- **2× Bandwidth (2 MHz) of the TL06x and TL03x Operational Amplifiers**
- **Low Supply Current . . . 290 μA/Ch Typ**
- **On-chip Offset Voltage Trimming for Improved DC Performance**
- **High Output Drive, Specified into 100-Ω Loads**
- **Lower Noise Floor Than Earlier Generations of Low-Power BiFETs**

description

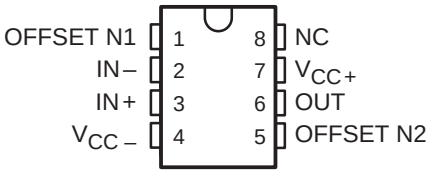
The TLE206x series of low-power JFET-input operational amplifiers doubles the bandwidth of the earlier generation TL06x and TL03x BiFET families without significantly increasing power consumption. Texas Instruments Excalibur process also delivers a lower noise floor than the TL06x and TL03x. On-chip zener trimming of offset voltage yields precision grades for dc-coupled applications. The TL206x devices are pin-compatible with other TI BiFETs; they can be used to double the bandwidth of TL06x and TL03x circuits, or to reduce power consumption of TL05x, TL07x, and TL08x circuits by nearly 90%.

BiFET operational amplifiers offer the inherently-higher input impedance of the JFET-input transistors, without sacrificing the output drive associated with bipolar amplifiers. This makes them better suited for interfacing with high-impedance sensors or very low-level ac signals. They also feature inherently better ac response than bipolar or CMOS devices having comparable power consumption. The TLE206x family features a high-output-drive circuit capable of driving 100-Ω loads at supplies as low as ±5 V. This makes them uniquely suited for driving transformer loads in modems and other applications requiring good ac characteristics, low power, and high output drive.

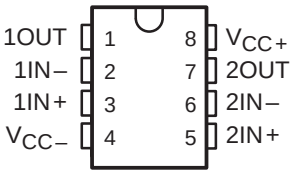
Because BiFET operational amplifiers are designed for use with dual power supplies, care must be taken to observe common-mode input voltage limits and output swing when operating from a single supply. DC biasing of the input signal is required and loads should be terminated to a virtual ground node at mid-supply. Texas Instruments TLE2426 integrated virtual ground generator is useful when operating BiFET amplifiers from single supplies.

The TLE206x are fully specified at ±15 V and ±5 V. For operation in low-voltage and/or single-supply systems, Texas Instruments LinCMOS families of operational amplifiers (TLC- and TLV-prefixes) are recommended. When moving from BiFET to CMOS amplifiers, particular attention should be paid to slew rate and bandwidth requirements, and output loading. The Texas Instrument TLV2432 and TLV2442 CMOS operational amplifiers are excellent choices to consider.

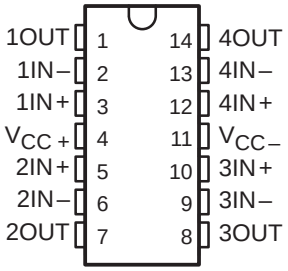
TLE2061, TLE2061A, AND TLE2061B
D, DB, JG, P, OR PW PACKAGE
(TOP VIEW)



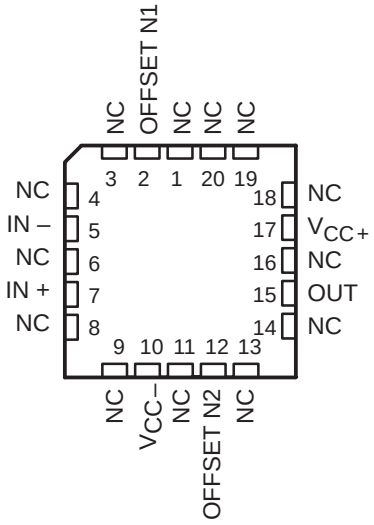
TLE2062, TLE2062A, TLE2062B
D, JG, OR P PACKAGE
(TOP VIEW)



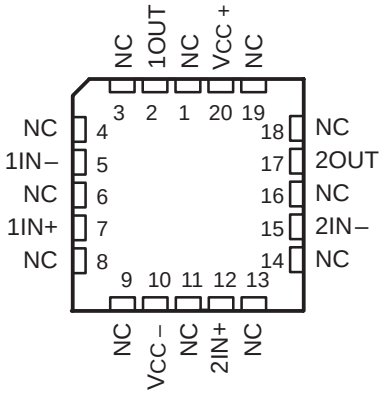
TLE2064, TLE2064A, TLE2064B
D, J, OR N PACKAGE
(TOP VIEW)



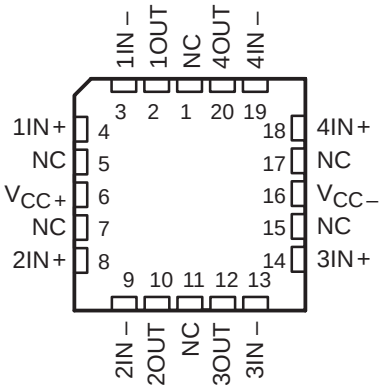
TLE2061M, TLE2061AM, TLE2061BM
FK PACKAGE
(TOP VIEW)



TLE2062M, TLE2062AM, TLE2062BM
FK PACKAGE
(TOP VIEW)

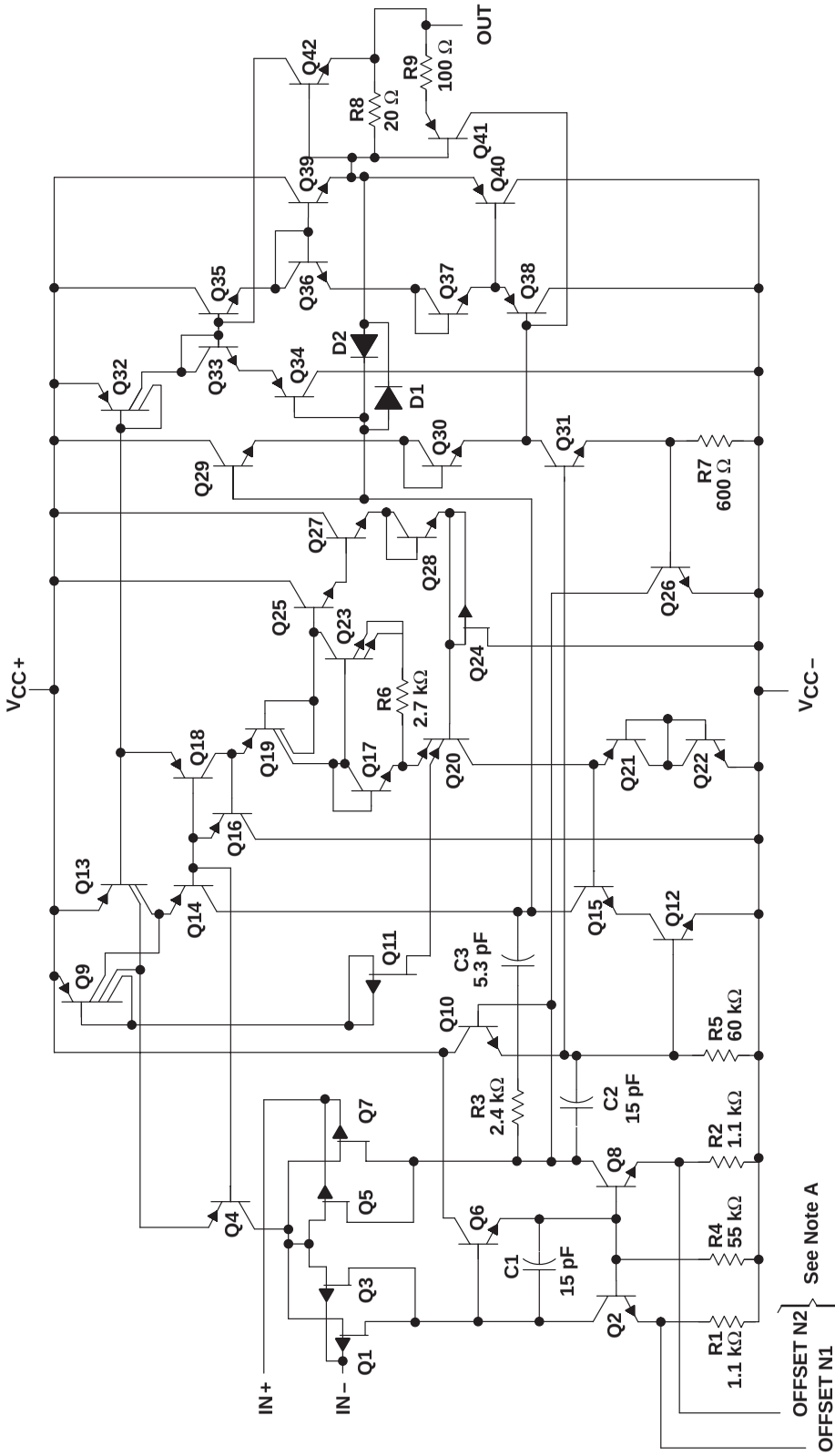


TLE2064M, TLE2064AM, TLE2064BM
FK PACKAGE
(TOP VIEW)



NC – No internal connection

equivalent schematic (each channel)



ACTUAL DEVICE COMPONENT COUNT			
COMPONENT	TLE2061	TLE2062	TLE2064
Transistors	43	42	42
Resistors	9	9	9
Diodes	1	2	2
Capacitors	3	3	3

NOTES: A. OFFSET N1 AND OFFSET N2 are only availiable on the TLE2061x devices.
B. Component values are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC+} (see Note 1) . . . . . 19 V
Supply voltage, V_{CC-} . . . . . –19 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±38 V
Input voltage range, V_I (any input) . . . . . $\pm V_{CC}$
Input current, I_I (each input) . . . . . ±1 mA
Output current, I_O . . . . . ±80 mA
Total current into V_{CC+} . . . . . 80 mA
Total current out of V_{CC-} . . . . . –80 mA
Duration of short-circuit current at (or below) 25°C (see Note 3) . . . . . unlimited
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: C suffix . . . . . 0°C to 70°C
I suffix . . . . . –40°C to 85°C
M suffix . . . . . –55°C to 125°C
Storage temperature range . . . . . –65°C to 150°C
Case temperature for 60 seconds: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, P, or PW package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package . . . . . 300°C

† 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.

NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-}.
2. Differential voltages are at IN+ with respect to IN–.
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D–8	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
D–14	950 mW	7.6 mW/°C	608 mW	494 mW	190 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW	230 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
PW	525 mW	4.2 mW/°C	336 mW	—	—

recommended operating conditions

		C SUFFIX		I SUFFIX		M SUFFIX		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC\pm}$		±3.5	±18	±3.5	±18	±3.5	±18	V
Common-mode input voltage, V_{IC}	$V_{CC\pm}$ = ± 5 V	–1.6	4	–1.6	4	–1.6	4	V
	$V_{CC\pm}$ = ± 15 V	–11	13	–11	13	–11	13	
Operating free-air temperature, T_A		0	70	–40	85	–55	125	°C

TLE2061I electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER			TEST CONDITIONS	T_A†	TLE2061I, TLE2061AI TLE2061BI			UNIT
					MIN	TYP	MAX	
V_{IO}	Input offset voltage	TLE2061I	V_{IC} = 0, R_S = 50 Ω	25°C		0.6	3	mV
				Full range			4.3	
		TLE2061AI		25°C		0.5	1.5	
				Full range			2.9	
		TLE2061BI		25°C		0.3	0.5	
				Full range			1.3	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		6		μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.04		μV/mo
I_{IO}	Input offset current			25°C		2		pA
				Full range			3	nA
I_{IB}	Input bias current			25°C		4		pA
				Full range			5	nA
V_{ICR}	Common-mode input voltage range			25°C	–11 to 13	–12 to 16		V
				Full range	–11 to 13			V
V_{OM+}	Maximum positive peak output voltage swing		R_L = 10 kΩ	25°C	13.2	13.7		V
				Full range	13			
			R_L = 600 Ω	25°C	12.5	13.2		
				Full range	12			
V_{OM-}	Maximum negative peak output voltage swing		R_L = 10 kΩ	25°C	–13.2	–13.7		V
				Full range	–13			
			R_L = 600 Ω	25°C	–12.5	–13		
				Full range	–12			
A_{VD}	Large-signal differential voltage amplification		V_O = ±10 V, R_L = 10 kΩ	25°C	30	230		V/mV
				Full range	20			
			V_O = 0 to 8 V, R_L = 600 Ω	25°C	25	100		
				Full range	10			
			V_O = 0 to –8 V, R_L = 600 Ω	25°C	3	25		
				Full range	01			
r_i	Input resistance			25°C		10^{12}		Ω
c_i	Input capacitance			25°C		4		pF
z_o	Open-loop output impedance		I_O = 0	25°C		280		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	72	90		dB
				Full range	65			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, R_S = 50 Ω	25°C	75	93		dB
				Full range	65			
I_{CC}	Supply current		V_O = 0, No load	25°C		290	350	μA
				Full range			375	
ΔI_{CC}	Supply-current change over operating temperature range			Full range		34		μA

† Full range is –40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLE2061I operating characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V

PARAMETER		TEST CONDITIONS		T_A†	TLE2061I TLE2061AI TLE2061BI			UNIT
					MIN	TYP	MAX	
SR	Slew rate at unity gain (see Figure 1)	R_L = 10 kΩ,	C_L = 100 pF	25°C	2.6	3.4		V/μs
				Full range	2.1			
V_n	Equivalent input noise voltage (see Figure 2)	f = 10 Hz,	R_S = 20 Ω	25°C		70	100	nV/√Hz
		f = 1 kHz,	R_S = 20 Ω			40	60	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.1		μV
I_n	Equivalent input noise current	f = 1 kHz		25°C		1.1		fA/√Hz
THD	Total harmonic distortion	A_{VD} = 2, $V_{O(PP)}$ = 2 V,	f = 10 kHz, R_L = 10 kΩ	25°C		0.025%		
B_1	Unity-gain bandwidth (see Figure 3)	R_L = 10 kΩ,	C_L = 100 pF	25°C		2		MHz
		R_L = 600 Ω,	C_L = 100 pF			1.5		
t_s	Settling time	0.1%		25°C		5		μs
		0.01%				10		
B_{OM}	Maximum output-swing bandwidth	A_{VD} = 1,	R_L = 10 kΩ	25°C		40		kHz
ϕ_m	Phase margin at unity gain (see Figure 3)	R_L = 10 kΩ,	C_L = 100 pF	25°C		60°		
		R_L = 600 Ω,	C_L = 100 pF			70°		

† Full range is –40°C to 85°C.