

Operational Amplifiers

SPECIFICATIONS (typical at rated supply voltage and load, and $T_A = 25^\circ\text{C}$, unless noted otherwise)

General Purpose IC's	Offset Voltage mV max	$\Delta E_{og}/\Delta T^\ddagger$, $\mu\text{V}/^\circ\text{C}$ max	Bias Current nA max	Slew Rate $\text{V}/\mu\text{s}$	Page
AD301A/201A/101A [†]	7.5/2/2	30/15/15	250/75/75	0.5 to 10*	17(C)
AD741/741C [†] Internal Comp.	5.0/6.0	No Spec.	500	0.5	65(C)
FET-Input Low Bias Current IC's and Module	Bias Current pA max	Offset Voltage mV max	$\Delta E_{og}/\Delta T^\ddagger$ $\mu\text{V}/^\circ\text{C}$ max	Slew Rate $\text{V}/\mu\text{s}$	
AD515J/K/L	0.3/0.15/0.075	3/1/1	50/15/25	0.3 min	15S
AD545J/K/L/M	2/1/1/1	1/1/0.5/0.25	25/15/5/3	0.3 min	41S
52J/K Module	3	0.5	3/1	0.25 min	75(C)
AD506J/K/L/S	15/10/5/10	3.5/1.5/1/1.5	75/25/10/50	3.0	21(C)
AD503J/K/S	15/10/10	50/20/20	75/25/50	3.0	21(C)
AD528J/K/S	30/15/15	3/1/1	50/25/25	50	57(C)
AD542J/K/L/S BIFET	50/25/25/25	2/1/0.5/1	20/10/5/15	3.0	33S
AD544J/K/L/S BIFET	50/25/25/25	2/1/0.5/1	20/10/5/15	12.0	37S
AD540J/K/S	50/25/25	50/20/20	75/25/50	6.0	61(C)
Electrometer IC and Modules	Bias Current fA max	Offset Voltage mV max	$\Delta E_{og}/\Delta T^\ddagger$ $\mu\text{V}/^\circ\text{C}$ max	Slew Rate V/ms min	
310J/K Inverting Module	10	10	30/10	0.4	97(C)
311J/K Noninverting Module	10	10	30/10	0.4	97(C)
AD515J/K/L IC Differential	300/150/75	3/1/1	50/15/25	300	15S
High Accuracy Low-Drift IC's and Module	Offset mV max	$\Delta E_{og}/\Delta T^\ddagger$, $\mu\text{V}/^\circ\text{C}$ max	Bias Current nA max	Slew Rate $\text{V}/\mu\text{s}$	
AD517J/K/L/S	0.150/0.05/0.025/0.05	3/1/0.5/1	5/2/1/2	0.1/0.1	47(C)
AD510J/K/L/S	0.1/0.05/0.025/0.05	3/1/0.5/1	25/13/10/13	0.1	37(C)
AD504J/K/L/M/S	2.5/1.5/0.5/0.5/0.5	5/3/1/0.5/1 nulled	200/100*80/80/80	0.12 to 2.5*	25(C)
52J/K Module	0.5	3/1	0.003	0.25 min	75(C)
AD301AL [†]	0.5	5.0	30	0.5 to 10*	17(C)
AD741J/K/L/S	3/2/0.5/2	20/15/5/15 untrimmed	200/75/50/75	0.5	65(C)
High Accuracy Low-Drift Chopper Amplifier Modules	Offset μV max	$\Delta E_{og}/\Delta T^\ddagger$ $\mu\text{V}/^\circ\text{C}$ max	Bias Current pA max	Slew Rate $\text{V}/\mu\text{s}$	
235J/K/L Inverting	25/25/15	0.5/0.25/0.1	100/50/50	0.3	85(C)
234J/K/L Inverting	50/20/20	1.0/0.3/0.1	100	30	81(C)
261J/K Low-Noise, Non-Inverting	25	0.3/0.1	300	100V/s	91(C)
260J/K Low-Cost, Non-Inverting	25	0.3/0.1	300	100V/s	89(C)
Fast, Wideband IC's and Modules	Settling Time to 0.1%, μs	Slew Rate $\text{V}/\mu\text{s}$, min	$\Delta E_{og}/\Delta T^\ddagger$, $\mu\text{V}/^\circ\text{C}$ max	I_{BIAS} nA max	
50J/K Module	0.1 (INV, max)	500 (INV)	50/15	2	71(C)
51A/B [‡] Module (-25°C to +85°C)	0.15 (INV, max) 0 to +70°C	400 (INV)	50/20	2	71(C)
(-55°C to +100°C Operating)	0.25 (INV, 0.05%) -25°C to +85°C				
HOS-050/050A [†] TO-8	0.08 (INV)	300 (INV)	150/35	2	45S
48J/K Fast Settling Module	0.5 (0.01%, max)	110 (INV)	50/15	0.05/0.025	69(C)
AD509J/K/S IC	0.2/0.5 max/0.5 max	80/80/100	20 typ/30/30	250/200/200	33(C)
AD518J/K/S IC	0.8	50	10 typ/15/20	500/250/250	53(C)
AD528J/K/S FET-Input IC	0.8	50	50/25/25	0.03/0.015/0.015	57(C)
AD507J/K/S IC	0.9	20/25/20	15 typ/15/20	25/15/15	29(C)
High-Output Modules	max E_{out}	max I_{out}	$\Delta E_{og}/\Delta T^\ddagger$ $\mu\text{V}/^\circ\text{C}$	I_{BIAS} pA max	
171J/K	±140V	±10mA	50/15	50/20	77(C)
50J/K	±10V	±100mA	50/15	2000	71(C)
51A/B [‡] -25°C to +85°C (Spec.) (-55°C to +100°C Oper.)	±10V	±100mA	50/20	2000	71(C)
Isolated Op Amp Modules					
277J/K/A	Inverting, non-inverting, differential op-amp applications, Input offset drift 3/1 $\mu\text{V}/^\circ\text{C}$ (nulled), bias current 20nA max, CMR 160dB min at dc, 120dB min at 60Hz, max CMV 3500V rms (60Hz, 1 min), ±2500V peak or dc, continuous, isolated power output, ±15mA @ ±15V.				133(C)

*Inverting - Actual value depends on compensation.

[†]301A, 301AL, 0 to +70°C; 201A, -25°C to +85°C; 101A, -55°C to +125°C;

741C, 0 to +70°C; 741, -55°C to +125°C; HOS, -55°C to +125°C.

[‡]Temperature range suffixes (e.g. AD504J/K/L/M/S) J/K/L/M, 0 to +70°C;

S, -55°C to +125°C; 51A/B, 277A, -25°C to +85°C.

Instrumentation Amplifiers

	606J/K/L/M Module	AD522A/B/S Hybrid IC	610J/K/L Module	AD521J/K/L/S Monolithic IC
Nominal Gain Range	1 to 10,000V/V	1 to 1000	1 to 10,000V/V	1 to 1000V/V
Gain Tempco, ppm/°C	±15 max	2 max, G = 1 50 max, G = 1000	±15 max	±(3 ± 0.05G) (J, K, L) ±(15 ± 0.4G) S
Nonlinearity, max (G = 100)	0.002%	0.01%/0.005%/0.005%	0.01%	0.2%/0.2%/0.1%/0.2% max
Offset Tempco RTI, $\mu\text{V}/^\circ\text{C}$				
G = 1	200/150/100/75 max	50/25/100 max	200/150/150	400/150/75/150 max
G = 1000	2/1/0.5/0.25 max	6/2/6 max	3/1/0.5 max	15/5/2/5 max
I_{BIAS} , nA max	+60	±25/15/25	+60	80/40/40/40
I_{BIAS} Tempco	-0.2nA/°C	±100/50/100pA/°C	-0.2nA/°C	1/0.5/0.5/0.5nA/°C max
I_{OS} , nA	±1	±20/10/20 max	±5	20/10/10/10 max
I_{OS} Tempco, pA/°C	±20	±100/50/100	±20	250/125/125/125 max
Noise, RTI, 0.1Hz - 10Hz, μV p-p				
G = 1	40(0.01 - 10Hz)	15	50(0.01 - 10Hz)	225
G = 1000	1 max (0.01 - 10Hz)	1.5	2.5/2/2 max (0.01 - 10Hz)	0.5
CMR at rated CMV				
1k Ω Unbalance, Frequency:	DC to 100Hz		DC to 100Hz	DC to 60Hz
G = 1, dB min	60	75/80/75	DC to 30Hz	60
G = 10, dB min	80	90/95/90	DC to 10Hz	80
G = 100, dB min	86	100	DC to 3Hz	86
G = 1000, dB min	90	100/110/100	DC to 1Hz	90
Small-Signal Frequency Range				
-3dB, typ				
G = 100	100kHz	3kHz	100kHz	200kHz
Settling Time to 0.1%, ±10V Output Step				
G = 100	30 μs	5ms	30 μs	10 μs
Temperature Range†	C	I/I/M	C	C/C/C/M
Page	117(C)	113(C)	121(C)	47S

*G = 1 to 1000, DC to 60Hz: 75/80/75dB for A/B/S

†C: 0 to +70°C, I: -25°C to +85°C, M: -55°C to +125°C.

Isolation Amplifiers

APPLICATION	PRIMARY CONSIDERATIONS	FEATURES	RECOMMENDED MODEL	PAGE
Industrial and Medical Instrumentation	Lowest Cost High Performance Patient Safety High CMR, CMV	±0.05% Nonlinearity, ±75ppm/°C Gain Drift 2.0 μA rms max leakage; Defibrillator Protection Floating Power Supply: ±8.5V dc @ ±5mA min 110dB min CMR @ 60Hz; ±5kV pk CMV (Pulse)	284J	137(C) Note 1
Industrial and Medical Instrumentation	Multi-Channel Reliability High CMV, CMR Isolated Supply	External Synchronization; 100kHz Osc — model 281 Meets IEEE SWC Standard and UL 544 Leakage Std 5kV pk pulse differential and Input/Output CMV 110dB min CMR @ 60Hz; ±15V dc @ ±15mA Isolated Supply	286J 281 (Osc)	147(C)
Industrial Instrumentation and Control Systems	Multi-Channel High Accuracy Low Cost Smallest Size	External Synchronization; model 947 or 948 driver 0.05% max nonlinearity, 100ppm/°C max gain drift, 5 $\mu\text{V}/^\circ\text{C}$ max input drift, Adjust. Gain, 1 to 1000V/V, 850V dc diff and in/out CMV, 1" x 1" x 0.56"	288J 288K 947 (Driver) 948 (Driver)	53S
Industrial Instrumentation and Control Systems	Highest Accuracy Versatility High CMV/CMR Isolated Supply	0.025% max nonlinearity, 1 $\mu\text{V}/^\circ\text{C}$ max input drift, Uncommitted High Performance Op Amp Front-End 160dB min CMR @ dc; 3.5kV rms CMV (1 min) Floating Power Supply: ±15V dc @ ±15mA min	277J 277K 277A	133(C)
Industrial Instrumentation and Control Systems	High Accuracy Wide Input/Output Range High CMV/CMR Floating Output	0.05% max nonlinearity, 5 $\mu\text{V}/^\circ\text{C}$ max input drift, ±10V Input/Output Range; 2.5kV dc CMV (Continuous), 120dB min CMR @ 60Hz, Fully Guarded Inputs 3-Port Isolation; 200V dc CMV Outputs to Pwr Com	275J 275K 275L	129(C)
Industrial Instrumentation and Control Systems	High Accuracy Low Impedance Output High CMV/CMR	0.03% max nonlinearity, 5 $\mu\text{V}/^\circ\text{C}$ max input drift ±10V min Input/Output Range; ±5mA Output Adjustable Gain, 1 to 1000V/V, 3000V rms 60Hz Input/Output Isolation (1 min), 115dB CMR @ 60Hz	285J 285K 285L	143(C)

¹ Product improved; new data sheet.