

General purpose JFET single operational amplifiers

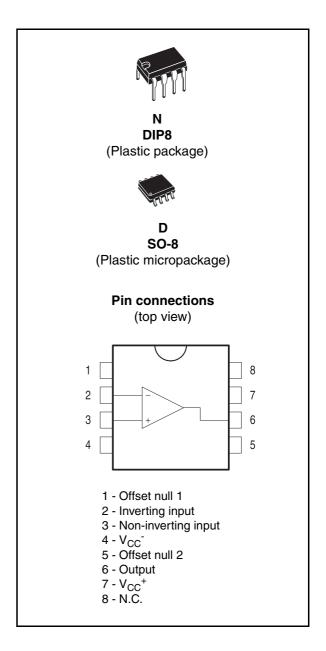
Features

- 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 (typ)

Description

The TL081, TL081A and TL081B are high-speed JFET input single 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.



Schematic diagram TL081

1 Schematic diagram

Figure 1. Schematic diagram

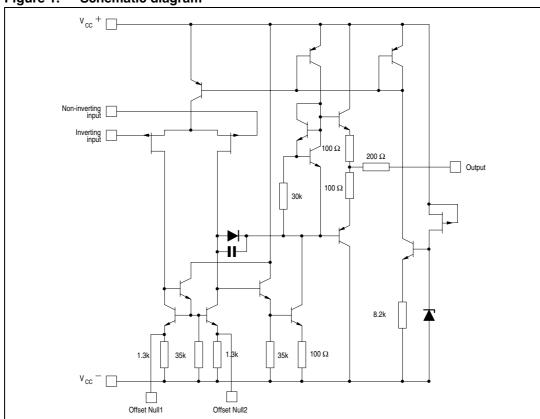
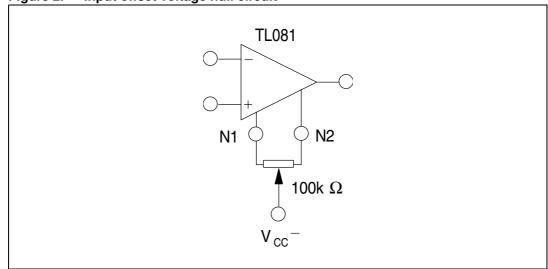


Figure 2. Input offset voltage null circuit



2 Absolute maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	TL081I, AI, BI	TL081C, AC, BC	Unit		
V _{CC}	Supply voltage (1)	±	±18			
V _{in}	Input voltage (2)	±	15	V		
V _{id}	Differential input voltage (3)	±	30	V		
P _{tot}	Power dissipation	68	30	mW		
	Output short-circuit duration (4)	Infinite				
T _{stg}	Storage temperature range	rage temperature range -65 to +150				
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	nction to case ^{(5) (6)} 40 41		°C/W		
	HBM: human body model ⁽⁷⁾		500			
ESD	MM: machine model ⁽⁸⁾	200		V		
	CDM: charged device model ⁽⁹⁾	1	kV			

- 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}⁻.
- 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: 100 pF discharged through a $1.5 \mathrm{k}\Omega$ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.
- 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.
- 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	TL081I, AI, BI	TL081C, AC, BC	Unit
V _{CC}	Supply voltage range	6	V	
T _{oper}	Operating free-air temperature range	-40 to +105	0 to +70	°C

Electrical characteristics TL081

3 Electrical characteristics

Table 3. $V_{CC} = \pm 15V$, $T_{amb} = +25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter		TL081I, AC, AI, BC, BI			TL081C		
			Тур.	Max.	Min.	Тур.	Max.	
V _{io}	Input offset voltage ($R_s = 50\Omega$) $T_{amb} = +25^{\circ}C \qquad TL081$ $TL081A$ $TL081B$ $T_{min} \le T_{amb} \le T_{max} \qquad TL081$ $TL081A$ $TL081B$		3 3 1	10 6 3 13 7 5		3	10	mV
DV _{io}	Input offset voltage drift		10			10		μV/°C
I _{io}	Input offset current ⁽¹⁾ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		5	100 4		5 100 10		pA nA
l _{ib}	Input bias current ⁽¹⁾ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		20	200 20		20	400 20	nA
A _{vd}	Large signal voltage gain $(R_L = 2k\Omega, V_0 = \pm 10V)$ $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	50 25	200		25 15	200		V/mV
SVR	Supply voltage rejection ratio ($R_S = 50\Omega$) $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	80 80	86		70 70	86		dB
I _{CC}	Supply current, no load $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$		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 ($R_S = 50\Omega$) $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	80 80	86		70 70	86		dB
I _{os}	Output short-circuit current $T_{amb} = +25^{\circ}C$ $T_{min} \le T_{amb} \le T_{max}$	10 10	40	60 60	10 10	40	60 60	mA
±V _{opp}	$\begin{aligned} & \text{Output voltage swing} \\ & T_{amb} = +25^{\circ}\text{C} & R_{L} = 2k\Omega \\ & R_{L} = 10k\Omega \\ & T_{min} \leq T_{amb} \leq T_{max} & R_{L} = 2k\Omega \\ & R_{L} = 10k\Omega \end{aligned}$	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 = 2k Ω , C_L = 100pF, unity gain	8	16		8	16		V/µs

Table 3. $V_{CC} = \pm 15V$, $T_{amb} = +25^{\circ}C$ (unless otherwise specified) (continued)

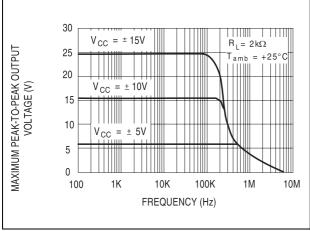
Symbol	Parameter		TL081I, AC, AI, BC, BI			TL081C		
		Min.	Тур.	Max.	Min.	Тур.	Max.	
t _r	Rise time ($T_{amb} = +25$ °C) $V_{in} = 20$ mV, $R_L = 2$ k Ω , $C_L = 100$ pF, unity gain		0.1			0.1		μs
K _{ov}	Overshoot ($T_{amb} = +25^{\circ}C$) $V_{in} = 20$ mV, $R_L = 2$ k Ω , $C_L = 100$ pF, unity gain		10			10		%
GBP	Gain bandwidth product (T_{amb} = +25°C) V_{in} = 10mV, R_L = 2k Ω , 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 ($T_{amb} = +25^{\circ}C$), F= 1kHz, $R_L = 2k\Omega_i C_L = 100pF$, $A_v = 20dB$, $V_o = 2V_{pp}$		0.01			0.01		%
e _n	Equivalent input noise voltage $R_S = 100\Omega$, F= 1kHz		15			15		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
Øm	Phase margin		45			45		degrees

The input bias currents are junction leakage currents which approximately double for every 10°C increase in the junction temperature.

Electrical characteristics TL081

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

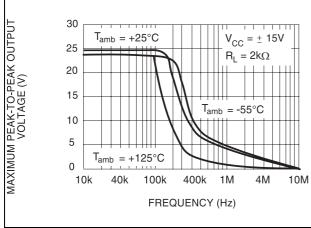
Figure 4. Maximum peak-to-peak output voltage versus frequency



30 MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE (V) $R_L = 10k\Omega$ 25 20 $V_{CC} = \pm 10V$ 15 10 5 0 100 1K 10K 100K 1M 10M FREQUENCY (Hz)

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

Figure 6. Maximum peak-to-peak output voltage versus free air temperature



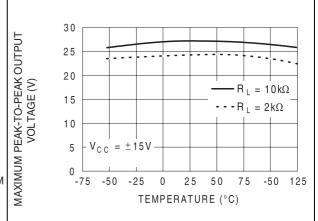
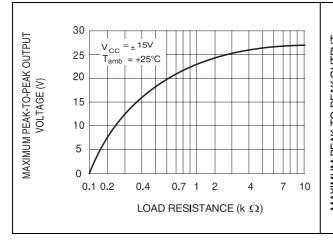


Figure 7. Maximum peak-to-peak output voltage versus load resistance

Figure 8. Maximum peak-to-peak output voltage versus supply voltage



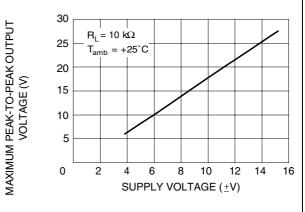
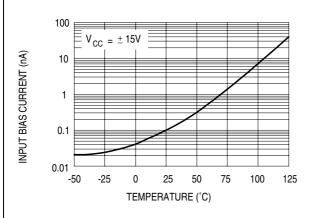


Figure 9. Input bias current versus free air temperature

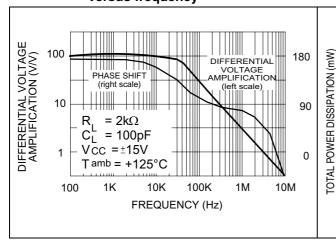
Figure 10. Large signal differential voltage amplification versus free air temp



1000 400 200 DIFFERENTIAL VOLTAGE AMPLIFICATION (V/V) 100 40 20 $V_{CC} = \pm 15V$ 10 $V_0 = \pm 10V$ 4 $= 2k \Omega$ 2 1 -75 -50 -25 0 25 50 100 125 TEMPERATURE (°C)

Figure 11. Large signal differential voltage amplification and phase shift versus frequency

Figure 12. Total power dissipation versus free air temperature



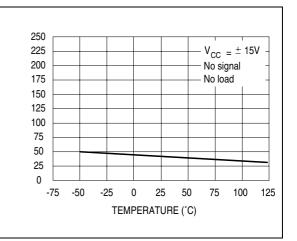
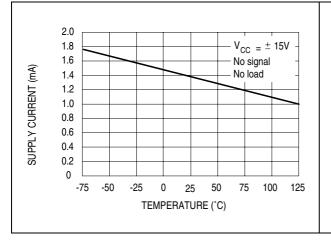
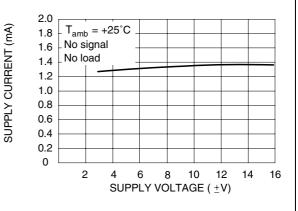


Figure 13. Supply current per amplifier versus Figure 14. Supply current per amplifier versus free air temperature supply voltage





Electrical characteristics TL081

Figure 15. Common mode rejection ratio versus free air temperature

Figure 16. Equivalent input noise voltage versus frequency

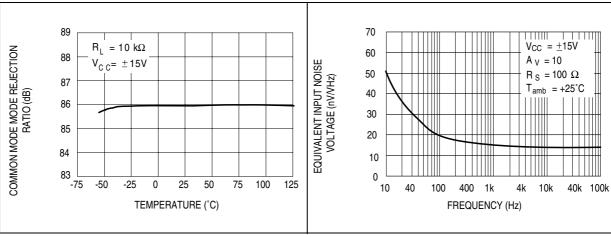


Figure 17. Output voltage versus elapsed time Figure 18. Total harmonic distortion versus frequency

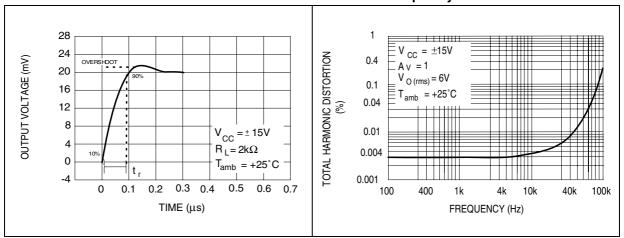
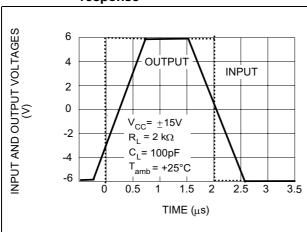


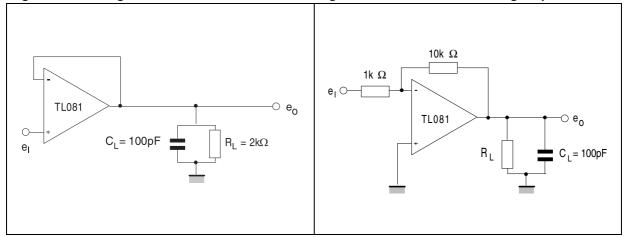
Figure 19. Voltage follower large signal pulse response



4 Parameter measurement information

Figure 20. Voltage follower

Figure 21. Gain-of-10 inverting amplifier



Typical applications TL081

5 Typical applications

Figure 22. 0.5 Hz square wave oscillator

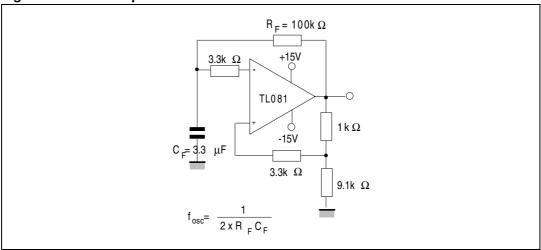
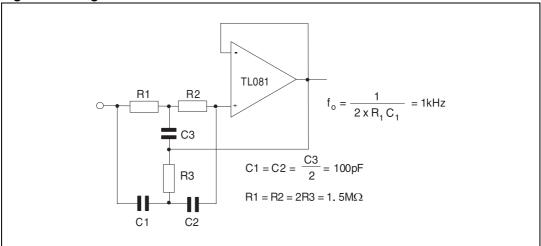


Figure 23. High Q notch filter



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TL081 Package information

6 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.

Package information TL081

6.1 DIP 8 package information

Figure 24. DIP8 package mechanical drawing

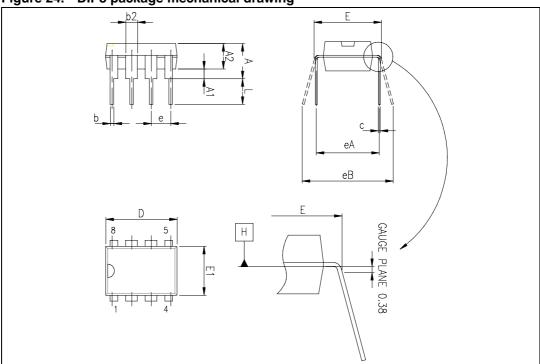


Table 4. DIP8 package mechanical data

			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α			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
С	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
е		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

TL081 Package information

6.2 SO-8 package information

Figure 25. SO-8 package mechanical drawing

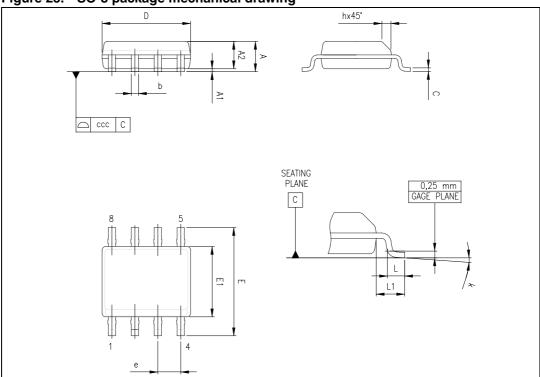


Table 5. SO-8 package mechanical data

			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α			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
С	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
е		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

Ordering information TL081

7 Ordering information

Table 6. Order codes

Order code	Temperature range	Package	Packing	Marking
TL081IN TL081AIN TL081BIN		DIP8	Tube	TL081IN TL081AIN TL081BIN
TL081ID/IDT TL081AID/AIDT TL081BID/BIDT	-40°C, +105°C	SO-8	Tube or tape & reel	081I 081AI 081BI
TL081IYD/DT ⁽¹⁾ TL081AIYD/DT ⁽¹⁾ TL081BIYD/DT ⁽¹⁾		SO-8 (Automotive grade)	Tube or tape & reel	081IY 081AIY 081BIY
TL081CN TL081ACN TL081BCN	0°C, +70°C	DIP8	Tube	TL081CN TL081ACN TL081BCN
TL081CD/CDT TL081ACD/ACDT TL081BCD/BCDT	0 0, +70 0	SO-8	Tube or tape & reel	081C 081AC 081BC

Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

8 Revision history

Table 7. Document revision history

Date	Revision	Changes
30-Apr-2001	1	Initial release.
27-Jul-2007	2	Added values for R _{thja} and R _{thjc} in <i>Table 1: Absolute maximum ratings</i> . Added <i>Table 2: Operating conditions</i> . Added automotive grade part numbers in <i>Table 6: Order codes</i> . Format update.
27-Jun-2008	3	Removed information concerning military temperature range (TL081Mx, TL081AMx, TL081BMx). Added missing order codes for automotive grade products and updated footnote in <i>Table 6: Order codes</i> .

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