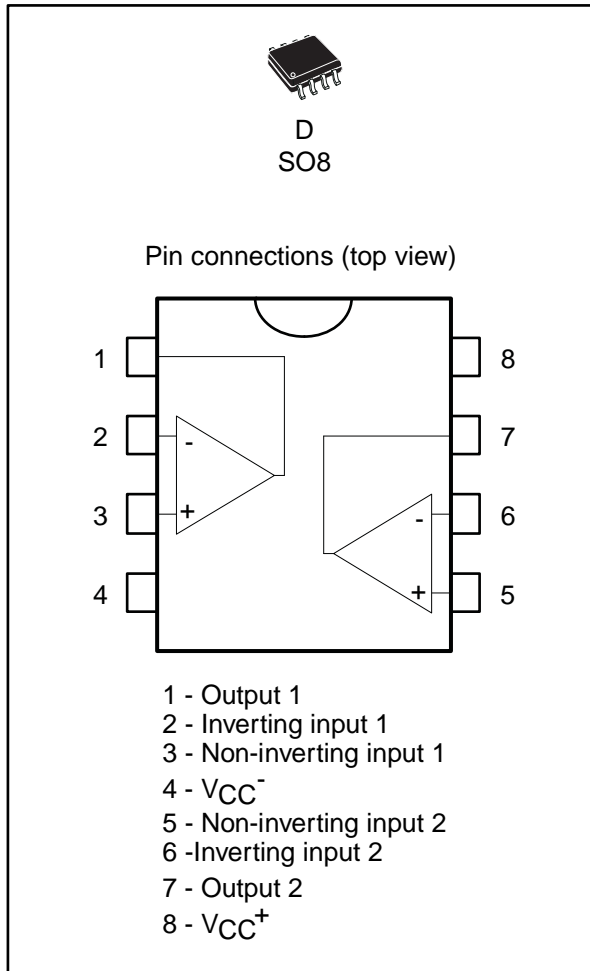


## Low noise JFET dual operational amplifiers

Datasheet - production data



### Features

- Wide common-mode (up to  $V_{CC}^+$ ) and differential voltage range
- Low input bias and offset current
- Low noise  $e_n = 15 \text{ nV}/\sqrt{\text{Hz}}$  (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:  $16 \text{ V}/\mu\text{s}$  (typ)

### Related products

- See TL071 for single op amp version
- See TL074 for quad op amp version

### Description

The TL072, TL072A, and TL072B are high speed JFET input dual operational amplifiers incorporating well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit.

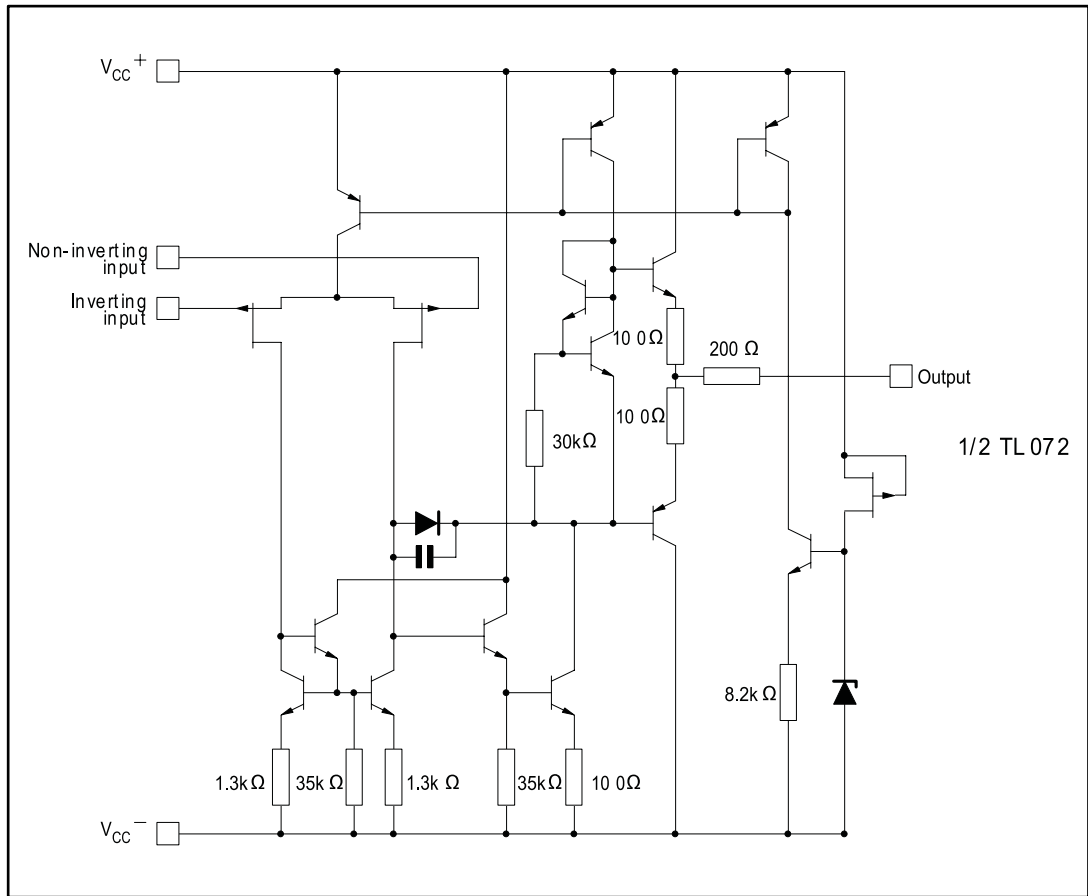
The devices feature high slew rates, low input bias and offset current, and low offset voltage temperature coefficients.

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# 1 Schematic diagram

Figure 1: Schematic diagram



## 2 Absolute maximum ratings and operating conditions

Table 1: Absolute maximum ratings

Symbol	Parameter	TL072I, AI, BI	TL072C, AC, BC	Unit
$V_{CC}$	Supply voltage <sup>(1)</sup>	±18		V
$V_{in}$	Input voltage <sup>(2)</sup>	±15		
$V_{id}$	Differential input voltage <sup>(3)</sup>	±30		
$R_{thja}$	Thermal resistance junction to ambient, SO8 <sup>(4)</sup>	125		°C/W
$R_{thjc}$	Thermal resistance junction to case, SO8 <sup>(4)</sup>	40		
	Output short-circuit duration <sup>(5)</sup>	Infinite		
$T_{stg}$	Storage temperature range	-65 to +150		°C
ESD	HBM: human body model <sup>(6)</sup>	1		kV
	MM: machine model <sup>(7)</sup>	200		V
	CDM: charged device model <sup>(8)</sup>	1.5		kV

**Notes:**

<sup>(1)</sup>All voltage values, except the 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  $V_{CC}^-$ .

<sup>(2)</sup>The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.

<sup>(3)</sup>Differential voltages are the non-inverting input terminal voltages with respect to the inverting input terminal.

<sup>(4)</sup>Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

<sup>(5)</sup>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.

<sup>(6)</sup>Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of pin combinations with other pins floating.

<sup>(7)</sup>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 W). This is done for all couples of pin combinations with other pins floating.

<sup>(8)</sup>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	TL072I, AI, BI	TL072C, AC, BC	Unit
$V_{CC}$	Supply voltage	6 to 36		V
$T_{oper}$	Operating free-air temperature range	-40 to +125	0 to +70	°C

### 3 Electrical characteristics

Table 3: Electrical characteristics at VCC = ±15 V, Tamb = +25 °C (unless otherwise specified).

Symbol	Parameter	TL072I, AC, AI, BC, BI			TL072C			Unit	
		Min.	Typ.	Max.	Min.	Typ.	Max.		
V <sub>io</sub>	Input offset voltage (R <sub>s</sub> = 50 Ω) T <sub>amb</sub> = +25 °C	TL072		3	10		3	10	mV
		TL072A		3	6				
		TL072B		1	3				
	Input offset voltage (R <sub>s</sub> = 50 Ω) T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	TL072			13			13	
		TL072A			7				
		TL072B			5				
ΔV <sub>io</sub> /ΔT	Input offset voltage drift		10			10		μV/°C	
I <sub>io</sub>	Input offset current, T <sub>amb</sub> = +25 °C <sup>(1)</sup>		5	100		5	100	pA	
	Input offset current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>			4			10	nA	
I <sub>ib</sub>	Input bias current, T <sub>amb</sub> = +25 °C <sup>(1)</sup>		20	200		20	200	pA	
	Input bias current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> <sup>(1)</sup>			20			20	nA	
A <sub>vd</sub>	Large signal voltage gain (R <sub>L</sub> = 2 kΩ, V <sub>o</sub> = ±10 V), T <sub>amb</sub> = +25 °C	50	200		25	200		V/mV	
	Large signal voltage gain (R <sub>L</sub> = 2 kΩ, V <sub>o</sub> = ±10 V), T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	25			15				
SVR	Supply voltage rejection ratio (R <sub>S</sub> = 50 Ω), T <sub>amb</sub> = +25 °C	80	86		70	86		dB	
	Supply voltage rejection ratio (R <sub>S</sub> = 50 Ω), T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	80			70				
I <sub>CC</sub>	Supply current, no load, T <sub>amb</sub> = +25 °C		1.4	2.5		1.4	2.5	mA	
	Supply current, no load, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>			2.5			2.5		
V <sub>icm</sub>	Input common mode voltage range	±11	-12 to +15		±11	-12 to +15		V	
CMR	Common mode rejection ratio (R <sub>S</sub> = 50 Ω), T <sub>amb</sub> = +25 °C	80	86		70	86		dB	
	Common mode rejection ratio (R <sub>S</sub> = 50 Ω), T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	80			70				
I <sub>os</sub>	Output short-circuit current, T <sub>amb</sub> = +25 °C	10	40	60	10	40	60	mA	
	Output short-circuit current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	10		60	10		60		
±V <sub>opp</sub>	Output voltage swing, T <sub>amb</sub> = +25 °C	R <sub>L</sub> = 2 kΩ	10	12		10	12	V	
		R <sub>L</sub> = 10 kΩ	12	13.5		12	13.5		
	Output voltage swing, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>	R <sub>L</sub> = 2 kΩ	10			10			
		R <sub>L</sub> = 10 kΩ	12			12			

Electrical characteristics

TL072, TL072A, TL072B

Symbol	Parameter	TL072I, AC, AI, BC, BI			TL072C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
SR	Slew rate, $V_{in} = 10\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain	8	16		8	16		V/ $\mu\text{s}$
$t_r$	Rise time, $V_{in} = 20\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain		0.1			0.1		$\mu\text{s}$
$K_{ov}$	Overshoot, $V_{in} = 20\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain		10			10		%
GBP	Gain bandwidth product, $V_{in} = 10\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $F = 100\text{ kHz}$	2.5	4		2.5	4		MHz
$R_i$	Input resistance		$10^{12}$			$10^{12}$		$\Omega$
THD	Total harmonic distortion, $F = 1\text{ kHz}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $A_v = 20\text{ dB}$ , $V_o = 2\text{ V}_{pp}$		0.01			0.01		%
$e_n$	Equivalent input noise voltage, $R_S = 100\ \Omega$ , $F = 1\text{ kHz}$		15			15		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
$\phi_m$	Phase margin		45			45		degrees
$V_{o1}/V_{o2}$	Channel separation, $A_v = 100$		120			120		dB

Notes:

(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 ( $R_L = 2\text{ k}\Omega$ )

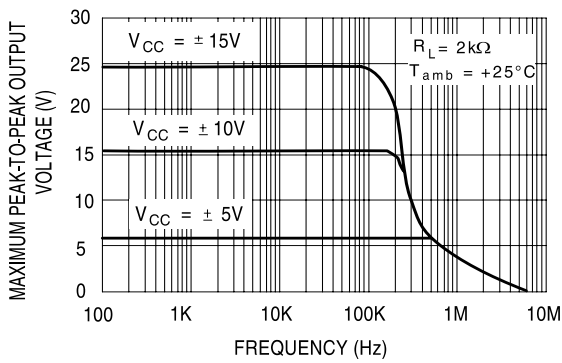


Figure 3: Maximum peak-to-peak output voltage versus frequency ( $R_L = 10\text{ k}\Omega$ )

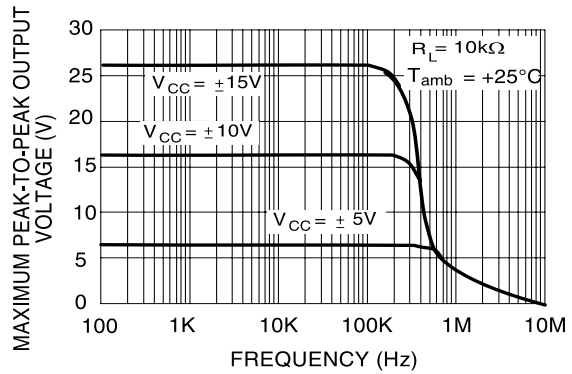


Figure 4: Maximum peak-to-peak output voltage versus frequency

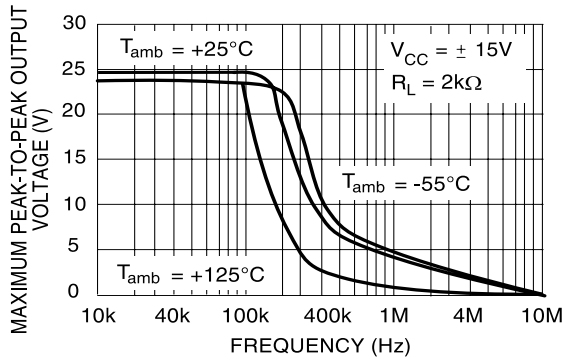


Figure 5: Maximum peak-to-peak output voltage versus free air temperature

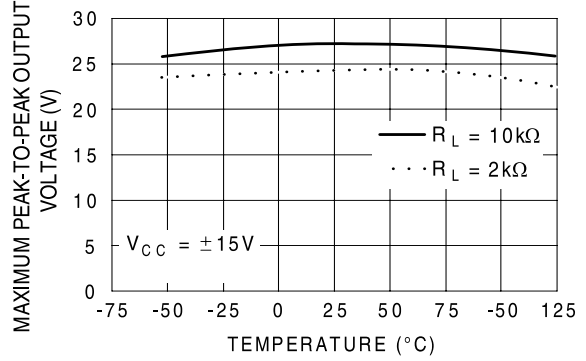


Figure 6: Maximum peak-to-peak output voltage versus load resistance

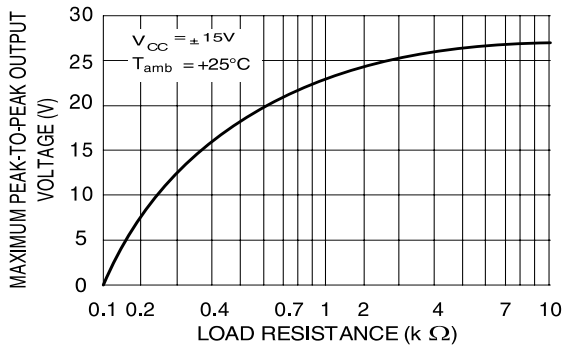


Figure 7: Maximum peak-to-peak output voltage versus supply voltage

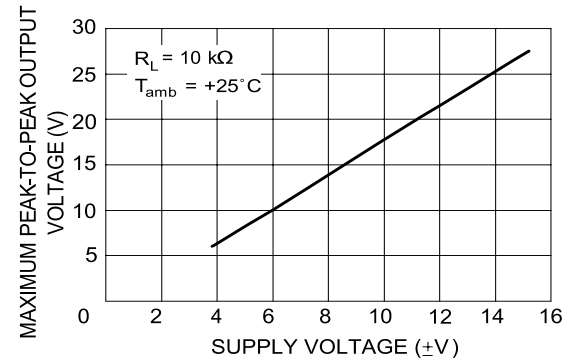


Figure 8: Input bias current versus free air temperature

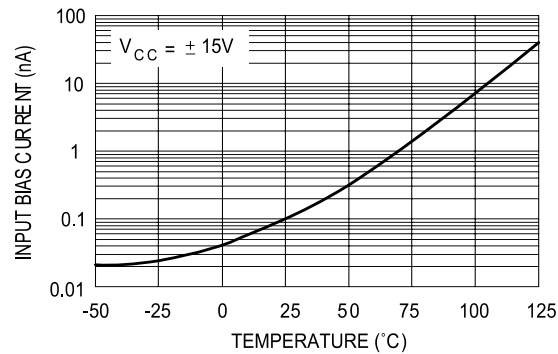


Figure 9: Large signal differential voltage amplification versus free air temperature

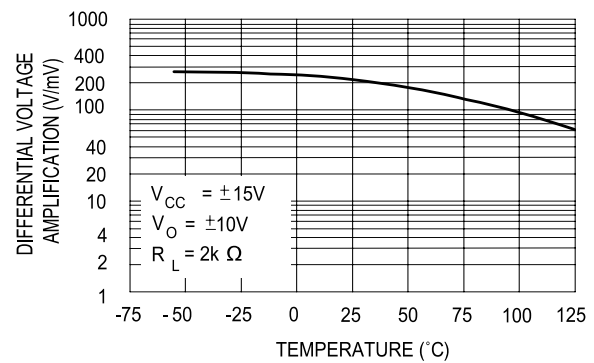


Figure 10: Large signal differential voltage amplification and phase shift versus frequency

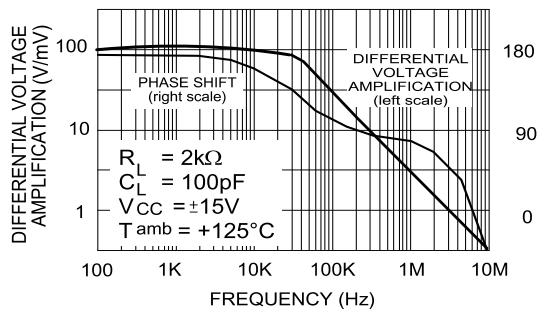


Figure 11: Total power dissipation versus free air temperature

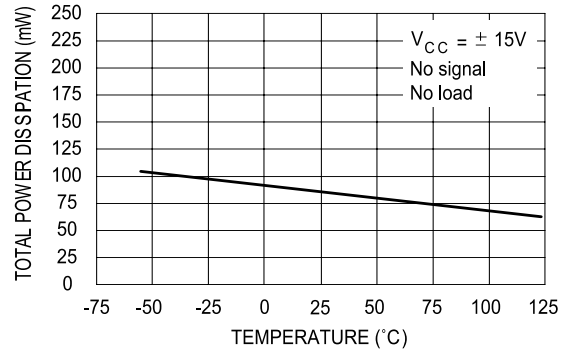


Figure 12: Supply current per amplifier versus free air temperature

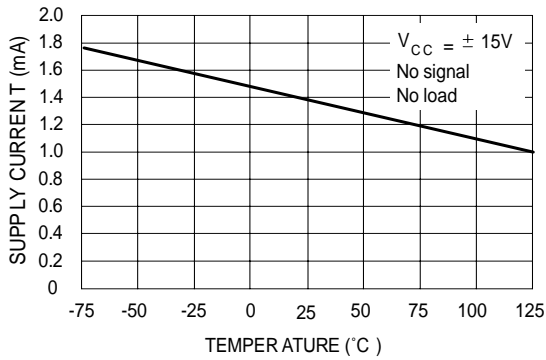


Figure 13: Common mode rejection ratio versus free air temperature

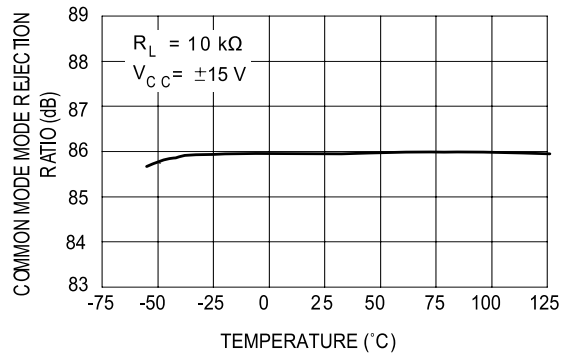


Figure 14: Voltage follower large signal pulse response

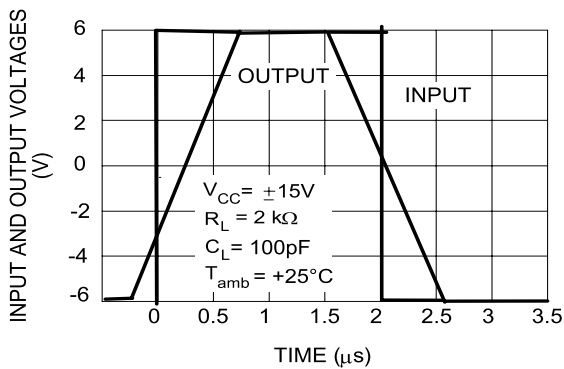


Figure 15: Output voltage versus elapsed time

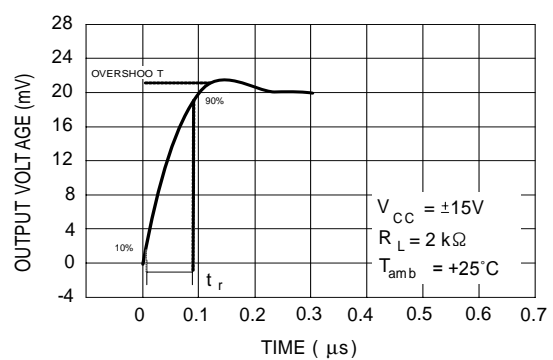




Figure 16: Equivalent input noise voltage versus frequency

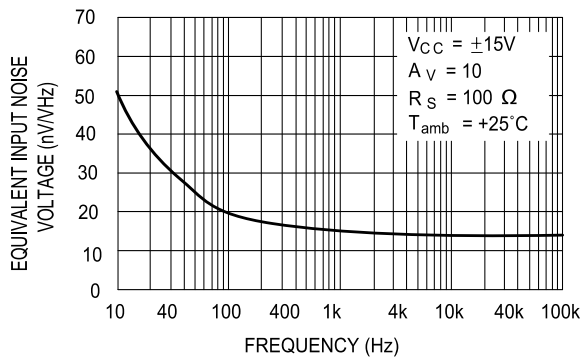
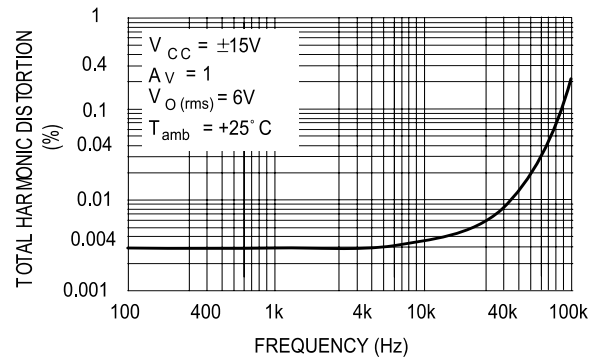


Figure 17: Total harmonic distortion versus frequency



## 4 Parameter measurement information

Figure 18: Voltage follower

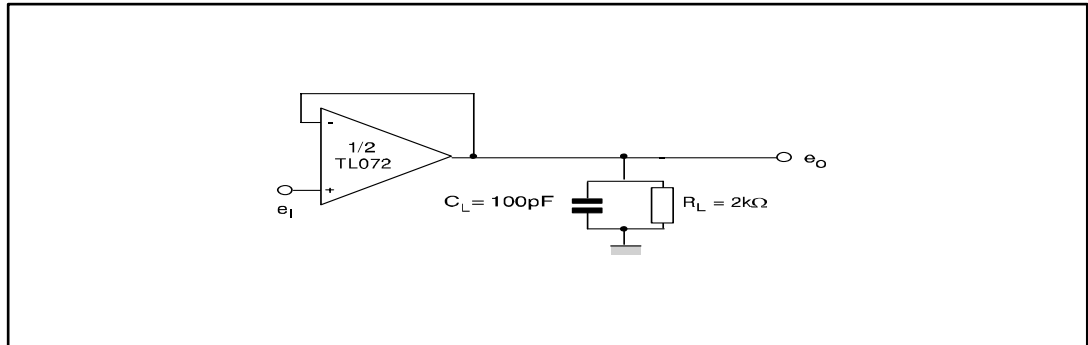
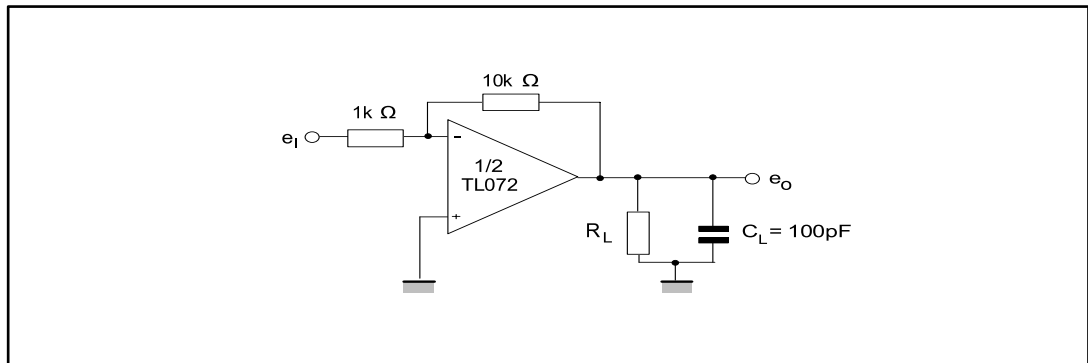
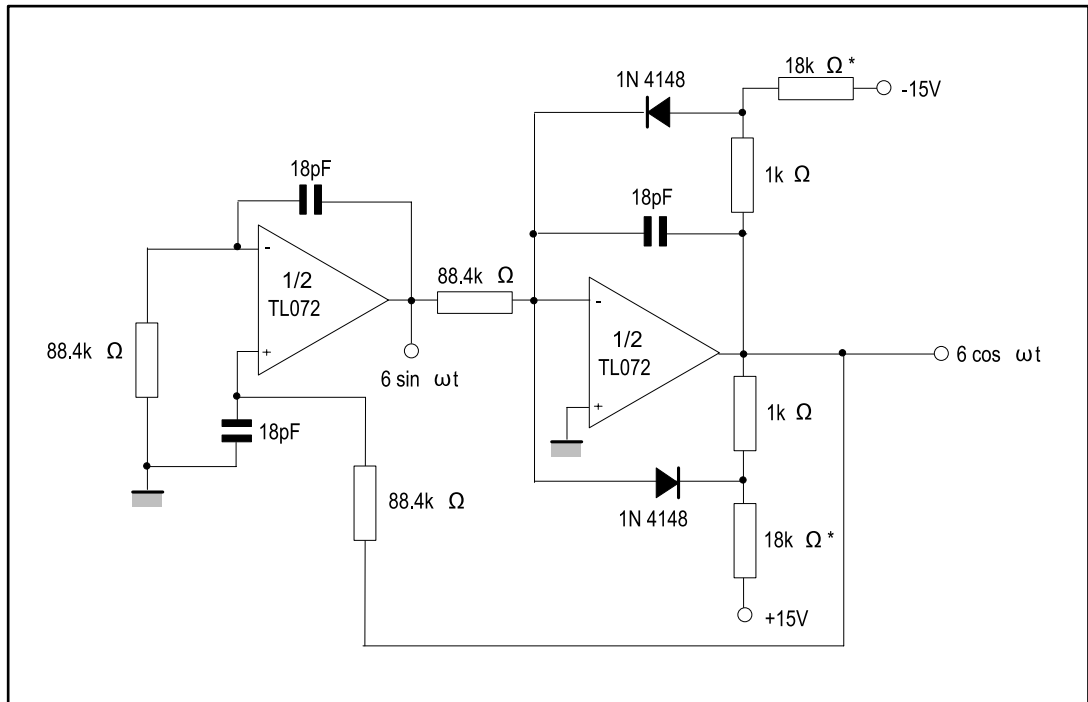


Figure 19: Gain-of-10 inverting amplifier



## 5 Typical application

Figure 20: 100 kHz quadruple oscillator



1. The resistor values of [Figure 20](#) may be adjusted for a symmetrical output

## 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](http://www.st.com). ECOPACK is an ST trademark.

### 6.1 SO8 package information

Figure 21: SO8 package mechanical drawing

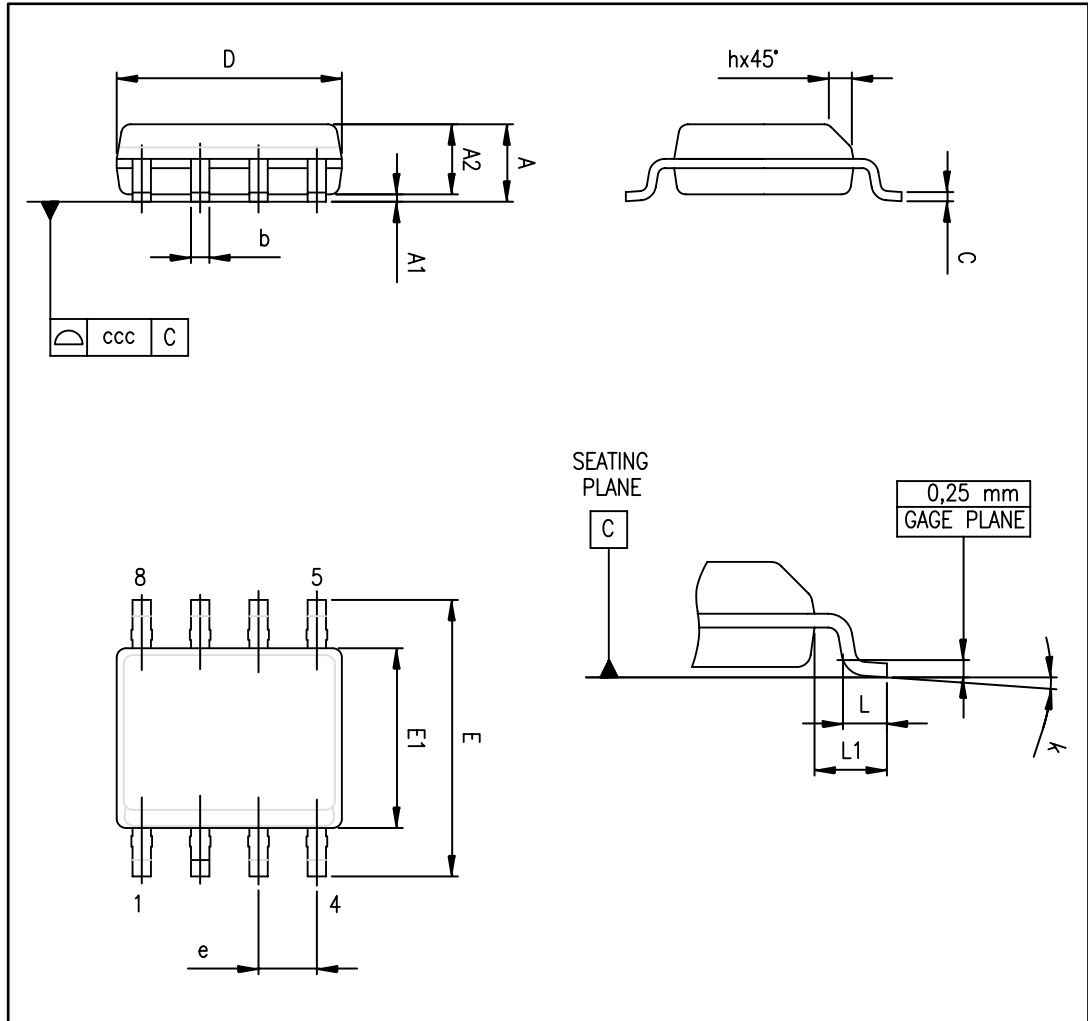


Table 4: SO8 package mechanical data

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
E	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

## 7 Ordering information

Table 5: Order codes

Order code	Temperature range	Package	Packing	Marking
TL072IDT	-40 °C, +125 °C	SO8	Tape and reel	072I
TL072AIDT				072AI
TL072BIDT				072BI
TL072CDT	0 °C, +70 °C			072C
TL072ACDT				072AC
TL072BCDT				072BC
TL072IYDT <sup>(1)</sup>	-40 °C, +125 °C	SO8 (automotive grade)		072IY
TL072AIYDT <sup>(1)</sup>				072AIY
TL072BIYDT <sup>(1)</sup>				072BIY

**Notes:**

<sup>(1)</sup> Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent.

## 8 Revision history

Table 6: Document revision history

Date	Revision	Changes
28-Mar-2001	1	Initial release.
02-Apr-2004	2	Correction to pin connection diagram on cover page. Unpublished.
04-Dec-2006	3	Modified graphics in package mechanical data.
06-Mar-2007	4	Expanded order codes table and added automotive grade order codes. See <a href="#">Table 5: "Order codes"</a> . Added thermal resistance and ESD tolerance in <a href="#">Table 1: "Absolute maximum ratings"</a> . Added <a href="#">Table 2: "Operating conditions"</a> . Updated package mechanical data to make it compliant with the latest JEDEC standards.
13-Mar-2008	5	ESD HBM value modified in AMR table. Re-ordered order codes table. Removed TL072BIY and TL072AIY order codes from order code table. Corrected footnote for automotive grade order codes in order codes table.
15-Jul-2008	6	Removed information concerning military temperature range (TL072Mx, TL072AMx, TL072BMx). Added order codes for automotive grade products in <a href="#">Table 5: "Order codes"</a> .
04-Jul-2012	7	Removed part numbers TL072IYD, TL072AIYD, TL072BIYD. Updated <a href="#">Table 5: "Order codes"</a> .
19-Jun-2014	8	Removed DIP8 package Added <a href="#">Related products</a> <a href="#">Table 2: "Operating conditions"</a> : temperature range for "I" versions changed from "-40 °C, +105 °C" to "-40 °C, +125 °C". <a href="#">Table 3: Electrical characteristics at VCC = ±15 V, Tamb = +25 °C (unless otherwise specified)</a> : replaced DV <sub>io</sub> with ΔV <sub>io</sub> /ΔT. <a href="#">Table 5: "Order codes"</a> : temperature range for "I" version order codes changed from "-40 °C, +105 °C" to "-40 °C, +125 °C"; removed tube packing and related order codes. Updated disclaimer

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