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MOTOROLA

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/μs 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.

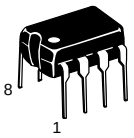
- Low Input Offset Voltage: 2.0 mV Max (Single)
  3.0 mV Max (Dual)
- Low T.C. of Input Offset Voltage: 10 μV/°C
- Low Input Offset Current: 20 pA
- Low Input Bias Current: 60 pA
- Low Input Noise Voltage: 18 nV/$\sqrt{Hz}$
- Low Input Noise Current: 0.01 pA/$\sqrt{Hz}$
- Low Total Harmonic Distortion: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

ORDERING INFORMATION

Device	Function	Operating Temperature Range	Package
LF411CD	Single	T_A = 0° to +70°C	SO–8
LF411CN			Plastic DIP
LF412CD	Dual		SO–8
LF412CN			Plastic DIP

SINGLE/DUAL JFET OPERATIONAL AMPLIFIERS

SEMICONDUCTOR TECHNICAL DATA

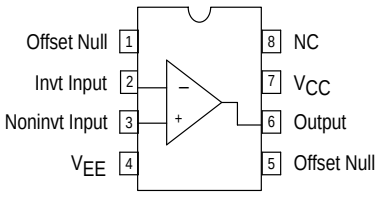


N SUFFIX
PLASTIC PACKAGE
CASE 626

D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO–8)

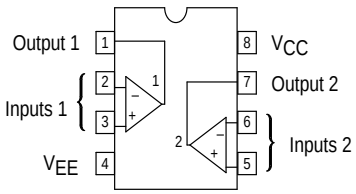
PIN CONNECTIONS

LF411C



(Single, Top View)

LF412C



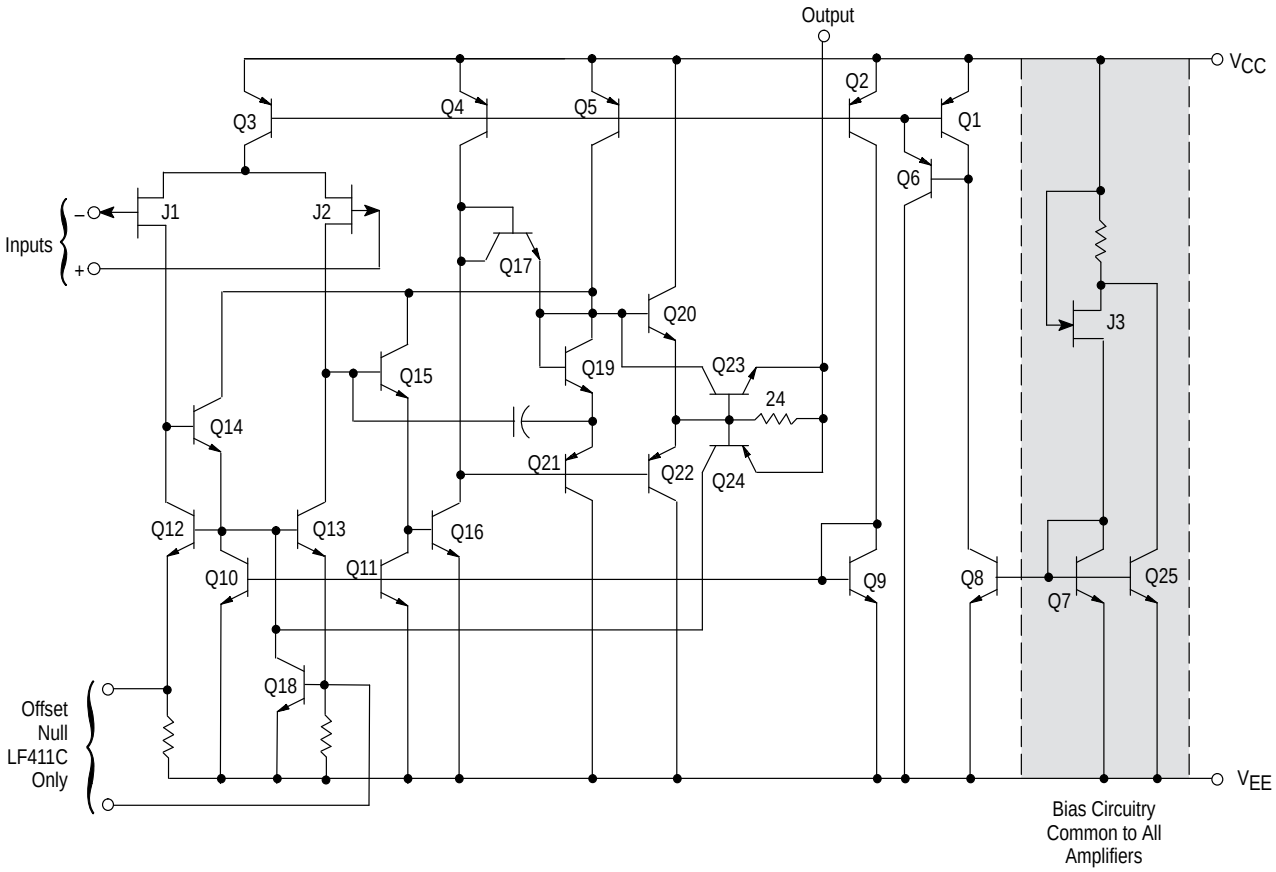
(Dual, Top View)

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)	LF411CN/412CN LF411CD/412CD	$R\theta_{JA}$	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)



ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = –15 V, T_A = 0° to 70°C, unless otherwise noted.)

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

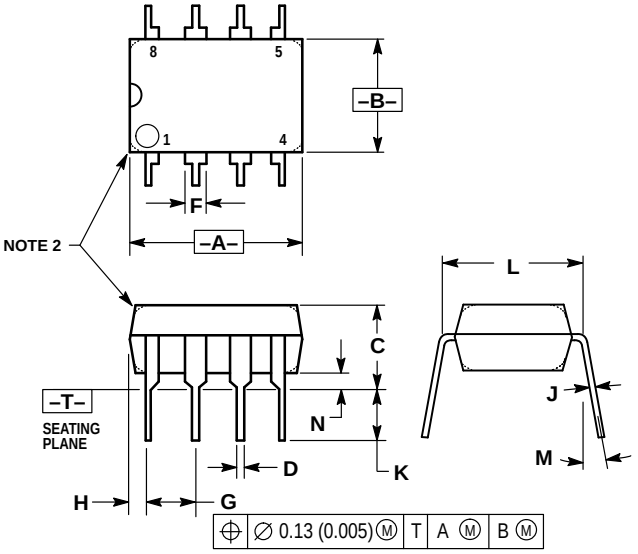
NOTE: 3. Measured with V_{CC} and V_{EE} simultaneously varied.

AC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = –15 V, T_A = 25°C, unless otherwise noted.)

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

OUTLINE DIMENSIONS

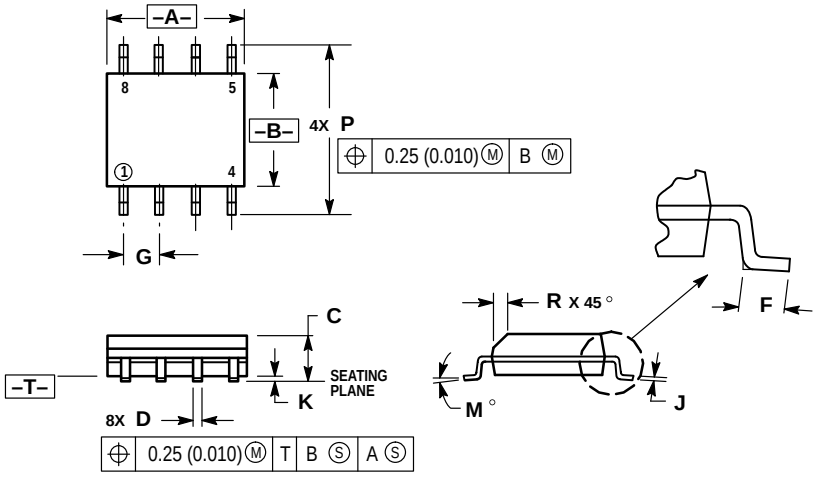
N SUFFIX
PLASTIC PACKAGE
CASE 626–05
ISSUE K



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.

	MILLIMETERS		INCHES	
DIM	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.

	MILLIMETERS		INCHES	
DIM	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

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