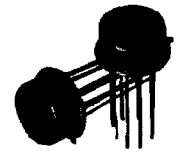
BURR-BROWN®



OPA111

www.burr-brown.com/databook/OPA111.html

Low Noise Precision *Difet*® OPERATIONAL AMPLIFIER

FEATURES

- LOW NOISE: 100% Tested, 8nV$\sqrt{Hz}$ max (10kHz)
- LOW BIAS CURRENT: 1pA max
- LOW OFFSET: 250μV max
- LOW DRIFT: 1μV/°C max
- HIGH OPEN-LOOP GAIN: 120dB min
- HIGH COMMON-MODE REJECTION: 100dB min

APPLICATIONS

- PRECISION INSTRUMENTATION
- DATA ACQUISITION
- TEST EQUIPMENT
- OPTOELECTRONICS
- MEDICAL EQUIPMENT—CAT SCANNER
- RADIATION HARD EQUIPMENT

DESCRIPTION

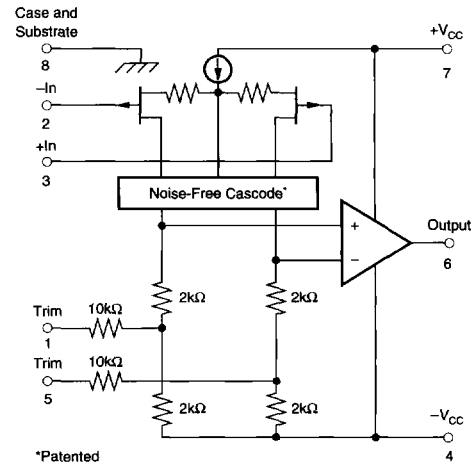
The OPA111 is a precision monolithic dielectrically isolated FET (*Difet*®) operational amplifier. Outstanding performance characteristics allow its use in the most critical instrumentation applications.

Noise, bias current, voltage offset, drift, open-loop gain, common-mode rejection, and power supply rejection are superior to BIFET® amplifiers.

Very low bias current is obtained by dielectric isolation with on-chip guarding.

Laser trimming of thin-film resistors gives very low offset and drift. Extremely low noise is achieved with patented circuit design techniques. A new cascode design allows high precision input specifications and reduced susceptibility to flicker noise.

Standard 741 pin configuration allows upgrading of existing designs to higher performance levels.



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BURR-BROWN®

SPECIFICATIONS

ELECTRICAL

At V_{CC} = ±15VDC and T_A = +25°C, unless otherwise noted.

PARAMETER	CONDITION	OPA111AM			OPA111BM			OPA111SM			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
INPUT											
NOISE											
Voltage, f_O = 10Hz	100% Tested		40	80		30	60		40	80	nV/√Hz
f_O = 100Hz	100% Tested		15	40		11	30		15	40	nV/√Hz
f_O = 1kHz	100% Tested		8	15		7	12		8	15	nV/√Hz
f_O = 10kHz	100% Tested		6	8		6	8		6	8	nV/√Hz
f_B = 10Hz to 10kHz	100% Tested		0.7	1.2		0.6	1		0.7	1.2	µVrms
f_B = 0.1Hz to 10Hz	(1)		1.6	3.3		1.2	2.5		1.6	3.3	µVp-p
Current, f_B = 0.1Hz to 10Hz	(1)		9.5	15		7.5	12		9.5	15	fAp-p
f_O = 0.1Hz thru 20kHz	(1)		0.5	0.8		0.4	0.6		0.5	0.8	fA/√Hz
OFFSET VOLTAGE[2]											
Input Offset Voltage	V_{CM} = 0VDC		±100	±500		±50	±250		±100	±500	µV
Average Drift	T_A = T_{MIN} to T_{MAX}		±2	±5		±0.5	±1		±2	±5	µV/°C
Supply Rejection	V_{CC} = ±10V to ±18V	90	110		100	110		90	110		dB
			±3	±31		±3	±10		±3	±31	µV/V
BIAS CURRENT[2]											
Input Bias Current	V_{CM} = 0VDC		±0.8	±2		±0.5	±1		±0.8	±2	pA
OFFSET CURRENT[2]											
Input Offset Current	V_{CM} = 0VDC		±0.5	±1.5		±0.25	±0.75		±0.5	±1.5	pA
IMPEDANCE											
Differential			10^{13} ‖ 1			10^{13} ‖ 1			10^{13} ‖ 1		Ω ‖ pF
Common-Mode			10^{14} ‖ 3			10^{14} ‖ 3			10^{14} ‖ 3		Ω ‖ pF
VOLTAGE RANGE											
Common-Mode Input Range		±10	±11		±10	±11		±10	±11		V
Common-Mode Rejection	V_{IN} = ±10VDC	90	110		100	110		90	110		dB
OPEN-LOOP GAIN, DC											
Open-Loop Voltage Gain	R_L ≥ 2kΩ	114	125		120	125		114	125		dB
FREQUENCY RESPONSE											
Unity Gain, Small Signal			2			2			2		MHz
Full Power Response	20Vp-p, R_L = 2kΩ	16	32		16	32		16	32		kHz
Slew Rate	V_O = ±10V, R_L = 2kΩ	1	2		1	2		1	2		V/µs
Settling Time, 0.1%	Gain = −1, R_L = 2kΩ		6			6			6		µs
0.01%	10V Step		10			10			10		µs
Overload Recovery, 50% Overdrive[3]	Gain = −1		5			5			5		µs
RATED OUTPUT											
Voltage Output	R_L = 2kΩ	±11	±12		±11	±12		±11	±12		V
Current Output	V_O = ±10VDC	±5.5	±10		±5.5	±10		±5.5	±10		mA
Output Resistance	DC, Open Loop		100			100			100		Ω
Load Capacitance Stability	Gain = +1		1000			1000			1000		pF
Short Circuit Current		10	40		10	40		10	40		mA
POWER SUPPLY											
Rated Voltage			±15			±15			±15		VDC
Voltage Range, Derated Performance		±5		±18	±5		±18	±5		±18	VDC
Current, Quiescent	I_O = 0mADC		2.5	3.5		2.5	3.5		2.5	3.5	mA
TEMPERATURE RANGE											
Specification	Ambient Temp.	−25		+85	−25		+85	−55		+125	°C
Operating	Ambient Temp.	−55		+125	−55		+125	−55		+125	°C
Storage	Ambient Temp.	−65		+150	−65		+150	−65		+150	°C
θ Junction-Ambient			200			200			200		°C/W

NOTES: (1) Sample tested—this parameter is guaranteed. (2) Offset voltage, offset current, and bias current are measured with the units fully warmed up. (3) Overload recovery is defined as the time required for the output to return from saturation to linear operation following the removal of a 50% input overdrive.

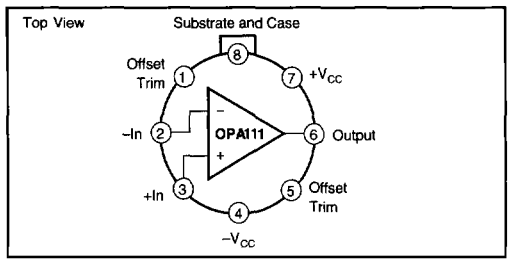
ELECTRICAL (FULL TEMPERATURE RANGE SPECIFICATIONS)

At V_{CC} = ±15VDC and T_A = T_{MIN} to T_{MAX} unless otherwise noted.

PARAMETER	CONDITION	OPA111AM			OPA111BM			OPA111SM			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
TEMPERATURE RANGE											
Specification Range	Ambient Temp.	–25		+85	–25		+85	–55		+125	°C
INPUT											
OFFSET VOLTAGE(1)											
Input Offset Voltage	V_{CM} = 0VDC		±220	±1000		±110	±500		±300	±1500	µV
Average Drift			±2	±5		±0.5	±1		±2	±5	µV/°C
Supply Rejection	V_{CC} = ±10V to ±18V	*86*	*100*		*90*	*100*		*86*	*100*		*dB*
			±10	±50		±10	±32		±10	±50	µV/V
BIAS CURRENT(1)											
Input Bias Current	V_{CM} = 0VDC		±50	±250		±30	±130		±820	±4100	pA
OFFSET CURRENT(1)											
Input Offset Current	V_{CM} = 0VDC		±30	±200		±15	±100		±510	±3100	pA
VOLTAGE RANGE											
Common-Mode Input Range		±10	±11		±10	±11		±10	±11		V
Common-Mode Rejection	V_{IN} = ±10VDC	*86*	*100*		*90*	*100*		*86*	*100*		*dB*
OPEN-LOOP GAIN, DC											
Open-Loop Voltage Gain	R_L ≥ 2kΩ	110	120		114	120		110	120		dB
RATED OUTPUT											
Voltage Output	R_L = 2kΩ	±10.5	±11		±11	±11.5		±11	±11.5		V
Current Output	V_O = ±10VDC	±5.25	±10		±5.25	±10		±5.25	±10		mA
Short Circuit Current	V_O = 0VDC	10	40		10	40		10	40		mA
POWER SUPPLY											
Current, Quiescent	I_O = 0mADC		2.5	3.5		2.5	3.5		2.5	3.5	mA

NOTES: (1) Offset voltage, offset current, and bias current are measured with the units fully warmed up.

CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Supply	±18VDC
Internal Power Dissipation(1)	750mW
Differential Input Voltage(2)	±36VDC
Input Voltage Range(2)	±18VDC
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–55°C to +125°C
Lead Temperature (soldering, 10s)	+300°C
Output Short Circuit Duration(3)	Continuous
Junction Temperature	+175°C

NOTES: (1) Packages must be derated based on θ_{JC} = 150°C/W or θ_{JA} = 300°C/W. (2) For supply voltages less than ±18VDC, the absolute maximum input voltage is equal to +18V > V_{IN} > $-V_{CC}$ – 6V. See Figure 2. (3) Short circuit may be to power supply common only. Rating applies to +25°C ambient. Observe dissipation limit and T_J.

PACKAGE INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER(1)
OPA111AM	TO-99	001
OPA111BM	TO-99	001
OPA111SM	TO-99	001

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ORDERING INFORMATION

PRODUCT	PACKAGE	TEMPERATURE RANGE	OFFSET VOLTAGE, MAX (µV)
OPA111AM	TO-99	–25°C to +85°C	±500
OPA111BM	TO-99	–25°C to +85°C	±250
OPA111SM	TO-99	–55°C to +125°C	±500

ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.