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/μs Min.
- Fast Settling to 0.01% 1.5μs

APPLICATIONS

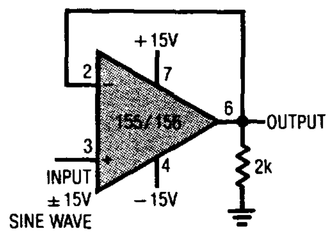
- Output Amplifiers for D/A Converters
- Fast Sample and Hold Circuits
- High Speed Integrators
- Photocell Amplifiers
- High Input Impedance Buffers

DESCRIPTION

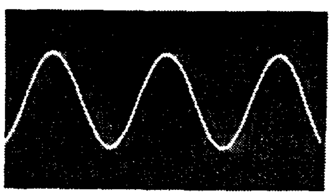
Linear Technology's LF155/156 series features several improvements compared to similar types from other manufacturers: offset voltage drift with temperature and slew rate are guaranteed on all grades, not just on the more expensive "A" grades. Other specifications such as voltage gain and high temperature 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 ±15V 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.

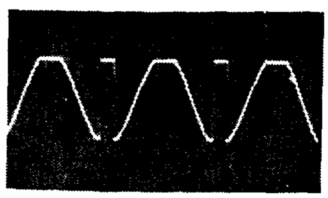
Voltage Follower with Input Exceeding the Negative Common-Mode Range



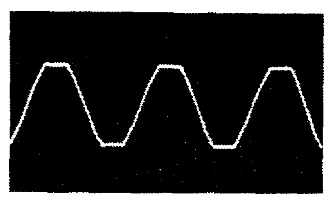
INPUT
10V/DIV
0.5ms/DIV



OUTPUT
STANDARD
155/156
10V/DIV



OUTPUT
LINEAR TECH
155/156
10V/DIV



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

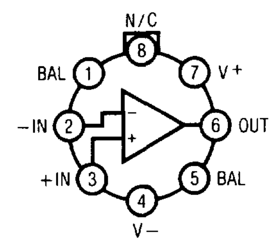
Maximum Junction Temperature
- LF155A/155/156A/156 .... 150°C
- LF355A/355/356A/356 .... 100°C

Storage Temperature Range
- All Devices .... −65°C to 150°C

Lead Temperature (Soldering, 10 sec.)........ 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW

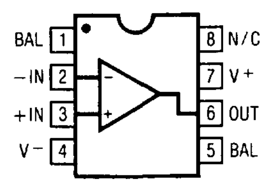


H PACKAGE
METAL CAN

ORDER PART NUMBER

LF155H	LF156H
LF155AH	LF156AH
LF355H	LF356H
LF355AH	LF356AH

TOP VIEW



N8 PACKAGE
8 PIN PLASTIC

LF355N8	LF356N8
LF355AN8	LF356AN8

V_{OS} is adjusted with a 20k or 50k potentiometer between the balance terminals. The wiper is tied to V^+

ELECTRICAL CHARACTERISTICS (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LF155A/156A LF355A/356A MIN	TYP	MAX	LF155/156 MIN	TYP	MAX	LF355/356 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	$T_A = 25°C$			1	2		2	3.5		3	8	mV
		Over Temperature	●			2.5			4.8			9	mV
		355A/356A	●			2.3							mV
$\frac{\Delta V_{OS}}{\Delta T}$	Average TC of Input Offset Voltage	$R_S = 50\Omega$	●		3	5		5	15		5	25	µV/°C
	Change in Average TC with V_{OS} Adjust	$R_S = 50\Omega$ (Note 4)	●		0.5			0.5			0.5		µV/°C per mV
I_{OS}	Input Offset Current	$T_j = 25°C$ (Note 3)			3	10		3	20		3	50	pA
		$T_j \le 125°C$	●			9			9			—	nA
		$T_j \le 70°C$	●			0.7			—			1.5	nA
I_B	Input Bias Current	$T_j = 25°C$ (Note 3)			30	50		30	100		30	200	pA
		$T_j \le 125°C$	●			15			15			—	nA
		$T_j \le 70°C$	●			0.9			—			3.0	nA
R_{IN}	Input Resistance	$T_j = 25°C$			10^{12}			10^{12}			10^{12}		Ω
A_{VOL}	Large Signal Voltage Gain	$V_S = \pm 15V$, $T_A = 25°C$, $V_O = \pm 10V$, $R_L = 2k$		75	200		50	200		40	200		V/mV
		Over Temperature	●	30			25			25			V/mV

ELECTRICAL CHARACTERISTICS (Note 2)

SYMBOL	PARAMETER	CONDITIONS		LF155A/156A LF355A/356A MIN	TYP	MAX	LF155/156 MIN	TYP	MAX	LF355/356 MIN	TYP	MAX	UNITS
V_O	Output Voltage Swing	$V_S=\pm15V$, $R_L=10k$ $V_S=\pm15V$, $R_L=2k$	● ●	±12 ±10	±13 ±12		±12 ±10	±13 ±12		±12 ±10	±13 ±12		V V
V_{CM}	Input Common-Mode Voltage Range	$V_S=\pm15V$	●	±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	$V_S=\pm10V$ to $\pm18V$ $V_S=\pm10V$ to $\pm15V$	● ●	85	100 —		85	100 —		— 80	— 100		dB dB
I_S	Supply Current	$T_A=25°C$, $V_S=\pm15V$ 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	$A_V=+1$ $T_A=25°C$, $V_S=\pm15V$ 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	$T_A=25°C$, $V_S=\pm15V$ 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%	$T_A=25°C$, $V_S=\pm15V$ LF155 Series (Note 5) LF156 Series			4 1.5			4 1.5			4 1.5		µs µs
e_n	Input Noise Voltage Density	$T_A=25°C$, $V_S=\pm15V$ f=100Hz LF155 Series LF156 Series			25 15			25 15			25 15		$nV/\sqrt{Hz}$ $nV/\sqrt{Hz}$
		f=1000Hz LF155 Series LF156 Series			20 12			20 12			20 12		$nV/\sqrt{Hz}$ $nV/\sqrt{Hz}$
i_n	Input Noise Current Density	$T_A=25°C$, $V_S=\pm15V$ 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	$\pm15V \le V_S \le \pm20V$	$\pm15V \le V_S \le \pm18V$	$V_S=\pm15V$
T_A	$-55°C \le T_A \le +125°C$	$0°C \le T_A \le +70°C$	$0°C \le T_A \le +70°C$

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

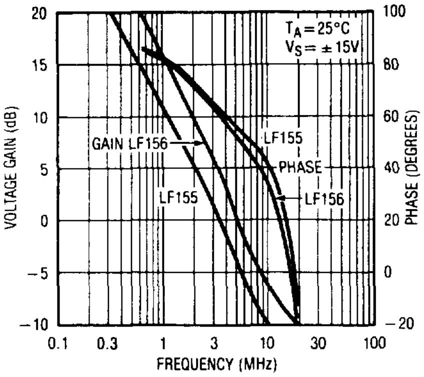
Note 3: The input bias currents are junction leakage currents which approximately double for every 10°C increase in the junction temperature, T_j. Due to limited production test time, the input bias currents measured are correlated to junction temperature. In normal operation the junction temperature 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 (0.5µV/°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.

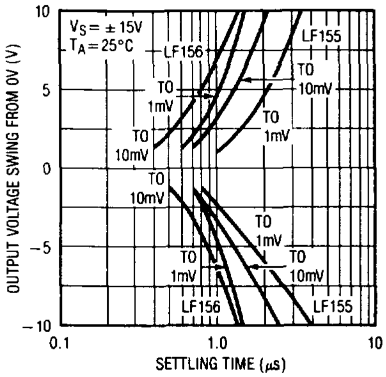
Note 5: Settling time is defined here for a unity gain inverter connection using 2kΩ resistors. It is the time required for the error voltage (the voltage at the inverting input pin on the amplifier) to settle to within 0.01% of its final value from the time a 10V step input is applied to the inverter.

TYPICAL PERFORMANCE CHARACTERISTICS

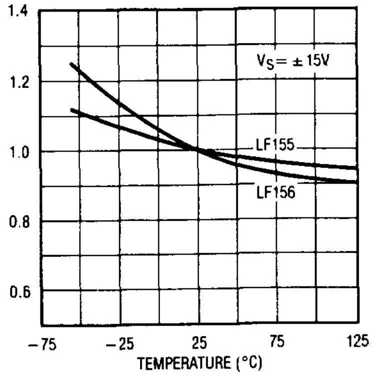
Gain, Phase vs Frequency



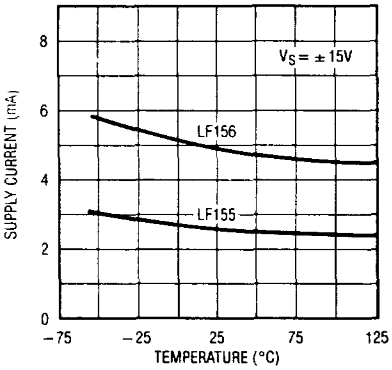
Inverter Settling Time



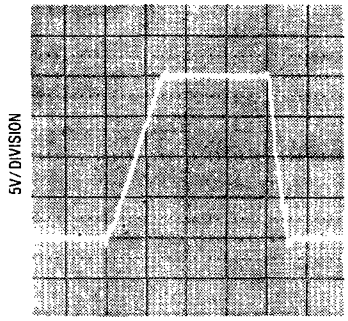
Normalized Slew Rate vs Temperature



Supply Current vs Temperature

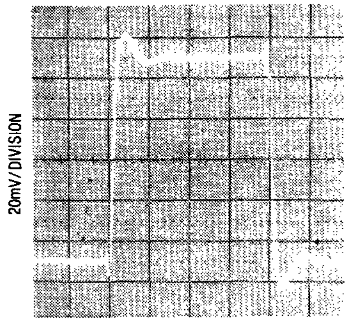


LF156 Large Signal Response



$A_V = +1$, $C_L = 100pF$, 1μs/DIV

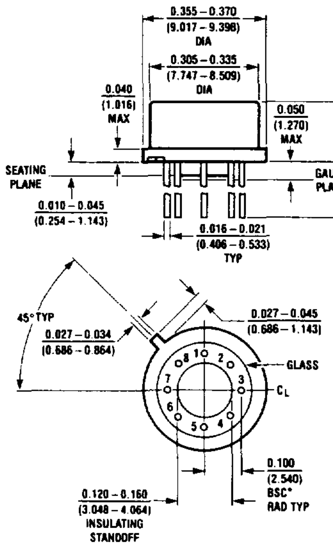
LF156 Small Signal Response



$A_V = +1$, $C_L = 100pF$, 0.2μSEC/DIV

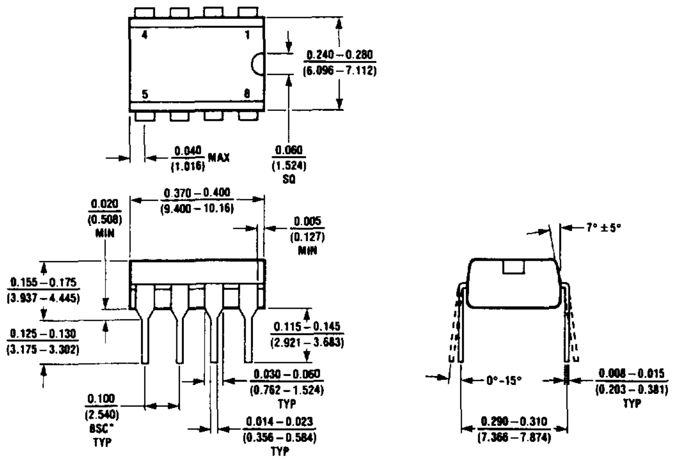
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

H Package Metal Can



$T_j$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

$T_j$max	θ_{ja}
100°C	130°C/W

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