Dual Precision JFET Input Operational Amplifiers

FEATURES

- Internally Trimmed Offset Voltage — 1mV Max.
- Offset Voltage Drift — 10μV/°C Max.
- High Slew Rate — 10V/μs Min.
- Wide Bandwidth — 3.5MHz Min.
- Low Supply Current per Amplifier — 1.8mA Typ.
- Low Input Bias Current — 10pA Typ.
- Standard 8-Pin Configuration
- All Packages Available: Metal Can, Hermetic DIP, Plastic DIP

APPLICATIONS

- Sample and Hold Amplifiers
- Output Amplifier for Dual Current Output DACs
- High Speed Integrators
- Photocell Amplifiers
- High Input Impedance Instrumentation Amplifiers

DESCRIPTION

Linear Technology's LF412A and OP-215 series of dual JFET input op amps feature several improvements compared to similar types from other manufacturers.

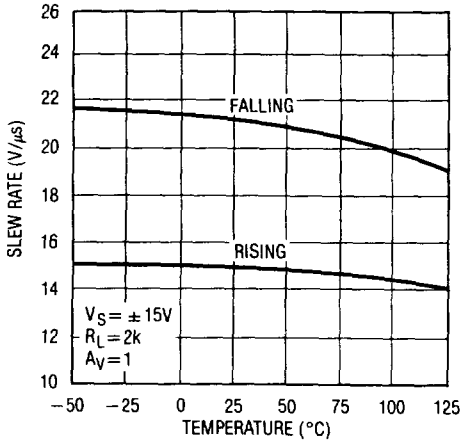
Both devices have lower input bias and offset currents over the entire temperature range, and are available in all standard 8-pin packages.

In addition, Linear's LF412A has lower voltage noise and higher voltage gain. Linear's OP-215 supply currents are nearly halved.

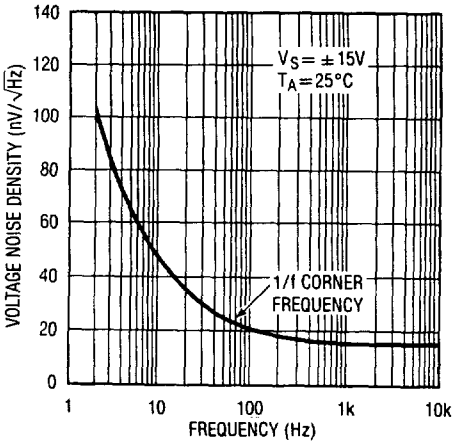
Please see the LT1057/LT1058 data sheet for applications requiring higher performance. The LT1057 is a pin compatible JFET input dual, the LT1058 is a JFET input quad op amp in the standard 14-pin DIP configuration.

2

Slew Rate



Voltage Noise Density vs Frequency



ABSOLUTE MAXIMUM RATINGS

Supply Voltage
- LF412AM/AC, OP-215A/E ..... ±22V
- LF412M/C, OP-215C/G ..... ±18V

Internal Power Dissipation 670mW

Operating Temperature Range
- LF412AM/M, OP-215A/C ..... −55°C to 125°C
- LF412AC/C, OP-215E/G ..... 0°C to 70°C

Differential Input Voltage
- LF412AM/AC, OP-215A/E ..... ±40V
- LF412M/C, OP-215C/G ..... ±30V

Input Voltage (Note A)
- LF412AM/AC, OP-215A/E ..... ±20V
- LF412M/C, OP-215C/G ..... ±16V

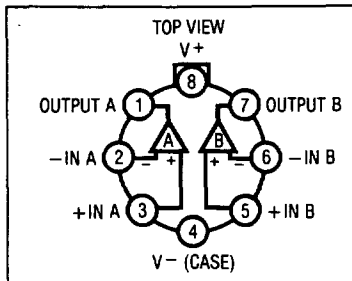
Output Short Circuit Duration ..... Indefinite

Storage Temperature Range ..... −65°C to 150°C

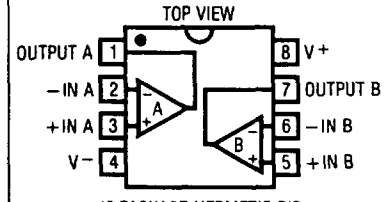
Lead Temperature (Soldering, 10 sec) ..... 300°C

Note A: Maximum negative input voltage is equal to the negative supply voltage.

PACKAGE/ORDER INFORMATION



H PACKAGE METAL CAN



J8 PACKAGE HERMETIC DIP
N8 PACKAGE PLASTIC DIP

ORDER PART NUMBER	
LF412AMH	OP-215AH
LF412MH	OP-215CH
LF412ACH	OP-215EH
LF412CH	OP-215GH
LF412AMJ8	OP-215AJ8
LF412MJ8	OP-215CJ8
LF412ACJ8	OP-215EJ8
LF412CJ8	OP-215GJ8
LF412ACN8	OP-215EN8
LF412CN8	OP-215GN8

ELECTRICAL CHARACTERISTICS

V_S = ±20V for LF412A, V_S = ±15V for all other grades. V_{CM} = 0V, T_A = 25°C unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	OP-215A/E MIN	OP-215A/E TYP	OP-215A/E MAX	LF412AM/AC MIN	LF412AM/AC TYP	LF412AM/AC MAX	LF412, OP-215C/G MIN	LF412, OP-215C/G TYP	LF412, OP-215C/G MAX	UNITS
V_{OS}	Input Offset Voltage		—	0.2	1.0	—	0.3	1.0	—	0.5	3.0	mV
I_{OS}	Input Offset Current	T_j = 25°C (Note 1)	—	6	50	—	6	50	—	10	100	pA
		Warmed-Up	—	10	100	—	10	100	—	15	200	pA
		V_S = ±15V										
I_B	Input Bias Current	T_j = 25°C (Note 1)	—	±10	±100	—	±10	±100	—	±15	±200	pA
		Warmed-Up	—	±15	±300	—	±15	±300	—	±20	±400	pA
		V_S = ±15V										
R_{IN}	Input Resistance		—	10^{12}	—	—	10^{12}	—	—	10^{12}	—	Ω
A_{VOL}	Large Signal Voltage Gain	$R_L \geq 2k\Omega$, V_O = ±10V	150	400	—	100	300	—	50	250	—	V/mV
		V_S = ±15V										
V_O	Output Voltage Swing	R_L = 10kΩ, V_S = ±15V	±12	±13	—	±12	±13	—	±12	±13	—	V
		R_L = 2kΩ, V_S = ±15V	±11	±12.7	—	±11	±12.7	—	±11	±12.7	—	V
I_S	Supply Current		—	3.8	6.0	—	3.6	5.6	—	3.8	6.8	mA
SR	Slew Rate	V_S = ±15V	10	15	—	10	15	—	8	13	—	V/μs
GBW	Gain Bandwidth Product	V_S = ±15V (Note 2)	3.5	5.7	—	3.5	5.7	—	3.0	5.5	—	MHz
	Settling Time	to 0.01%	—	2.3	—	—	2.3	—	—	2.4	—	μs
		to 0.10%	—	1.1	—	—	1.1	—	—	1.2	—	μs
	Input Voltage Range		±11	+14.5 −11.5	—	±16	+19.5 −16.5	—	±11	+14.5 −11.5	—	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = ±16V	—	—	—	80	100	—	—	—	—	dB
		V_{CM} = ±11V	75	100	—	—	—	—	72	100	—	dB
		V_{CM} = ±10.5V	86	100	—	—	—	—	82	100	—	dB
PSRR	Power Supply Rejection Ratio	V_S = ±10V to ±20V	—	—	—	80	100	—	—	—	—	dB
		V_S = ±10V to ±18V	86	100	—	—	—	—	80	100	—	dB
e_n	Input Noise Voltage Density	f_o = 100Hz	—	20	—	—	20	—	—	20	—	nV/√Hz
		f_o = 1000Hz	—	15	—	—	15	—	—	15	—	nV/√Hz
i_n	Input Noise Current Density	f_o = 100Hz	—	0.01	—	—	0.01	—	—	0.01	—	pA/√Hz
		f_o = 1000Hz	—	0.01	—	—	0.01	—	—	0.01	—	pA/√Hz
	Channel Separation	f = 1Hz to 20kHz	—	120	—	—	120	—	—	120	—	dB

ELECTRICAL CHARACTERISTICS

$V_S = \pm 20V$ for LF412A, $V_S = \pm 15V$ for all other grades. $V_{CM} = 0V$, $-55°C \le T_A \le 125°C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		OP-215A MIN	OP-215A TYP	OP-215A MAX	LF412AM MIN	LF412AM TYP	LF412AM MAX	LF412M, OP-215C MIN	LF412M, OP-215C TYP	LF412M, OP-215C MAX	UNITS
V_{OS}	Input Offset Voltage		●	—	0.5	2.0	—	0.7	2.0	—	1.0	5.0	mV
	Average Input Offset Voltage Drift		●	—	3 (Note 3)	10	—	4	10	—	5 (Note 3)	20	µV/°C
I_{OS}	Input Offset Current	$T_j = 125°C$ (Note 1)	●	—	0.8	8	—	0.8	8	—	1.0	12	nA
		$T_A = 125°C$, Warmed-Up	●	—	1.2	14	—	1.2	14	—	1.5	22	nA
		$V_S = \pm 15V$											
I_B	Input Bias Current	$T_j = 125°C$ (Note 1)	●	—	±1.5	±10	—	±1.5	±10	—	±1.8	±15	nA
		$T_A = 125°C$, Warmed-Up	●	—	±2.2	±18	—	±2.2	±18	—	±2.7	±28	nA
		$V_S = \pm 15V$											
	Input Voltage Range	OP-215	●	±10.3	+14.5 −11.5	—	—	—	—	±10.3	+14.5 −11.5	—	V
		LF412	●	—	—	—	±16	+19.5 −16.5	—	±11	+14.5 −11.5	—	V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = \pm 16V$	●	—	—	—	80	100	—	—	—	—	dB
		$V_{CM} = \pm 11V$	●	—	—	—	—	—	—	70	100	—	dB
		$V_{CM} = \pm 10.3V$	●	82	100	—	—	—	—	80	100	—	dB
I_S	Supply Current		●	—	4.2	6.8	—	4.0	5.6	—	4.2	6.8	mA
PSRR	Power Supply Rejection Ratio	$V_S = \pm 10V$ to $\pm 20V$	●	—	—	—	80	100	—	—	—	—	dB
		$V_S = \pm 10V$ to $\pm 16V$	●	80	100	—	—	—	—	78	100	—	dB
A_{VOL}	Large Signal Voltage Gain	$R_L \ge 2k\Omega$, $V_O = \pm 10V$ $V_S = \pm 15V$	●	30	150	—	30	150	—	25	150	—	V/mV
V_O	Output Voltage Swing	$R_L \ge 10k\Omega$, $V_S = \pm 15V$	●	±12	±13	—	±12	±13	—	±12	±13	—	V

ELECTRICAL CHARACTERISTICS

$V_S = \pm 20V$ for LF412A, $V_S = \pm 15V$ for all other grades. $V_{CM} = 0V$, $0°C \le T_A \le 70°C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		OP-215E MIN	OP-215E TYP	OP-215E MAX	LF412AC MIN	LF412AC TYP	LF412AC MAX	LF412C, OP-215G MIN	LF412C, OP-215G TYP	LF412C, OP-215G MAX	UNITS
V_{OS}	Input Offset Voltage		●	—	0.4	1.65	—	0.5	1.45	—	0.7	3.9	mV
	Average Input Offset Voltage Drift		●	—	3 (Note 3)	15	—	4	10	—	5 (Note 3)	20	µV/°C
I_{OS}	Input Offset Current	$T_j = 70°C$ (Note 1)	●	—	0.06	0.45	—	0.06	0.45	—	0.08	0.65	nA
		$T_A = 70°C$, Warmed-Up	●	—	0.08	0.8	—	0.08	0.8	—	0.10	1.2	nA
		$V_S = \pm 15V$											
I_B	Input Bias Current	$T_j = 70°C$ (Note 1)	●	—	±0.12	±0.7	—	±0.12	±0.7	—	±0.14	±0.9	nA
		$T_A = 70°C$, Warmed-Up	●	—	±0.16	±1.4	—	±0.16	±1.4	—	±0.19	±1.8	nA
		$V_S = \pm 15V$											
	Input Voltage Range	OP-215	●	±10.3	+14.5 −11.5	—	—	—	—	±10.3	+14.5 −11.5	—	V
		LF412	●	—	—	—	±16	+19.5 −11.5	—	±11	+14.5 −11.5	—	V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = \pm 16V$	●	—	—	—	80	100	—	—	—	—	dB
		$V_{CM} = \pm 11V$	●	—	—	—	—	—	—	70	100	—	dB
		$V_{CM} = \pm 10.3V$	●	80	100	—	—	—	—	76	100	—	dB
I_S	Supply Current		●	—	4.0	6.8	—	3.8	5.6	—	4.0	6.8	mA
PSRR	Power Supply Rejection Ratio	$V_S = \pm 10V$ to $\pm 20V$	●	—	—	—	80	100	—	—	—	—	dB
		$V_S = \pm 10V$ to $\pm 16V$	●	80	100	—	—	—	—	76	100	—	dB
A_{VOL}	Large Signal Voltage Gain	$R_L \ge 2k\Omega$, $V_O = \pm 10V$ $V_S = \pm 15V$	●	50	180	—	50	180	—	35	180	—	V/mV
V_O	Output Voltage Swing	$R_L \ge 10k\Omega$, $V_S = \pm 15V$	●	±12	±13	—	±12	±13	—	±12	±13	—	V

The ● denotes the specifications which apply over the full operating temperature range. The shaded electrical specifications indicate those parameters which have been improved or guaranteed test limits provided for the first time.

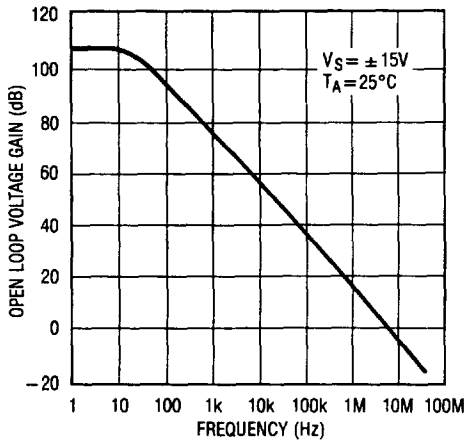
Note 1: Input bias and offset currents are specified for two different conditions. The T specification is with the junction at ambient temperature; the warmed-up specification is with the device operating in a warmed-up condition at the ambient temperature specified.

Note 2: Gain-bandwidth product is not tested. It is guaranteed by design and by inference from the slew rate measurement.

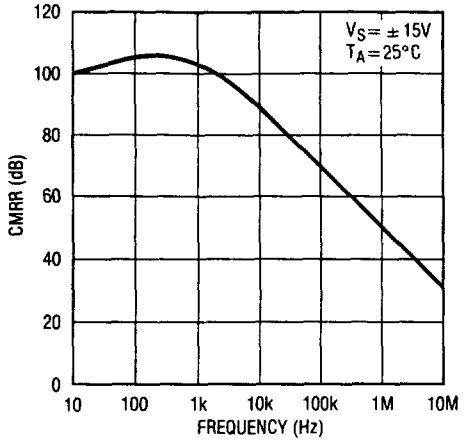
Note 3: The LF412A is 100% tested to this specification. All other grades are sample tested.

TYPICAL PERFORMANCE CHARACTERISTICS

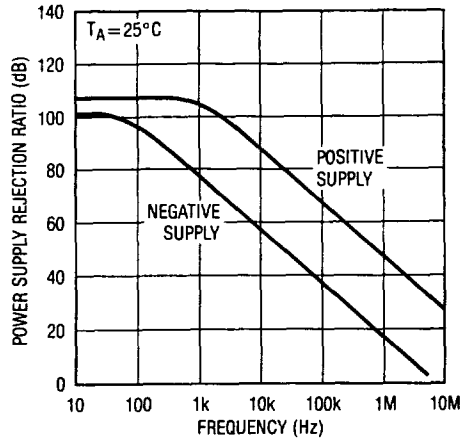
Open-Loop Frequency Response



Common-Mode Rejection Ratio vs Frequency



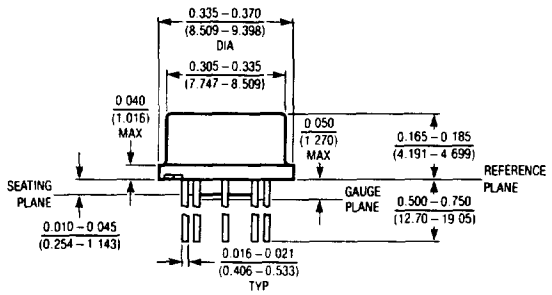
Power Supply Rejection Ratio vs Frequency

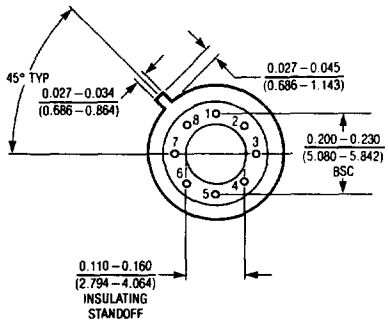


PACKAGE DESCRIPTIONS

Dimensions in inches (millimeters) unless otherwise noted.

H Package
TO-5 Metal Can

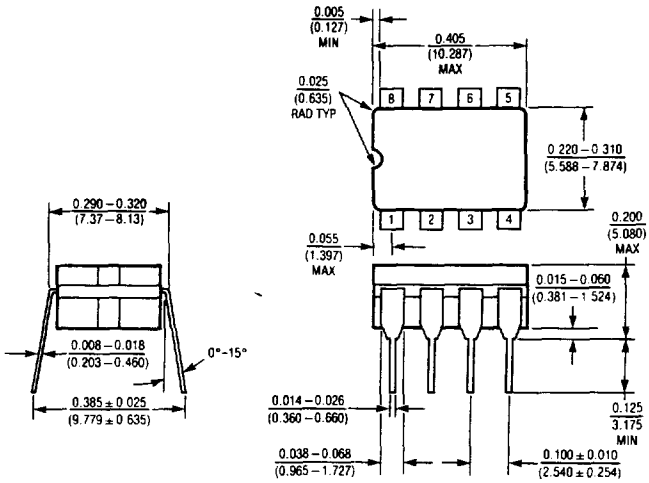




$T_j$max	θ_{ja}	θ_{jc}
165°C	140°C/W	40°C/W

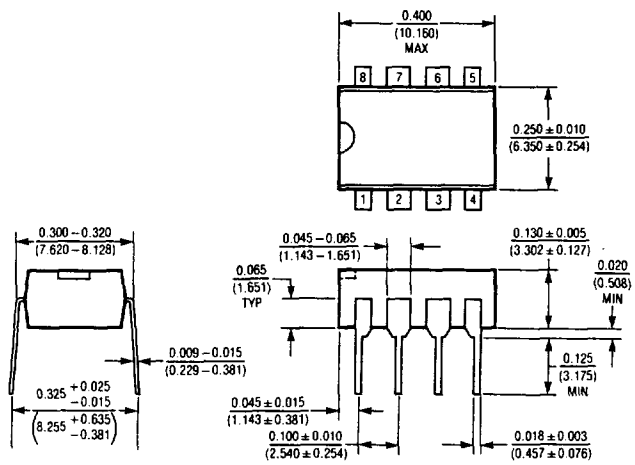
NOTE: LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND SEATING PLANE.

J Package
8 Lead Cerdip



$T_j$max	θ_{ja}
155°C	100°C/W

N Package
8 Lead Molded Dip



$T_j$max	θ_{ja}
115°C	130°C/W