ANALOG DEVICES

Low-Power Operational Amplifier Single or Dual Supply

OP-21

FEATURES

- Low Supply Current ..... 230μA Max
- Wide Supply Range ..... ±2.5V to ±15V
- Low Input Offset Voltage ..... 100μV Max
- Low Input Offset Voltage Drift ..... 1.0μV/°C Max
- High Common-Mode Input Range ..... V− (+0.5V) to V+ (−1.5V)
- High CMRR and PSRR ..... 100dB Min
- High Open-Loop Gain ..... 1000V/mV Min
- 125°C Temperature Tested Dice

GENERAL DESCRIPTION

The OP-21 is a precision low-power operational amplifier offering the benefits of low offset voltage and high slew rate with the advantages of low power. A supply range of ±2.5V to ±15V allows a wide range of applications.

Two military temperature range models and three industrial temperature range models are available in TO-99 cans and 8-Pin hermetic DIPs. Industrial temperature range models are also available in 8-Pin epoxy DIPs. See OP-221 for dual and OP-421 for quad versions of the OP-21.

ORDERING INFORMATION †

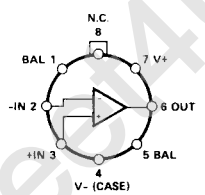
T_A = +25°C V_{OS} MAX (μV)	PACKAGE TO-99	PACKAGE CERDIP 8-PIN	PACKAGE PLASTIC 8-PIN	OPERATING TEMPERATURE RANGE
100	OP21AJ	OP21AZ*	–	MIL
100	–	OP21EZ	–	IND
200	OP21FJ	OP21FZ	OP21FP	IND
500	OP21GJ	–	OP21GP	XIND
500	–	–	OP21HS††	XIND

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

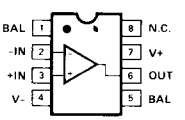
† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages.

†† For availability and burn-in information on SO and PLCC packages, contact your local sales office.

PIN CONNECTIONS



TO-99
(J-Suffix)

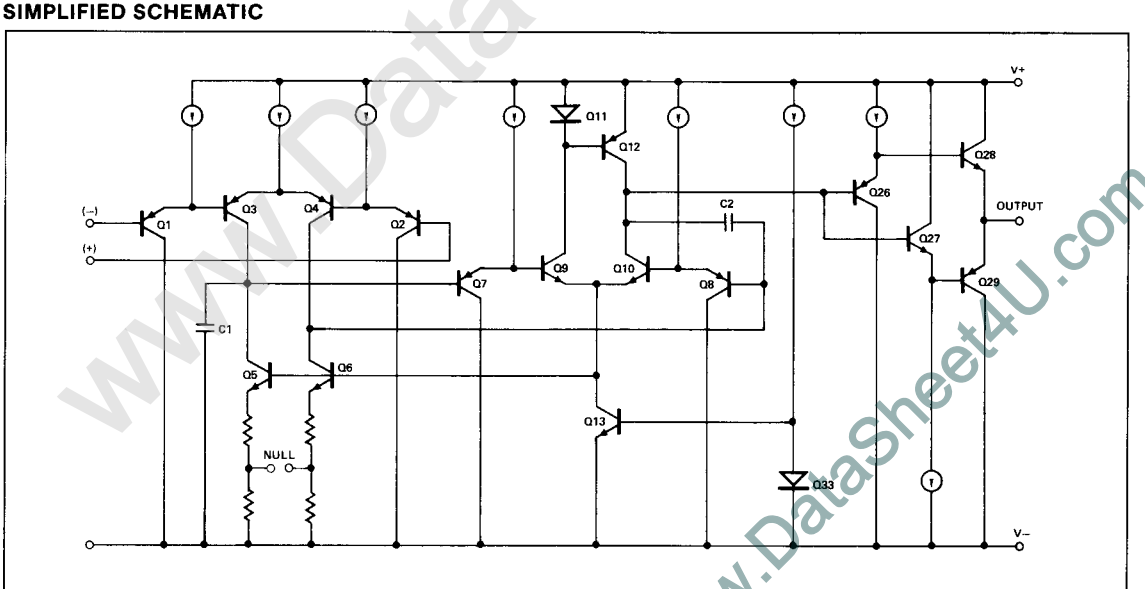


EPOXY MINI-DIP
(P-Suffix)

8-PIN HERMETIC DIP
(Z-Suffix)

8-PIN SO
(S-Suffix)

SIMPLIFIED SCHEMATIC



ABSOLUTE MAXIMUM RATINGS (Note 2)

Supply Voltage ..... ±18V
Differential Input Voltage ..... ±30V
Input Voltage ..... Supply Voltage
Output Short-Circuit Duration ..... Indefinite
Storage Temperature Range
J and Z Packages ..... −65°C to +125°C
P Package ..... −65°C to +125°C
Operating Temperature Range
OP-21A ..... −55°C to +125°C
OP-21E, OP-21F ..... −25°C to +85°C
OP-21HS, OP-21G ..... −40°C to +85°C
Junction Temperature (T_J) ..... −65°C to +150°C
Lead Temperature (Soldering, 60 sec) ..... 300°C

PACKAGE TYPE	Θ_{JA} (Note 1)	Θ_{JC}	UNITS
TO-99 (J)	150	18	°C/W
8-Pin Hermetic DIP (Z)	148	16	°C/W
8-Pin Plastic DIP (P)	103	43	°C/W
8-Pin SO (S)	158	43	°C/W

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

ELECTRICAL CHARACTERISTICS at $V_S = \pm 2.5V$ to $\pm 15V$ and $T_A = +25°C$, unless otherwise noted.

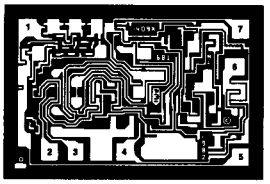
			OP-21A/E			OP-21F			OP-21G/H			
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	UNITS
Input Offset Voltage	V_{OS}	$V_S = \pm 15V$	—	40	100	—	150	200	—	300	500	µV
Input Offset Current	I_{OS}	$V_{CM} = 0$	—	0.6	4	—	0.8	5	—	1.2	6	nA
Input Bias Current	I_B	$V_{CM} = 0$	—	50	100	—	60	120	—	70	150	nA
Input Voltage Range	IVR	$V_S = \pm 15V$	−14.5/13.5	—	—	−14.5/13.5	—	—	−14.5/13.5	—	—	V
Common-Mode Rejection Ratio	CMRR	$V_S = \pm 15V$, No Load $-14.5V \le V_{CM} \le 13.5V$	100	110	—	90	105	—	84	100	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 2.5V$ to $\pm 15V$, No Load	—	2	6	—	4	10	—	10	32	µV/V
Large-Signal Voltage Gain	A_{VO}	$V_S = \pm 15V$, $R_L = 10k\Omega$, $V_O \pm 10V$	1000	2000	—	500	1500	—	500	1000	—	V/mV
Output Voltage Swing	V_O	$V_S = \pm 15V$, $R_L = 10k\Omega$	−13.7/14.0	—	—	−13.7/13.9	—	—	−13.6/13.8	—	—	V
Slew Rate	SR	$C_L = 100pF$, $R_L = 25k\Omega$	—	0.25	—	—	0.25	—	—	0.25	—	V/µs
Closed-Loop Bandwidth	BW	$A_{VCL} = +1$, $R_L = 10k\Omega$	—	600	—	—	600	—	—	600	—	kHz
Supply Current	I_{SY}	$V_S = \pm 2.5V$, No Load	—	170	230	—	180	275	—	190	300	µA
		$V_S = \pm 15V$, No Load	—	230	300	—	235	360	—	250	420	

ELECTRICAL CHARACTERISTICS at $V_S = \pm 2.5V$ to $\pm 15V$, $-55°C \le T_A \le +125°C$ for OP-21A, $-25°C \le T_A \le +85°C$ for OP-21E and OP-21F, $-40°C \le T_A \le +85°C$ for OP-21G and OP-21H, unless otherwise noted.

			OP-21A/E			OP-21F			OP-21G/H			
PARAMETER	**SYMBOL**	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
Average Input Offset Voltage Drift (Notes 1, 2)	TCV_{OS} TCV_{OSn}	Unnulled Nulled	—	0.5	1.0	—	1.0	2.0	—	2.5	5.0	μV/°C
Input Offset Voltage	V_{OS}		—	75	200	—	200	500	—	500	1000	μV
Input Offset Current	I_{OS}	$V_{CM} = 0$	—	0.7	5	—	0.7	6	—	0.8	8	nA
Input Bias Current	I_B	$V_{CM} = 0$	—	50	110	—	60	130	—	70	165	nA
Input Voltage Range	IVR		−14.3/13.2	—	—	−14.3/13.2	—	—	−14.3/13.2	—	—	V
Common-Mode Rejection Ratio	CMRR	No Load, $V_S = \pm 15V$, $-14.5V \le V_{CM} \le 13.2V$	96	105	—	86	100	—	80	95	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 2.5V$ to $\pm 15V$, No Load	—	4	10	—	6	18	—	18	57	μV/V
Large-Signal Voltage Gain	A_{VO}	$V_S = \pm 15V$, $R_L = 20k\Omega$, $V_O = \pm 10V$	500	1500	—	250	1300	—	250	1000	—	V/mV
Output Voltage Swing	V_O	$V_S = \pm 15V$, $R_L = 20k\Omega$	−13.5/13.8	—	—	−13.5/13.7	—	—	−13.5/13.6	—	—	V
Supply Current	I_{SY}	$V_S = \pm 2.5V$, No Load	—	205	275	—	215	330	—	230	360	μA
		$V_S = \pm 15V$, No Load	—	275	360	—	285	430	—	300	500	

NOTES:
1. Sample tested.
2. TCV_{OSn} is guaranteed by unnulled TCV_{OS} and device design.

DICE CHARACTERISTICS (125° C TESTED DICE AVAILABLE)



DIE SIZE 0.069 × 0.046 inch, 3174 sq. mils
(1.75 × 1.17 mm, 2.05 sq. mm)

1. BALANCE
2. INVERTING INPUT
3. NONINVERTING INPUT
4. V−
5. BALANCE
6. OUTPUT
7. V+

ELECTRICAL CHARACTERISTICS at V_S = ±15V, T_A = +25°C for OP-21N and OP-21G devices; T_A = +125°C for OP-21NT and OP-21GT devices, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-21NT LIMIT	OP-21N LIMIT	OP-21GT LIMIT	OP-21G LIMIT	UNITS
Input Offset Voltage	V_{OS}		200	100	500	200	µV MAX
Input Offset Current	I_{OS}	V_{CM} = 0	4	4	5	5	nA MAX
Input Bias Current	I_B	V_{CM} = 0	100	100	120	120	nA MAX
Input Voltage Range	IVR		−14.3 +13.5	−14.5 +13.5	−14.3 +13.5	−14.5 +13.5	V MIN
Common-Mode Rejection Ratio	CMRR	No Load CMVR = IVR	96	100	86	90	dB MIN
Power Supply Rejection Ratio	PSRR	V_S = ±2.5V to ±15V No Load	10	6	18	10	µV/V MAX
Large-Signal Voltage Gain	A_{VO}	R_L = 10kΩ, V_O = ±10V	500	1000	250	500	V/mV MIN
Output Voltage Swing	V_O	R_L = 10kΩ	−13.5 +13.8	−13.7 +14.0	−13.5 +13.8	−13.7 +13.9	V MIN
Supply Current	I_{SY}	No Load	300	300	360	360	µA MAX

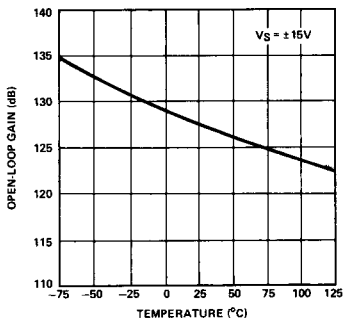
NOTES:
For 25° C characteristics of NT & GT devices, see N & G characteristics respectively.
Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualification through sample lot assembly and testing.

TYPICAL ELECTRICAL CHARACTERISTICS at V_S = ±15V, T_A = +25° C, unless otherwise noted.

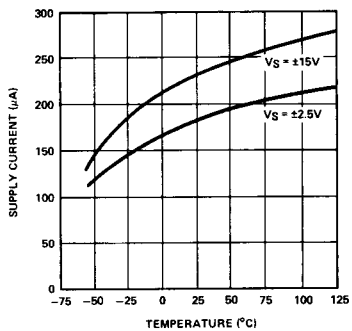
PARAMETER	SYMBOL	CONDITIONS	OP-21NT TYPICAL	OP-21N TYPICAL	OP-21GT TYPICAL	OP-21G TYPICAL	UNITS
Average Input Offset Voltage Drift	TCV_{OS}	Unnulled	0.5	0.5	1	1	µV/° C
Nulled Input Offset Voltage Drift	TCV_{OSn}	Nulled, R_p = 10kΩ	0.5	0.5	1	1	µV/° C
Large-Signal Voltage Gain	A_{VO}	R_L = 10kΩ	2000	2000	1500	1500	V/mV
Slew Rate	SR	R_L = 25kΩ C_L = 100pF	0.25	0.25	0.25	0.25	V/µs
Closed-Loop Bandwidth	BW	A_{VCL} = +1 R_L = 10kΩ	600	600	600	600	kHz

TYPICAL PERFORMANCE CHARACTERISTICS

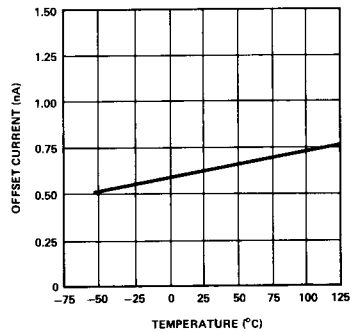
OPEN-LOOP GAIN vs TEMPERATURE



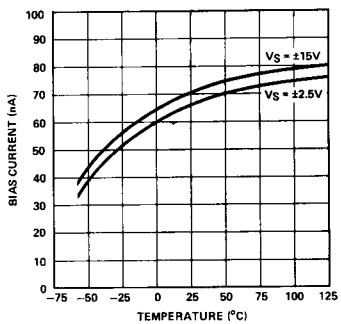
SUPPLY CURRENT vs TEMPERATURE



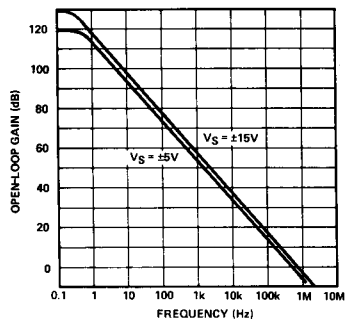
OFFSET CURRENT vs TEMPERATURE



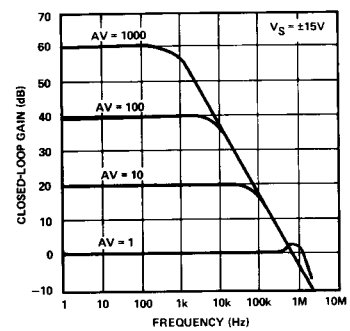
BIAS CURRENT vs TEMPERATURE



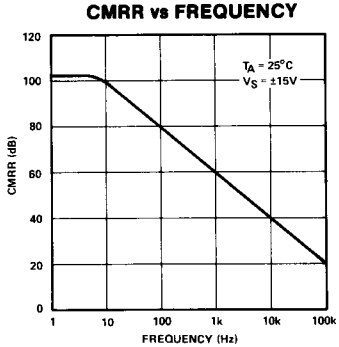
OPEN-LOOP GAIN vs FREQUENCY



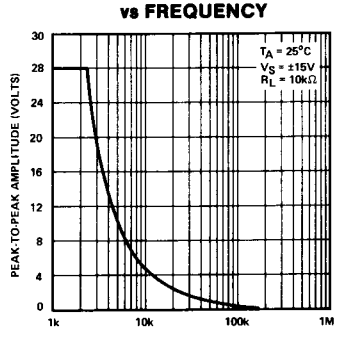
CLOSED-LOOP GAIN vs FREQUENCY



CMRR vs FREQUENCY

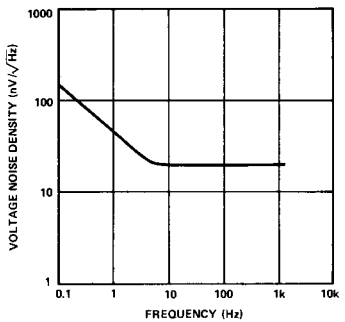


MAXIMUM OUTPUT SWING vs FREQUENCY

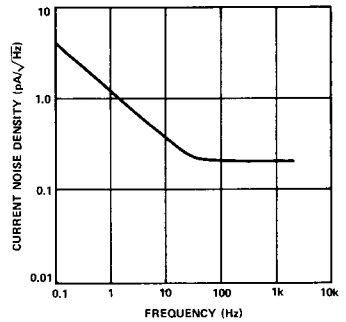


TYPICAL PERFORMANCE CHARACTERISTICS

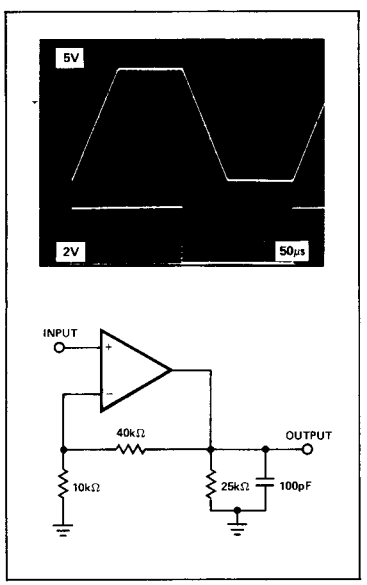
VOLTAGE NOISE DENSITY vs FREQUENCY



CURRENT NOISE DENSITY vs FREQUENCY



NONINVERTING LARGE-SIGNAL RESPONSE



NONINVERTING SMALL-SIGNAL RESPONSE