ANALOG DEVICES

Quad Micropower Operational Amplifier

OP-420

FEATURES

- **Low Supply Current** .... **200μA Max @ V_S = +5V**
- **Single-Supply Operation** .... **+5V to +30V**
- **Dual-Supply Operation** .... **±2.5V to ±15V**
- **Low Input Offset Voltage** .... **500μV Typ**
- **Low Input Offset Voltage Drift** .... **5μV/°C Typ**
- **High Common-Mode Input Range** ... **V− to (V+ − 1.5V)**
- **High CMRR** .... **100dB Typ**
- **High Open-Loop Gain** .... **1100V/mV Typ**
- **LM 148 Pinout**
- **Available in Die Form**

ORDERING INFORMATION †

T_A=+25°C V_{OS}MAX (mV)	PACKAGE CERDIP 14-PIN	LCC 20-CONTACT	PLASTIC	OPERATING TEMPERATURE RANGE
2.5	OP420BY	–	–	MIL
2.5	OP420FY	–	–	IND
4.0	OP420CY	OP420CRC/883	–	MIL
4.0	OP420GY	–	OP420GP	XIND
4.0	–	–	OP420GS	XIND
6.0	OP420HY	–	OP420HP	XIND
6.0	–	–	OP420HS	XIND

* For devices processed in total compliance to MIL-STD-883, add /883 after part number. Consult factory for 883 data sheet.

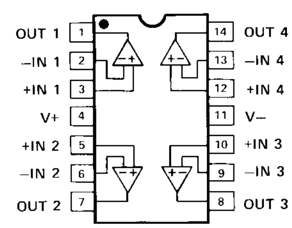
† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages.

GENERAL DESCRIPTION

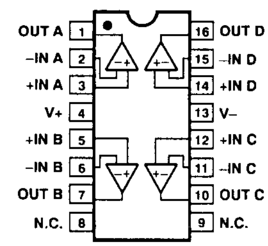
The OP-420 quad micropower operational amplifier is a single-chip quad patterned after the OP-20 precision micropower single operational amplifier. A Darlington PNP input stage allows the input common-mode voltage to include V−. The wide input range combined with low power-supply drain (~40μA/section at 5V), provides a unique solution for designs requiring high functional density and portable operation. Applications include two-wire transmitters for process control loops, battery-operated remote-line filters, signal preconditioning amplifiers, and a variety of multiple-gain block arrays.

For micropower applications requiring offset nulling, see the OP-20, OP-21 and OP-22 data sheets.

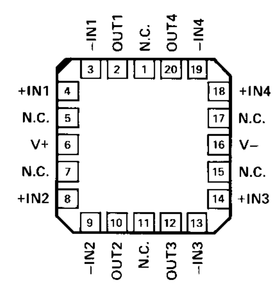
PIN CONNECTIONS



14-PIN HERMETIC DIP (Y-Suffix)
14-PIN EPOXY DIP (P-Suffix)

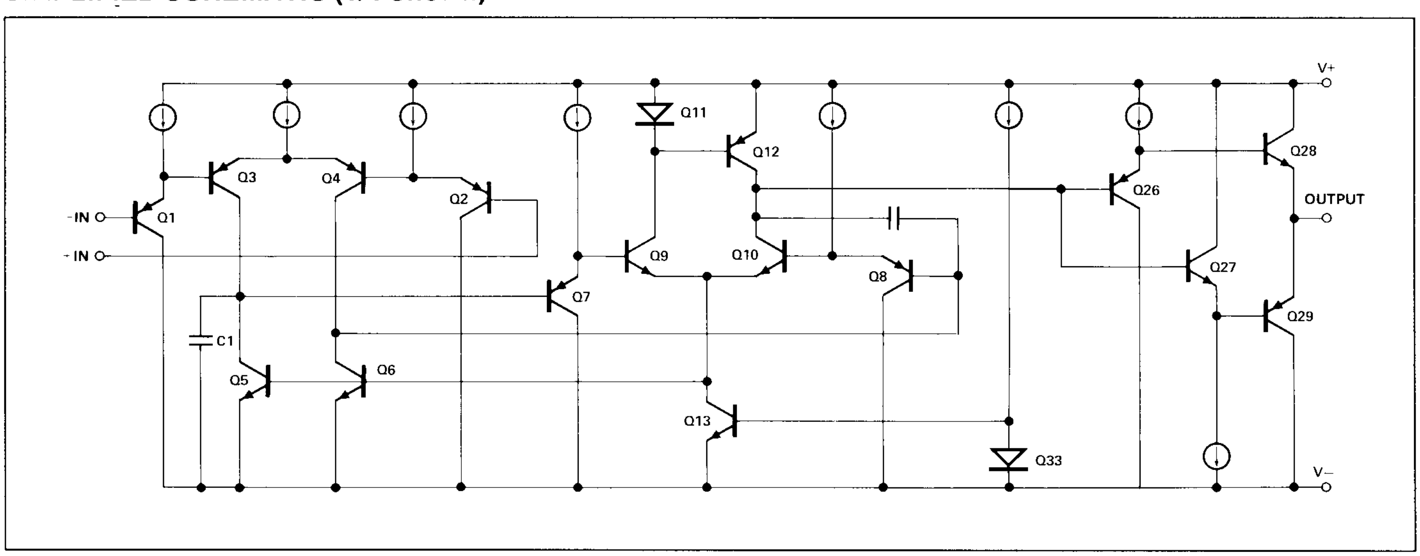


16-PIN SOL (S-Suffix)



OP-420CRC/883
20-LEAD LCC
(RC-Suffix)

SIMPLIFIED SCHEMATIC (1/4 Shown)



OP-420

ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage .... ±18V
Differential Input Voltage .... ±30V
Input Voltage .... Supply Voltage
Output Short-Circuit Duration .... Continuous (One Amplifier Only)
Storage Temperature Range .... −65°C to +150°C
Lead Temperature Range (Soldering, 60 sec) .... 300°C
Operating Temperature Range
  OP-420BY, OP-420CY, OP-420CRC .... −55°C to +125°C
  OP-420FY .... −25°C to +85°C
  OP-420G, OP-420H .... −40°C to +85°C
Junction Temperature(T_j) .... −65°C to +150°C

PACKAGE TYPE	Θ_{jA} (Note 2)	Θ_{jC}	UNITS
14-Pin Hermetic DIP (Y)	99	12	°C/W
14-Pin Plastic DIP (P)	76	33	°C/W
16-Pin SOL (S)	92	27	°C/W

NOTES:
1. Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.
2. Θ_{jA} is specified for worst case mounting conditions, i.e., Θ_{jA} is specified for device in socket for CerDIP and P-DIP packages; Θ_{jA} is specified for device soldered to printed circuit board for SOL package.

ELECTRICAL CHARACTERISTICS at $V_S = \pm15V$, $T_A = +25°C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-420B/OP-420F MIN	TYP	MAX	OP-420C/OP-420G MIN	TYP	MAX	OP-420H MIN	TYP	MAX	UNITS
Input Offset Voltage	V_{OS}	$V_S = \pm2.5V$ to $\pm15V$	—	0.5	2.5	—	1	4	—	2	6	mV
Input Offset Current (Note 1)	I_{OS}	$V_S = \pm2.5V$ to $\pm15V$	—	0.5	1.5	—	0.8	2.5	—	1.2	6	nA
Input Bias Current (Note 1)	I_B	$V_S = \pm2.5V$ to $\pm15V$	—	9	20	—	12	30	—	18	40	nA
Input Noise Voltage Density	e_n	$f_O = 10Hz$ $f_O = 100Hz$	—	50	—	—	50	—	—	50	—	$nV/\sqrt{Hz}$
Input Noise Current Density	i_n	$f_O = 10Hz$ $f_O = 100Hz$	—	0.12	—	—	0.12	—	—	0.12	—	$pA/\sqrt{Hz}$
Input Voltage Range	IVR	V+ = +5V, V− = 0V	0/3.5	—	—	0/3.5	—	—	0/3.5	—	—	V
		$V_S = \pm15V$	−15/13.5	—	—	−15/13.5	—	—	−15/13.5	—	—	
Common-Mode Rejection Ratio	CMRR	V+ = +5V, V− = 0V $0V \le V_{CM} \le 3.5V$	83	100	—	80	96	—	76	90	—	dB
		$V_S = \pm15V$ $-15V \le V_{CM} \le 13.5V$	83	100	—	80	96	—	76	90	—	
Power Supply Rejection Ratio	PSRR	$V_S = \pm2.5V$ to $\pm15V$; & V− = 0V, V+ = 5V to 30V	—	10	30	—	20	50	—	30	80	μV/V
Large-Signal Voltage Gain	A_{VO}	$R_L = 25k\Omega$, $V_O = \pm10V$	600	1100	—	400	900	—	200	800	—	V/mV
Slew Rate	SR		—	0.05	—	—	0.05	—	—	0.05	—	V/μs
Closed-Loop Bandwidth	BW	$A_{VCL} = +1.0$ $R_L = 10k\Omega$	—	150	—	—	150	—	—	150	—	kHz
Output Voltage Swing	V_O	V+ = 5V, V− = 0V, $R_L = 10k\Omega$	0.7/4.1	—	—	0.8/4.0	—	—	0.9/3.8	—	—	V
		$V_S = \pm15V$, $R_L = 25k\Omega$	±14.0	—	—	±14.0	—	—	±13.8	—	—	
Supply Current (Four Amplifiers)	I_{SY}	$V_S = \pm2.5V$, No Load	—	140	200	—	170	300	—	200	400	μA
		$V_S = \pm15V$, No Load	—	330	360	—	360	460	—	390	600	

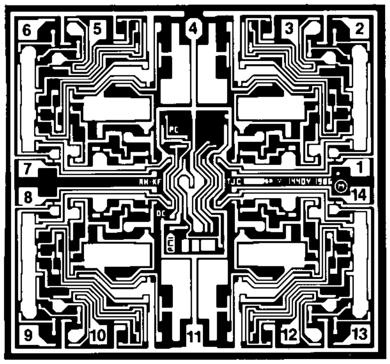
NOTE:
1. I_B and I_{OS} are measured at $V_{CM} = 0$.

ELECTRICAL CHARACTERISTICS at V_S = ±15V, −55°C ≤ +125°C for OP-420B and OP-420C, −25°C ≤ T_A ≤ +85°C for OP-420F, −40°C ≤ T_A ≤ +85°C for OP-420G and OP-420H, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-420B OP-420F MIN	OP-420B OP-420F TYP	OP-420B OP-420F MAX	OP-420C OP-420G MIN	OP-420C OP-420G TYP	OP-420C OP-420G MAX	OP-420H MIN	OP-420H TYP	OP-420H MAX	UNITS
Average Input Offset Voltage Drift (Note 1)	TCV_{OS}	Unnulled	—	5	10	—	8	15	—	15	25	μV/°C
Input Offset Voltage	V_{OS}	V_S = ±2.5V to ±15V	—	—	3.5	—	—	5.5	—	—	7.5	mV
Input Offset Current (Note 2)	I_{OS}	V_S = ±2.5V to ±15V	—	—	3	—	—	4	—	—	8	nA
Input Bias Current (Note 2)	I_B	V_S = ±2.5V to ±15V	—	—	30	—	—	40	—	—	60	nA
Input Voltage Range	IVR	V+ = +5V, V− = 0V	0/3.2	—	—	0/3.2	—	—	0/3.2	—	—	V
		V_S = ±15V	−15/13.2	—	—	−15/13.2	—	—	−15/13.2	—	—	
Common-Mode Rejection Ratio	CMRR	V+ = +5V, V− = 0V, 0V ≤ V_{CM} ≤ 3.2V	76	96	—	73	92	—	73	86	—	dB
		V_S = ±15V, −15V ≤ V_{CM} ≤ 13.2V	76	96	—	73	92	—	73	86	—	
Power Supply Rejection Ratio	PSRR	V_S = ±2.5V to ±15V and V− = 0V, V+ = 5V to 30V	—	15	50	—	25	80	—	40	100	μV/V
Large-Signal Voltage Gain	A_{VO}	V_S = ±15V, R_L = 50kΩ, V_O = ±10V	300	800	—	200	650	—	100	400	—	V/mV
Output Voltage Swing	V_O	V+ = 5V, V− = 0V, R_L = 20kΩ	0.9/3.9	—	—	1.0/3.8	—	—	1.1/3.6	—	—	V
		V_S = ±15V, R_L = 50kΩ	±13.8	—	—	±13.8	—	—	±13.6	—	—	
Supply Current (Four Amplifiers)	I_{SY}	V_S = ±2.5V, No Load	—	170	300	—	210	400	—	250	600	μA
		V_S = ±15V, No Load	—	390	500	—	420	640	—	500	800	

NOTES:
1. Sample tested.
2. I_B and I_{OS} are measured at V_{CM} = 0.

DICE CHARACTERISTICS



DIE SIZE 0.093 × 0.087 inch, 8091 sq. mils
(2.36 × 2.21 mm, 5.22 sq. mm)

1. OUTPUT 1
2. INVERTING INPUT 1
3. NONINVERTING INPUT 1
4. V+
5. NONINVERTING INPUT 2
6. INVERTING INPUT 2
7. OUTPUT 2
8. OUTPUT 3
9. INVERTING INPUT 3
10. NONINVERTING INPUT 3
11. V−
12. NONINVERTING INPUT 4
13. INVERTING INPUT 4
14. OUTPUT 4

WAFER TEST LIMITS at $V_S = \pm 15V$, $T_A = 25°C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-420N LIMIT	OP-420G LIMIT	OP-420GR LIMIT	UNITS
Input Offset Voltage	V_{OS}	$V_S = \pm 2.5V$ to $\pm 15V$	2.5	4	6	mV MAX
Input Offset Current	I_{OS}	$V_S = \pm 2.5V$ to $\pm 15V$, (Note 1)	1.5	2.5	6	nA MAX
Input Bias Current	I_B	$V_S = \pm 2.5V$ to $\pm 15V$, (Note 1)	20	30	40	nA MAX
Input Voltage Range	IVR		−15/13.5	−15/13.5	−15/13.5	V MIN
Common-Mode Rejection Ratio	CMRR	V+ = +5V, V− = 0V $0V \leq V_{CM} \leq 3.5V$ $V_S = \pm 15V$, $-15V \leq V_{CM} \leq 13.5V$	83 83	80 80	76 76	dB MIN
Power Supply Rejection Ratio	PSRR	$V_S = \pm 2.5V$ to $\pm 15V$ V− = 0V, V+ = +5V to +30V	30	50	80	μV/V MAX
Large-Signal Voltage Gain	A_{VO}	$R_L = 25k\Omega$, $V_O = \pm 10V$	600	400	200	V/mV MIN
Output Voltage Swing	V_O	V+ = +5V, V− = 0V $R_L = 10k\Omega$ $V_S = \pm 15V$ $R_L = 25k\Omega$	0.7/4.1 ±14.0	0.8/4.0 ±14.0	0.9/3.8 ±13.8	VMAX V MIN
Supply Current	I_{SY}	No Load, (Four Amplifiers)	360	460	600	μA MAX

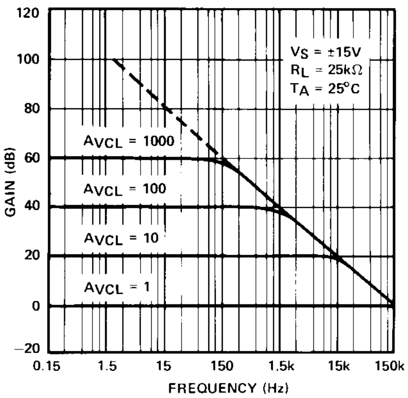
NOTES:

1. I_B and I_{OS} are measured at $V_{CM} = 0$.

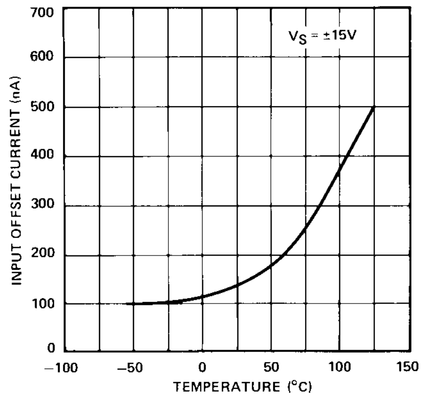
Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualification through sample lot assembly and testing.

TYPICAL PERFORMANCE CHARACTERISTICS

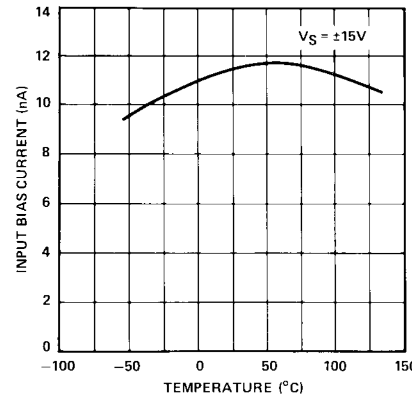
CLOSED-LOOP GAIN vs FREQUENCY



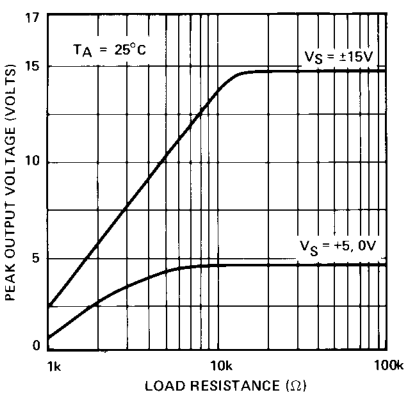
INPUT OFFSET CURRENT vs TEMPERATURE



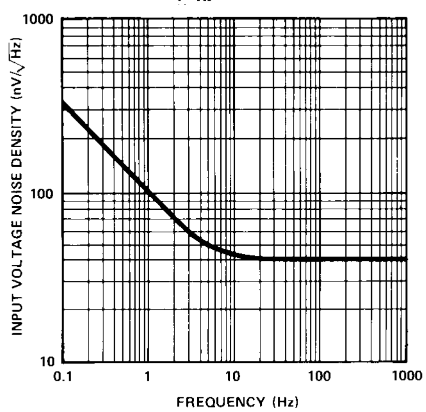
INPUT BIAS CURRENT vs TEMPERATURE



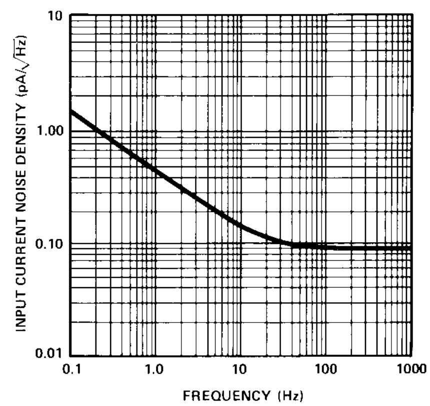
MAXIMUM OUTPUT VOLTAGE vs LOAD RESISTANCE



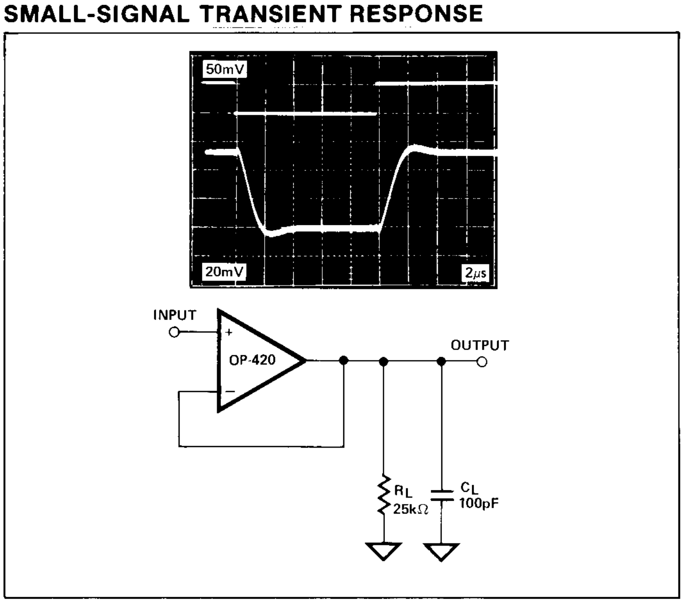
INPUT VOLTAGE NOISE DENSITY (e_n) vs FREQUENCY



INPUT CURRENT NOISE DENSITY (i_n) vs FREQUENCY



SMALL-SIGNAL TRANSIENT RESPONSE



LARGE-SIGNAL TRANSIENT RESPONSE