



TL08xx JFET-Input Operational Amplifiers

1 Features

- Low Power Consumption: 1.4 mA/ch Typical
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias Current: 30 pA Typical
- Low Input Offset Current: 5 pA Typical
- Output Short-Circuit Protection
- Low Total Harmonic Distortion: 0.003% Typical
- High Input Impedance: JFET Input Stage
- Latch-Up-Free Operation
- High Slew Rate: 13 V/μs Typical
- Common-Mode Input Voltage Range Includes V_{CC+}

2 Applications

- Tablets
- White goods
- Personal electronics
- Computers

3 Description

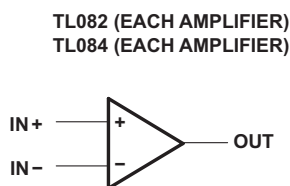
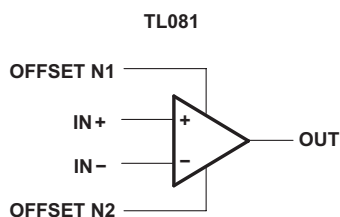
The TL08xx JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and low offset-voltage temperature coefficient.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TL084xD	SOIC (14)	8.65 mm × 3.91 mm
TL08xxFK	LCCC (20)	8.89 mm × 8.89 mm
TL084xJ	CDIP (14)	19.56 mm × 6.92 mm
TL084xN	PDIP (14)	19.3 mm × 6.35 mm
TL084xNS	SO (14)	10.3 mm × 5.3 mm
TL084xPW	TSSOP (14)	5.0 mm × 4.4 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Schematic Symbol



6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

				MIN	MAX	UNIT
V _{CC+}	Supply voltage ⁽²⁾			18		V
V _{CC−}				−18		
V _{ID}	Differential input voltage ⁽³⁾			±30		V
V _I	Input voltage ⁽²⁾⁽⁴⁾			±15		V
Duration of output short circuit ⁽⁵⁾				Unlimited		
Continuous total power dissipation				See Dissipation Rating Table		
T _A	Operating free-air temperature		TL08_C TL08_AC TL08_BC	0	70	°C
			TL08_I	−40	85	
			TL084Q	−40	125	
			TL08_M	−55	125	
Operating virtual junction temperature				150		°C
T _C	Case temperature for 60 seconds	FK package	TL08_M	260		°C
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	J or JG package	TL08_M	300		°C
T _{stg}	Storage temperature			−65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC–}.
- (3) Differential voltages are at IN+, with respect to IN–.
- (4) The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
- (5) 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.

6.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	1000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	1500	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

				MIN	MAX	UNIT
V _{CC+}	Supply voltage			5	15	V
V _{CC–}	Supply voltage			–5	–15	V
V _{CM}	Common-mode voltage			V _{CC–} + 4	V _{CC+} – 4	V
T _A	Ambient temperature	TL08xM		–55	125	°C
		TL08xQ		–40	125	
		TL08xl		–40	85	
		TL08xC		0	70	

Electrical Characteristics for TL08xC, TL08xxC, and TL08xl (continued)

 $V_{CC\pm} = \pm 15 \text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^{(1)}$	TL081C, TL082C, TL084C			TL081AC, TL082AC, TL084AC			TL081BC, TL082BC, TL084BC			TL081I, TL082I, TL084I			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
I_{CC}	Supply current (each amplifier)	$V_O = 0$, No load	25°C	1.4	2.8	1.4	2.8	1.4	2.8	1.4	2.8	1.4	2.8	2.8	mA
V_{O1}/V_{O2}	Crosstalk attenuation	$A_{VD} = 100$	25°C	120	120	120	120	120	120	120	120	120	120	120	dB

6.6 Electrical Characteristics for TL08xM and TL084x

 $V_{CC\pm} = \pm 15 \text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS ⁽¹⁾	T_A	TL081M, TL082M			TL084Q, TL084M			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	$V_O = 0$, $R_S = 50 \Omega$	25°C	3	6	3	9	9	mV
		Full range			9		15	15	
α_{VIO}	Temperature coefficient of input offset voltage	$V_O = 0$, $R_S = 50 \Omega$	Full range	18	18	18	18	18	$\mu\text{V}/^\circ\text{C}$
I_{IO}	Input offset current ⁽²⁾	$V_O = 0$	25°C	5	100	5	100	100	pA
		125°C		20	20	20	20	20	nA
I_{IB}	Input bias current ⁽²⁾	$V_O = 0$	25°C	30	200	30	200	200	pA
		125°C		50	50	50	50	50	nA
V_{ICR}	Common-mode input voltage range	25°C	± 11	-12 to 15	-12 to 15	± 11	-12 to 15	-12 to 15	V
V_{OM}	Maximum peak output voltage swing	$R_L = 10 \text{ k}\Omega$	25°C	± 12	± 13.5	± 12	± 13.5	± 13.5	V
		$R_L \geq 10 \text{ k}\Omega$	Full range	± 12	± 12	± 12	± 12	± 12	
		$R_L \geq 2 \text{ k}\Omega$		± 10	± 12	± 10	± 12	± 12	
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$, $R_L \geq 2 \text{ k}\Omega$	25°C	25	200	25	200	200	V/mV
		Full range		15	15	15	15	15	
B_1	Unity-gain bandwidth	25°C		3	3		3	3	MHz
r_i	Input resistance	25°C		10^{12}	10^{12}		10^{12}	10^{12}	Ω
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$, $V_O = 0$, $R_S = 50 \Omega$	25°C	80	86	80	86	86	dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC} = \pm 15 \text{ V}$ to $\pm 9 \text{ V}$, $V_O = 0$, $R_S = 50 \Omega$	25°C	80	86	80	86	86	dB
I_{CC}	Supply current (each amplifier)	$V_O = 0$, No load	25°C	1.4	2.8	1.4	2.8	2.8	mA
V_{O1}/V_{O2}	Crosstalk attenuation	$A_{VD} = 100$	25°C	120	120	120	120	120	dB

(1) All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

(2) Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 13. Pulse techniques must be used that maintain the junction temperatures as close to the ambient temperature as possible.

6.7 Operating Characteristics

 $V_{CC\pm} = \pm 15 \text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	$V_I = 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 19	8 ⁽¹⁾	13		V/ μs
	$V_I = 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, $T_A = -55^\circ\text{C}$ to 125°C , See Figure 19	5 ⁽¹⁾			

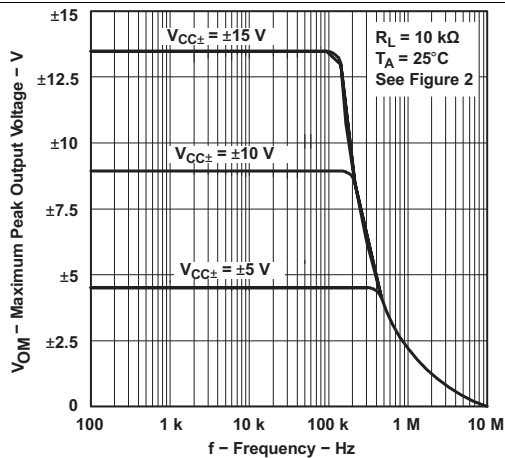
(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

6.9 Typical Characteristics

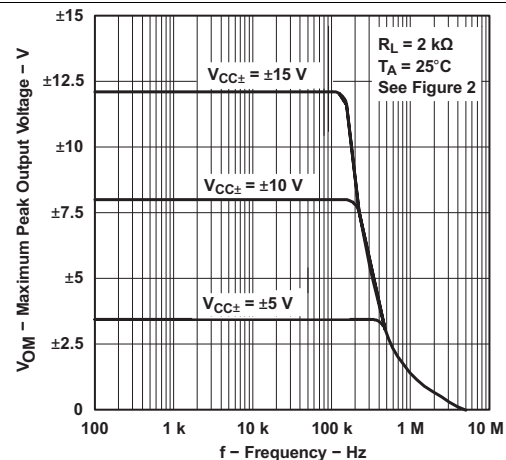
Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. The Figure numbers referenced in the following graphs are located in [Parameter Measurement Information](#).

Table 1. Table of Graphs

			Figure
V_{OM}	Maximum peak output voltage	versus Frequency versus Free-air temperature versus Load resistance versus Supply voltage	Figure 1, Figure 2, Figure 3 Figure 4 Figure 5 Figure 6
A_{VD}	Large-signal differential voltage amplification	versus Free-air temperature versus Load resistance	Figure 7 Figure 8
	Differential voltage amplification	versus Frequency with feed-forward compensation	Figure 9
P_D	Total power dissipation	versus Free-air temperature	Figure 10
I_{CC}	Supply current	versus Free-air temperature versus Supply voltage	Figure 11 Figure 12
I_{IB}	Input bias current	versus Free-air temperature	Figure 13
	Large-signal pulse response	versus Time	Figure 14
V_O	Output voltage	versus Elapsed time	Figure 15
CMRR	Common-mode rejection ratio	versus Free-air temperature	Figure 16
V_n	Equivalent input noise voltage	versus Frequency	Figure 17
THD	Total harmonic distortion	versus Frequency	Figure 18



**Figure 1. Maximum Peak Output Voltage
vs
Frequency**



**Figure 2. Maximum Peak Output Voltage
vs
Frequency**