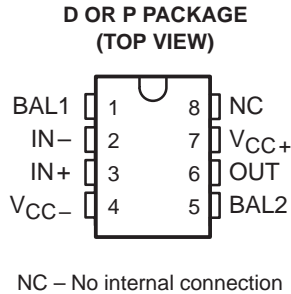


LF411  
JFET-INPUT OPERATIONAL AMPLIFIER

SLOS011C – MARCH 1987 – REVISED OCTOBER 1997

- Low Input Bias Current, 50 pA Typ
- Low Input Noise Current, 0.01 pA/ $\sqrt{\text{Hz}}$  Typ
- Low Supply Current, 2 mA Typ
- High Input impedance,  $10^{12} \Omega$  Typ
- Low Total Harmonic Distortion
- Low 1/f Noise Corner, 50 Hz Typ
- Package Options Include Plastic Small-Outline (D) and Standard (P) DIPs



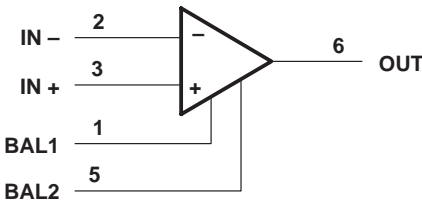
description

This device is a low-cost, high-speed, JFET-input operational amplifier with very low input offset voltage and a maximum input offset voltage drift. It requires low supply current, yet maintains a large gain-bandwidth product and a fast slew rate. In addition, the matched high-voltage JFET input provides very low input bias and offset currents.

The LF411 can be used in applications such as high-speed integrators, digital-to-analog converters, sample-and-hold circuits, and many other circuits.

The LF411C is characterized for operation from 0°C to 70°C. The LF411I is characterized for operation from –40°C to 85°C.

symbol



AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGE	
		SMALL OUTLINE (D)	PLASTIC DIP (P)
0°C to 70°C	2 mV	LF411CD	LF411CP
–40°C to 85°C	2 mV	LF411ID	LF411IP

The D packages are available taped and reeled. Add the suffix R to the device type (i.e., LF411CDR).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1997, Texas Instruments Incorporated

# LF411

## JFET-INPUT OPERATIONAL AMPLIFIER

SLOS011C – MARCH 1987 – REVISED OCTOBER 1997

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC+}$	18 V
Supply voltage, $V_{CC-}$	–18 V
Differential input voltage, $V_{ID}$	$\pm 30$ V
Input voltage, $V_I$ (see Note 1)	$\pm 15$ V
Duration of output short circuit	Unlimited
Continuous total power dissipation	500 mW
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package	197°C/W
P package	104°C/W
Storage temperature range, $T_{stg}$	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTES: 1. Unless otherwise specified, the absolute maximum negative input voltage is equal to the negative power supply voltage.  
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

### recommended operating conditions

	C SUFFIX		I SUFFIX		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC+}$	3.5	18	3.5	18	V
Supply voltage, $V_{CC-}$	–3.5	–18	–3.5	–18	V
Operating free-air temperature, $T_A$	0	70	–40	–85	°C

### electrical characteristics over operating free-air temperature range, $V_{CC\pm} = \pm 15$ V (unless otherwise specified)

PARAMETER		TEST CONDITIONS	$T_A$		MIN	TYP	MAX	UNIT
			LF411C	LF411I				
$V_{IO}$	Input offset voltage	$V_{IC} = 0$ , $R_S = 10$ k $\Omega$	25°C	25°C	0.8		2	mV
$\alpha_{VIO}$	Average temperature coefficient of input offset voltage	$V_{IC} = 0$ , $R_S = 10$ k $\Omega$			10		20†	$\mu V/^\circ C$
$I_{IO}$	Input offset current‡	$V_{IC} = 0$	25°C	25°C	25		100	pA
			70°C	85°C			2	nA
$I_{IB}$	Input bias current‡	$V_{IC} = 0$	25°C	25°C	50		200	pA
			70°C	85°C			4	nA
$V_{ICR}$	Common-mode input voltage range				$\pm 11$	–11.5 to 14.5		V
$V_{OM}$	Maximum peak output-voltage swing	$R_L = 10$ k $\Omega$			$\pm 12$	$\pm 13.5$		V
$A_{VD}$	Large-signal differential voltage	$V_O = \pm 10$ V, $R_L = 2$ k $\Omega$	25°C	25°C	25	200		V/mV
			0°C to 70°C	–40°C to 85°C	15	200		
$r_i$	Input resistance	$T_J = 25^\circ C$				10 <sup>12</sup>		$\Omega$
CMR R	Common-mode rejection ratio	$R_S \leq 10$ k $\Omega$			70	100		dB
$k_{SVR}$	Supply-voltage rejection ratio	See Note 3			70	100		dB
$I_{CC}$	Supply current				2	3.4		mA

† At least 90% of the devices meet this limit for  $\alpha_{VIO}$ .

‡ Input bias currents of an FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive. Pulse techniques must be used that will maintain the junction temperatures as close to the ambient temperature as possible.

NOTE 3: Supply-voltage rejection ratio is measured for both supply magnitudes increasing or decreasing simultaneously.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

# LF411

## JFET-INPUT OPERATIONAL AMPLIFIER

SLOS011C – MARCH 1987 – REVISED OCTOBER 1997

operating characteristics,  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Slew rate		8	13		V/ $\mu\text{s}$
B <sub>1</sub>	Unity-gain bandwidth		2.7	3		MHz
V <sub>n</sub>	Equivalent input noise voltage	f = 1 kHz, R <sub>S</sub> = 20 $\Omega$		18		nV/ $\sqrt{\text{Hz}}$
I <sub>n</sub>	Equivalent input noise current	f = 1 kHz		0.01		pA/ $\sqrt{\text{Hz}}$



## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LF411CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	0 to 70	LF411C	<a href="#">Samples</a>
LF411CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	0 to 70	LF411C	<a href="#">Samples</a>
LF411CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	0 to 70	LF411C	<a href="#">Samples</a>
LF411CP	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	NIPDAU	N / A for Pkg Type	0 to 70	LF411CP	<a href="#">Samples</a>
LF411CPE4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	NIPDAU	N / A for Pkg Type	0 to 70	LF411CP	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

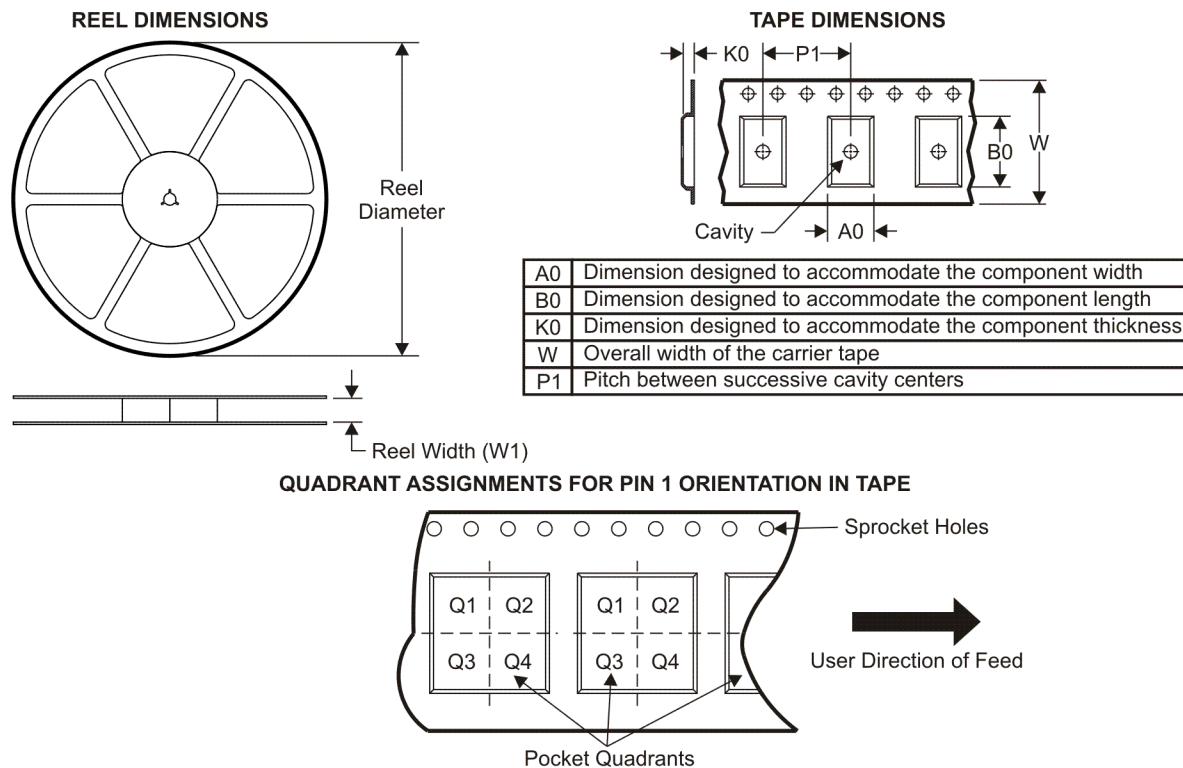
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

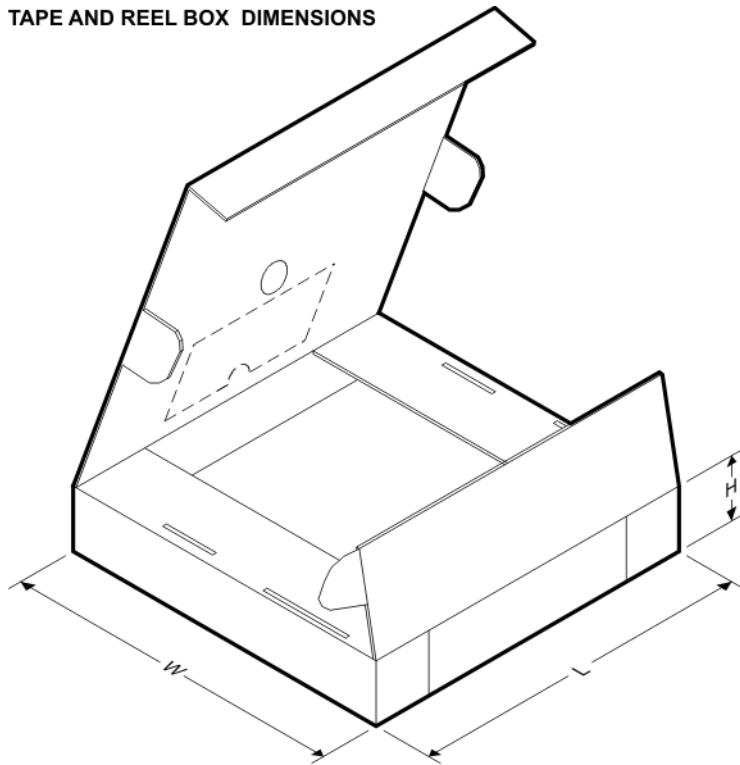
**TAPE AND REEL INFORMATION**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LF411CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LF411CDR	SOIC	D	8	2500	340.5	338.1	20.6



## PACKAGE OUTLINE

**SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



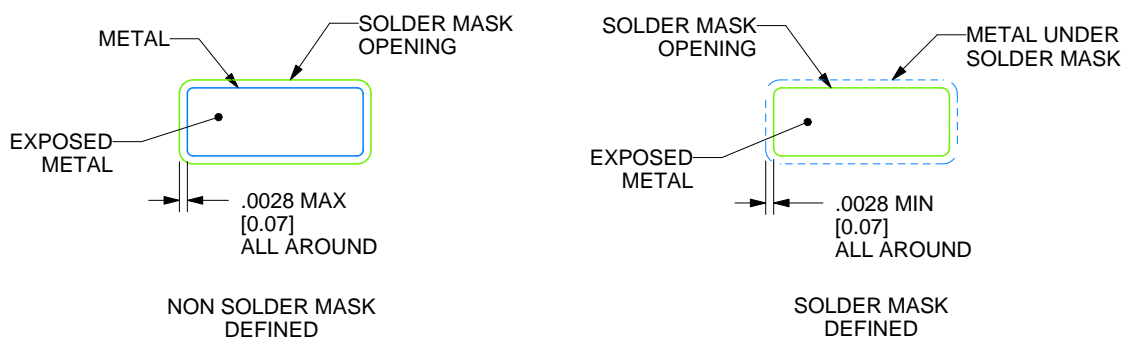
**D0008A**

### SOIC - 1.75 mm max height

## SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:8X



## SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

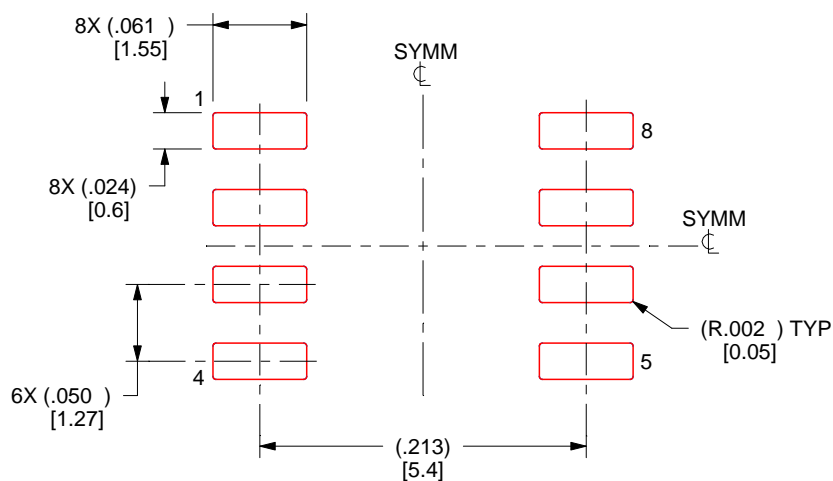
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON .005 INCH [0.125 MM] THICK STENCIL  
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MS-001 variation BA.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale ([www.ti.com/legal/termsofsale.html](http://www.ti.com/legal/termsofsale.html)) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2020, Texas Instruments Incorporated