

LF155/LF156/LF256/LF257/LF355/LF356/LF357

JFET Input Operational Amplifiers

General Description

These are the first monolithic JFET input operational amplifiers to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors (BI-FET™ Technology). These amplifiers feature low input bias and offset currents/low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

Features

Advantages

- Replace expensive hybrid and module FET op amps
- Rugged JFETs allow blow-out free handling compared with MOSFET input devices
- Excellent for low noise applications using either high or low source impedance—very low 1/f corner
- Offset adjust does not degrade drift or common-mode rejection as in most monolithic amplifiers
- New output stage allows use of large capacitive loads (5,000 pF) without stability problems
- Internal compensation and large differential input voltage capability

Applications

- Precision high speed integrators
- Fast D/A and A/D converters
- High impedance buffers
- Wideband, low noise, low drift amplifiers

- Logarithmic amplifiers
- Photocell amplifiers
- Sample and Hold circuits

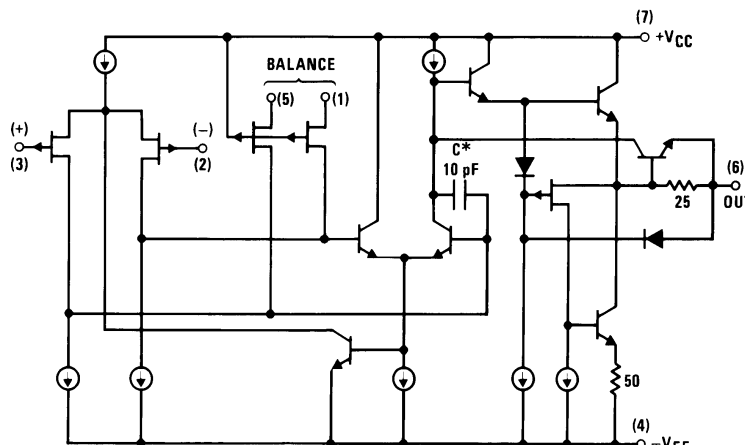
Common Features

- Low input bias current: 30pA
- Low Input Offset Current: 3pA
- High input impedance: $10^{12}\Omega$
- Low input noise current: $0.01 \text{ pA}/\sqrt{\text{Hz}}$
- High common-mode rejection ratio: 100 dB
- Large dc voltage gain: 106 dB

Uncommon Features

	LF155/ LF355	LF156/ LF256/ LF356	LF257/ LF357 ($A_V=5$)	Units
■ Extremely fast settling time to 0.01%	4	1.5	1.5	μs
■ Fast slew rate	5	12	50	$\text{V}/\mu\text{s}$
■ Wide gain bandwidth	2.5	5	20	MHz
■ Low input noise voltage	20	12	12	$\text{nV}/\sqrt{\text{Hz}}$

Simplified Schematic



*3pF in LF357 series.

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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.

	LF155/6	LF256/7/LF356B	LF355/6/7
Supply Voltage	±22V	±22V	±18V
Differential Input Voltage	±40V	±40V	±30V
Input Voltage Range (Note 2)	±20V	±20V	±16V
Output Short Circuit Duration	Continuous	Continuous	Continuous
T_{JMAX}			
H-Package	150°C	115°C	115°C
N-Package		100°C	100°C
M-Package		100°C	100°C
Power Dissipation at $T_A = 25^\circ\text{C}$ (Notes 1, 8)			
H-Package (Still Air)	560 mW	400 mW	400 mW
H-Package (400 LF/Min Air Flow)	1200 mW	1000 mW	1000 mW
N-Package		670 mW	670 mW
M-Package		380 mW	380 mW
Thermal Resistance (Typical) θ_{JA}			
H-Package (Still Air)	160°C/W	160°C/W	160°C/W
H-Package (400 LF/Min Air Flow)	65°C/W	65°C/W	65°C/W
N-Package		130°C/W	130°C/W
M-Package		195°C/W	195°C/W
(Typical) θ_{JC}			
H-Package	23°C/W	23°C/W	23°C/W
Storage Temperature Range	-65°C to +150°C	-65°C to +150°C	-65°C to +150°C
Soldering Information (Lead Temp.)			
Metal Can Package			
Soldering (10 sec.)	300°C	300°C	300°C
Dual-In-Line Package			
Soldering (10 sec.)	260°C	260°C	260°C
Small Outline Package			
Vapor Phase (60 sec.)		215°C	215°C
Infrared (15 sec.)		220°C	220°C
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.			
ESD tolerance			
(100 pF discharged through 1.5k Ω)	1000V	1000V	1000V

DC Electrical Characteristics

(Note 3)

Symbol	Parameter	Conditions	LF155/6			LF256/7 LF356B			LF355/6/7			Units
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input Offset Voltage	$R_S=50\Omega$, $T_A=25^\circ\text{C}$ Over Temperature		3	5		3	5		3	10	mV
					7		6.5		13			mV
$\Delta V_{OS}/\Delta T$	Average TC of Input Offset Voltage	$R_S=50\Omega$		5			5			5	$\mu\text{V}/^\circ\text{C}$	
$\Delta\text{TC}/\Delta V_{OS}$	Change in Average TC with V_{OS} Adjust	$R_S=50\Omega$, (Note 4)		0.5			0.5			0.5	$\mu\text{V}/^\circ\text{C}$ per mV	
I_{OS}	Input Offset Current	$T_J=25^\circ\text{C}$, (Notes 3, 5) $T_J \leq T_{HIGH}$		3	20		3	20		3	50	pA
					20		1		2			nA

DC Electrical Characteristics (Continued)

(Note 3)

Symbol	Parameter	Conditions	LF155/6			LF256/7 LF356B			LF355/6/7			Units
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_B	Input Bias Current	$T_J=25^\circ\text{C}$, (Notes 3, 5) $T_J \leq T_{HIGH}$		30	100		30	100		30	200	pA nA
R_{IN}	Input Resistance	$T_J=25^\circ\text{C}$		10^{12}			10^{12}			10^{12}		Ω
A_{VOL}	Large Signal Voltage Gain	$V_S=\pm 15\text{V}$, $T_A=25^\circ\text{C}$ $V_O=\pm 10\text{V}$, $R_L=2\text{k}$ Over Temperature	50	200		50	200		25	200		V/mV V/mV
V_O	Output Voltage Swing	$V_S=\pm 15\text{V}$, $R_L=10\text{k}$ $V_S=\pm 15\text{V}$, $R_L=2\text{k}$	± 12	± 13		± 12	± 13		± 12	± 13		V V
V_{CM}	Input Common-Mode Voltage Range	$V_S=\pm 15\text{V}$	± 11	+15.1 -12		± 11	± 15.1 -12		+10	+15.1 -12		V V
CMRR	Common-Mode Rejection Ratio		85	100		85	100		80	100		dB
PSRR	Supply Voltage Rejection Ratio	(Note 6)	85	100		85	100		80	100		dB

DC Electrical Characteristics

$T_A = T_J = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$

Parameter	LF155		LF355		LF156/256/257/356B		LF356		LF357		Units
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	
Supply Current	2	4	2	4	5	7	5	10	5	10	mA

AC Electrical Characteristics

$T_A = T_J = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$

Symbol	Parameter	Conditions	LF155/355	LF156/256/ 356B	LF156/256/356/ LF356B	LF257/357	Units
			Typ	Min	Typ	Typ	
SR	Slew Rate	LF155/6: $A_V=1$, LF357: $A_V=5$	5	7.5	12		V/ μs V/ μs
GBW	Gain Bandwidth Product		2.5		5	20	MHz
t_s	Settling Time to 0.01%	(Note 7)	4		1.5	1.5	μs
e_n	Equivalent Input Noise Voltage	$R_S=100\Omega$ $f=100\text{ Hz}$ $f=1000\text{ Hz}$	25 20		15 12	15 12	nV/ $\sqrt{\text{Hz}}$ nV/ $\sqrt{\text{Hz}}$
i_n	Equivalent Input Current Noise	$f=100\text{ Hz}$ $f=1000\text{ Hz}$	0.01 0.01		0.01 0.01	0.01 0.01	pA/ $\sqrt{\text{Hz}}$ pA/ $\sqrt{\text{Hz}}$
C_{IN}	Input Capacitance		3		3	3	pF

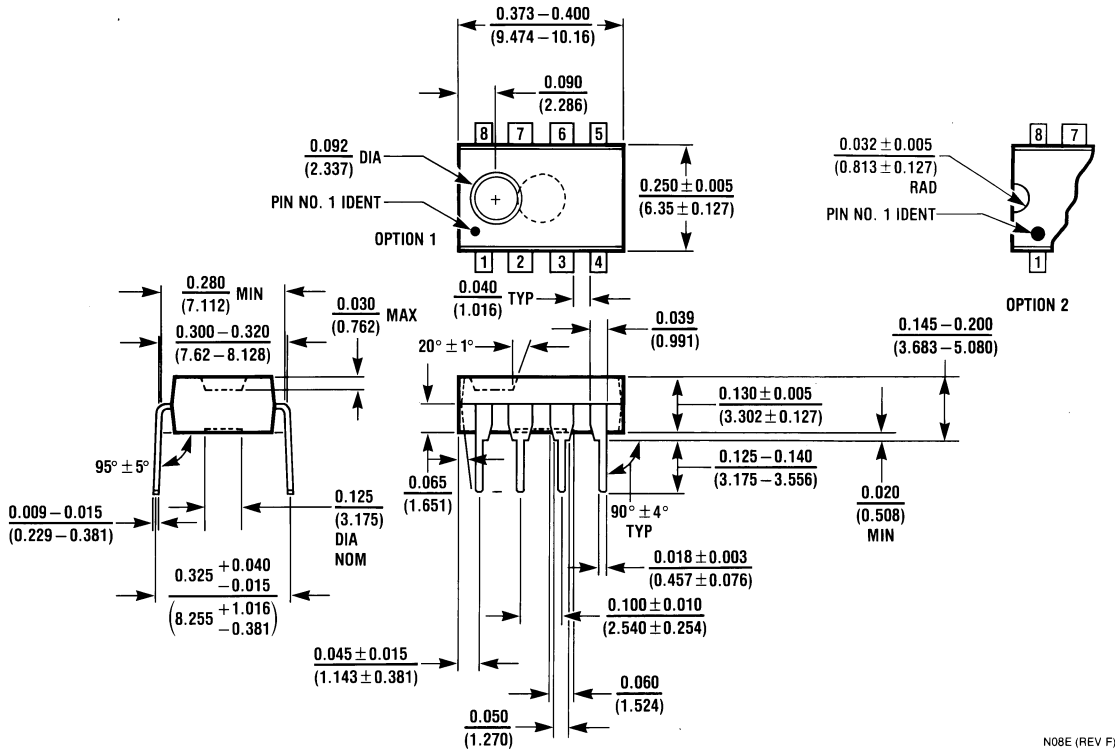
Notes for Electrical Characteristics

Note 1: The maximum power dissipation for these devices must be derated at elevated temperatures and is dictated by T_{JMAX} , θ_{JA} , and the ambient temperature, T_A . The maximum available power dissipation at any temperature is $P_D=(T_{JMAX}-T_A)/\theta_{JA}$ or the 25°C P_{DMAX} , whichever is less.

Note 2: Unless otherwise specified the absolute maximum negative input voltage is equal to the negative power supply voltage.

Note 3: Unless otherwise stated, these test conditions apply:

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Molded Dual-In-Line Package (N)
Order Number LF356N
NS Package Number N08E

N08E (REV F)

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.