TL062

Low power JFET dual operational amplifiers

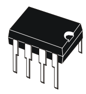
Features

- Very low power consumption : 200µA
- Wide common-mode (up to V_{CC}^+) and differential voltage ranges
- Low input bias and offset currents
- Output short-circuit protection
- High input impedance JFET input stage
- Internal frequency compensation
- Latch up free operation
- High slew rate : 3.5V/µs

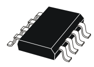
Description

The TL062, TL062A and TL062B 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.

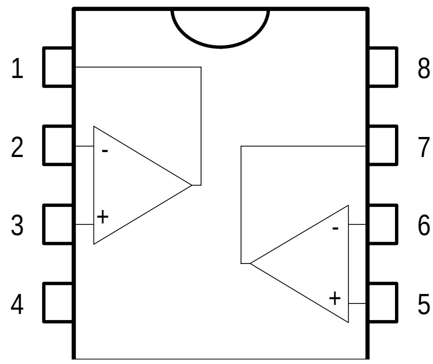


N
DIP8
(Plastic package)



D
SO-8
(Plastic micropackage)

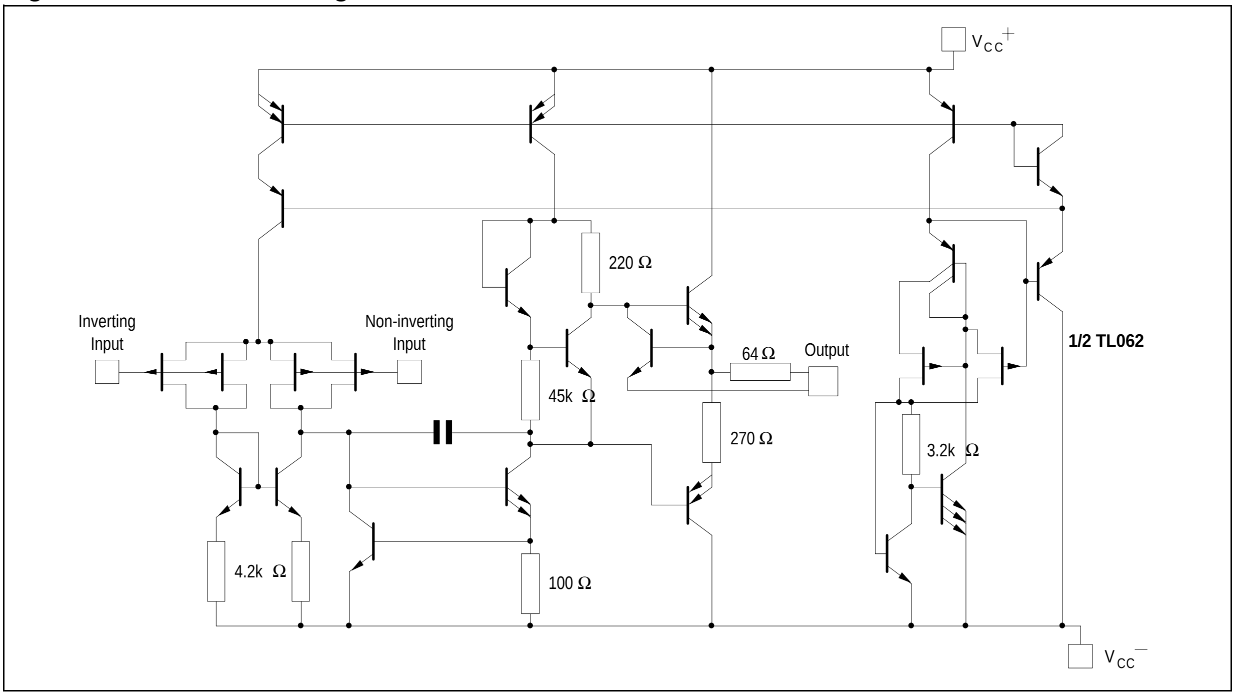
Pin connections
(top view)



1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - V_{CC}^-
5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - V_{CC}^+

1 Schematic diagram

Figure 1. Schematic diagram



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TL062M, AM, BM	TL062I, AI, BI	TL062C, 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
	Output short-circuit duration (4)	Infinite			
T_{stg}	Storage temperature range	-65 to +150	-65 to +150	-65 to +150	°C
R_{thja}	Thermal resistance junction to ambient(5) (6) SO-8 DIP8	 125 85			°C/W
R_{thjc}	Thermal resistance junction to case(5) (6) SO-8 DIP8	 40 41			°C/W
ESD	HBM: human body model(7)	900			V
	MM: machine model(8)	150			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. 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.
5. Short-circuits can cause excessive heating and destructive dissipation.
6. Rth are typical values.
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	TL062M, AM, BM	TL062I, AI, BI	TL062C, 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	TL062M			TL062I			TL062C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{io}	Input offset voltage (R_S = 50Ω) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		3	6 15		3	6 9		3	15 20	mV
DV_{io}	Temperature coefficient of input offset voltage (R_S = 50Ω)		10			10			10		µV/°C
I_{io}	Input offset current (1) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		5	100 20		5	100 10		5	200 5	pA nA
I_{ib}	Input bias current (1) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		30	200 50		30	200 20		30	400 10	pA nA
V_{icm}	Input common mode voltage range	±11.5	+15 -12		±11.5	+15 -12		±11	+15 -12		V
V_{opp}	Output voltage swing (R_L = 10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	20 20	27		20 20	27		20 20	27		V
A_{vd}	Large signal voltage gain R_L = 10kΩ, V_o = ±10V, T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	4 4	6		4 4	6		3 3	6		V/mV
GBP	Gain bandwidth product T_{amb} = +25°C, R_L =10kΩ, C_L = 100pF		1			1			1		MHz
R_i	Input resistance		10^{12}			10^{12}			10^{12}		Ω
CMR	Common mode rejection ratio R_S = 50Ω	80	86		80	86		70	76		dB
SVR	Supply voltage rejection ratio R_S = 50Ω	80	95		80	95		70	95		dB
I_{CC}	Supply current, no load T_{amb} = +25°C, no load, no signal		200	250		200	250		200	250	µA
V_{o1}/V_{o2}	Channel separation A_v = 100, T_{amb} = 25°C		120			120			120		dB
P_D	Total power consumption T_{amb} = +25°C, no load, no signal		6	7.5		6	7.5		6	7.5	mW
SR	Slew rate V_i=10V, R_L = 10kΩ, C_L= 100pF, A_v=1	1.5	3.5		1.5	3.5		1.5	3.5		V/µs

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

Symbol	Parameter	TL062M			TL062I			TL062C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
t_r	Rise time V_i = 20mV, R_L = 10kΩ, C_L = 100pF, A_V = 1		0.2			0.2			0.2		µs
K_{ov}	Overshoot factor (see *Figure 15*) V_i = 20mV, R_L = 10kΩ, C_L = 100pF, A_V = 1		10			10			10		%
e_n	Equivalent input noise voltage R_S = 100Ω, f = 1kHz		42			42			42		$\frac{nV}{\sqrt{Hz}}$

1. The input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive.Pulse techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.

Table 4. V_{CC} = ±15V, T_{amb} = +25°C (unless otherwise specified)

Symbol	Parameter	TL062AC, AI, AM			TL062BC, BI, BM			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input offset voltage (R_S = 50Ω) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		3	6 7.5		2	3 5	mV
DV_{io}	Temperature coefficient of input offset voltage (R_S = 50Ω)		10			10		µV/°C
I_{io}	Input offset current (1) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		5	100 3		5	100 3	pA nA
I_{ib}	Input bias current (1) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		30	200 7		30	200 7	nA
V_{icm}	Input common mode voltage range	±11.5	+15 -12		±11.5	+15 -12		
V_{opp}	Output voltage swing (R_L = 10kΩ) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	20 20	27		20 20	27		V
A_{vd}	Large signal voltage gain R_L = 10kΩ, V_o = ±10V, T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	4 4	6		4 4	6		V/mV
GBP	Gain bandwidth product T_{amb} = +25°C, R_L =10kΩ, C_L = 100pF		1			1		MHz
R_i	Input resistance		10^{12}			10^{12}		Ω
CMR	Common mode rejection ratio R_S = 50Ω	80	86		80	86		dB

Table 4. V_{CC} = ±15V, T_{amb} = +25°C (unless otherwise specified) (continued)

Symbol	Parameter	TL062AC, AI, AM			TL062BC, BI, BM			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
SVR	Supply voltage rejection ratio R_S = 50Ω	80	95		80	95		dB
I_{CC}	Supply current, no load T_{amb} = +25°C, no load, no signal		200	250		200	250	µA
V_{o1}/V_{o2}	Channel separation A_v = 100, T_{amb} = +25°C		120			120		
P_D	Total power consumption T_{amb} = +25°C, no load, no signal		6	7.5		6	7.5	mW
SR	Slew rate V_i = 10V, R_L = 10kΩ, C_L = 100pF, A_v = 1	1.5	3.5		1.5	3.5		V/µs
t_r	Rise time V_i = 20mV, R_L = 10kΩ, C_L = 100pF, A_v = 1		0.2			0.2		µs
K_{ov}	Overshoot factor (see *Figure 15*) V_i = 20mV, R_L = 10kΩ, C_L = 100pF, A_v = 1		10			10		%
e_n	Equivalent input noise voltage R_S = 100Ω, f = 1kHz		42			42		$\frac{nV}{\sqrt{Hz}}$

1. The input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive.Pulse techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.

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

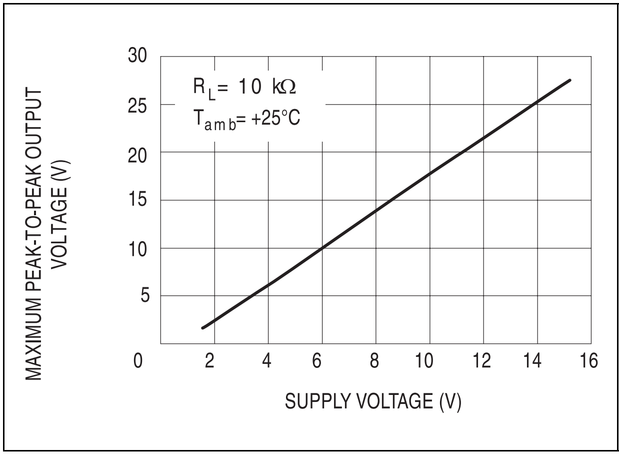


Figure 3. Maximum peak-to-peak output voltage versus free air temp

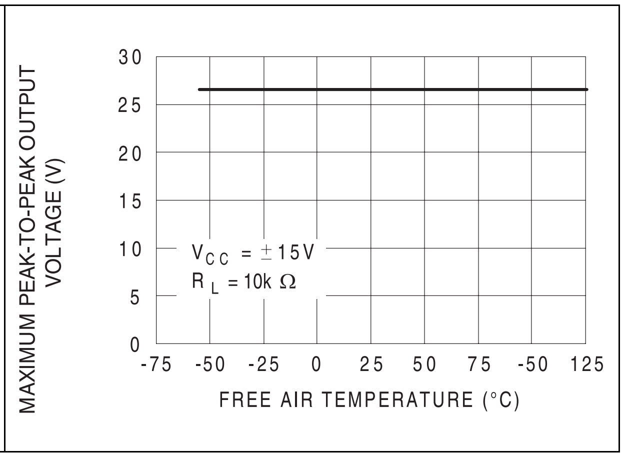


Figure 4. Maximum peak-to-peak output voltage versus load resistance

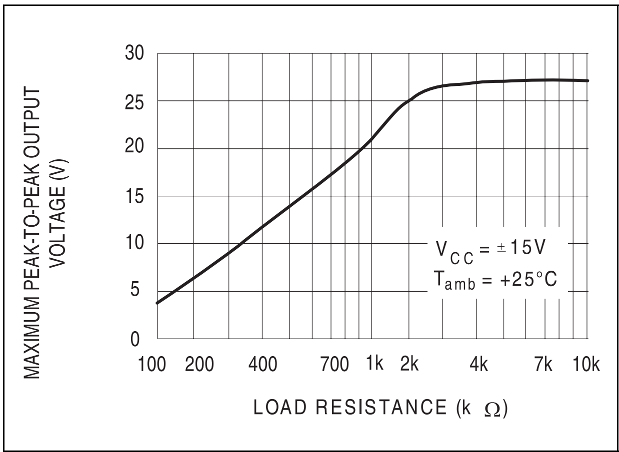


Figure 5. Maximum peak-to-peak output voltage versus frequency

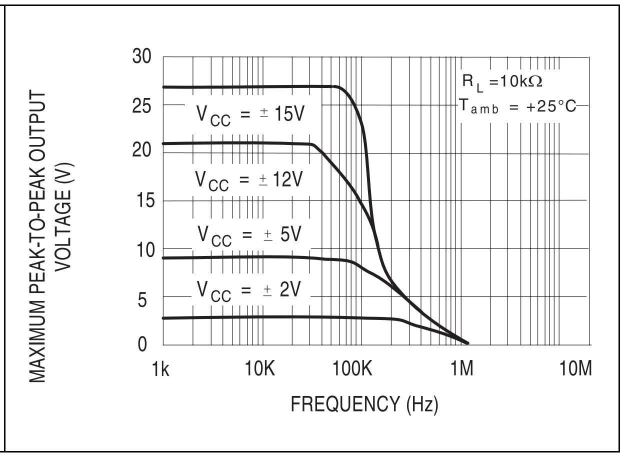


Figure 6. Differential voltage amplification versus free air temperature

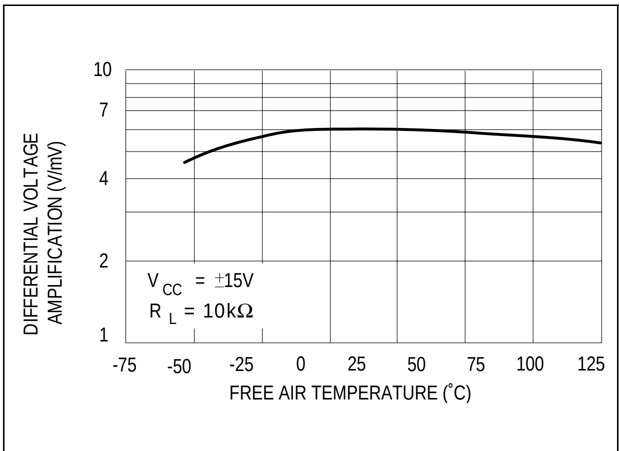


Figure 7. Large signal differential voltage amplification and phase shift versus frequency

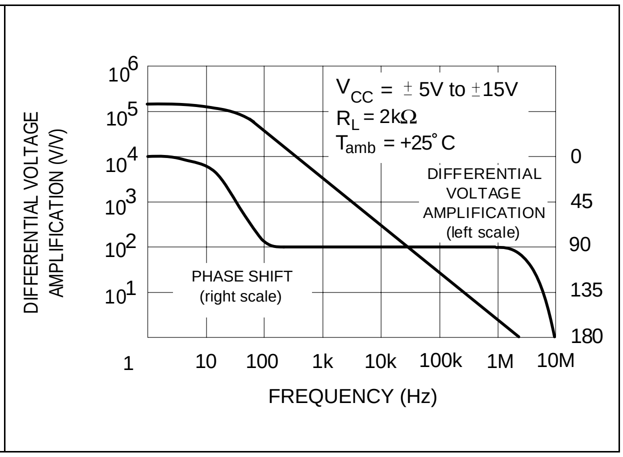


Figure 8. Supply current per amplifier versus supply voltag

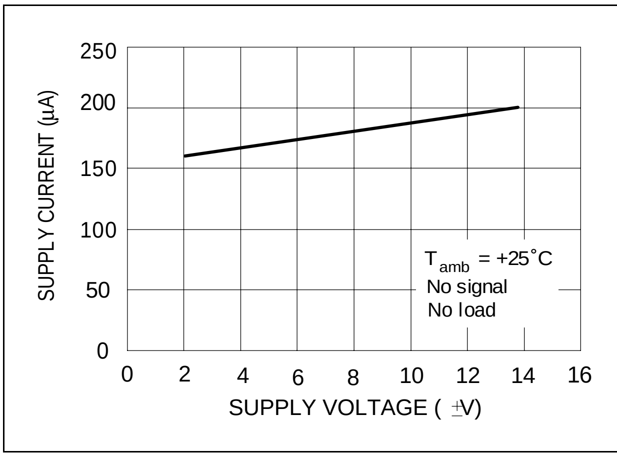


Figure 9. Supply current per amplifier versus free air temperature

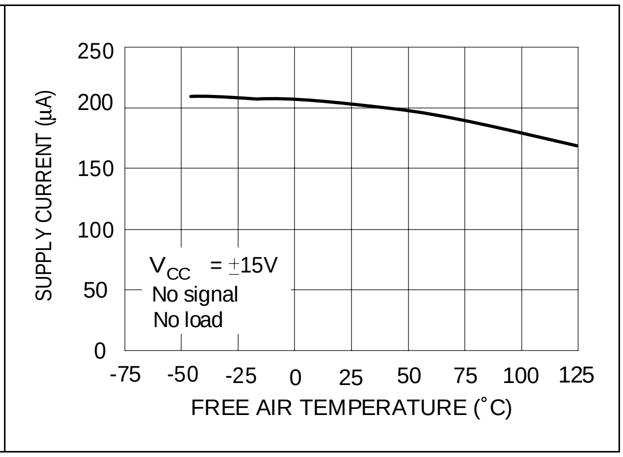


Figure 10. Total power dissipated versus free air temperature

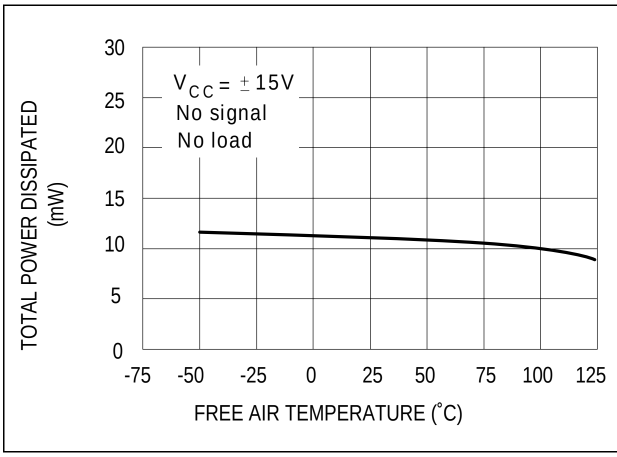


Figure 11. Common mode rejection ratio versus free air temperature

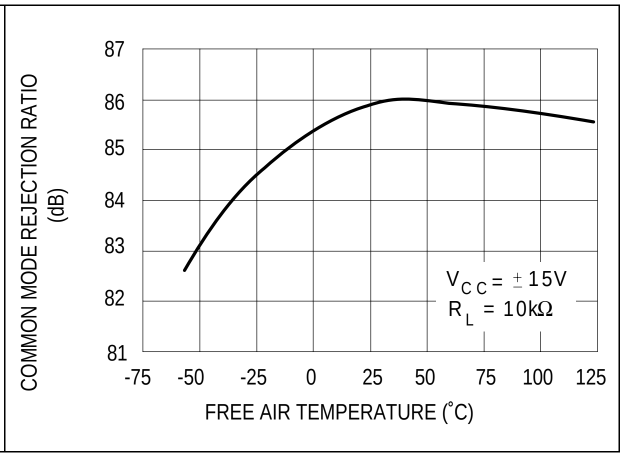


Figure 12. Normalized unity gain bandwidth slew rate, and phase shift versus temperature

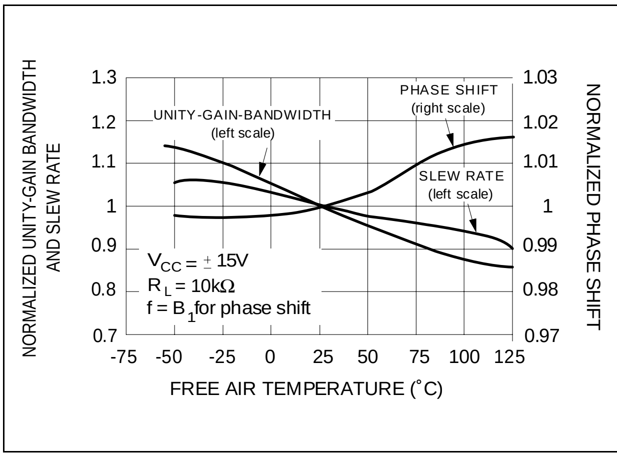


Figure 13. Input bias current versus free air temperature

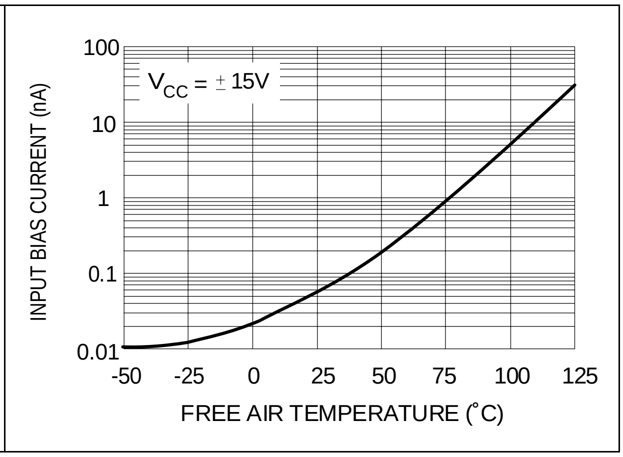


Figure 14. Voltage follower large signal pulse response

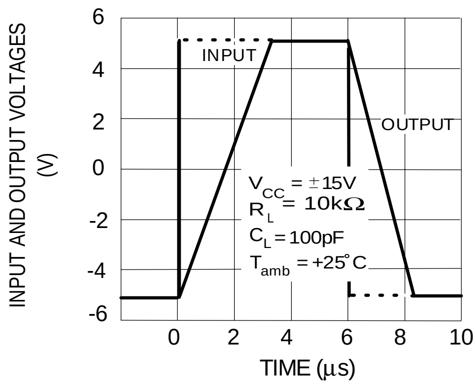


Figure 15. Output voltage versus elapsed time

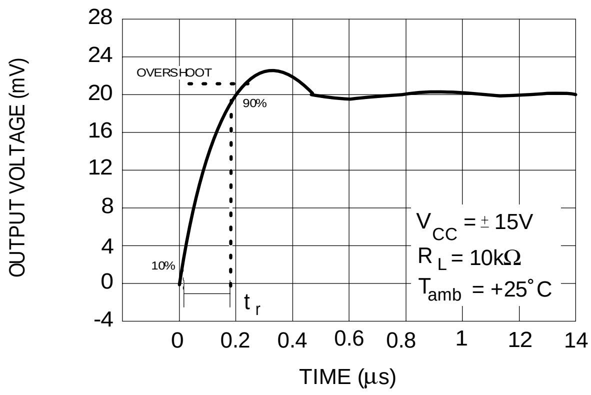
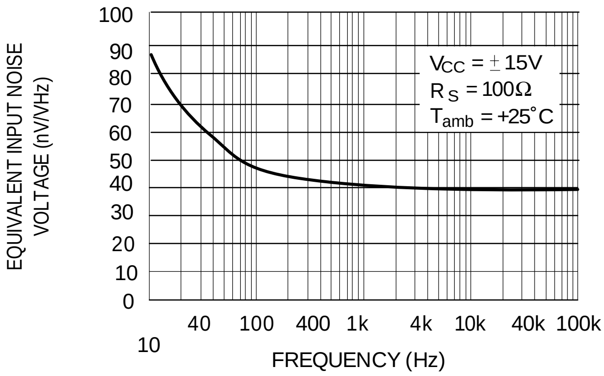


Figure 16. Equivalent input noise voltage versus frequency



Parameter measurement information

Figure 17. Voltage follower

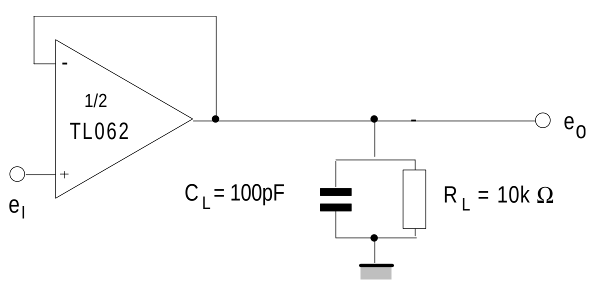
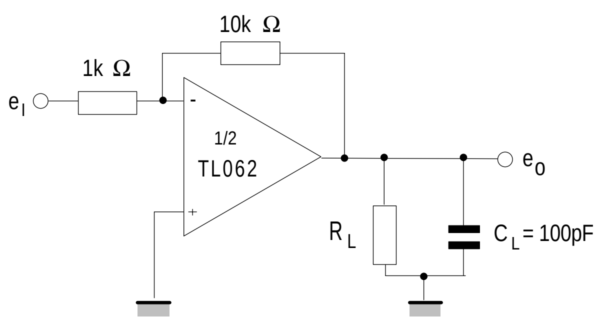
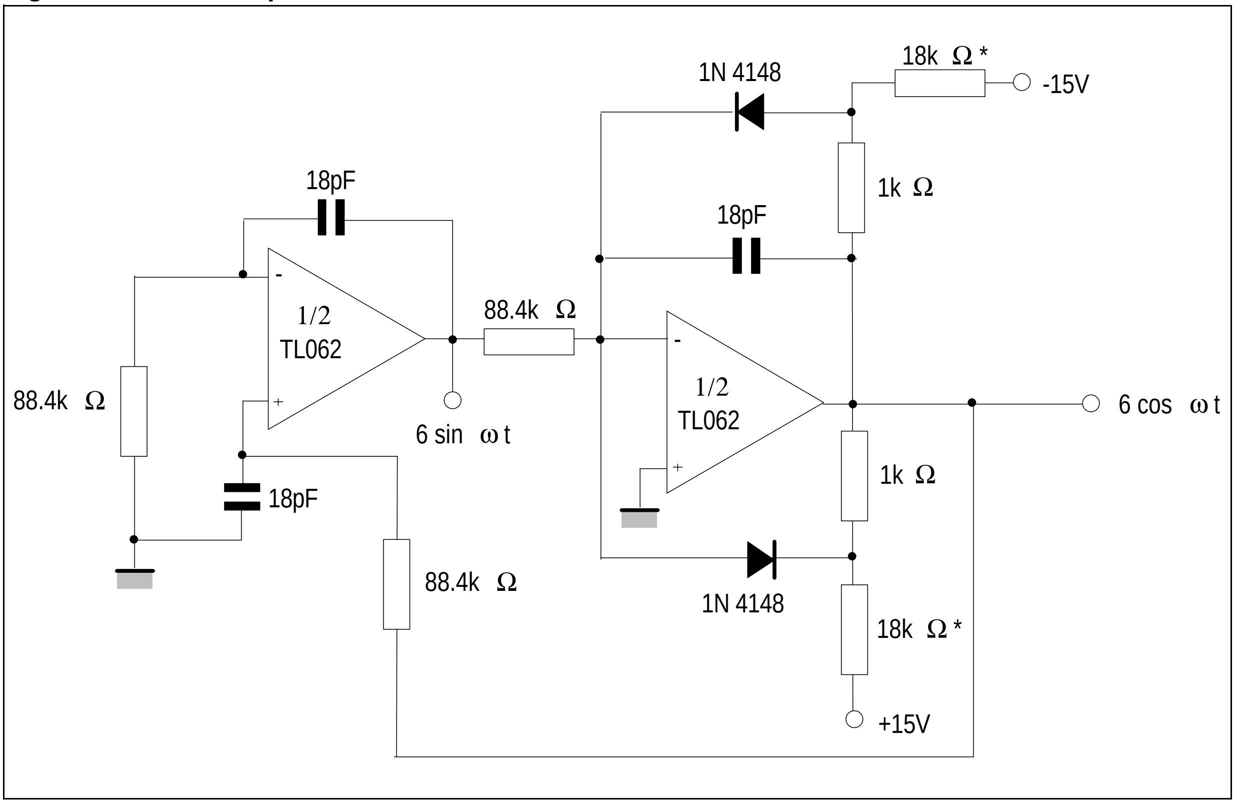


Figure 18. Gain-of-10 inverting amplifier



4 Typical applications

Figure 19. 100KHz quadrature oscillator



1. These resistor values may be adjusted for a symmetrical output.

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 20. DIP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.210
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.115	0.130	0.195
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.045	0.060	0.070
c	0.20	0.25	0.36	0.008	0.010	0.014
D	9.02	9.27	10.16	0.355	0.365	0.400
E	7.62	7.87	8.26	0.300	0.310	0.325
E1	6.10	6.35	7.11	0.240	0.250	0.280
e		2.54			0.100	
eA		7.62			0.300	
eB			10.92			0.430
L	2.92	3.30	3.81	0.115	0.130	0.150

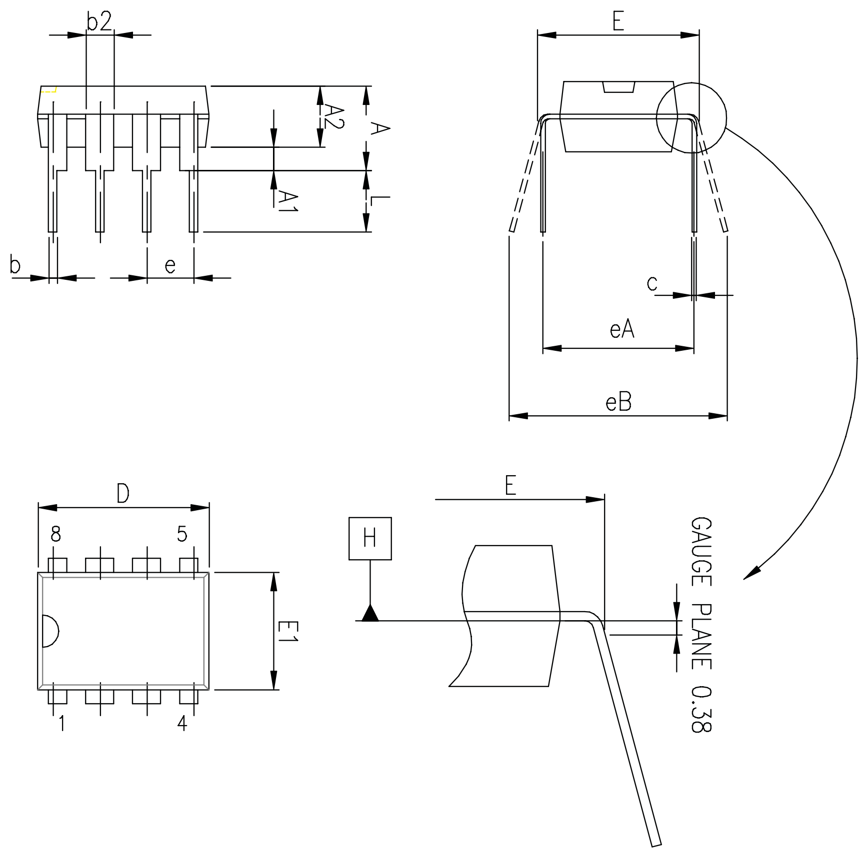
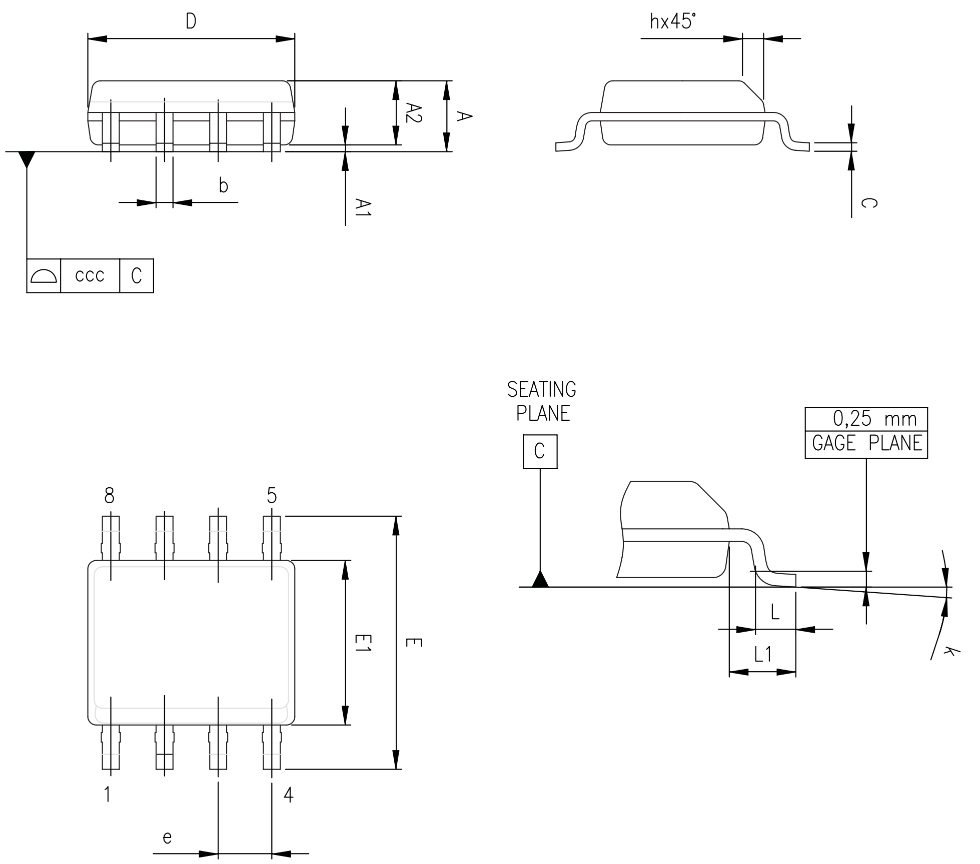


Figure 21. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
H	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	1°		8°	1°		8°
ccc			0.10			0.004



6 Ordering information

Table 5. Order codes

Part number	Temperature range	Package	Packing	Marking
TL062MN TL062AMN TL062BMN	-55°C, +125°C	DIP8	Tube	TL062MN TL062AMN TL062BMN
TL062MD/MDT TL062AMD/AMDT TL062BMD/BMDT		SO-8	Tube or tape & reel	062M 062AM 062BM
TL062IN TL062AIN TL062BIN	-40°C, +105°C	DIP8	Tube	TL062IN TL062AIN TL062BIN
TL062ID/IDT TL062AID/AIDT TL062BID/BIDT		SO-8	Tube or tape & reel	062I 062AI 062BI
TL062CN TL062ACN TL062BCN	0°C, +70°C	DIP8	Tube	TL062CN TL062ACN TL062BCN
TL062CD/CDT TL062ACD/ACDT TL062BCD/BCDT		SO-8	Tube or tape & reel	062C 062AC 062BC

7 Revision history

Table 6. Document revision history

Date	Revision	Changes
28-Mar-2001	1	Initial release.
27-Jul-2007	2	Added values for R_{thja} and R_{thjc} in *Table 1: Absolute maximum ratings*. Added *Table 2: Operating conditions*. Updated format.

Please Read Carefully: