

JFET-Input Operational Amplifiers

Low Supply Current (LF155)

High-Speed (LF156)

FEATURES

- *Guaranteed* Offset Voltage Drift on All Grades
- *Guaranteed* Slew Rate on All Grades
- *Guaranteed* Low Input Offset Current 10pA Max.
- *Guaranteed* Low Input Bias Current 50pA Max.
- *Guaranteed* High Slew Rate (156A/356A) 10V/ μ s Min.
- Fast Settling to 0.01% 1.5 μ s

APPLICATIONS

- Output Amplifiers for D/A Converters
- Fast Sample and Hold Circuits
- High Speed Integrators
- Photocell Amplifiers
- High Input Impedance Buffers

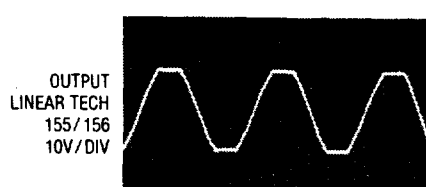
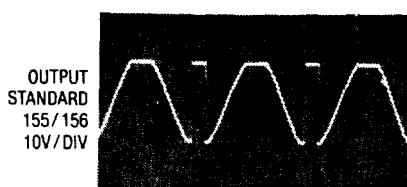
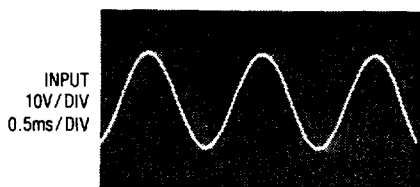
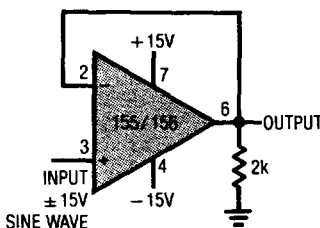
DESCRIPTION

Linear Technology's LF155/156 series features several improvements compared to similar types from other manufacturers: offset voltage drift with temperature and slew rate are guaranteed on all grades, not just on the more expensive "A" grades. Other specifications such as voltage gain and high temperature bias and offset currents are also improved.

The industry standard LF155/156 devices exhibit phase reversal at the output when the negative common-mode limit at the input is exceeded (i.e., from -12V to -15V with $\pm 15\text{V}$ supplies). This can cause lock-up in servo systems. As shown below, Linear Technology's LF155/156 does not have this problem due to unique phase reversal protection circuitry. For applications requiring higher performance, see the LT1055 and LT1056 data sheets.

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Voltage Follower with Input Exceeding the Negative Common-Mode Range



ABSOLUTE MAXIMUM RATINGS

Supply Voltage

LF155A/155/355A,	
LF156A/156/356A	± 22V
LF355/356	± 18V

Differential Input Voltage

LF155A/155/156A/156	± 40V
LF355A/355/356A/356	± 30V

Input Voltage (Note 1)

LF155A/155/156A/156	± 20V
LF355A/355/356A/356	± 16V

Output Short Circuit Duration

Indefinite

Operating Temperature Range

LF155A/155/156A/156	− 55°C to 125°C
LF355A/355/356A/356	0°C to 70°C

Maximum Junction Temperature

LF155A/155/156A/156	150°C
LF355A/355/356A/356	100°C

Storage Temperature Range

All Devices	− 65°C to 150°C
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Lead Temperature (Soldering, 10 sec.)

300°C

PACKAGE/ORDER INFORMATION

TOP VIEW H PACKAGE METAL CAN	ORDER PART NUMBER <table> <tr> <td>LF155H</td> <td>LF156H</td> </tr> <tr> <td>LF155AH</td> <td>LF156AH</td> </tr> <tr> <td>LF355H</td> <td>LF356H</td> </tr> <tr> <td>LF355AH</td> <td>LF356AH</td> </tr> </table>	LF155H	LF156H	LF155AH	LF156AH	LF355H	LF356H	LF355AH	LF356AH
LF155H	LF156H								
LF155AH	LF156AH								
LF355H	LF356H								
LF355AH	LF356AH								
TOP VIEW N8 PACKAGE 8 PIN PLASTIC	<table> <tr> <td>LF355N8</td> <td>LF356N8</td> </tr> <tr> <td>LF355AN8</td> <td>LF356AN8</td> </tr> </table> V_{OS} is adjusted with a 20k or 50k potentiometer between the balance terminals. The wiper is tied to V^+	LF355N8	LF356N8	LF355AN8	LF356AN8				
LF355N8	LF356N8								
LF355AN8	LF356AN8								

ELECTRICAL CHARACTERISTICS (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LF155A/156A LF355A/356A			LF155/156			LF355/356			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	$T_A = 25^\circ\text{C}$ Over Temperature	●		1	2		2	3.5		3	8	mV
		355A/356A	●			2.5			4.8			9	mV
$\frac{\Delta V_{OS}}{\Delta T}$	Average TC of Input Offset Voltage	$R_S = 50\Omega$	●		3	5		5	15		5	25	$\mu\text{V}/^\circ\text{C}$
	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	$T_J = 25^\circ\text{C}$ (Note 3)	●		3	10		3	20		3	50	pA
		$T_J \leq 125^\circ\text{C}$	●			9			9			—	nA
		$T_J \leq 70^\circ\text{C}$	●			0.7			—			1.5	nA
I_B	Input Bias Current	$T_J = 25^\circ\text{C}$ (Note 3)	●		30	50		30	100		30	200	pA
		$T_J \leq 125^\circ\text{C}$	●			15			15			—	nA
		$T_J \leq 70^\circ\text{C}$	●			0.9			—			3.0	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	●	75	200		50	200		40	200		V/mV
			●	30			25			25			V/mV

ELECTRICAL CHARACTERISTICS (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LF155A/156A LF355A/356A			LF155/156			LF355/356			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_O	Output Voltage Swing	$V_S = \pm 15V$, $R_L = 10k$ $V_S = \pm 15V$, $R_L = 2k$	● ●	± 12 ± 10	± 13 ± 12		± 12 ± 10	± 13 ± 12		± 12 ± 10	± 13 ± 12		V V
V_{CM}	Input Common-Mode Voltage Range	$V_S = \pm 15V$	●	± 11	$+15.1$ -12		± 11	$+15.1$ -12		± 10	± 15.1 -12		V
CMRR	Common-Mode Rejection Ratio		●	.85	100		85	100		80	100		dB
PSRR	Supply Voltage Rejection Ratio	$V_S = \pm 10V$ to $\pm 18V$ $V_S = \pm 10V$ to $\pm 15V$	● ●	85	100		85	100		—	—		dB dB
I_S	Supply Current	$T_A = 25^\circ C$, $V_S = \pm 15V$ LF155/355 Series LF156/356 Series LF356A			2 5 5	4 7 7		2 5 —	4 7 —		2 5 —	4 10 —	mA mA mA
SR	Slew Rate	$A_V = +1$ $T_A = 25^\circ C$, $V_S = \pm 15V$ LF155/355 Series LF156/356 Series			5 10	7 12		5 9	7 12		2.5 4	6 12	V/ μs V/ μs
GBW	Gain Bandwidth Product	$T_A = 25^\circ C$, $V_S = \pm 15V$ LF155/355 Series LF156/356 Series		— 4	2.5 5		2.5 5			2.5 5			MHz MHz
t_S	Settling Time to 0.01%	$T_A = 25^\circ C$, $V_S = \pm 15V$ LF155 Series (Note 5) LF156 Series			4 1.5		4 1.5			4 1.5			μs μs
e_n	Input Noise Voltage Density	$T_A = 25^\circ C$, $V_S = \pm 15V$ $f = 100Hz$ LF155 Series LF156 Series $f = 1000Hz$ LF155 Series LF156 Series			25 15 20 12		25 15 20 12			25 15 20 12			nV/ $\sqrt{Hz}$ nV/ $\sqrt{Hz}$ nV/ $\sqrt{Hz}$ nV/ $\sqrt{Hz}$
i_n	Input Noise Current Density	$T_A = 25^\circ C$, $V_S = \pm 15V$ $f = 100Hz$ $f = 1000Hz$			0.01 0.01		0.01 0.01			0.01 0.01			pA/ $\sqrt{Hz}$ pA/ $\sqrt{Hz}$
C_{IN}	Input Capacitance		●	3			3			3			pF

The ● denotes the specifications which apply over the full operating temperature range. The shaded electrical specifications indicate those parameters which have been improved or guaranteed test limits provided for the first time.

For MIL-STD components, please refer to LTC 883C data sheet for test listing and parameters.

Note 1: Unless otherwise specified, the absolute maximum negative input voltage is equal to the negative power supply voltage.

Note 2: Unless otherwise stated, these test conditions apply:

	LF155A/156A LF155/156	LF355A/356A	LF355/356
Supply Voltage, V_S	$\pm 15V \leq V_S \leq \pm 20V$	$\pm 15V \leq V_S \leq \pm 18V$	$V_S = \pm 15V$
T_A	$-55^\circ C \leq T_A \leq +125^\circ C$	$0^\circ C \leq T_A \leq +70^\circ C$	$0^\circ C \leq T_A \leq +70^\circ C$

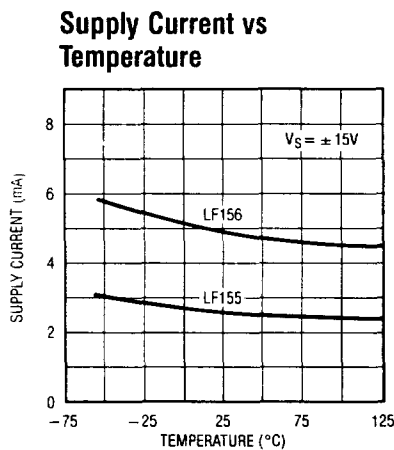
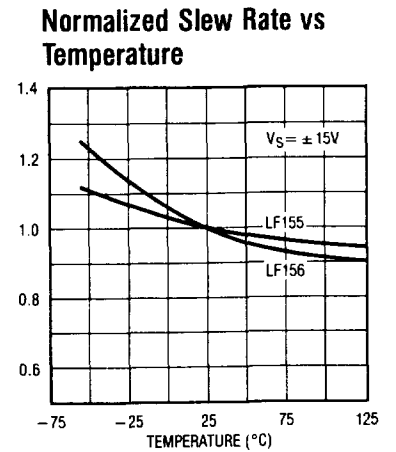
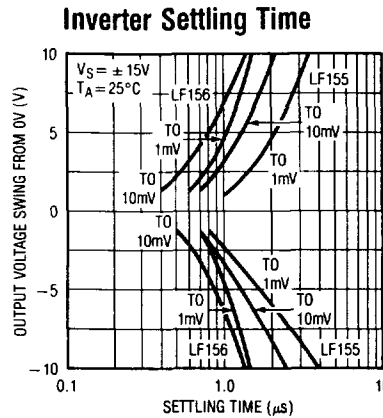
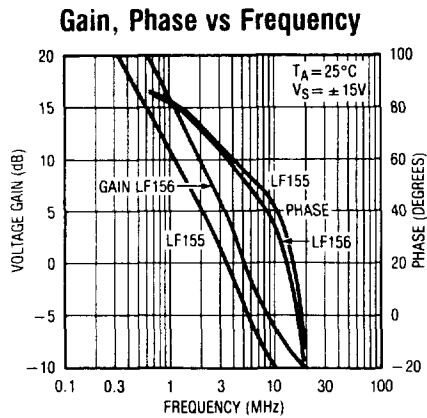
and V_{OS} , I_B and I_{OS} are measured at $V_{CM} = 0$.

Note 3: The input bias currents are junction leakage currents which approximately double for every $10^\circ C$ increase in the junction temperature, T_J . Due to limited production test time, the input bias currents measured are correlated to junction temperature. In normal operation the junction temperature rises above the ambient temperature as a result of internal power dissipation, P_D . $T_J = T_A + \Theta_{JA} P_D$ where Θ_{JA} is the thermal resistance from junction to ambient. Use of a heat sink is recommended if input bias current is to be kept to a minimum.

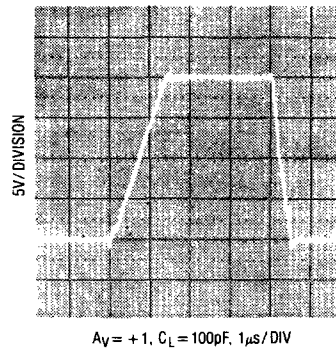
Note 4: The temperature coefficient of the adjusted input offset voltage changes only a small amount ($0.5\mu V/^\circ C$ typically) for each mV of adjustment from its original unadjusted value. Common-mode rejection and open loop voltage gain are also unaffected by offset adjustment.

Note 5: Settling time is defined here for a unity gain inverter connection using $2k\Omega$ resistors. It is the time required for the error voltage (the voltage at the inverting input pin on the amplifier) to settle to within 0.01% of its final value from the time a 10V step input is applied to the inverter.

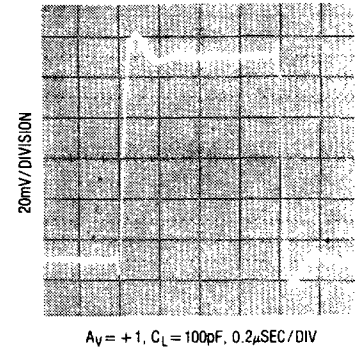
TYPICAL PERFORMANCE CHARACTERISTICS



LF156 Large Signal Response

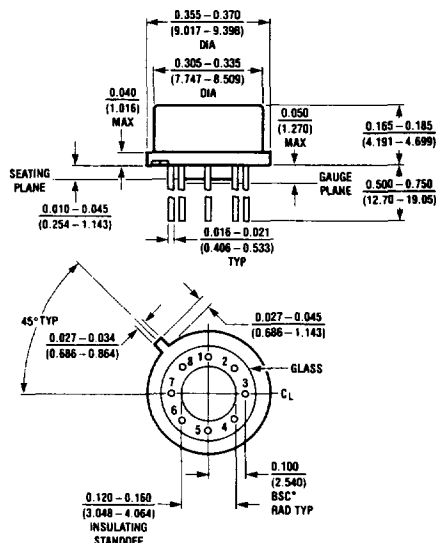


LF156 Small Signal Response



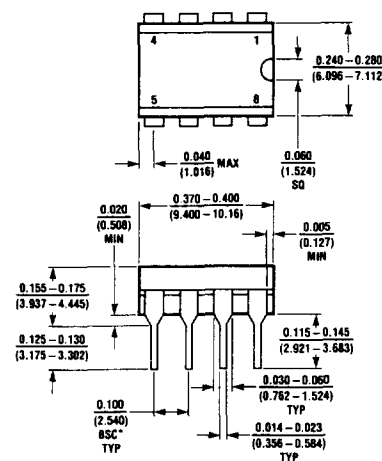
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

H Package Metal Can



$T_{j\text{max}}$	θ_{ja}	θ_{jc}
150°C	150°C/W	45°C/W

N8 Package 8 Lead Plastic



*LEADS WITHIN 0.007 OF TRUE POSITION (TP) AT GAUGE PLANE

$T_{j\text{max}}$	θ_{ja}
100°C	130°C/W