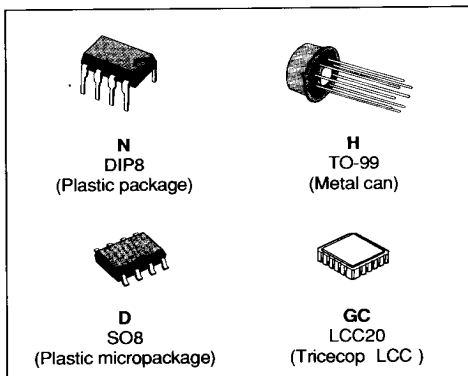


LOW POWER J-FET INPUT SINGLE OP-AMPS

- VERY LOW POWER CONSUMPTION
- WIDE COMMON-MODE AND DIFFERENTIAL VOLTAGE RANGES
- LOW INPUT BIAS AND OFFSET CURRENTS
- TYPICAL SUPPLY CURRENT : 200 μ A
- OUTPUT SHORT-CIRCUIT PROTECTION
- HIGH INPUT IMPEDANCE J-FET INPUT STAGE
- INTERNAL FREQUENCY COMPENSATION
- LATCH UP FREE OPERATION
- HIGH SLEW RATE : 3.5 V/ μ s (typ)



DESCRIPTION

The TL061, TL061A and TL061B are high speed J-FET input single operational amplifier family. Each of these J-FET input operational amplifiers incorporates well matched, high voltage J-FET 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.

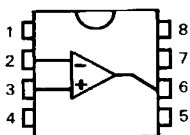
ORDER CODES

Part Number	Temperature Range	Package			
		N	D	H	GC
TL061M	- 55 °C to + 125 °C			•	•
TL061I	- 40 °C to + 105 °C	•	•		
TL061C	0 °C to + 70 °C	•	•		
TL061AC	0 °C to + 70 °C	•	•		
TL061BC	0 °C to + 70 °C	•	•		

Note : Hi-Rel Versions Available
Examples : TL061MH, TL061IN

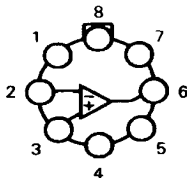
PIN CONNECTIONS (Top views)

**DIP8
SO8**



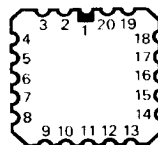
5 - Balance
 6 - Output
 7 - V_{CC}
 8 - NC

TO-99



1 - Balance
 2 - Inverting input
 3 - Non-inverting input
 4 - V_{CC}

LCC20



1 - NC
 2 - Balance
 3 - NC
 4 - NC
 5 - Inverting input
 6 - NC
 7 - Non-inverting input
 8 - NC
 9 - NC
 10 - V_{CC}

11 - NC
 12 - Balance
 13 - NC
 14 - NC
 15 - Output
 16 - NC
 17 - V_{CC}
 18 - NC
 19 - NC
 20 - NC

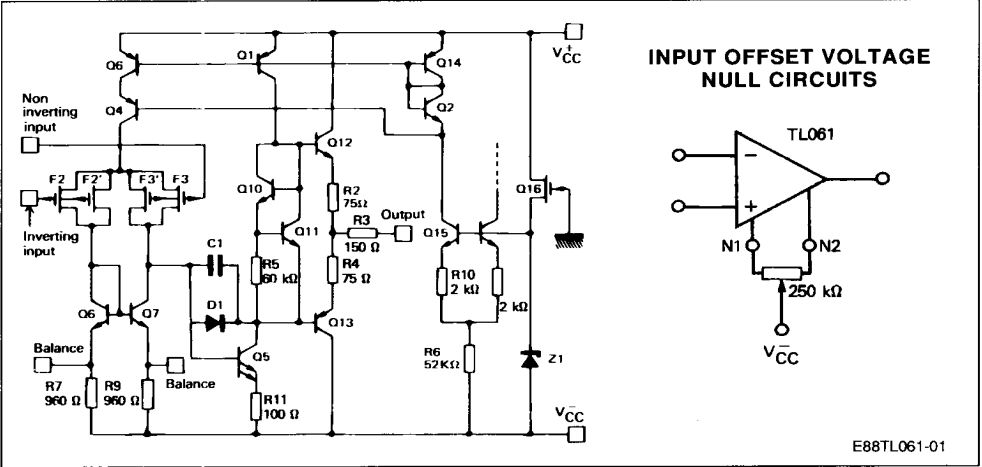
MAXIMUM RATINGS

Symbol	Parameter	TL061M	TL061I	TL061C	Unit
V _{CC}	Supply Voltage (note 1)	± 18	± 18	± 18	V
V _{ID}	Differential Input Voltage (note 2)	± 30	± 30	± 30	V
V _I	Input Voltage (note 3)	± 15	± 15	± 15	V
	Output Short-circuit Duration (note 4)	Indefinite	Indefinite	Indefinite	
P _{TOT}	Power Dissipation (note 5)	680	680	680	mW
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	− 65 to + 150	− 65 to + 150	°C

* Devices bonded on a 6 cm x 0.15 cm glass epoxy substrate with 30 mm² of 35 μm thick copper.

- Notes :
1. All voltage values, except differential voltages, 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. Differential voltages are at the non-inverting input terminal with respect to the inverting input terminal.
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
 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 exceed.
 5. For operation above + 25 °C free-air temperature, refer to dissipation derating table.

SCHEMATIC DIAGRAM



Case	Balance	Inverting Input	Non-Inverting Input	V _{CC}	V _{CC}	Output	N.C.
DIP8 SO8 TO-99	1, 5	2	3	4	7	6	8
LCC20	2, 12	5	7	10	17	15	*

* LCC20 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS

TL061M : $-55^{\circ}\text{C} \leq T_{\text{amb}} \leq +125^{\circ}\text{C}$

TL061I : $-40^{\circ}\text{C} \leq T_{\text{amb}} \leq +105^{\circ}\text{C}$

TL061C : $0^{\circ}\text{C} \leq T_{\text{amb}} \leq +70^{\circ}\text{C}$

$V_{\text{CC}} = \pm 15\text{V}$.

All characteristics are specified under open-loop conditions unless otherwise specified.

Symbol	Parameter	TL061M			TL061I			TL061C			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{S}} = 50\ \Omega$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$, $R_{\text{S}} = 50\ \Omega$		3	6 9		3	6 9		3	15 20	mV
αV_{IO}	Temperature Coefficient of Input Offset Voltage ($R_{\text{S}} = 50\ \Omega$)		10			10			10		$\mu\text{V}/^{\circ}\text{C}$
I_{IO}	Input Offset Current * $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		5	100 20		5	100 10		5	200 5	pA nA
I_{B}	Input Bias Current * $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		30	200 50		30	200 20		30	400 10	pA nA
V_{I}	Input Common-mode Voltage Range ($T_{\text{amb}} = +25^{\circ}\text{C}$)	± 11	± 12		± 11.5	± 12		± 10	± 11		V
V_{OPP}	Output Voltage Swing : $R_{\text{L}} = 10\ \text{K}\Omega$, $T_{\text{amb}} = +25^{\circ}\text{C}$ $R_{\text{L}} \geq 10\ \text{K}\Omega$, $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	20 20	27		20 20	27		20 20	27		V
A_{VD}	Large Signal Voltage Gain $T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{L}} \geq 10\ \text{K}\Omega$, $V_{\text{O}} = \pm 10\ \text{V}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$, $R_{\text{L}} \geq 10\ \text{K}\Omega$, $V_{\text{O}} = \pm 10\ \text{V}$	4 4	6		4 4	6		3 3	6		V/mV
GW_{R}	Small Signal Bandwidth ($T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{L}} = 10\ \text{K}\Omega$)		1			1			1		MHz
R_{I}	Input Resistance ($T_{\text{amb}} = +25^{\circ}\text{C}$)		10^{12}			10^{12}			10^{12}		Ω
CMR	Common-mode Rejection Ratio ($R_{\text{S}} \geq 10\ \text{K}\Omega$, $T_{\text{amb}} = +25^{\circ}\text{C}$)	80	86		80	86		70	76		dB
SVR	Supply Voltage Rejection Ratio ($\Delta V_{\text{CC}}/\Delta V_{\text{IO}}$) $R_{\text{S}} \geq 10\ \text{K}\Omega$, $T_{\text{amb}} = +25^{\circ}\text{C}$	80	95		80	95		70	95		dB
I_{CC}	Supply Current ($T_{\text{amb}} = +25^{\circ}\text{C}$, no load, no signal)		200	250		200	250		200	250	μA
P_{D}	Total Power Consumption (each amplifier) $T_{\text{amb}} = +25^{\circ}\text{C}$, No load, no signal		6	7.5		6	7.5		6	7.5	mW

* 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 is possible.

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	TL061M			TL061I, C			Unit.
		Min.	Typ.	Max.	Min.	Typ.	Max.	
S_{VO}	Slew Rate ($e_{\text{I}} = 10\ \text{V}$, $R_{\text{L}} = 10\ \text{K}\Omega$, $C_{\text{L}} = 100\ \text{pF}$, $A_{\text{V}} = 1$)	2	3.5			3.5		V/ μs
t_{r}	Rise Time ($e_{\text{I}} = 20\ \text{mV}$, $R_{\text{L}} = 10\ \text{K}\Omega$, $C_{\text{L}} = 100\ \text{pF}$, $A_{\text{V}} = 1$) (see fig. 1)		0.2			0.2		μs
K_{OV}	Overshoot Factor ($e_{\text{I}} = 20\ \text{mV}$, $R_{\text{L}} = 10\ \text{K}\Omega$, $C_{\text{L}} = 100\ \text{pF}$, $A_{\text{V}} = 1$) (see fig. 1)		10			10		%
V_{n}	Equivalent Input Noise Voltage ($R_{\text{S}} = 100\ \text{K}\Omega$, $f = 1\ \text{KHz}$)		42			42		$\text{nV}/\sqrt{\text{Hz}}$

ELECTRICAL CHARACTERISTICS
TL061C : $0^{\circ}\text{C} \leq T_{\text{amb}} \leq +70^{\circ}\text{C}$
 $V_{\text{CC}} = \pm 15\text{V}$

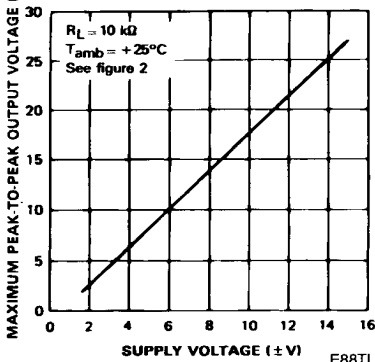
All characteristics are specified under open-loop conditions unless otherwise specified.

Symbol	Parameter	TL061C			TL061AC			TL061BC			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{IO}	Input Offset Voltage $T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{S}} = 50\ \Omega$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$, $R_{\text{S}} = 50\ \Omega$		3	15 20		3	6 7.5		2	3 5	mV
αV_{IO}	Temperature Coefficient of Input Offset Voltage ($R_{\text{S}} = 50\ \Omega$)		10			10			10		$\mu\text{V}/^{\circ}\text{C}$
I_{IO}	Input Offset Current * $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		5	200 5		5	100 3		5	100 3	pA nA
I_{IB}	Input Bias Current * $T_{\text{amb}} = +25^{\circ}\text{C}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$		30	400 10		30	200 7		30	200 7	pA nA
V_{I}	Input Common-mode Voltage Range	± 10	± 11		± 11.5	± 12		± 11.5	± 12		V
V_{OPP}	Output Voltage Swing : $R_{\text{L}} = 10\ \text{K}\Omega$, $T_{\text{amb}} = +25^{\circ}\text{C}$ $R_{\text{L}} \geq 10\ \text{K}\Omega$, $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	20 20	27		20 20	27		20 20	27		V
A_{VD}	Large Signal Voltage Gain $T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{L}} \geq 10\ \text{K}\Omega$, $V_{\text{O}} = \pm 10\ \text{V}$ $T_{\text{min}} \leq T_{\text{amb}} \leq T_{\text{max}}$	3 3	6		4 4	6		4 4	6		V/mV
GW_{R}	Small Signal Bandwidth ($T_{\text{amb}} = +25^{\circ}\text{C}$, $R_{\text{L}} = 10\ \text{K}\Omega$)		1			1			1		MHz
R_{I}	Input Resistance ($T_{\text{amb}} = +25^{\circ}\text{C}$)		10^{12}			10^{12}			10^{12}		Ω
CMR	Common-mode Rejection Ratio ($R_{\text{S}} \geq 10\ \text{K}\Omega$; $T_{\text{amb}} = +25^{\circ}\text{C}$)	70	76		80	86		80	86		dB
SVR	Supply Voltage Rejection Ratio ($\Delta V_{\text{CC}}/\Delta V_{\text{IO}}$) $R_{\text{S}} \geq 10\ \text{K}\Omega$, $T_{\text{amb}} = +25^{\circ}\text{C}$	70	95		80	95		80	95		dB
I_{CC}	Supply Current ($T_{\text{amb}} = +25^{\circ}\text{C}$, no load, no signal)		200	250		200	250		200	250	μA
P_{D}	Total Power Consumption (each amplifier) $T_{\text{amb}} = +25^{\circ}\text{C}$, no load, no signal		6	7.5		6	7.5		6	7.5	mW

* 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 is possible.

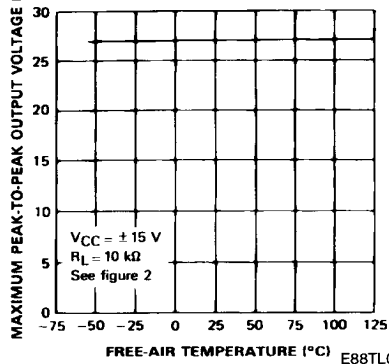
TYPICAL CHARACTERISTICS

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE



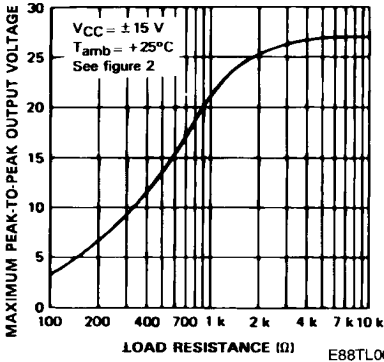
E88TL061-02

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE



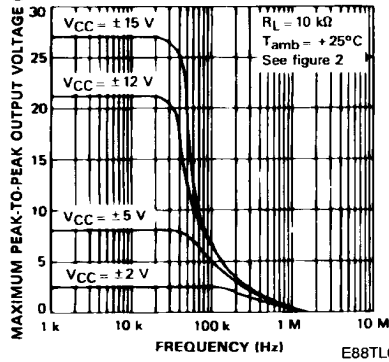
E88TL061-03

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
LOAD RESISTANCE



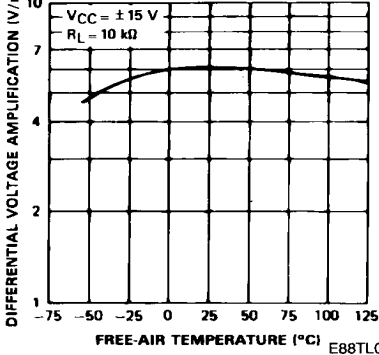
E88TL061-04

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY



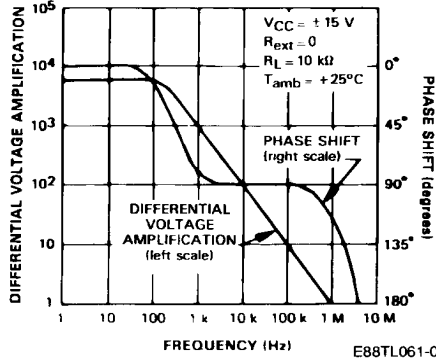
E88TL061-05

DIFFERENTIAL VOLTAGE AMPLIFICATION
vs
FREE-AIR TEMPERATURE



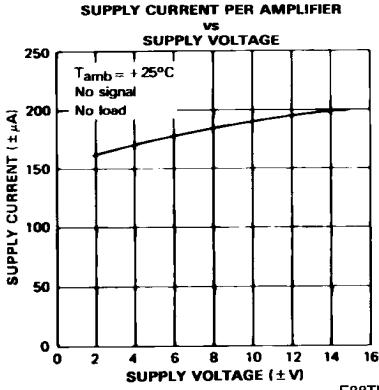
E88TL061-06

LARGE SIGNAL
DIFFERENTIAL VOLTAGE AMPLIFICATION
AND PHASE SHIFT vs FREQUENCY

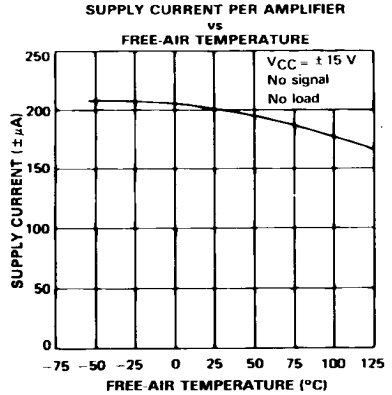


E88TL061-07

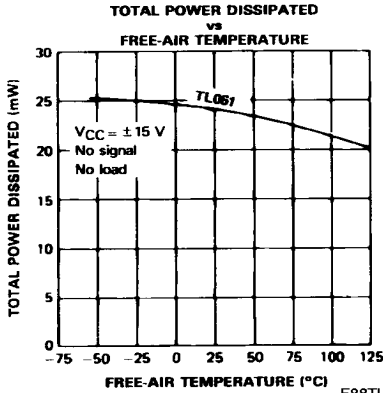
TYPICAL CHARACTERISTICS (continued)



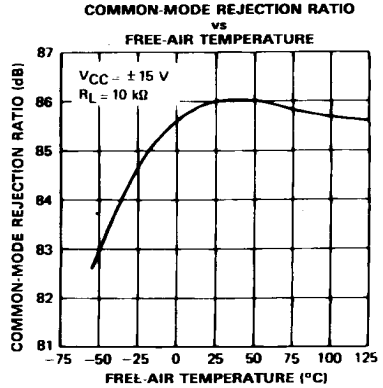
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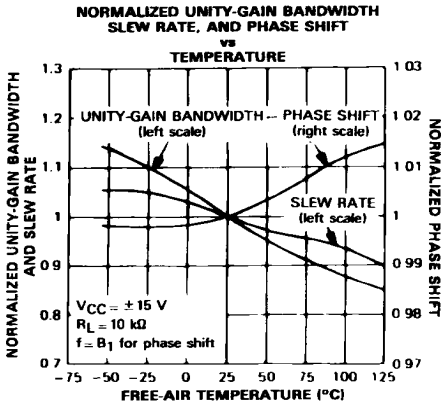
E88TL061-09



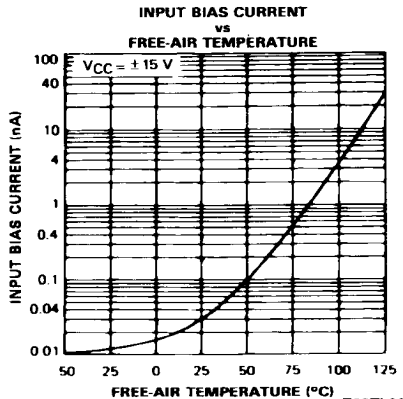
E88TL061-10



E88TL061-11

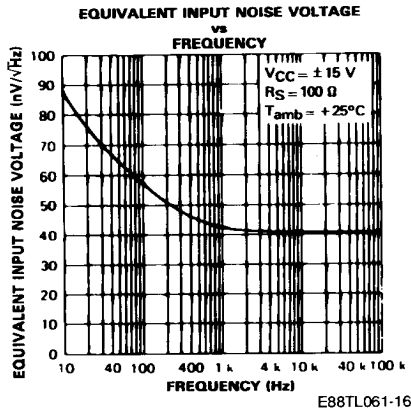
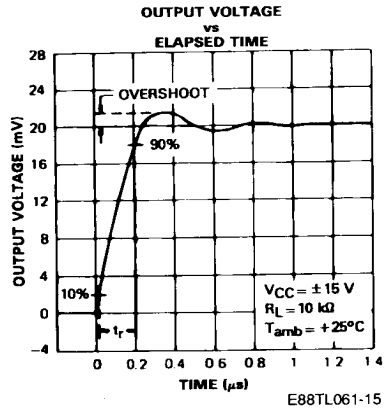
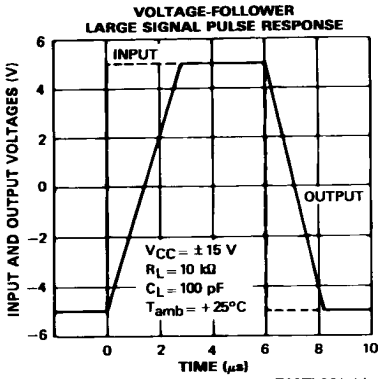


E88TL061-12



E88TL061-13

TYPICAL CHARACTERISTICS (continued)



PARAMETER MEASUREMENT INFORMATION

Figure 1 : Voltage follower.

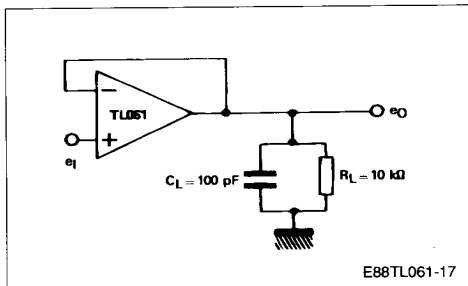
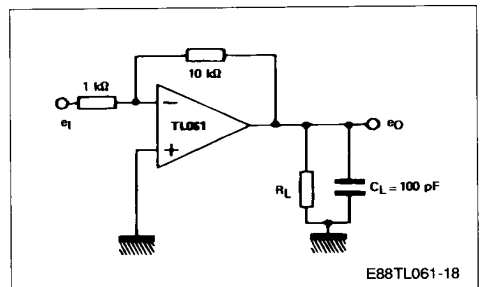
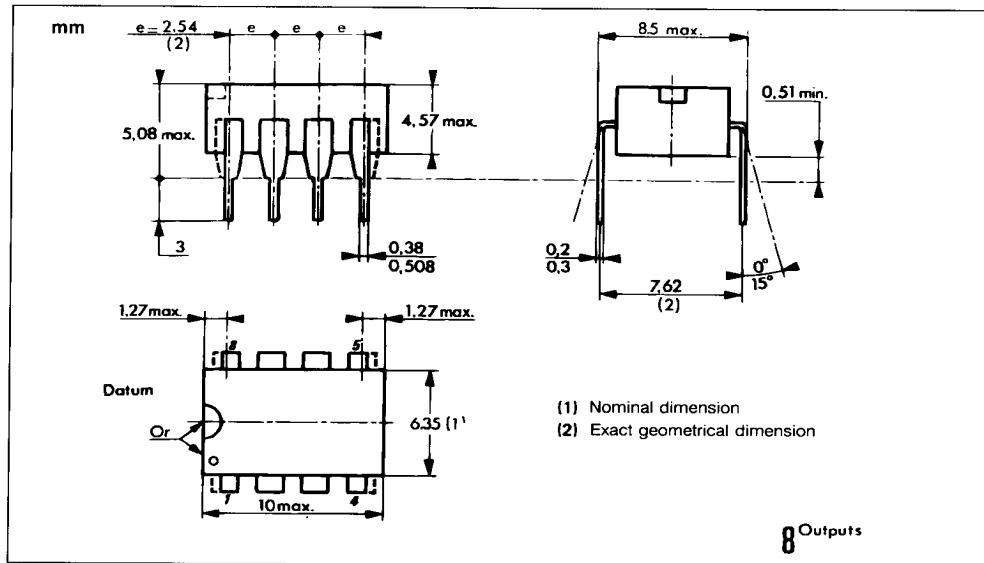


Figure 2 : Gain-of-10 inverting amplifier.

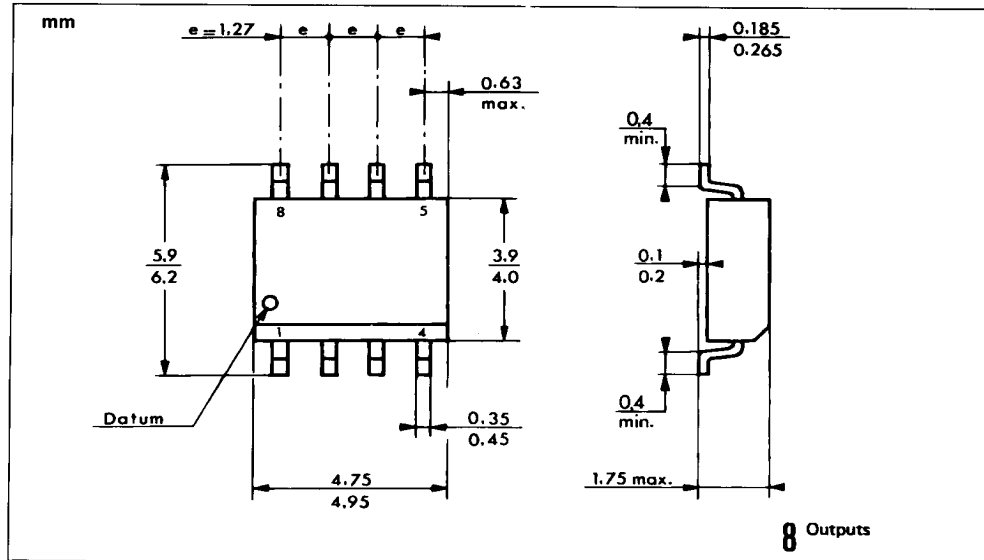


PACKAGE MECHANICAL DATA

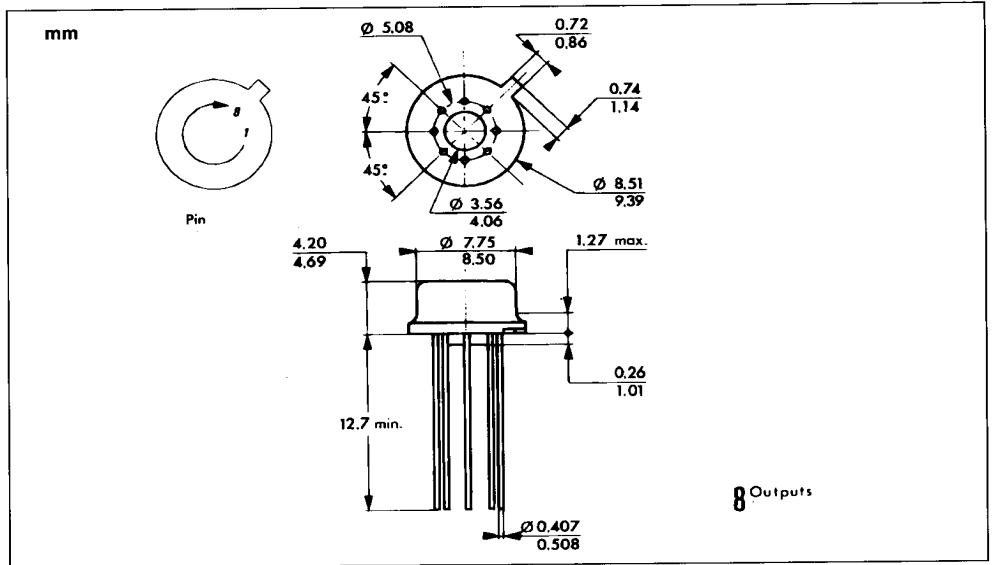
8 PINS – PLASTIC DIP



8 PINS – PLASTIC MICROPACKAGE (SO)



TO-99 – METAL CAN



20 PINS – TRICECOP (LCC)

