic package)

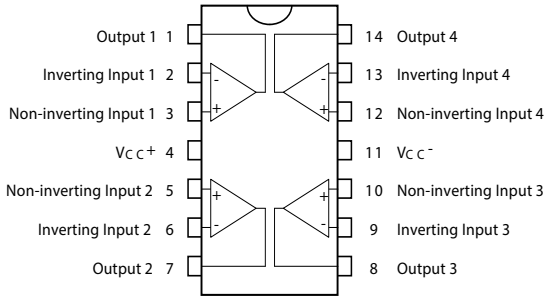


D
TSSOP14
(Thin shrink small outline package)

D
SO-14
(Plastic micropackage)



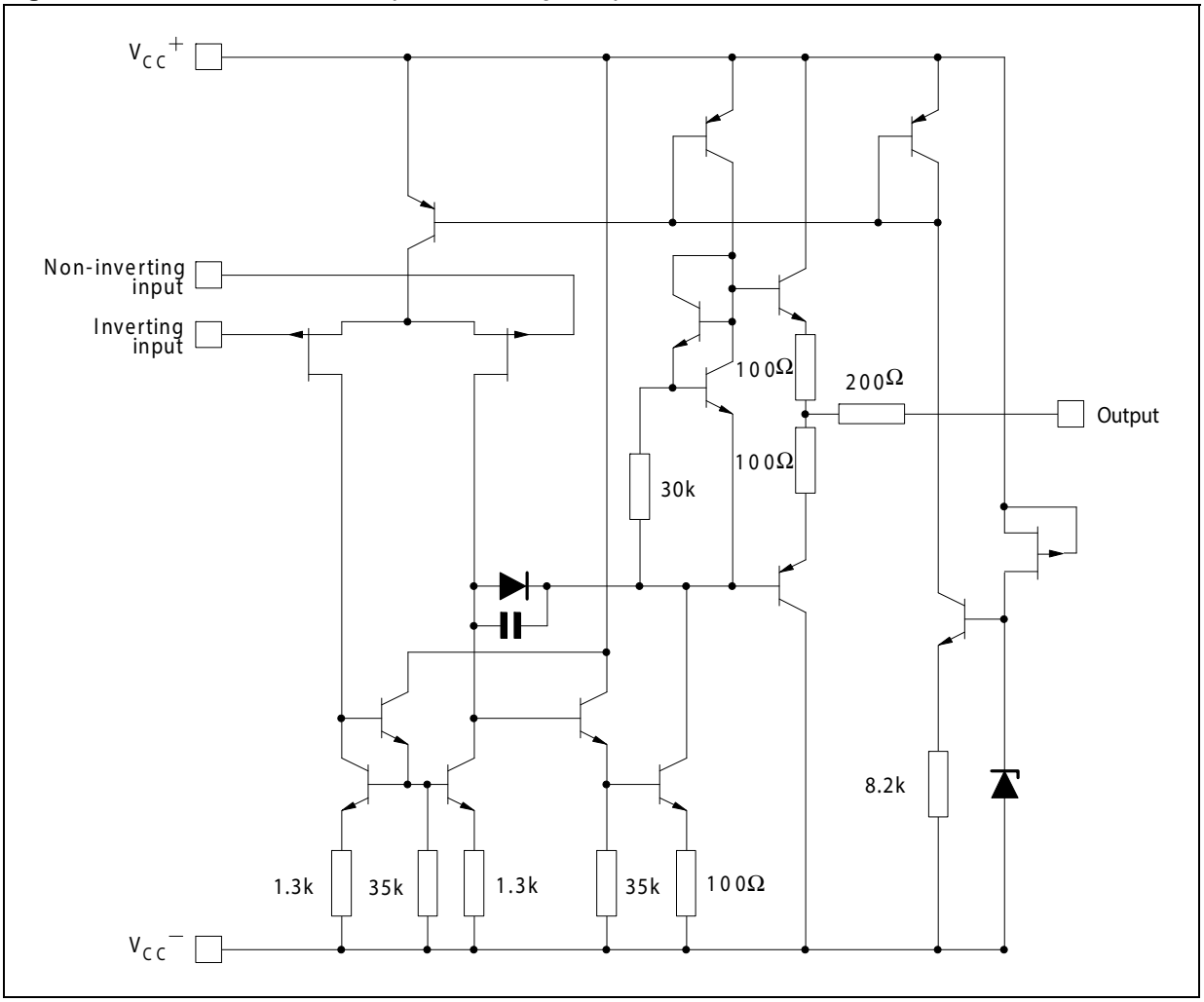
Pin connections
(Top view)



Contents

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
V_{CC}	Supply voltage(1)	±18	V
V_{in}	Input voltage(2)	±15	
V_{id}	Differential input voltage(3)	±30	
R_{thja}	Thermal resistance junction to ambient(4)(5) DIP14 TSSOP14 SO-14	 80 100 105	°C/W
R_{thjc}	Thermal resistance junction to case(4)(5) DIP14 TSSOP14 SO-14	 33 32 31	
P_{tot}	Power dissipation	680	mW
	Output short-circuit duration(6)	Infinite	
T_{oper}	Operating free-air temperature range: for TL084I/TL084AI/TL084BI	-40 to +105	°C
	Operating free-air temperature range: for TL084C/TL084AC/TL084BC	0 to +70	
T_{stg}	Storage temperature range	-65 to +150	
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. 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: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
8. Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), 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	TL084I/AI/BI	TL084C/AC/BC	Unit
V_{CC}	Supply voltage range	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} = ±15 V, T_{amb} = +25 °C (unless otherwise specified)

Symbol	Parameter	TL084I/AI/AC/BI/BC			TL084C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input offset voltage (R_s = 50 Ω) T_{amb} = +25 °C TL084 T_{amb} = +25 °C TL084A T_{amb} = +25 °C TL084B $T_{min} \le T_{amb} \le T_{max}$ TL084 $T_{min} \le T_{amb} \le T_{max}$ TL084A $T_{min} \le T_{amb} \le T_{max}$ TL084B		 3 3 1	 10 6 3 13 7 5		3	 10 13	mV
$\Delta V_{io}/\Delta T$	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 = 2 kΩ, V_o = ±10 V) 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 = 50 Ω) 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 = 50 Ω) 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 R_L = 2 kΩ R_L = 10 kΩ $T_{min} \le T_{amb} \le T_{max}$ R_L = 2 kΩ R_L = 10 kΩ	10 12 10 12	12 13.5		10 12 10 12	12 13.5		V
SR	Slew rate V_{in} = 10 V, R_L = 2 kΩ, C_L = 100 pF, unity gain	8	16		8	16		V/µs

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

Symbol	Parameter	TL084I/AI/AC/BI/BC			TL084C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
t_r	Rise time V_{in} = 20 mV, R_L = 2 kΩ, C_L = 100 pF, unity gain		0.1			0.1		µs
K_{ov}	Overshoot V_{in} = 20 mV, R_L = 2 kΩ, C_L = 100 pF, unity gain		10			10		%
GBP	Gain bandwidth product V_{in} = 10 mV, R_L = 2 kΩ, C_L = 100 pF, F= 100 kHz	2.5	4		2.5	4		MHz
R_i	Input resistance		10^{12}			10^{12}		Ω
THD	Total harmonic distortion F= 1 kHz, R_L = 2 kΩ, C_L = 100 pF, A_v = 20 dB, V_o = 2 V_{pp})		0.01			0.01		%
e_n	Equivalent input noise voltage R_S = 100 Ω, F= 1 kHz		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 vs. frequency (R_L = 2 kΩ)

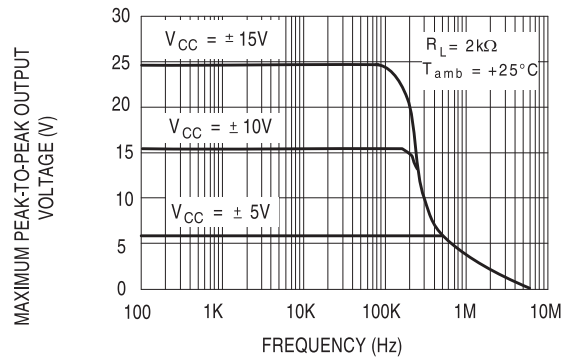


Figure 3. Maximum peak-to-peak output voltage vs. frequency (R_L = 10 kΩ)

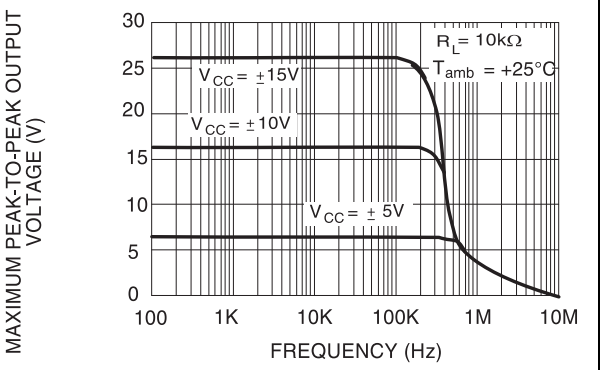


Figure 4. Maximum peak-to-peak output voltage vs. frequency and temp.

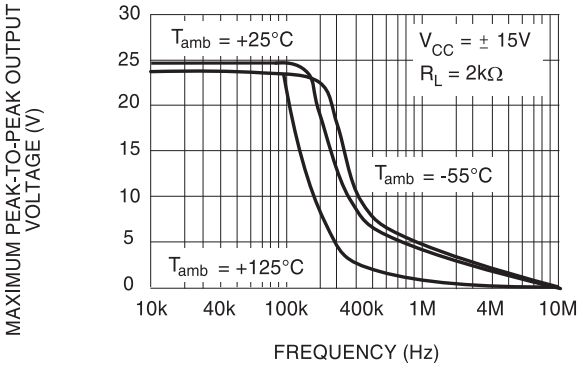


Figure 5. Maximum peak-to-peak output voltage vs. free air temp.

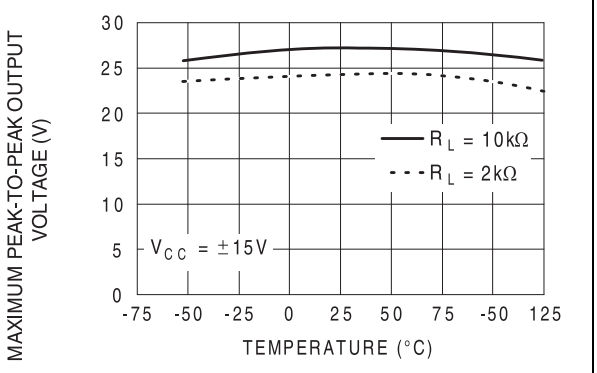


Figure 6. Maximum peak-to-peak output voltage vs. load resistance

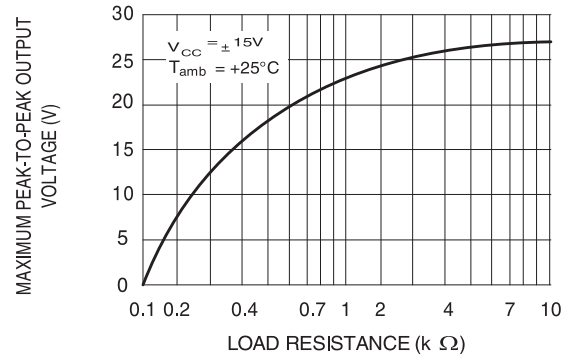


Figure 7. Maximum peak-to-peak output voltage vs. supply voltage

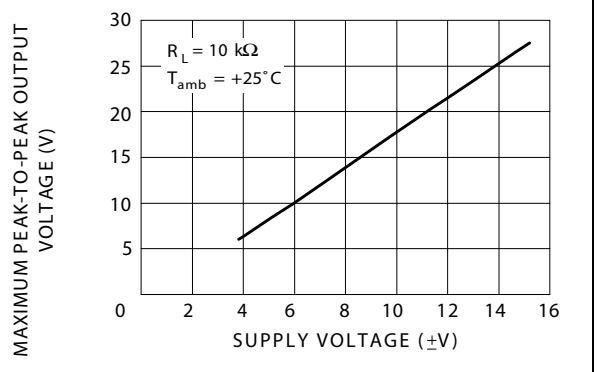


Figure 8. Input bias current vs. free air temp.

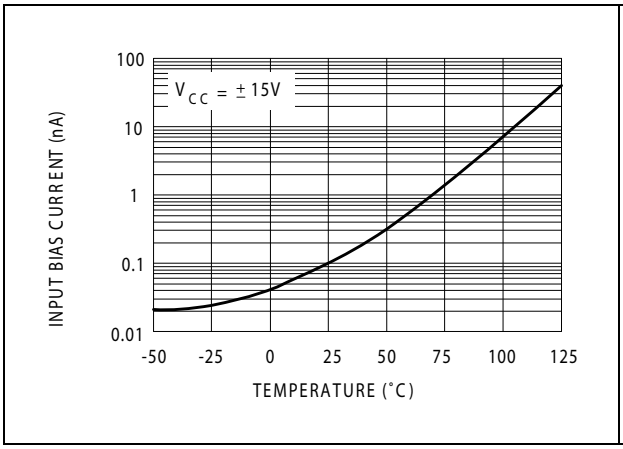


Figure 9. Large signal differential voltage amplification vs. free air temp.

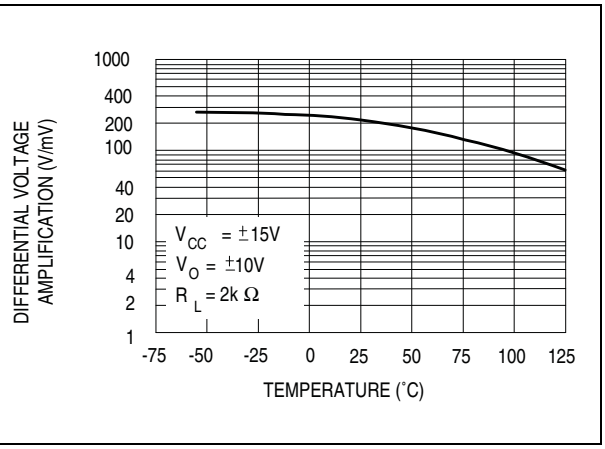


Figure 10. Large signal differential voltage amplification and phase shift vs. frequency

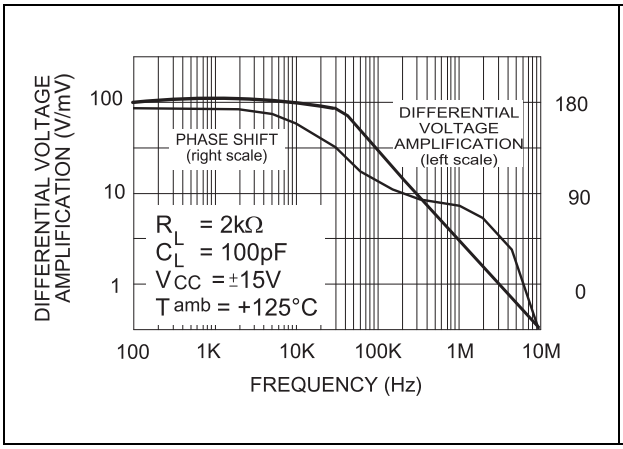


Figure 11. Total power dissipation vs. free air temp.

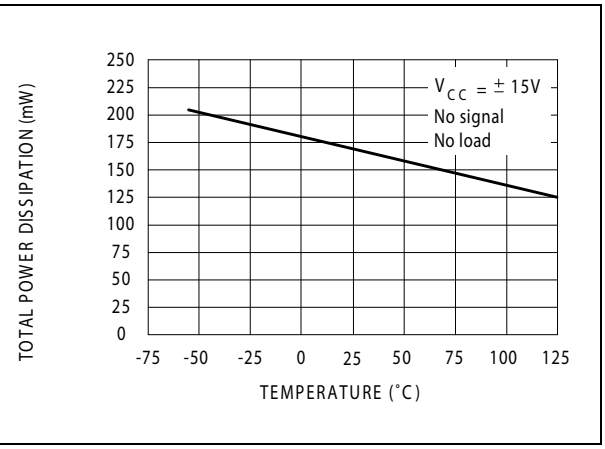


Figure 12. Supply current per amplifier vs. free air temp.

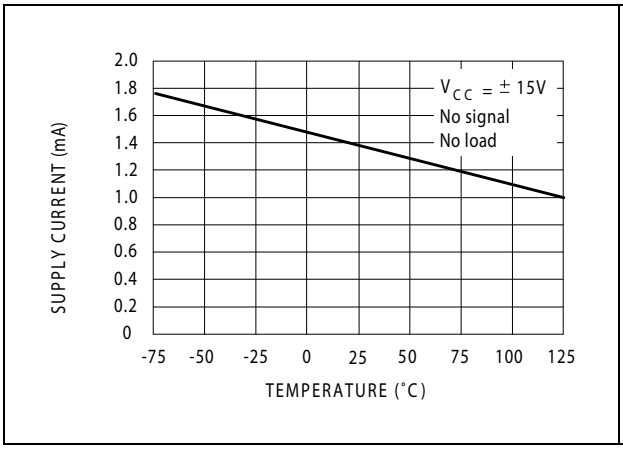


Figure 13. Supply current per amplifier vs. supply voltage

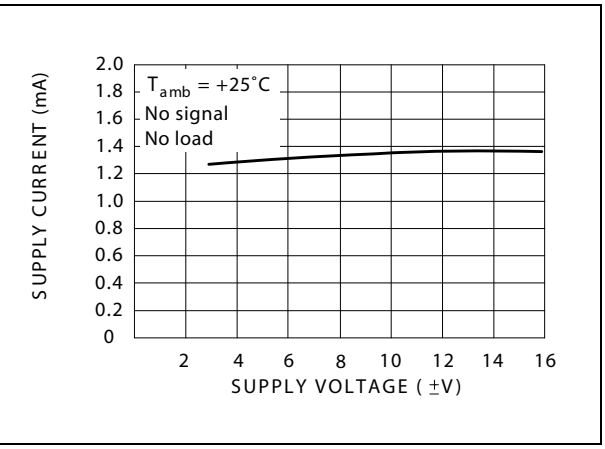


Figure 14. Common mode rejection ratio vs. free air temp.

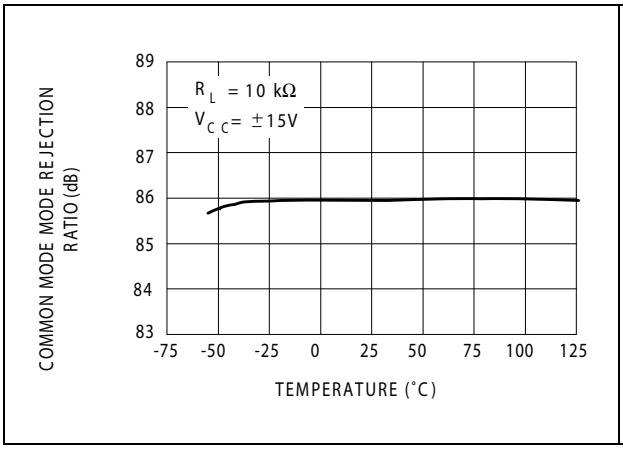


Figure 15. Voltage follower large signal pulse response

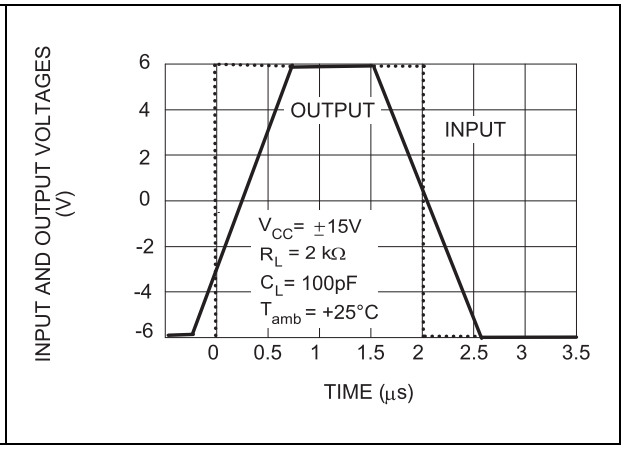


Figure 16. Output voltage vs. elapsed time

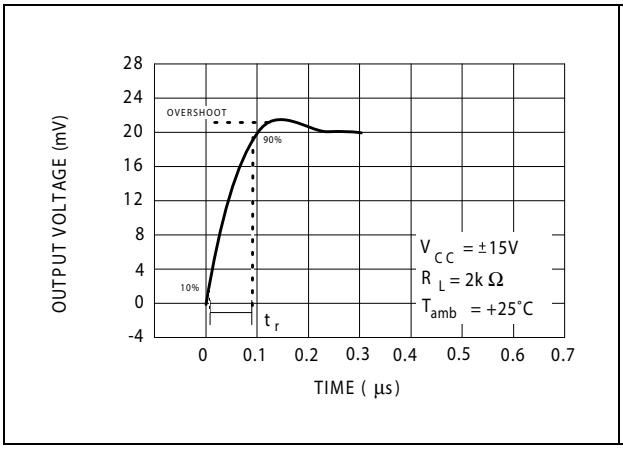


Figure 17. Equivalent input noise voltage vs. frequency

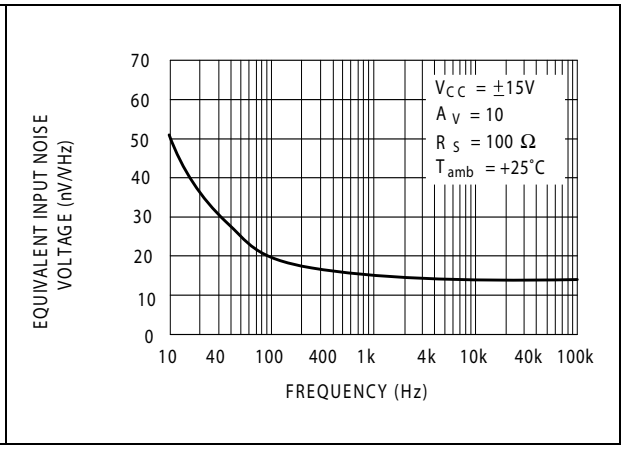
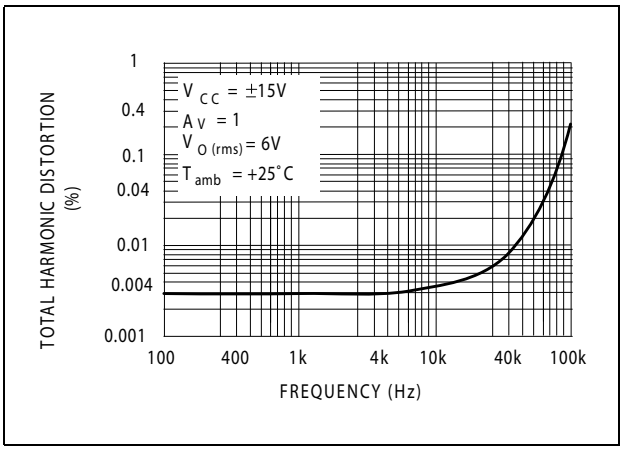


Figure 18. Total harmonic distortion vs. frequency



4 Parameter measurement information

Figure 19. Voltage follower

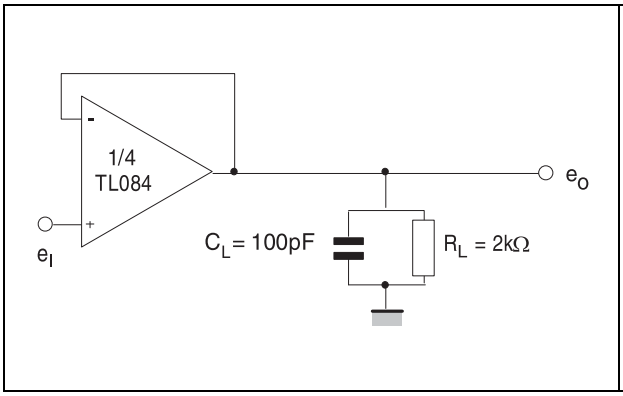
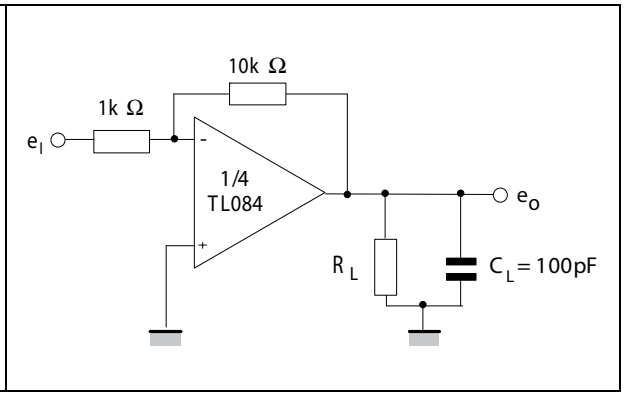


Figure 20. Gain-of-10 inverting amplifier



5 Typical applications

Figure 21. Audio distribution amplifier

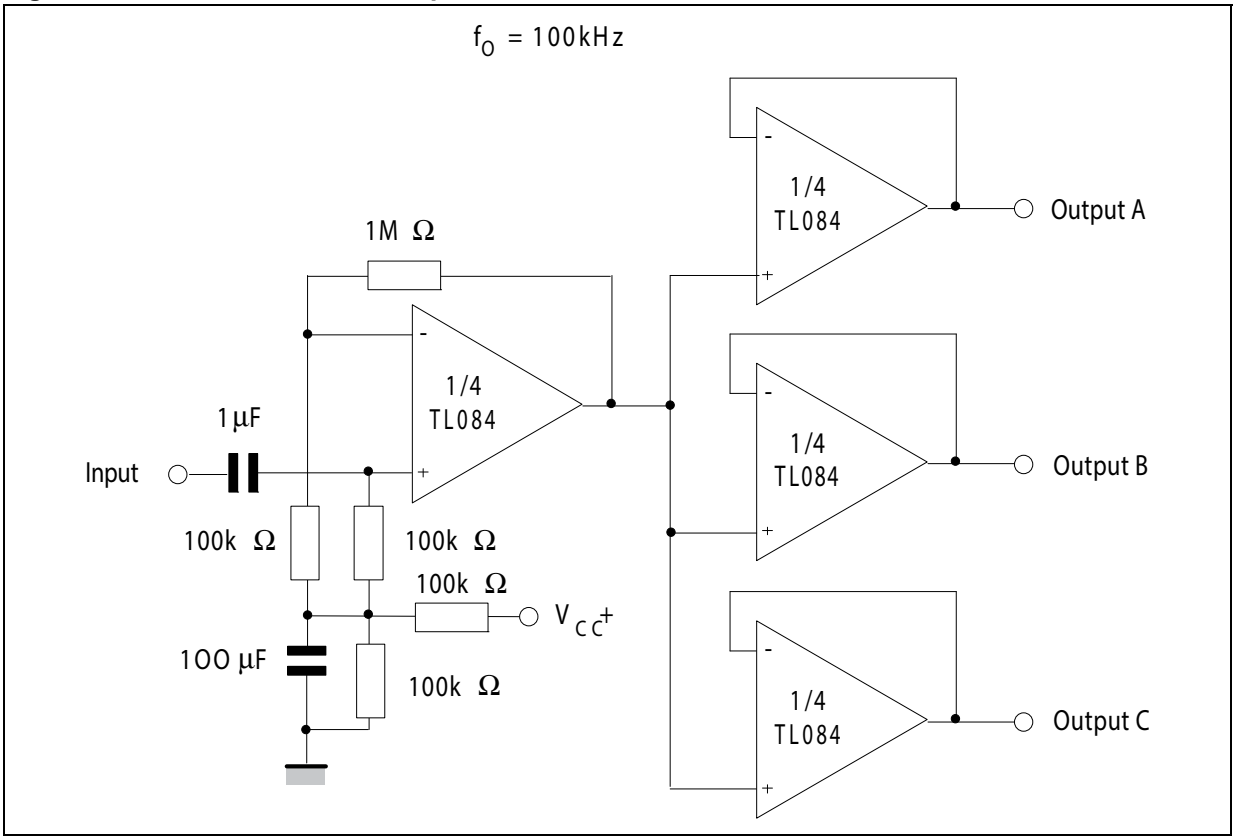


Figure 22. Positive feeback bandpass filter

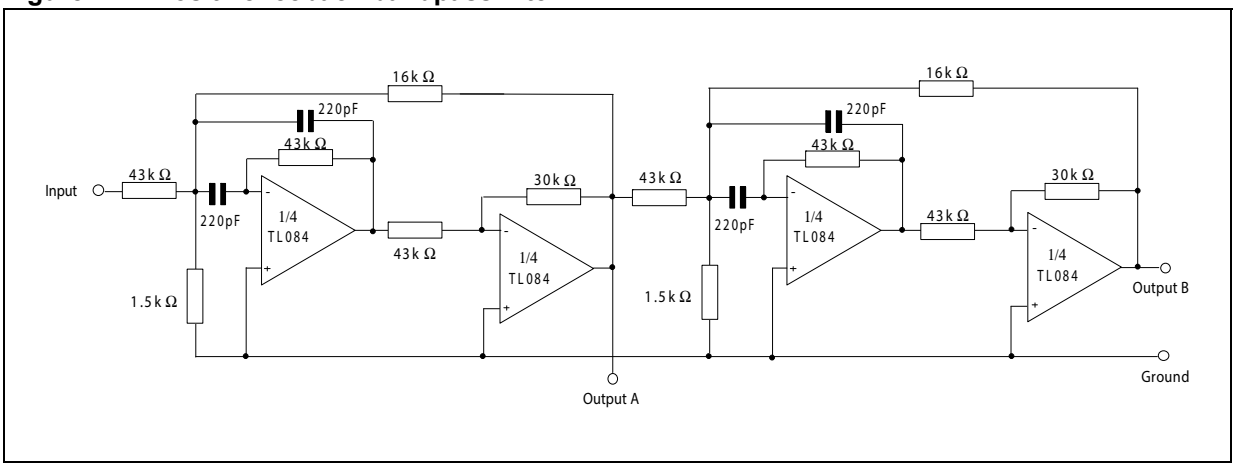
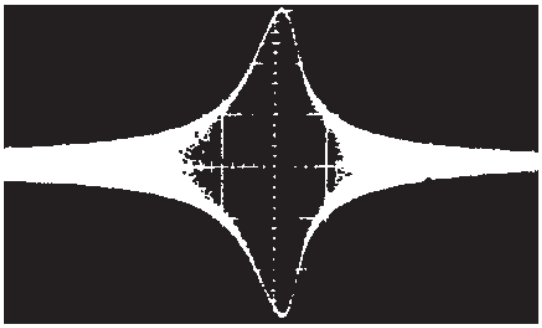
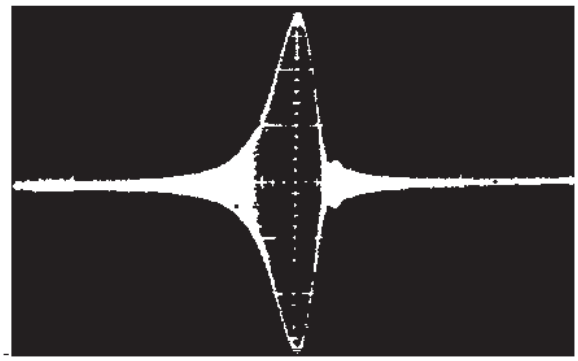


Figure 23. Output A



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

Figure 24. 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 25. DIP14 package mechanical drawing

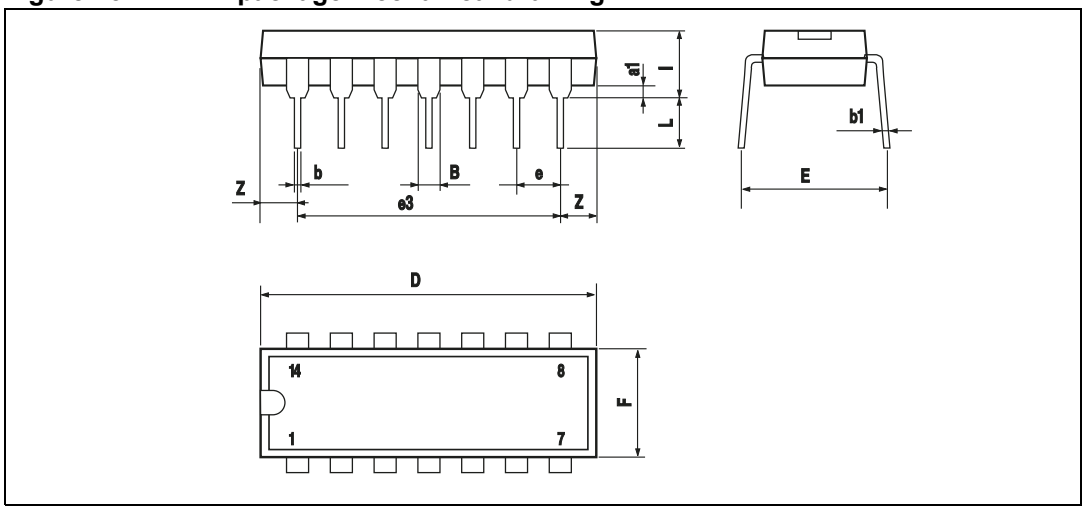


Table 4. DIP14 package mechanical data

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

6.2 TSSOP14 package information

Figure 26. TSSOP14 package mechanical drawing

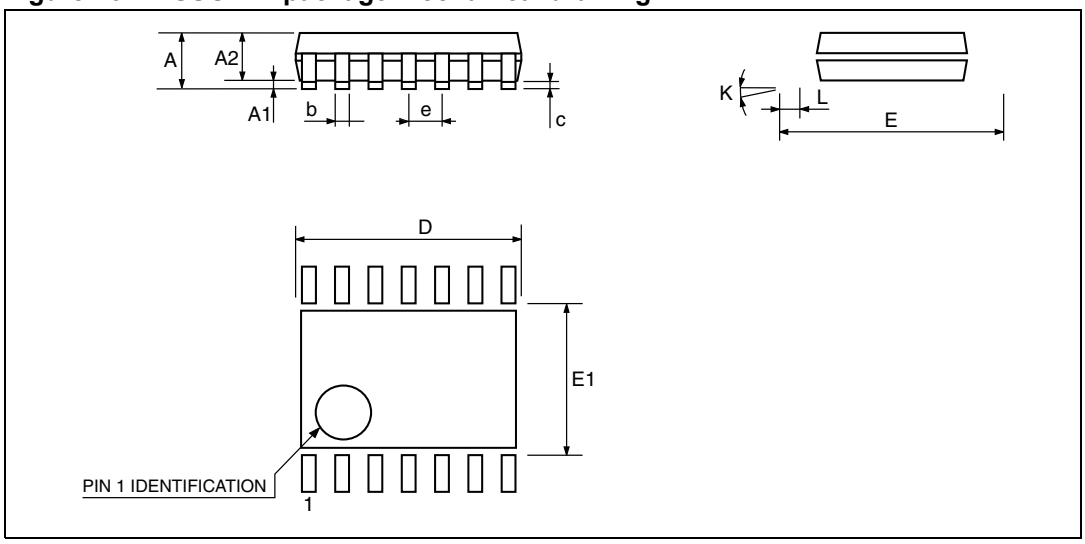


Figure 27. TSSOP14 package mechanical data

Ref.	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°
L1	0.45	0.60	0.75	0.018	0.024	0.030

6.3 SO-14 package information

Figure 28. SO-14 package mechanical drawing

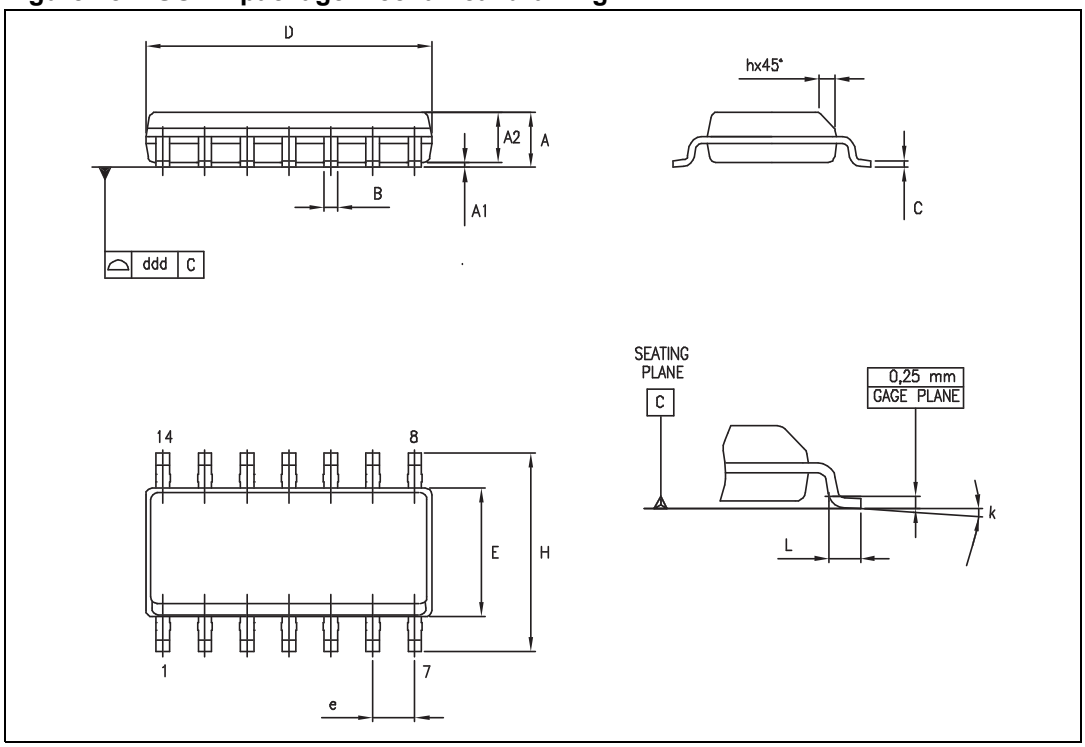


Table 5. SO-14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004

7 Ordering information

Table 6. Order codes

Order code	Temperature range	Package	Packing	Marking
TL084IN TL084AIN TL084BIN	-40°C, +105°C	DIP14	Tube	TL084IN TL084AIN TL084BIN
TL084ID/IDT TL084AID/AIDT TL084BID/BIDT		SO-14	Tube or tape & reel	084I 084AI 084BI
TL084IYDT(1) TL084AIYDT(1) TL084BIYDT(1)		SO-14 (Automotive grade)	Tube or tape & reel	084IY 084AIY 084BIY
TL084IP/IPT TL084AIP/AIPT TL084BIP/BIPT		TSSOP14	Tube or tape & reel	084I 084AI 084BI
TL084CN TL084ACN TL084BCN	0°C, +70°C	DIP14	Tube	TL084CN TL084ACN TL084BCN
TL084CD/CDT TL084ACD/ACDT TL084BCD/BCDT		SO-14	Tube or tape & reel	084C 084AC 084BC
TL084CP/CPT TL084ACP/ACPT TL084BCP/BCPT		TSSOP14	Tube or tape & reel	084C 084AC 084BC

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

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*. Template update.
15-Jul-2008	3	Removed information concerning military temperature ranges (TL084Mx, TL084AMx, TL084BMx). Added automotive grade order codes in *Table 6: Order codes*.
05-Jul-2012	4	Removed commercial types TL084IYD, TL084AIYD and TL084BIYD. Updated *Table 6: Order codes*.
29-Jan-2013	5	Added part numbers TL084A and TL084B. Added SO-14 package silhouette. Updated layout of *Table 1: Absolute maximum ratings*. Updated of *Table 3: V_{CC} = ±15 V, T_{amb} = +25 °C (unless otherwise specified)*. Replaced SO-14 package mechanical drawing (*Figure 28: SO-14 package mechanical drawing*). Replaced SO-14 package mechanical data (*Table 5: SO-14 package mechanical data*).