National Semiconductor

LF412
Low Offset, Low Drift Dual JFET Input Operational Amplifier

General Description

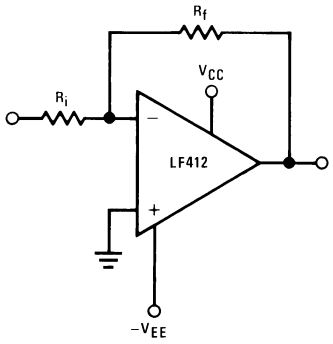
These devices are low cost, high speed, JFET input operational amplifiers with very low input offset voltage and guaranteed input offset voltage drift. They require low supply current yet maintain a large gain bandwidth product and fast slew rate. In addition, well matched high voltage JFET input devices provide very low input bias and offset currents. The LF412 dual is pin compatible with the LM1558, allowing designers to immediately upgrade the overall performance of existing designs.

These amplifiers may be used in applications such as high speed integrators, fast D/A converters, sample and hold circuits and many other circuits requiring low input offset voltage and drift, low input bias current, high input impedance, high slew rate and wide bandwidth.

Features

- Internally trimmed offset voltage: 1 mV (max)
- Input offset voltage drift: 10 µV/˚C (max)
- Low input bias current: 50 pA
- Low input noise current: 0.01 pA/$\sqrt{\text{Hz}}$
- Wide gain bandwidth: 3 MHz (min)
- High slew rate: 10V/µs (min)
- Low supply current: 1.8 mA/Amplifier
- High input impedance: $10^{12}\Omega$
- Low total harmonic distortion ≤0.02%
- Low 1/f noise corner: 50 Hz
- Fast settling time to 0.01%: 2 µs

Typical Connection



00565641

Ordering Information

LF412XYZ

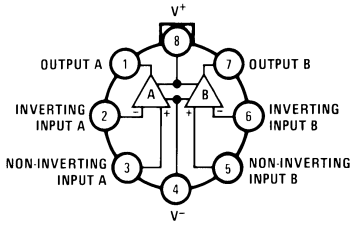
X indicates electrical grade

Y indicates temperature range
- "M" for military
- "C" for commercial

Z indicates package type
- "H" or "N"

Connection Diagrams

Metal Can Package



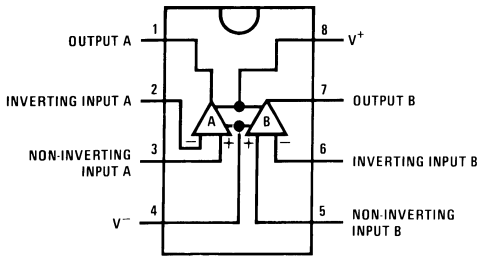
Note. Pin 4 connected to case.

TOP VIEW

00565642

Order Number LF412MH, LF412CH or LF412MH/883 (Note 1)
See NS Package Number H08A

Dual-In-Line Package



TOP VIEW

00565644

Order Number LF412ACN, LF412CN or LF412MJ/883 (Note 1)
See NS Package Number J08A or N08E

BI-FET II™ is a trademark of National Semiconductor Corporation.

 DS005656

Absolute Maximum Ratings (Note 2)

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

(Note 11)

	LF412A	LF412
Supply Voltage	±22V	±18V
Differential Input Voltage	±38V	±30V
Input voltage Range (Note 3)	±19V	±15V
Output Short Circuit Duration (Note 4)	Continuous	Continuous

	H Package	N Package
Power Dissipation (Note 12)	(Note 5)	670 mW
T_j max	150˚C	115˚C
θ_{jA} (Typical)	152˚C/W	115˚C/W
Operating Temp. Range	(Note 6)	(Note 6)
Storage Temp. Range	$-65˚C \le T_A \le 150˚C$	$-65˚C \le T_A \le 150˚C$
Lead Temp. (Soldering, 10 sec.)	260˚C	260˚C
ESD Tolerance (Note 13)	1700V	1700V

DC Electrical Characteristics

(Note 7)

Symbol	Parameter	Conditions		LF412A			LF412			Units
				Min	Typ	Max	Min	Typ	Max	
V_{OS}	Input Offset Voltage	R_S=10 kΩ, T_A=25˚C			0.5	1.0		1.0	3.0	mV
$\Delta V_{OS}/\Delta T$	Average TC of Input Offset Voltage	R_S=10 kΩ (Note 8)			7	10		7	20	µV/˚C
I_{OS}	Input Offset Current	V_S=±15V (Notes 7, 9)	T_j=25˚C		25	100		25	100	pA
			T_j=70˚C			2			2	nA
			T_j=125˚C			25			25	nA
I_B	Input Bias Current	V_S=±15V (Notes 7, 9)	T_j=25˚C		50	200		50	200	pA
			T_j=70˚C			4			4	nA
			T_j=125˚C			50			50	nA
R_{IN}	Input Resistance	T_j=25˚C			10^{12}			10^{12}		Ω
A_{VOL}	Large Signal Voltage Gain	V_S=±15V, V_O=±10V, R_L=2k, T_A=25˚C		50	200		25	200		V/mV
		Over Temperature		25	200		15	200		V/mV
V_O	Output Voltage Swing	V_S=±15V, R_L=10k		±12	±13.5		±12	±13.5		V
V_{CM}	Input Common-Mode Voltage Range			±16	+19.5		±11	+14.5		V
					−16.5			−11.5		V
CMRR	Common-Mode Rejection Ratio	$R_S \le 10k$		80	100		70	100		dB
PSRR	Supply Voltage Rejection Ratio	(Note 10)		80	100		70	100		dB
I_S	Supply Current	V_O = 0V, R_L = ∞			3.6	5.6		3.6	6.5	mA

Note 2: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

AC Electrical Characteristics

(Note 7)

Symbol	Parameter	Conditions	LF412A			LF412			Units
			Min	Typ	Max	Min	Typ	Max	
	Amplifier to Amplifier Coupling	T_A=25˚C, f=1 Hz-20 kHz (Input Referred)		−120			−120		dB
SR	Slew Rate	V_S=±15V, T_A=25˚C	10	15		8	15		V/µs
GBW	Gain-Bandwidth Product	V_S=±15V, T_A=25˚C	3	4		2.7	4		MHz

AC Electrical Characteristics (Continued)

(Note 7)

Symbol	Parameter	Conditions	LF412A			LF412			Units
			Min	Typ	Max	Min	Typ	Max	
THD	Total Harmonic Dist	A_V=+10, R_L=10k, V_O=20 Vp-p, BW=20 Hz-20 kHz		≤0.02			≤0.02		%
e_n	Equivalent Input Noise Voltage	T_A=25˚C, R_S=100Ω, f=1 kHz		25			25		$nV/\sqrt{Hz}$
i_n	Equivalent Input Noise Current	T_A=25˚C, f=1 kHz		0.01			0.01		$pA/\sqrt{Hz}$

Note 3: Unless otherwise specified the absolute maximum negative input voltage is equal to the negative power supply voltage.

Note 4: Any of the amplifier outputs can be shorted to ground indefintely, however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.

Note 5: For operating at elevated temperature, these devices must be derated based on a thermal resistance of θ_{jA}.

Note 6: These devices are available in both the commercial temperature range 0˚C≤T_A≤70˚C and the military temperature range −55˚C≤T_A≤125˚C. The temperature range is designated by the position just before the package type in the device number. A "C" indicates the commercial temperature range and an "M" indicates the military temperature range. The military temperature range is available in "H" package only. In all cases the maximum operating temperature is limited by internal junction temperature T_j max.

Note 7: Unless otherwise specified, the specifications apply over the full temperature range and for V_S=±20V for the LF412A and for V_S=±15V for the LF412. V_{OS}, I_B, and I_{OS} are measured at V_{CM}=0.

Note 8: The LF412A is 100% tested to this specification. The LF412 is sample tested on a per amplifier basis to insure at least 85% of the amplifiers meet this specification.

Note 9: 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+θ_{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 10: Supply voltage rejection ratio is measured for both supply magnitudes increasing or decreasing simultaneously in accordance with common practice. V_S = ±6V to ±15V.

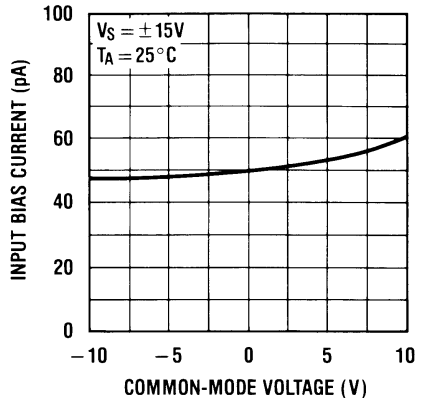
Note 11: Refer to RETS412X for LF412MH and LF412MJ military specifications.

Note 12: Max. Power Dissipation is defined by the package characteristics. Operating the part near the Max. Power Dissipation may cause the part to operate outside guaranteed limits.

Note 13: Human body model, 1.5 kΩ in series with 100 pF.

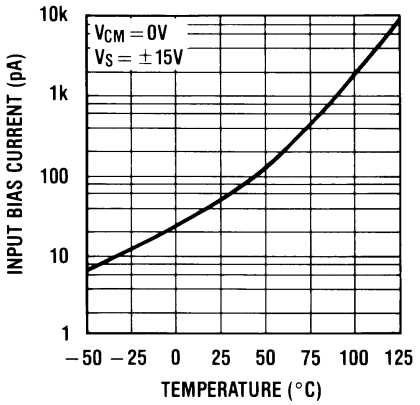
Typical Performance Characteristics

Input Bias Current



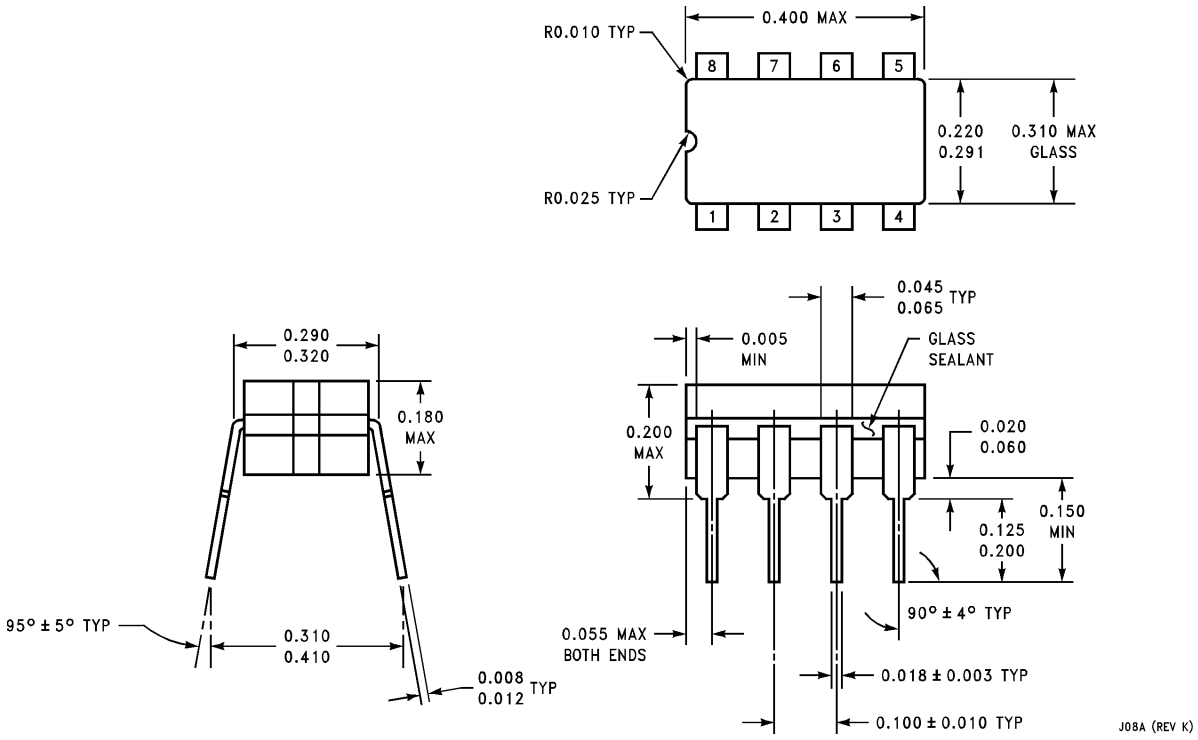
00565610

Input Bias Current

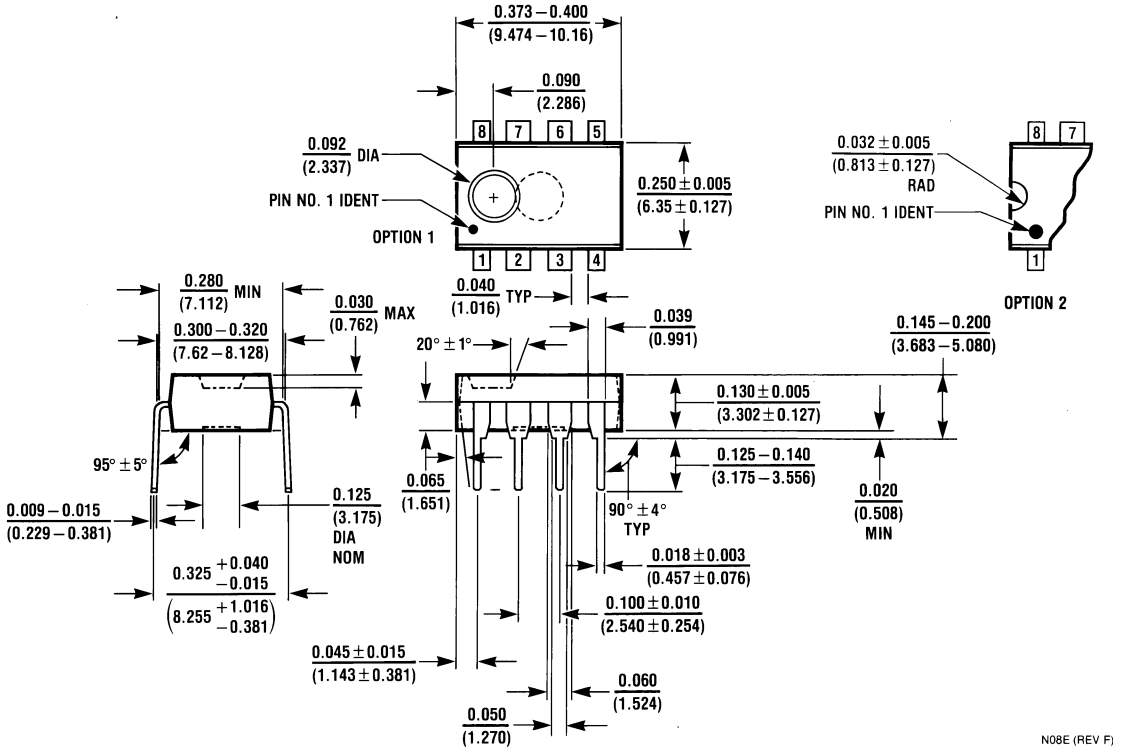


00565611

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



Dual-In-Line Package (J)
Order Number LF412MJ/883
NS Package Number J08A



Dual-In-Line Package (N)
Order Number LF412ACN or LF412CN
NS Package Number N08E