PRECISION OPERATIONAL AMPLIFIER

FEATURES/BENEFITS

- Low Noise
- Low Input Bias Current
- Low Input Offset Voltage
- Low Drift
- High Common-Mode Rejection
- High Open-Loop Gain

Preliminary Specification

APPLICATIONS

- Medical Instrumentation
- Process Control Equipment
- Sensors
- Robotics
- Test Equipment
- Instrumentation
- Avionics
- Data Acquisition

DESCRIPTION

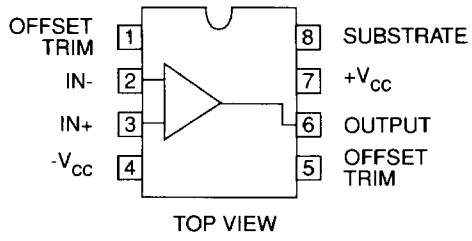
The SP111 and SP121 are precision monolithic operational amplifiers with outstanding performance characteristics that allow their use in even the most demanding instrumentation applications.

Designed completely with vertical transistor structures and dielectric isolation along with the use of Sipex' special SiFET® field effect transistors, the SP111/121 can provide superior performance in even the harshest of environments. This construction provides a latch-free performance in a radiation environment. Radiation tolerance is significantly improved over designs utilizing junction isolation, trench isolation, or lateral transistors in dielectric isolation.

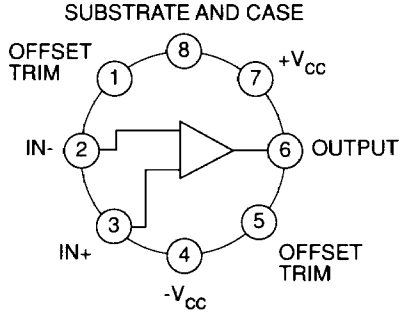
Precision performance characteristics such as low input bias current, low input offset voltage, low input noise current, minimal drift, high open-loop gain, high common-mode rejection ratio, and high power supply rejection ratio exceed those of other field effect transistor technology amplifiers.

Improved performance in existing designs is easily obtained due to the industry standard 741 pin configuration.

CONNECTION DIAGRAMS



TOP VIEW



PARTS NUMBERING

Part Number	Package	Operating Range
SP111AIH	TO-99 CAN	-25°C to +85°C
SP111AMH	TO-99 CAN	-55°C to +125°C
SP111AMH/883*	TO-99 CAN	-55°C to +125°C
SP111BIH	TO-99 CAN	-25°C to +85°C
SP121BCH	TO-99 CAN	0°C to +70°C
SP121ACP	8-PIN PLASTIC DIP	0°C to +70°C

* Processed in compliance with MIL-STD-883

ABSOLUTE MAXIMUM RATINGS[1]

Voltage between $+V_{CC}$ and $-V_{CC}$ Terminals 33V
Differential Input Voltage 33V
Input Voltage Range ..... ±16.5V
Output Short Circuit Duration ..... Continuous
Maximum Junction Temperature ..... +175°C
Maximum Storage Temperature Range ..... -65°C < T_A < +150°C

ELECTRICAL CHARACTERISTICS

$+V_{CC}$ = +15V, $-V_{CC}$ = -15V, and pin 8 connected to ground unless otherwise specified.

			SP111AIH			SP111AMH SP111AMH/883			
PARAMETERS	**CONDITIONS**	**TEMP**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
Offset Voltage	V_{CM} = 0 Vdc	25°C		±100	±500		±100	±500	µV
		Full		±220	±1000		±300	±1500	µV
Average Offset Voltage Drift		Full		±2	±5		±2	±5	µV/°C
Bias Current	V_{CM} = 0 Vdc	25°C		±0.8	±2		±0.8	±2	pA
		Full		±50	±250		±820	±4100	pA
Offset Current	V_{CM} = 0 Vdc	25°C		±0.5	±1.5		±0.5	±1.5	pA
		Full		±30	±200		±510	±3100	pA
Differential Impedance		25°C		10^{13} ‖ 1			10^{13} ‖ 1		Ω‖ pF
Common Mode Impedance		25°C		10^{14} ‖ 3			10^{14} ‖ 3		Ω‖ pF
Common Mode Range		25°C	±10	±11		±10	±11		V
		Full	±10	±11		±10	±11		V
Input Noise Voltage Density									
f_O = 10 Hz		25°C		40	80		40	80	nV/√Hz
f_O = 100 Hz		25°C		15	40		15	40	nV/√Hz
f_O = 1 Hz		25°C		10	15		10	15	nV/√Hz
f_O = 10 kHz		25°C		9			9		nV/√Hz
f_O = 10 Hz to 10 kHz		25°C		0.7	1.2		0.7	1.2	μV_{RMS}
f_O = 0.1 Hz to 10 Hz		25°C		1.6	3.3		1.6	3.3	μV_{p-p}
Input Noise Current Density									
f_O = 0.1 Hz to 10 kHz		25°C		9.5	15		9.5	15	fA_{p-p}
f_O = 0.1 Hz thru 20 kHz		25°C		0.5	0.8		0.5	0.8	fA/√Hz
Large Signal Voltage Gain	$R_L \geq 2$ kΩ	25°C	114	125		114	125		dB
		Full	110	120		110	120		dB
Common Mode Rejection	V_{IN} = ±10 Vdc	25°C	90	110		90	110		dB
Ratio		Full	86	100		86	100		dB
Minimum Stable Gain		Full	1			1			
Gain-Bandwidth Product		25°C		2			2		MHz
Output Voltage Swing	$R_L \geq 2$ kΩ	25°C	±11	±12		±11	±12		V
		Full	±10.5	±11		±11	±11.5		V
Output Current	V_O = ±10 Vdc	25°C	±5.5	±10		±5.5	±10		mA
		Full	±5.25	±10		±5.25	±10		mA
Short Circuit Current	V_O = 0 Vdc	Full	10	40		10	40		mA
Output Resistance	DC, Open-loop	25°C		100			100		Ω
Full Power Bandwidth	$20V_{p-p}$, R_L = 2 kΩ	25°C	16	32		16	32		kHz
Slew Rate	V_O = ±10V, R_L = 2 kΩ	25°C	1	5		1	5		V/µsec
Settling Time	A_V = -1, R_L = 2 kΩ								
10V to 0.1%		25°C		6			6		µsec
10V to 0.01%		25°C		10			10		µsec
Overload Recovery[2]	A_V = -1								
50% Overdrive		25°C		5	3.5		5		µsec
Supply Current	I_O = 0 mADC	25°C		2.5	3.5		2.5	3.5	mA
		Full		2.5			2.5	3.5	mA
Power Supply Rejection Ratio	V_{CC} = ±10V to ±16.5V	25°C	90	110		90	110		dB
		Full	86	100		86	100		dB

ELECTRICAL CHARACTERISTICS

$+V_{CC}$ = +15V, $-V_{CC}$ = -15V, and pin 8 connected to ground unless otherwise specified.

			SP111BIH			
PARAMETERS	**CONDITIONS**	**TEMP**	**MIN**	**TYP**	**MAX**	**UNITS**
Offset Voltage	V_{CM} = 0 Vdc	25°C		±50	±250	µV
		Full		±110	±500	µV
Average Offset Voltage Drift		Full		±0.5	±1	µV/°C
Bias Current	V_{CM} = 0 Vdc	25°C		±0.5	±1	pA
		Full		±30	±130	pA
Offset Current	V_{CM} = 0 Vdc	25°C		±0.25	±0.75	pA
		Full		±15	±100	pA
Differential Impedance		25°C		10^{13} ‖ 1		Ω‖ pF
Common Mode Impedance		25°C		10^{14} ‖ 3		Ω‖ pF
Common Mode Range		25°C	±10	±11		V
		Full	±10	±11		V
Input Noise Voltage Density						
f_O = 10 Hz		25°C		30	60	nV/√Hz
f_O = 100 Hz		25°C		12	30	nV/√Hz
f_O = 1 kHz		25°C		9	12	nV/√Hz
f_O = 10 kHz		25°C		8		nV/√Hz
f_O = 10 Hz to 10 kHz		25°C		0.6	1.0	μV_{RMS}
f_O = 0.1 Hz to 10 Hz		25°C		1.2	2.5	μV_{p-p}
Input Noise Current Density						
f_O = 0.1 Hz to 10 kHz		25°C		7.5	12	fA_{p-p}
f_O = 0.1 Hz thru 20 kHz		25°C		0.4	0.6	fA/√Hz
Large Signal Voltage Gain	$R_L \geq 2$ kΩ	25°C	120	125		dB
		Full	114	120		dB
Common Mode Rejection Ratio	V_{IN} = ±10 Vdc	25°C	100	110		dB
		Full	90	100		dB
Minimum Stable Gain		Full	1			dB
Gain-Bandwidth Product		25°C		2		MHz
Output Voltage Swing	$R_L \geq 2$ kΩ	25°C	±11	±12		V
		Full	±11	±11.5		V
Output Current	V_O = ±10 Vdc	25°C	±5.5	±10		mA
		Full	±5.25	±10		mA
Short Circuit Current	V_O = 0 Vdc	Full	10	40		mA
Output Resistance	DC, Open-loop	25°C		100		Ω
Full Power Bandwidth	$20V_{p-p}$, R_L = 2 kΩ	25°C	16	32		kHz
Slew Rate	V_O = ±10V, R_L = 2 kΩ	25°C	1	5		V/µsec
Settling Time	A_V = -1, R_L = 2 kΩ					
10V to 0.1%		25°C		6		µsec
10V to 0.01%		25°C		10		µsec
Overload Recovery[2]						
50% Overdrive		25°C		6		µsec
Supply Current	Quiescent Current	25°C		2.5	3.5	mA
	with I_O = 0 mADC					
		Full		2.5	3.5	mA
Power Supply Rejection Ratio	V_{CC} = ±10V to ±16.5V	25°C	100	110		dB
		Full	90	100		dB

ELECTRICAL CHARACTERISTICS

$+V_{CC}$ = +15V, $-V_{CC}$ = -15V, and pin 8 connected to ground unless otherwise specified.

			SP121BCH			SP121ACP			
PARAMETERS	**CONDITIONS**	**TEMP**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
Offset Voltage	V_{CM} = 0 Vdc	25°C		±0.5	±2		±0.5	±3	mV
		Full		±1	±3		±1	±5	mV
Average Offset Voltage Drift		Full		±3	±10		±3	±10	µV/°C
Bias Current	V_{CM} = 0 Vdc	25°C		±1	±5		±1	±10	pA
		Full		±23	±115		±23	±250	pA
Offset Current	V_{CM} = 0 Vdc	25°C		±0.7	±4		±0.7	±8	pA
		Full		±16	±100		±16	±200	pA
Differential Impedance		25°C		10^{13} ‖ 1			10^{13} ‖ 1		Ω‖ pF
Common Mode Impedance		25°C		10^{14} ‖ 3			10^{14} ‖ 3		Ω‖ pF
Common Mode Range		25°C	±10	±11		±10	±11		V
		Full	±10	±11		±10	±11		V
Input Noise Voltage Density									
f_O = 10 Hz		25°C		40			50		nV/√Hz
f_O = 100 Hz		25°C		15			18		nV/√Hz
f_O = 1 kHz		25°C		10			12		nV/√Hz
f_O = 10 kHz		25°C		9			10		nV/√Hz
f_O = 10 Hz to 10 kHz		25°C		0.7			0.8		μV_{RMS}
f_O = 0.1 Hz to 10 Hz		25°C		1.6			2		μV_{p-p}
Input Noise Current Density									
f_O = 0.1 Hz to 10 kHz		25°C		15			21		fA_{p-p}
f_O = 0.1 Hz thru 20 kHz		25°C		0.8			1.1		fA/√Hz
Large Signal Voltage Gain	$R_L \geq 2$ kΩ	25°C	110	120		106	114		dB
		Full	106	116		100	110		dB
Common Mode Rejection	V_{IN} = ±10 Vdc	25°C	86	104		82	110		dB
Ratio		Full	82	98		80	96		dB
Minimum Stable Gain		Full	1			1			
Gain-Bandwidth Product		25°C		2			2		MHz
Output Voltage Swing	$R_L \geq 2$ kΩ	25°C	±11	±12		±11	±12		V
		Full	±10.5	±11		±10.5	±11		V
Output Current	V_O = ±10 Vdc	25°C	±5.5	±10		±5.5	±10		mA
		Full	±5.25	±10		±5.25	±10		mA
Short Circuit Current	V_O = 0 Vdc	Full	10	40		10	40		mA
Output Resistance	DC, Open-loop	25°C		100			100		Ω
Full Power Bandwidth	$20V_{p-p}$, R_L = 2 kΩ	25°C		32			32		kHz
Slew Rate	V_O = ±10V, R_L = 2 kΩ	25°C		5			5		V/µsec
Settling Time	A_V = -1, R_L = 2 kΩ								
10V to 0.1%		25°C		6			6		µsec
10V to 0.01%		25°C		10			10		µsec
Overload Recovery[2]	A_V = -1								
50% Overdrive		25°C		5			5		µsec
Supply Current	I_O = 0 mADC	25°C		2.5	4		2.5	4.5	mA
		Full		2.5	4.5		2.5	5.0	mA
Power Supply Rejection Ratio	V_{CC} = ±10V to ±16.5V	25°C	86	104		86	104		dB
		Full	82	94		82	94		dB

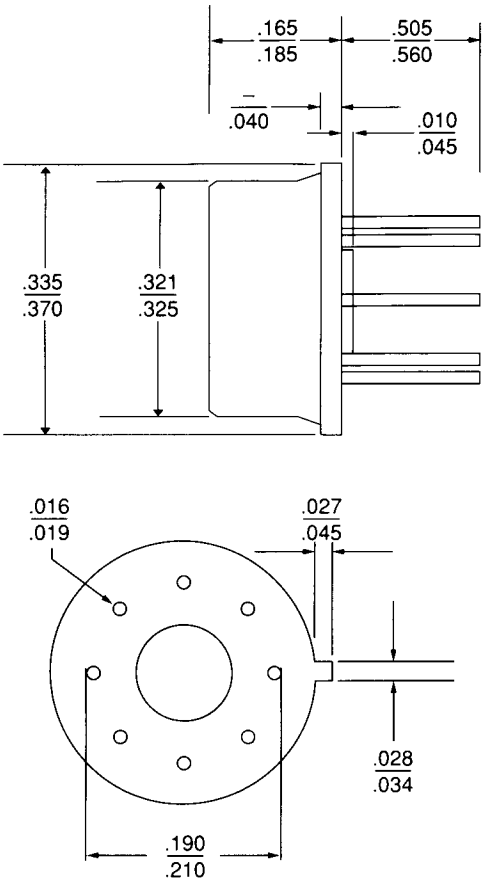
NOTES

The following notes apply to the Electrical Characteristics and Absolute Maximum Ratings Tables:

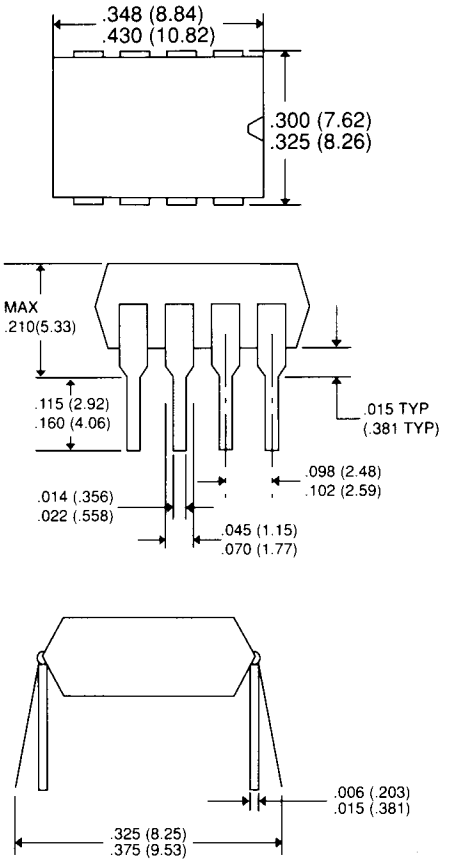
1. Absolute maximum ratings represent the values beyond which the part may be damaged. Functional operation at these values is not necessarily implied.
2. Overload recovery is defined as the time required for the output to resume linear operation after reaching saturation due to a 50% input overdrive.

PACKAGE OUTLINES

8 PIN TO -99 METAL CAN



8 PIN PLASTIC DIP



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