



LF411C LF412C

Low Offset, Low Drift JFET Input Operational Amplifiers

Through innovative design concepts and precision matching this monolithic high speed JFET input operational amplifier family offers very low input offset voltage as well as low temperature coefficient of input offset voltage. The amplifier requires less than 3.4 mA per amplifier of supply current yet exhibits greater than 2.7 MHz of gain bandwidth product and more than 8.0 V/ μ s slew rate. Through the use of JFET inputs the amplifier has very low input bias currents and low input offset currents. The amplifier utilizes industry standard pinouts which afford the user the opportunity to directly upgrade circuit performance without the need for redesign.

The LF411C and LF412C are available in the industry standard plastic 8-pin DIP and SO-8 surface mount packages, and specified over the commercial temperature range.

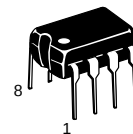
- Low Input Offset Voltage: 2.0 mV Max (Single)
3.0 mV Max (Dual)
- Low T.C. of Input Offset Voltage: 10 μ V/ $^{\circ}$ C
- Low Input Offset Current: 20 pA
- Low Input Bias Current: 60 pA
- Low Input Noise Voltage: 18 nV/ $\sqrt{\text{Hz}}$
- Low Input Noise Current: 0.01 pA/ $\sqrt{\text{Hz}}$
- Low Total Harmonic Distortion: 0.05%
- Low Supply Current: 2.5 mA
- High Input Resistance: $10^{12} \Omega$
- Wide Gain Bandwidth: 8.0 MHz
- High Slew Rate: 25 V/ μ s (Typ)
- Fast Settling Time: 1.6 μ s (to within 0.01%)
- Internally Compensated

ORDERING INFORMATION

Device	Function	Operating Temperature Range	Package
LF411CD	Single	$T_A = 0^{\circ}$ to $+70^{\circ}\text{C}$	SO-8
LF411CN			Plastic DIP
LF412CD	Dual		SO-8
LF412CN			Plastic DIP

SINGLE/DUAL JFET OPERATIONAL AMPLIFIERS

SEMICONDUCTOR TECHNICAL DATA

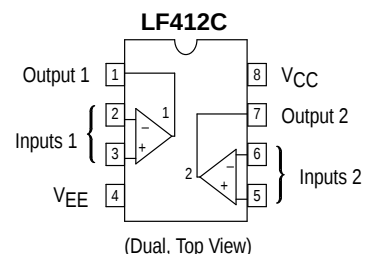
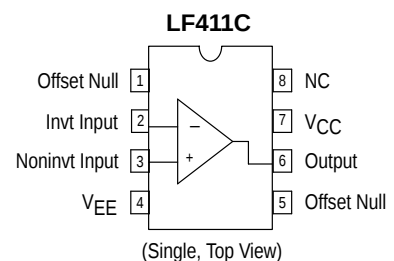


N SUFFIX
PLASTIC PACKAGE
CASE 626



D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

PIN CONNECTIONS



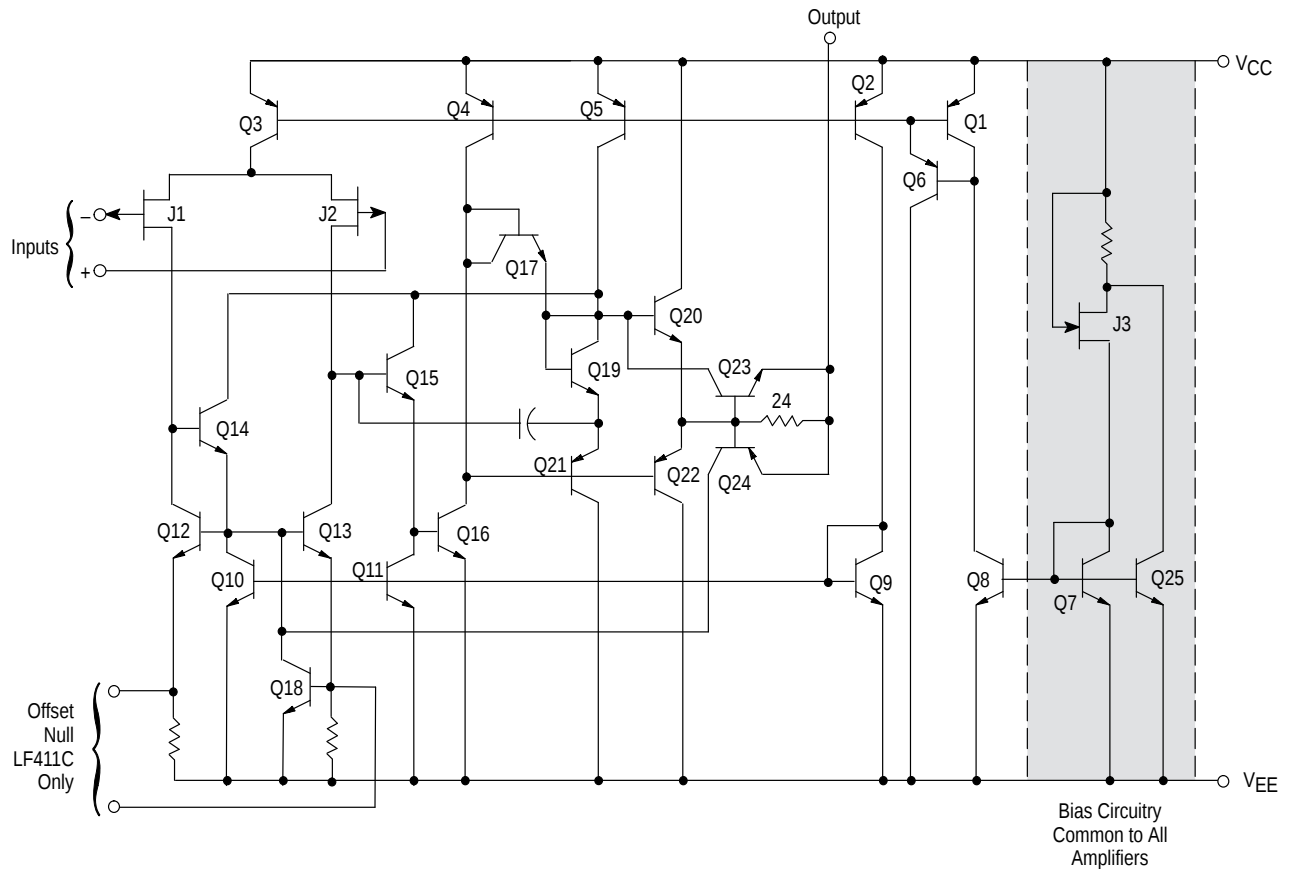
LF411C LF412C

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltages	$V_{CC}, V_{EE} $	+18	V
Input Differential Voltage Range (Note 1)	V_{IDR}	± 30	V
Input Voltage Range (Note 1)	V_{IR}	± 15	V
Output Short Circuit Duration (Note 2)	t_{SC}	Indefinite	sec
Maximum Junction Temperature	T_J	+150	°C
Operating Ambient Temperature Range	T_A	0 to 70	°C
Thermal Resistance (Junction-to-Ambient)	$R\theta_{JA}$	100 180	°C/W
Storage Temperature	T_{stg}	-60 to +150	°C
Maximum Power Dissipation	P_D	(Note 2)	mW

NOTES: 1. Input voltages should not exceed V_{CC} or V_{EE} .
2. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded.

Representative Schematic Diagram (Each Amplifier)



LF411C LF412C

ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = 0^\circ$ to 70°C , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ($R_S = 10\text{ k}\Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) LF411 LF412	$ V_{IO} $	– –	0.5 1.0	2.0 3.0	mV
Average Temperature Coefficient of Input Offset Voltage ($R_S = 10\text{ k}\Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$)	$\Delta V_{IO} / \Delta T$	–	10	–	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) LF411 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C LF412 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C	I_{IO}	– – – –	20 – 25 –	100 2.0 100 2.0	pA nA pA nA
Input Bias Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) LF411 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C LF412 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C	I_{IB}	– – – –	0.6 – 0.5 –	200 4.0 200 4.0	pA nA pA nA
Large Signal Voltage Gain ($V_O = \pm 10\text{ V}$, $R_L = 2.0\text{ k}\Omega$) LF411 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C LF412 $T_A = 25^\circ\text{C}$ $T_A = 0^\circ$ to 70°C	A_{VOL}	25 15 25 15	80 – 150 –	– – – –	V/mV
Output Voltage Swing ($V_{ID} = \pm 1.0\text{ V}$, $R_L = 10\text{ k}\Omega$) LF411 LF412	V_{O+} V_{O-} V_{O+} V_{O-}	+12 – +12 –	+13.9 –14.7 +14.0 –14.0	– –12 – –12	V
Common Mode Input Voltage Range ($V_O = 0\text{ V}$) LF411 LF412	V_{ICR}	+11 – +11 –	+14 –14 +15 –12	–11 – –11 –	V
Common Mode Rejection ($V_{CM} = \pm 11\text{ V}$, $R_S \leq 10\text{ k}\Omega$) LF411 LF412	CMR	70 70	90 100	– –	dB
Power Supply Rejection (Note 3) ($V_{CC} V_{EE} = +15\text{ V}$, -15 V to $+5.0\text{ V}$, -5.0 V) LF411 LF412	PSR	70 70	86 100	– –	dB
Power Supply Current ($V_O = 0\text{ V}$) LF411 LF412	I_D	– –	2.5 2.8	3.4 6.8	mA

NOTE: 3. Measured with V_{CC} and V_{EE} simultaneously varied.

LF411C LF412C

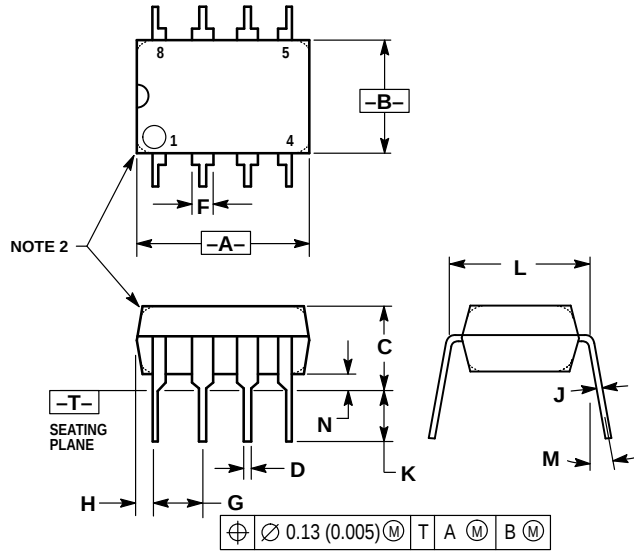
AC ELECTRICAL CHARACTERISTICS ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Slew Rate ($V_{in} = -10\text{ V to }+10\text{ V}$, $R_L = 2.0\text{ k}\Omega$, $A_V = +1.0$) LF411 LF412	SR	8.0 8.0	25 13	— —	V/ μs
Gain Bandwidth Product LF411 LF412	GBW	2.7 2.7	8.0 4.0	— —	MHz
Channel Separation ($f = 1.0\text{ Hz to }20\text{ kHz}$, LF412)	CS	—	-120	—	dB
Differential Input Resistance ($V_{CM} = 0\text{ V}$)	R_{in}	—	10^{12}	—	$\text{k}\Omega$
Equivalent Input Voltage Noise ($R_S = 100\text{ }\Omega$, $f = 1.0\text{ kHz}$) LF411 LF412	e_n	— —	30 25	— —	$\text{nV}/\sqrt{\text{Hz}}$
Equivalent Input Noise Current ($f = 1.0\text{ kHz}$) LF411 LF412	i_n	— —	0.01 0.01	— —	$\text{pA}/\sqrt{\text{Hz}}$

LF411C LF412C

OUTLINE DIMENSIONS

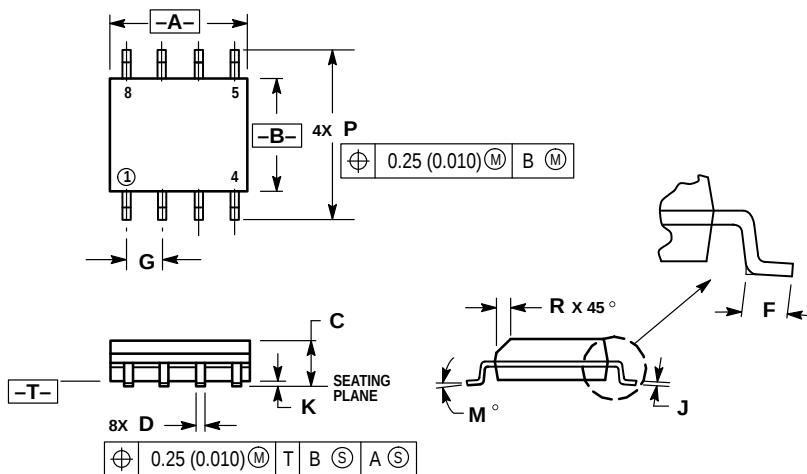
N SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K



- NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
 3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M		10°		10°
N	0.76	1.01	0.030	0.040

D SUFFIX PLASTIC PACKAGE CASE 751-05 (SO-8) ISSUE N



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.18	0.25	0.007	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

LF411C LF412C

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:

USA / EUROPE: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE (602) 244-6609
INTERNET: <http://Design-NET.com>

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



MOTOROLA



CODELINE TO BE PLACED HERE

LF411C/D

