

**INDEX**

**SUBJECT INDEX**

**ANALOG DEVICES PARTS INDEX**



# SUBJECT INDEX

## A

- Accelerometer:  
 amplifier, III.48  
 high-performance amplifiers, III.51-52
- Active filter, VI.1-2  
 characteristics, VI.3  
 FDNR, VI.9  
 multiple feedback, VI.5, VI.9  
 realizations, VI.9  
 Sallen-Key, VI.5, VI.9  
 state variable, VI.5, VI.9
- AD712 Data Sheet, III.59
- AD7528 Dual 8-Bit CMOS DAC Application Note, VI.33
- ADC:  
 12-bit nonsampling,  
 encoder block diagram, VII.37  
 with SHA, VII.39  
 subranging, VII.36-39  
 driving, VII.36-39  
 12-bit sampling,  
 block diagram, VII.40  
 driving, VII.39-44  
 dynamic performance, VII.41  
 harmonic distortion, VII.41  
 input circuit, VII.42  
 key specifications, VII.40, VII.43  
 S/(N+D), VII.41  
 14-bit sampling,  
 antialiasing filter, VII.48  
 block diagram, VII.44  
 digital error correction, VII.44  
 harmonic distortion, VII.45  
 key specifications, VII.45  
 wide dynamic range, VII.44-49  
 16-bit sampling,  
 AGND SENSE, VII.54-56  
 block diagram, VII.53  
 DGND, VII.54-55  
 ENOB, VII.55  
 equivalent input circuit, VII.56  
 key specifications, VII.53  
 precision, driving, VII.52, VII.52-58  
 S/(N+D), VII.54-55  
 switched-capacitor charge redistribution,  
 VII.52  
 adjustable positive and negative clamp circuit,  
 VII.63  
 antialiasing filter, VII.1  
 optimum system noise performance, VII.30  
 parameters, VI.4  
 specifications, VII.29-30  
 bit sizes, VII.5  
 buffer amplifier, VII.36, VII.38  
 current feedback amplifier, VII.14, VII.44  
 data acquisition system, VII.38  
 dc drift, system dynamic range, VII.18  
 DCS architecture, VII.3  
 drive amplifier,  
 harmonic distortion, VII.22-23  
 primary functions, VII.10  
 signal conditioner, VII.10  
 and system performance, VII.9-29  
 drive amplifier selection, VII.1  
 DSP applications, VII.4  
 DSP signal processing, VII.1  
 dynamic testing, VII.5  
 encoders, VII.2  
 ENOB, VII.5  
 equivalent input circuit, VII.38  
 FFT, VII.5-6  
 flash converter, Schottky diode, VII.65  
 FPBW, VII.9  
 ground, XII.10  
 high performance video, input buffer, VIII.16  
 input bandwidth, VII.28  
 input buffer, VIII.16  
 input clamping and protection circuits,  
 VII.62-65  
 key specifications, VII.37  
 large offset shifts, gain reduction, VII.17  
 low distortion drive circuit, VII.47  
 nonsampling, dc specifications, VII.3  
 Nyquist bandwidth, VII.5, VII.29  
 Nyquist criterion, VII.3  
 offset voltage drift, VII.16-17  
 output noise, input bandwidth, VII.29  
 overvoltage recovery time, VII.62  
 peak harmonic, VII.8  
 peak spurious, VII.8  
 performance, VII.2-9  
 quantization theory, VII.8  
 reconstructed FFT fundamental, VII.9  
 S/(N+D), VII.6-8  
 sampling, VII.1, VII.2-4  
 SAR, nonsampling, VII.30-36  
 Schottky diodes, VII.62-63  
 SFDR, VII.8, VII.22  
 SHA interface, VII.4  
 SHAs, VII.2  
 sigma-delta digital audio,  
 block diagram, VII.58  
 CMOS implementation of switched capaci-

- tor, VII.60
  - differential driver (one channel), VII.61
  - driving, VII.58-61
  - equivalent circuit, VII.61
  - key specifications, VII.59
  - single-ended switched capacitor integra-  
tor, VII.60
    - T-switch circuit, VII.59-60
    - signal RMS, VII.5
    - in simultaneous sampling data acquisition  
system, VII.2
    - SNR, VII.5-7
    - subranging, digitally corrected, VII.43
    - successive approximation, VII.2
      - op amp settling time measurement, XI.19
    - supply, 3-terminal regulators, VII.65
    - THD, VII.8
    - theoretical quantization noise, VII.5
    - total amplifier output offset voltage, VII.16-  
17
      - voltage feedback amplifier, VII.10-11
        - dc gain accuracy, VII.12
- ADSpice amplifier, III.45
- ADSpice model:
  - bandwidth variance, XIII.11
  - circuit board parasitics, XIII.20
  - circuit design, XIII.9
  - constituents, XIII.3-4
  - current feedback amplifier, input stage,  
XIII.11
    - current feedback resistor, XIII.10-11
    - damped ringing frequency prediction, XIII.5
    - input and gain stages, XIII.4
    - multiplier,
      - gain-bandwidth, XIII.16
      - KVL equations, XIII.16-17
    - noise analysis, XIII.9
    - noise generators, XIII.6
    - open architecture, XIII.3
    - output stage, XIII.5
    - overshoot prediction, XIII.5
    - pole/zero stages, XIII.4-5
    - simulation vs. CMRR modeling, XIII.21-22
    - temperature drift, XIII.14
    - three-variable analog multiplier/divider,  
XIII.18
      - total RMS noise, XIII.13
      - voltage reference model, XIII.11-14
        - transient load response, XIII.12
- AGC amplifier:
  - low noise,
    - gain, IX.40
    - schematic, IX.39
    - stabilization, IX.40-41
- AGC systems, output S/N ratio, optimization,  
IX.55
- AGND, circuit, XII.11
- Alexander, M., X.19
- Allen, P.E., VI.33
- Amplifier, charge-sensitive, III.48
- Amplifier Becomes Glitch-Free Clipper  
(EDN), X.19
- Amplifier/limited. *See:* A/0
- An I.C. Amplifier User's Guide to Decoupling,  
Grounding, and Making Things Go Right for  
a Change, XI.62, XI.63-70
- Analog circuit:
  - 3V logic supply, IV.34
  - 5V logic supply, IV.31-33
  - ADSpice model, XIII.2-6
  - analog multiplier model, XIII.14-19
  - CMRR performance, XIII.21-22
  - current feedback amplifier model, XIII.10
    - input and gain stage, XIII.10
  - DC parameters, test circuit, XIII.23
  - differential LC filter, IV.32-33
  - flicker coefficients, XIII.8
  - glitch noise, IV.33
  - high performance, prototyping, XII.23-25
  - IC sockets, disadvantages, XII.24
  - low noise, with ESR capacitors, IV.33
  - macromodel vs. micromodel, XIII.2-3
  - Minimounts, XII.24
  - modeling, XIII.22-24
  - noise, XII.9-10
    - input stage, XIII.7
    - pole stage, XIII.7
  - noise model, XIII.6-9
    - full noise analysis, XIII.8
  - noise-free supply, IV.32
  - performance, modeling, XII.21
  - prototyping, hints, XII.25
  - RMS noise minimization, XIII.9
  - simulation, XIII.1-29, XIII.21-22
  - simulation vs. breadboarding, XIII.20-21
  - Solder Mounts, XII.24
  - vector boards, disadvantages, XII.24
  - voltage reference model, XIII.11-14
    - total RMS noise, XIII.13
  - voltage spikes, IV.31-32
- Analog Devices, VII.66
- Analog filter, types, VI.1
- Analog ground. *See:* AGND
- Analog ground sense. *See:* AGND SENSE
- Analog multiplier model, analog function  
prediction, XIII.14-19
- Analysis and Design of Analog Integrated  
Circuits, 2nd ed., III.59
- Analysis and Design of the Op Amp Current  
Source, VIII.38
- Analysis of Problems in Dynamics by Elec-  
tronic Circuits (Proc. I.R.E.), X.19

- Antialiasing filter:  
 active, design, VI.9  
 broadband noise, VII.30  
 Butterworth design, VI.9  
 design, VI.9-14  
 dynamic range effects, VII.29-30  
 FDNR, VI.15  
 optimum system noise performance, VII.30  
 parameters, VI.4  
 for reducing driver noise, VII.48  
See also names of individual filter types
- Audio circuit:  
 CMR, V.6, V.8  
 CMR vs frequency for ac trim, V.7  
 CMR vs frequency for dc trim, V.6  
 design, V.3  
 gain control, V.3  
 line driver, high performance composite, V.18-21  
 op amp applications, V.1-21  
 performance, V.8-9  
 simulation, V.6  
 specifications, V.2  
 THD+N, V.4
- Audio IC Op Amp Applications, 3rd ed., V.22
- Audio line receiver, V.5  
 CMR, V.11  
 interfacing, V.11  
 THD+N, V.11
- Automatic gain control. See: AGC
- Automotive headlight dimmer, photodiode, III.1
- Automotive twilight detector, photodiode, III.1
- ## B
- Bandpass filter:  
 biquad,  
 circuit characteristics, VI.17  
 frequency response, VI.17  
 with quad amplifier, VI.16
- Bar code reader:  
 photodiode, III.1  
 wide bandwidth, III.33
- Barber, William L., IX.104
- Bias current:  
 cancellation disaster, III.11  
 compensation, III.10-12  
 dc error sources, III.8, III.10  
 input, cancellation, III.11  
 output voltage, effect of resistance, III.12
- BiFET op amp, III.7-8, III.49  
 input circuit, III.13  
 phase inversion, X.31  
 specifications, III.8
- Biquad bandpass filter with quad amplifier, VI.16
- Blinchikoff, H.J., VI.33
- Blood particle analyzer, photodiode, III.1
- Bode plot:  
 closed loop bandwidth, III.20  
 closed loop gain, III.20  
 definitions, III.20  
 feedback loop attenuation, III.20  
 generalized noise gain, III.20  
 loop gain, III.20  
 noise gain, III.18, III.20  
 op amp, III.18-19  
 open loop gain, III.20  
 preamp photodiode, compensation on phase margin, III.36  
 signal gain, III.20  
 voltage feedback op amp, VII.11
- Boltzmann's constant, IX.4, IX.7, XI.26-27, XI.62
- Bowers, Derek F., X.1, X.19
- Boyle, G.R., X.19
- Boyle model, simulation, XIII.3, XIII.5-6
- Breadboard, and circuit board parasitics, XIII.20
- Bridge amplifier:  
 all-element varying, II.2-3, II.10-15  
 basic configurations, II.2-3  
 chopper stabilized amplifier, II.15  
 error budget analysis, II.17  
 instrumentation amplifier, II.15  
 low-power RTD thermometer, II.7  
 op amp, critical parameters, II.15-16  
 optimum performance, selection, II.15-27  
 precision op amp, II.15  
 single-element varying, II.2-3, II.4-6  
 system requirements, II.15  
 transducer signals, II.2-3  
 two-element varying, II.2-3, II.8-10  
See also Sensor bridge
- Bridge circuit:  
 instrumentation amplifier, II.27  
 RTD signal conditioning, errors, II.60-62
- Bridge sensor, for 3-op amp instrumentation amplifier, II.30
- Broadband Amplifier Applications, IX.104
- Broadcast video:  
 introduction, VIII.1-6  
 signal,  
 horizontal sync, VIII.2  
 vertical sync, VIII.2  
 television interlace format, VIII.1
- Brokaw, Paul, XI.1, XI.62, XI.63-70
- Brown, Edmund R., IX.104

Brunner, Eberhard, IX.115  
Bryant, James M., X.1, X.20, XI.1, XI.21, XII.1  
Budak, A., VI.33  
Buffer, ultra-high speed, VIII.22-28  
Butterworth filter:  
  antialiasing,  
    specifications, VI.9  
    tuning table values, VI.10  
  transfer functions, VI.4-5  
Buxton, Joe, VII.66, XIII.1

## C

Camcorder, 3V logic supply, IV.34  
Capacitor:  
  dielectric absorption, XI.36-37  
  features, VI.22  
  inductance, XI.36-37  
  leakage, XI.36-37  
  SHA, XI.37  
  thermal stability, XI.36-37  
  type, features, XI.38  
Careful Design Tames High-Speed Op Amps (Electronic Design), VII.66  
CaT scanner, photodiode, III.1  
Cate, T., X.19  
CBFET:  
  key specifications, VII.35  
  for precision ADCs, VII.35  
CCD imaging:  
  ADC, VII.2  
  op amp settling time, VII.23  
Cellular communication, 3V logic supply, IV.34  
Charge transducer:  
  capacitive, III.48  
  charge-emitting, III.48  
  low-noise circuit, III.49-50  
Charge-sensitive amplifier, III.48  
Chebyshev filter, transfer functions, VI.4-5  
Chopper op amp, See: Chopper stabilized amplifier  
Chopper stabilized amplifier:  
  comparison with precision op amp, II.39  
  noise gain, II.39  
  noise generation, II.37  
  wideband noise, II.38  
  zero offset voltage and drift, II.37-39  
Circuit board:  
  anisotropy, XII.1  
  flowchart, XII.18  
  ground plane, XII.12-13  
    breaks, XII.14-15  
    ground planes, XI.48  
    guard rings, XII.1-2  
    leakage resistance, XII.2  
    multiple, ground, XII.15-17  
    power planes, XI.48  
    standoff insulator, virgin Teflon, XII.2  
    transmission lines, XII.13-15  
Circuit layout, to minimize noise, IV.31  
Circuit noise, XII.9-10  
Clarke, Bob, IX.1, IX.115  
CMOS ADC, analog input voltage, VII.64  
CMOS DAC Application Guide, VI.33  
CMOS logic, interface with op amp comparator, X.26-27  
CMOS multiplexer, VII.36, VII.38  
CMOS system, op amp, IV.1  
CMR:  
  audio circuit, V.6-8  
  capacitive unbalance, V.8  
Cold junction compensated battery-powered thermocouple amplifier, IV.17  
Columbia Research Labs 2682 Strain Sensor, II.14  
Common-mode rejection. See: CMR  
Common-mode rejection ratio. See: CMRR  
Comparators:  
  functions, X.20  
  vs. op amps, X.20  
  speed, X.23  
Composite amplifier, FET input IC, V.18  
Composite buffer:  
  circuit description, V.19-20  
  design, V.20  
  low distortion, V.19  
  performance, V.20-21  
  THD+N, V.20-21  
Composite line amplifier, THD+N, V.20  
Composite video sync tip DC restorer, VIII.13-14  
Computer simulation, op amp design, X.18  
Conductor, resistance, calculations, XI.40  
Current drive linear amplifier:  
  calibration, II.63  
  implementation, II.62-63  
Current feedback. See: CFB  
Current feedback amplifier:  
  bandwidth variance, XIII.10-11  
  dc gain accuracy, VII.15-16  
  equivalent circuit, VII.14  
  feedback resistor, XIII.10-11  
  model, input and gain stage, XIII.10  
Current Feedback Audio Power Amplifier (AES Preprint #2902), X.19  
Current-Mode Analogue Signal Processing (Proceedings of the BCTM), X.19

Current-to-voltage converter. See: I/V converter  
 Cutoff frequency, filter, VI.2-3

## D

DAC:  
 CMOS, IV.20  
 ground, XII.10  
 high-performance, I/V converter, III.57-58  
 loop current, IV.4  
 loop-powered, IV.3  
 output voltage, IV.4  
 in programmable state variable filter, VI.14  
 single supply, loop-powered, IV.3-4  
 Dark current, photodiode, reverse bias, III.3  
 Darling, T.F., X.19  
 Decompensated amplifier, as I/V converter, III.56-57  
 Design with Operational Amplifiers and Analog Integrated Circuits, VI.33  
 Detector Log Video Amplifier, IX.59  
 DGND, circuit, XII.11  
 Differential amplifier, scheme, V.5  
 Differential line receiver. See: Line receiver  
 Differential transmission, mixed signal system, XII.20  
 Digital audio:  
 antialiasing filter, VI.14  
 frequency response, VI.15  
 Digital circuit, noise, XII.9-10  
 Digital ground. See: DGND  
 DLVA, IX.59  
 Document scanner, wide bandwidth photodiode, III.33  
 DUT, IV.26, XI.12  
 television, differential gain and phase, VIII.5  
 Dynamic range, definitions, IX.2  
 Dynamic range compression, log amp, IX.58

## E

Ebers-Moll modeling, IX.72  
 ECL logic, interface with op amp comparator, X.26  
 Effective number of bits. See: ENOB  
 EG&G Vactec, III.59  
 EIA RS-170, monochrome television signal, VIII.2  
 Eighth Order Programmable Lowpass Analog Filter Using 12-Bit DACs, VI.33  
 Elbert, Mark, IX.105

Electromagnetic interference. See: EMI  
 Electromagnetic noise interference, XI.53-54  
 Electronic Filter Design Handbook, VI.33  
 Electrostatic damage. See: ESD  
 Electrostatic discharge protection, XII.4  
 Elliptical filter, transition region, VI.4-5  
 EMI, prevention, XI.54  
 ENOB, VII.5, VII.7  
 ESD:  
 discharge protection, XII.4  
 integrated circuit damage, XII.3-4  
 prevention, manual, XII.4, XII.26  
 E.S.D. Prevention Manual, XII.4, XII.26

## F

False ground:  
 in 50/60 Hz notch filter, IV.7-9  
 audio and video systems, IV.5  
 design, IV.5-6  
 high-quality low impedance, IV.5-6  
 ultrasonic AGC receiver, IV.9, IV.9-10  
 Faraday shield, grounded, XI.49, XI.56  
 Fast Fourier Transform. See: FFT  
 Fast scanner, wide bandwidth photodiode, III.33  
 Fatigue load strain sensor amplifier, II.14  
 Fatigue monitoring strain sensing circuit, all-element varying, II.14  
 Fax machine, wide bandwidth photodiode, III.33  
 FDNR:  
 antialiasing filter, VI.15  
 configuration, VI.7-9  
 implementation, VI.11, VI.13  
 in General Impedance Converter (GIC), VI.7  
 impedance transformation, VI.8  
 op amp,  
 FET input, VI.28  
 loop gain, VI.28  
 requirements, VI.26, VI.28  
 sensitivity, VI.28  
 FET-input op amp, III.37-38  
 bias current, temperature dependence, III.10  
 for gain-bandwidth increase, III.45  
 FFT, VII.5  
 Fiber optic receiver:  
 high speed, III.46  
 photodiode, III.1  
 wide bandwidth photodiode, III.33  
 Filter:

- active components, problems, VI.18
  - active element, op amp, VI.24-32
  - active. See: Active filter
  - allpass, VI.1
  - antialiasing. See: Antialiasing filter; Name of specific filter type
    - band reject, VI.30
    - bandpass, VI.1, VI.30
      - frequency response, VI.32
    - bandstop, VI.1
    - bandwidth, and op amp selection, VI.14
  - capacitors,
    - design considerations, VI.20-21, VI.24
    - equivalent circuits, VI.21
    - features, VI.22
    - materials, VI.24
    - temperature coefficients, VI.19-20
  - class, VI.1
  - composition, VI.5
  - design, VI.1-9
  - frequency, VI.21
  - highpass, VI.1, VI.30
  - implementation, problems, VI.18-31
  - lowpass, VI.1, VI.18-31
  - op amp,
    - considerations, VI.28
    - gain variation, VI.24-26
    - limitations, VI.24-32
    - performance, VI.5
  - open loop gain, VI.31
    - and op amp selection, VI.14
  - order, problems, VI.18
  - parameters, VI.2-4
    - cutoff frequency, VI.2-3
    - minimum passband attenuation, VI.2-3
    - order, VI.2-3
    - passband attenuation, VI.2-3
    - passband ripple, VI.2-3
    - stopband frequency, VI.2-3
  - passive components,
    - capacitors, design problems, VI.19-20
    - problems, VI.18
    - resistors, design problems, VI.19
  - passive. See: Passive filter
  - Q enhancement, VI.30
  - resistors,
    - design considerations, VI.19
    - features, VI.23
    - values below 100 ohms, VI.21
  - single-pole, VI.5
  - slewrate, and op amp selection, VI.14
  - specifications, VI.4
  - two-pole, VI.5
  - voltage-controlled, VI.5-6
- Filter noise bandwidth, IX.4
- Filtering in the Time and Frequency Domain, VI.33
- Fitchen, F.C., IX.12
- Flash ADC, VII.52, IX.37
  - Schottky diode, VII.65
- Flash converter:
  - 8-bit sampling,
    - block diagram, VII.50
    - driving, characteristics, VII.50
    - dynamic performance, VII.52
    - equivalent input circuit, VII.51
    - harmonic distortion, VII.49, VII.51
    - high speed, driving, VII.49-52
    - signal-dependent capacitance, VII.51
- Floating a Source Output (HP Journal), V.22
- Flow meter, transducer, two-element varying, II.8
- FPBW, and ADC drive amplifier, VII.9
- Francis, Dick, XI.62
- Franco, S., VI.33
- Fredrikson, Thomas M., III.59, VII.66, VIII.38
- Frequency Dependent Negative Resistor. See: FDNR
- Full-power bandwidth. See: FPBW
- ## G
- GaAs gain block, as op amp, III.46
- Gain error:
  - calculation, VII.22
  - as function of frequency, VII.22
- Garcia, Adolfo A., II.1, II.40, XI.1
- Gay, M.S., IX.104
- General Impedance Converter (GIC), VI.7
- Ghausi, M.S., VI.33
- Gilbert, Barrie, IX.1, IX.104, IX.105, IX.115
- Givens, S., X.19
- Gradshteyn, I.S., IX.69
- Gray, Paul R., III.59, VII.66
- Ground:
  - digital and analog, XII.9-11
  - false. See: False ground
  - loops, XII.6-8
  - noise, XII.7-8, XII.10
  - op amp, IV.2-3
    - negative rail, IV.3-5
    - voltage drop, IV.3
  - star, XII.8-9
- Ground plane:
  - circuit board, XII.12-13
  - current flow, slit, XII.13
- Grounding and Shielding Techniques in Instrumentation, 3rd ed., III.59, VII.66



**H**

- Hamamatsu Photonics, III.59
- Handbook of Filter Synthesis, VI.33
- Hardware:
  - cage jacks, XII.22
  - digital and analog grounds, XII.9-11
  - ESD, XII.3-4
  - ground loops, XII.6-8
  - ground noise, XII.7-8
  - ground plane, XII.12-13
  - grounding and signal routing, XII.5-20
  - guard rings, XII.1-2
  - high-performance analog circuit, prototyping, XII.23-25
  - insulators, leakage, XII.1-4
  - multiple card, system ground, XII.15-17
  - pin sockets, XII.22
  - problem areas, XII.21-25
  - signal routing, XII.17-20
  - sockets, disadvantages, XII.22-23
  - SPICE modeling, limitations, XII.21-22
  - star grounds, XII.8-9
  - system ground, XII.15-17
  - transmission lines, XII.13-15
- HDTV, transimpedance amplifier, VIII.7
- Henry, Tim, VIII.38
- High definition television (HDTV), I.2
- High density television. *See*: HDTV
- High performance video ADC differential input buffer, VIII.16-17
- High Speed Design Seminar, 1989, VII.66, VIII.38
- High speed differential line drivers and receivers, VIII.29-36
  
- High speed three op amp instrumentation amplifier, VIII.36-37
- Huelsman, L.P., VI.33
- Hughes, Richard Smith, IX.104
- Hydrophone:
  - amplifier, III.48
  - amplifier configuration,
    - ac coupled, III.54
    - dc servo loop, III.54
  - high-performance amplifiers, III.51, III.53-54
    - charge-output, III.53-54
    - voltage-output, III.53-54
- Hysteresis:
  - in op amp, X.32-34
  - proportional to resistor ratio, X.33

**I**

- I/V converter:
  - high-performance audio, III.57-58
  - using decompensated amplifier, III.56-57
- IC amplifiers, audio systems, V.1
- IC Op-Amp Cookbook, 3rd ed., III.59, VII.66
- IEEE Standard 746-1984, VIII.38
- IEEE Standard for Performance Measures of A/D and D/A Converters for PCM Television Circuits, VIII.38
- Impedance and Admittance Transformations Using Operational Amplifiers (Lightning Empiricist), V.22
- Input bias current cancellation, III.11
- Input current noise:
  - inverting, III.24
  - non-inverting, III.24
- Input offset voltage test circuit, II.18
  - errors, II.19
  - thermoelectric voltages, II.19
- Input voltage noise, III.22-24
  - Bode plot, III.22
  - spectral density, III.23
- Instrumentation amplifier:
  - 3-op amp, remote bridge sensor, II.30
  - 8-pin package, selection, II.32-34
  - ac common-mode rejection, trimming capacitor, II.29
  - BiFET input, II.28-29
  - CMRR performance, current feedback, II.33
  - digitally programmable gain, selection, II.32
    - discrete, II.28
    - high input impedance, selection, II.32
    - high precision, selection, II.31
    - input overvoltage protected, selection, II.31
    - input overvoltage protection, II.35
    - input protection, II.34-36
      - resistors in series, II.34
    - monolithic, II.28
      - ease of use, II.33-34
      - gain setting resistor, II.30
    - selection, II.27-36
    - single supply,
      - design, IV.15-16
      - selection, II.31
- Insulator, leakage, XII.1-4
- Integrated line driver, V.17
- Integrated line receiver, V.10
  - ac trim, V.9
  - CM trim, V.9
  - CMR, V.10
  - monolithic technology, V.9-11
- Interlacing, broadcast video, VIII.1

Introduction to Modern Network Synthesis, VI.33  
Introduction to the Theory and Design of Active Filters, VI.33  
Intuitive Operational Amplifiers, III.59, VII.66, VIII.38  
ISSCC Digest of Technical Papers 1968, IX.104

## J

Jenkins, A., X.19  
JFET:  
  op amp, III.55  
  in sync tip DC restorer, VIII.14  
Johnson noise, XI.22-27  
  feedforward resistor, III.24  
  op amp, II.23  
  precision, II.22  
  reduction, in T network, III.31  
  resistor in non-inverting input, III.24  
  spectral density, III.26  
Journal of Solid State Circuits, IX.104  
Jung, Walter G., III.59, V.1, V.22, VII.66, VIII.1, VIII.7, VIII.13, VIII.15, VIII.16

## K

Kapoor, A., X.19  
Kester, Walt ., III.1, III.32, VII.1, VIII.1, VIII.38, XI.1, XI.17  
Kirchoff's law, electric currents, XII.5  
Kitchin, Chuck, III.1  
Kulkarni, D.V., X.19

## L

Laker, K.R., VI.33  
Large scale integration (LSI), I.2  
Laser printer, photodiode, III.1  
Lidgley, F.J., X.19  
Light meter, photodiode, III.1  
Limited/output gm. See: G/0  
Line driver, V.12-21  
  circuit types, V.12  
  composite,  
    FET input op amps, V.18  
    high performance, V.18-21  
  cross-coupled differential, V.14-16  
    configuration, V.16  
    with line receiver, V.16  
    performance, V.15-16  
    THD+N, V.15

high performance audio, applications, V.5  
integrated, V.17  
  op amp trio, V.17  
  performance, V.17  
  THD+N, V.17  
inverter-follower, V.12-14  
  CMR, V.12  
  dual op amp, V.12, V.13  
  gain blocks, V.13  
  pseudo differential, V.12  
Line receiver:  
  CMRR, V.5  
  effect of ac trim, V.8  
  high performance audio, applications, V.5-11  
  IC, V.10  
  instrumentation amplifier, V.5  
  resistor critical dependence, V.5  
  THD+N, op amp performance, V.9  
Linear Control Systems, III.59  
Linear Design Seminar Notes, XI.62  
Linearized thermistor amplifier, II.68-69  
Lock-In Amplifiers: Principles and Applications, IX.12  
Log amp, IX.58-103  
  5-stage,  
    cascaded, IX.98  
    characteristics, IX.97  
    dc coupling, IX.97  
    dc logarithmic transfer function, IX.98  
    error function, IX.98  
    schematic, IX.96  
  8-stage,  
    absolute error, IX.81  
    input weighting, IX.88-89  
    simulated output, IX.80, IX.87-88  
  amplifier/limiter stage, IX.83-89  
    DC transfer function, IX.83  
  baseband, IX.73  
    amplifier/limiter stage, IX.84  
    dual-gain amplifier cascade, IX.76  
    voltage chain, IX.77  
  bipolar differential, IX.100-103  
    A/0 amplifier, IX.102  
    limited knee voltage, IX.103  
    temperature compensation, IX.103  
  BJT differential, IX.100  
    A/0, IX.100  
    DC transfer function, IX.101  
    G/0, IX.100  
  broadband, 70 dB, IX.99  
  classification, IX.58-60  
    baseband, IX.58-59  
    true log amp, IX.59  
    video log amp, IX.58-59

demodulating, IX.58-60  
 SDLA, IX.58-59  
 translinear, IX.58-59  
 X-AMP, IX.60  
 collector current, Ebers-Moll modeling, IX.72  
 demodulating,  
 AC input, IX.66  
 DC input, IX.67  
 Gaussian input, IX.69  
 noise input, IX.69  
 output, IX.67  
 waveform effect, IX.66-70  
 waveform signature, IX.68  
 design, IX.73-99  
 mathematical considerations, IX.73-99  
 differential form, conversion, IX.95  
 dual-gain, DC transfer function, IX.74  
 dynamic range, IX.80-82  
 G/0 stages, mathematical summation, IX.89-94  
 gm cells, advantages, IX.89  
 high temperature, errors, IX.71-72  
 lin-log transition, definition, IX.76  
 logarithmic transfer function, IX.73-75, IX.80  
 low frequency, 95 dB, cascaded, IX.99  
 maximum output, IX.80-82  
 mid-log transition, definition, IX.78  
 output function, IX.79  
 Patterson, IX.71  
 peak error, IX.80-82  
 peak output-voltage error, IX.82  
 progressive compression, IX.73-79  
 progressive-compression,  
 auxiliary G/0 stages, IX.89-94  
 current steps, IX.94  
 differential, IX.95  
 purpose, IX.58  
 scaling, IX.61-63  
 DC reference source, IX.63  
 stability, IX.61  
 transfer function graph, IX.62  
 signal compression, IX.58  
 slope voltage, IX.79, IX.85-87  
 small-signal behavior, IX.63-65  
 AC log function, IX.65  
 incremental gain, IX.63-64  
 logarithmic transfer function, IX.65  
 transconductance cells, mathematical summation, IX.89-94  
 transdiode, IX.71  
 translinear, IX.70-71  
 DC or low frequency use, IX.70  
 logarithmic output, IX.71

saturation current, IX.70  
 temperature effect, IX.70  
 waveform effect on intercept, IX.66-70  
 Logarithmic amplifier. *See*: Log amp  
 Logarithmic Amplifiers, IX.104  
 Logarithmic transfer function, graph, IX.62  
 Logic output, vs. op amp output, X.25-28  
 Low distortion drive circuit for precision wide dynamic range ADCs, VIII.21-22  
 Low impedance strain gauge sensor, IV.28  
 Low noise auto-zero circuit, common-mode error correction, II.20-21  
 Low Noise Electronic Design, IX.12  
 Low-Power Op-Amp Delivers Precision at Low Signal Levels (EDN), X.19

## M

Macromodel:  
 advantages and disadvantages, XIII.2  
 finished level device, XIII.2  
 methodology, XIII.2  
 Macromodeling of Integrated Circuit Operational Amplifiers (IEEE J. Solid-State Circuits), X.19  
 Magnetic pick-up apparatus, IV.28  
 Manchester coding, in op amp, III.46  
 Maximally flat filter, transfer functions, VI.4  
 MDAC:  
 Johnson noise, IX.13  
 MOS switches, IX.13  
 Meade, M.L., IX.12  
 Medical ultrasound device, using X-AMP, IX.30  
 Melsa, James L., III.59  
 Meyer, Robert G., III.59, VII.66  
 Micromodel:  
 advantages and disadvantages, XIII.2  
 methodology, XIII.2  
 transistor level model, XIII.2  
 Microphone:  
 low-noise,  
 preamp  
 dc servo output, V.1-4  
 scheme, V.2  
 performance, V.4  
 THD+N, V.4  
 MicroSim Probe, RMS noise evaluation program, XIII.9  
 Minimum passband attenuation, filter, VI.2-3  
 Mixed signal system:  
 8-bit resolution, XII.19  
 differential transmission, XII.20  
 edge connections, XII.19

ground error minimization, XII.20  
 multiple ground pins, XII.17-18  
 signal routing, XII.17-18  
 Mixed-Signal Design Seminar, 1991, VII.66, XI.62  
 Modern Filter Design: Active RC and Switched Capacitors, VI.33  
 Morrison, Ralph, III.59, VII.66  
 The MOS Transistor, IX.12  
 Motchenbacher, C.D., IX.12  
 Motorola 5082-4204 PIN Photodiode, III.34  
 Multiple card system:  
   ground, XII.16  
   impedance minimization, XII.16  
   star analog ground, XII.17  
 Multiple feedback filter:  
   bandpass, VI.31  
   Spice simulation, VI.30-31  
   configuration, VI.5-6  
   implementation, VI.12, VI.29  
   limitations, VI.29  
   op amp,  
     loop gain, VI.26-27  
     sensitivity, VI.26-27  
 Multiplexer output buffering, op amp settling time, VII.23  
 Multiplying D/A converter. *See:* MDAC  
 Mutual inductance, noise source, XI.51-52

## N

Negative temperature coefficient. *See:* NTC  
 New Spice Compatible Op Amp Model Boosts ac Simulation Accuracy (EDN), X.19  
 Noise:  
   1/f corner frequency, XI.23-24  
   coupling,  
     capacitive, XI.49-50  
     grounding Faraday shield, XI.49-50  
     conduction, XI.46-48  
     electromagnetic interference (EMI), XI.53-54  
   mutual inductance, XI.51-52  
   external,  
     definition, XI.46  
     measurement, XI.59-61  
   filter, bandwidth, IX.4  
   generator, IX.4-6  
   glitch, II.37  
   ground,  
     broadband transformer, XI.60  
     instrumentation amplifier, XI.58  
     oscilloscope, XI.58  
     spectrum analyzer, XI.60

input, IX.6-7  
 intrinsic amplifier, II.37  
 photoelectric effects, XI.54-55  
 reduction, physical separation, XI.58  
 signal processing, IX.3-7  
 switching power supplies, XI.55-58  
 transistor, IX.5-6  
 voltage, IX.5-6  
 Noise and Operational Amplifier Circuits (Analog Dialog 25th Anniversary Issue, III.59  
 Noise reduction, by output filtering, III.27  
 Noise Reduction Techniques in Electronic Systems, 2nd ed., III.59, VII.66  
 Noise spectral density. *See:* NSD  
 Nonlinear Circuits Handbook, IX.104  
 Nonlinear Circuits Handbook (Analog Devices, Inc.), II.70  
 Notch filter:  
   50/60 Hz single supply,  
     characteristics, IV.8  
     passband symmetry, IV.7  
     schematic, IV.7  
     voltage gain, IV.8  
   band reject, VI.30  
   bandpass, VI.30  
   false ground, IV.7-9  
 NPN Pairs Yield Ultra-Lownoise Op-Amp (EDN), X.19  
 NTSC color video:  
   diagram, VIII.2  
   field timing diagram, VIII.3  
   PAL comparison, VIII.4  
   signal generation, VIII.4  
 Nyquist bandwidth, VII.5  
 Nyquist criterion, VII.4  
   for ADC, VII.3

## O

Offset voltage:  
   and bias current model, III.9  
   input,  
     from thermoelectric voltage, III.16, III.18  
     nulling, III.12-16  
   nulling,  
     using inverting input, III.14  
     using non-inverting input, III.14-15  
 OMEGA Temperature Measurement Handbook, II.70  
 Op amp:  
   in 100 dB RMS/AGC system, impedance buffer, IX.50  
   2-op amp circuit, comparison, X.17

- AC response, for three-variable multiplier, XIII.18
- ADC, VII.1
  - drive amplifier, VII.9
  - input bypass, VII.35-36
- ADSpice model, XIII.2, XIII.19
- analog circuit, 3V logic supply, IV.34
- analog multiplier,
  - block diagram, IX.21
  - schematic, IX.18
- application, X.1-35
  - audio, V.1-21
  - as comparators, X.20-35
  - composite amplifier, X.3-7
  - feedback loop gain, X.3
  - supply sensing, X.15-17
- applications, chart, I.4
- bandwidth increase,
  - gain splitting, III.44
  - noise penalty, III.44
- basic specifications, X.2
- bias current,
  - dc error sources, III.8, III.10
  - model, III.8-9
- BiFET, I.1
  - ESD failure, XII.3
  - input anomalies, X.30
  - instrumentation amplifier, scheme, II.29
  - output phase reversal, XI.2-4
    - elimination, XI.5
    - series resistor, XI.6
  - output voltage, XI.2
  - series resistance values, XI.6
  - voltage noise, III.55
- bipolar, I.3
  - BiFET, III.55
  - driving 16-bit sampling ADC, VII.57
  - key specifications, VII.57
  - low distortion, VII.56-58
  - noise gain, II.39
  - wideband noise, II.38
- Bode plot, III.18-19
- bridge amplifier, key parameters, II.16
- by market, I.5
- channel A1, in X-AMP, IX.36
- in charge output transducer, III.49
- chopper, I.3
- circuit,
  - layout, noise minimization, IV.31
  - noise
    - estimation, III.39-44
    - gain, III.8
    - spectral densities, III.40
    - signal gain, III.8
  - clamp circuitry, output limiting, X.28
  - closed loop gain, for change in open loop gain, VII.13
  - closed loop output impedance, VII.33
  - CMOS, I.3
    - zero-volt input, IV.11
  - with CMOS DAC, IV.19-20
  - as comparator,
    - advantages, X.21-22
    - CMOS gate interface, X.26-27
    - common-mode effects, X.21-22
    - ECL gate interface, X.26
    - ground current feedback, X.32
    - hysteresis, X.34
      - and stability, X.21-22
    - input circuitry, X.29-31
    - input structure effects, X.21-22
    - output structure effects, X.21-22
    - precautions, X.35
    - saturation time, X.24
    - speed, X.21-25
    - threshold calculation, X.34
    - TTL gate interface, X.26-27
    - zener diode use, X.10-11
  - comparison, III.38
  - compensation pin,
    - abuses, X.12-13
    - clipping, X.12-13
  - composite line drivers, THD, V.18
  - composite video,
    - signal clamping, VIII.14
    - sync tip DC restorer, diagram, VIII.13
  - cross-coupled, V.14-16
  - current bias, III.7
  - current feedback, VI.27, VI.29
    - bandwidth, VII.21
    - closed loop bandwidth, VII.15
    - closed loop gain equations, VII.20
    - closed loop non-linearity, VII.16
    - equivalent circuit, VII.14
    - gain accuracy, VII.15
    - gain and phase response, VII.21
    - gain stability, VII.15
    - harmonic distortion, VII.46, VII.52
    - key specifications, VII.46
    - loop gain, VII.15
  - current noise, II.24
    - low voltage, II.25
  - current-to-voltage converter, III.5
  - dc drift, system dynamic range, VII.18
  - dc open loop gain, VII.12
  - DC-coupled signal path, in 100 dB RMS/AGC system, IX.50
  - desaturation time, X.23-24
  - design, computer simulation, X.18
  - distortion, VI.25

- distortion vs. frequency, I.6
- drift, calculation, VII.16-17
- drive amplifier for 16-bit sampling ADC, VII.56
- driving ADC,
  - latch-up protection, VII.63-64
  - supply sequencing protection, VII.63-64
- dual, in inverter-follower line driver, V.12
- dual high-speed, output current-to-voltage conversion, IX.18, IX.20
- dual supply, XI.2
- dynamic range, VI.29
- equivalent circuit, voltage feedback, VII.11
- evolution, X.1-2
- fast logarithmic amplifier, X.3
- feedback, series-mode precision rectifier, X.11-12
- FET, I.3
- FET-input, III.37
  - comparison, III.38
- filter, limitations, VI.24-32
- filter Q, gain peaking, VI.29
- finite gain-bandwidth, VI.25
- flash converter, VII.52
- full-wave rectifier, X.13
- GaAs gain block, III.46
- gain of 1000 amplifier, error budget, II.17
- gain error calculation, VII.22
- gain nonlinearity, and gain error, XI.15
- gain-bandwidth, VII.18
  - FET input amplifier, III.45
- ground, IV.2-3
- guard ring potential, III.5-6
- harmonic distortion, VII.22, VII.42
- heatsink, III.9
- high impedance, JFET input, XI.2
- high impedance low current, applications, III.1-59
  - in high impedance transducer, III.47
  - high performance JFET input, composite amplifier, X.5-6
  - high performance video, ADC differential input buffer, VIII.16-17
  - high speed 10-bit ADC, VIII.16-17
  - high speed,
    - settling time
      - false summing junction, XI.17
      - measurement, XI.17-21
      - summing junction gain, XI.18
  - high speed BiFET, ultra-low noise, II.25
  - high speed FET, XI.17-18
    - settling time, XI.18
  - high speed photodiode preamp, selection, III.37-39
  - high speed video,
    - applications, VIII.1-17
    - bandwidths, VIII.11
    - capacitors, VIII.12
    - diagram, VIII.9
    - differential gain and phase, VIII.11
    - differential line driver and receiver, VIII.30
    - frequency and pulse response, VIII.10
    - gain and phase performance, VIII.16-17
    - ground, VIII.10
    - harmonic distortion, VIII.9
    - large capacitive loads, VIII.12
    - as low pass filter, VIII.15
    - NTSC composite signal, VIII.15
    - open loop gain, VIII.8
    - optimized differential ADC buffer, VIII.17
    - power management, VIII.12
    - recommended resistors, VIII.11
    - specifications, VIII.7
    - sync stripper, VIII.15-16
- high-speed bipolar, I.3
- history, X.1-2
- hysteresis, X.32-34
  - from positive feedback, X.34
- IC,
  - evolution, I.2
  - history, I.1
- input bias current/input offset voltage, I.3
- input bias current/input voltage noise, I.3
- input device, protective circuitry, X.30
- input impedance, VI.25, VI.27-28, X.29
- input noise, spectral density, II.24, VII.26
- input offset voltage,
  - derated, IV.23
  - drift
    - derating, IV.25-26
    - worst-case estimate, IV.25-26
  - feedback control, II.60
  - nulling, III.12-16
- input overvoltage protection, instrumentation amplifier, II.35-36
- input voltage noise, III.27, VII.25
- JFET, I.3
  - ion-implanted, p-channel, XI.2-3
  - JFET input,
    - DC error correction, X.6-7
    - precision superbeta output, composite amplifier, X.6-7
    - voltage noise, II.25
  - JFET performance, IV.8
  - JFET versus bipolar, III.55
  - Johnson noise, II.23, III.22, VII.25
  - latch-up, X.32-34
  - line receiver, THD+N, V.9
  - loop gain decrease with frequency, VI.27

- low input bias current, II.46
- low input offset voltage, II.46
- low power, IV.1-34
  - circuit impedance, IV.29-31
  - CMOS and TTL gates, X.28
  - noise pickup, IV.29-31
  - output drive capability, IV.29
- low-noise AGC amplifier, IX.38-41
- monolithic, X.1-19
- multiplier, block diagram, XIII.15
- noise, XI.21-62
  - 1/f, XI.23
  - calculation, XI.22
  - capacitive loads, instability, XI.34
  - capacitors, XI.36-38
  - characteristics, XI.24
  - circuit, XI.36-45
    - capacitors, XI.36-38
    - resistors, XI.39-45
  - compensated, XI.35
  - components, XI.23
  - conduction, remedies, XI.49
  - current, XI.24-25
  - decoupling, XI.33
  - decoupling power supplies, XI.47
  - eliminating shared path, XI.47
  - external, XI.21-22, XI.46
  - frequency differences, XI.30
  - glass diode photocurrent, XI.55
  - ground planes, XI.48
  - high frequency instability, XI.32-33
  - high frequency oscillation, XI.30-35
  - input current, XI.26
  - instability, XI.30-35
  - insufficient frequency compensation, XI.34
  - internal circuit, XI.21-22
    - current, XI.22-25
    - Johnson, XI.22-27
    - resistors, XI.22-27
    - voltage, XI.22-25
  - Johnson, XI.26-27
  - low frequency, XI.23
  - magnetic shielding, XI.51-52
  - minimization, XI.21
  - parasitic oscillation, XI.31-32
    - decoupling, XI.33
    - detection, XI.31
  - photoelectric effects, XI.54-55
  - physical separation, XI.58
  - power planes, XI.48
  - reactive loads, XI.34
  - reducing common impedance, XI.47
  - referred to input, XI.27-28
  - referred to output, XI.27-28
  - resistors, XI.26-27
  - shared common impedance, XI.47
  - SNR degradation, XI.36
  - source resistance, XI.29
  - sources, XI.21-22, XI.27-30
  - specifications, IX.7
  - spectral density, XI.23-24
  - stability, XI.35
  - switching power supplies, XI.55-58
  - unity gain stable, XI.35-36
  - voltage, XI.23-24
    - white noise, XI.23-24
- noise figure, IX.7, XI.30-31
- noise increase, IV.2
- noise model, II.24, III.23, VII.26
- noise specifications, VII.25
- non-linear circuit applications, IX.1-103
- noninverting input current noise, VII.25
- null pins,
  - abuses, X.7-9
  - differenc nulling schemes, X.7-9
  - feedback connection, X.8
  - low-power bandgap voltage, X.9
- offset voltage, model, III.8-9
- open loop, as comparator, instability, X.32
- open-loop gain, II.46
  - nonlinearity, XI.11-16
    - definition, XI.11-12
    - test circuit, XI.12
  - output voltage, XI.12
  - stability, VII.14
- output, X.25-28
  - clamping to TTL levels, X.11
  - vs. logic output, X.25-28
- output current, recovery capabilities, IV.6
- output filter, effects on voltage noise, III.43-44
- output impedance, VI.25
- output noise,
  - antialiasing filter, VII.30-31
  - current feedback, VII.28
  - effect of noise gain, VII.27
  - spectral density, VII.48-49
    - Bode plot, VII.27
- output voltage,
  - input signal clipping, XI.1
  - phase reversal, XI.1-10
- output voltage noise, III.41-42
  - equivalent input noise current, III.42
  - lowpass filter, III.41, III.43
  - total, III.41
- output voltage offset model, VII.17
- performance, X.2
  - and filter, VI.5
- performance requirements, by market, I.4

- photodiode preamp, III.39
- potentiometer, offset null pins, III.12-13
- power supply rejection error, IV.23
- precision,
  - comparison with chopper stabilized amplifier, II.39
  - DC error analysis, II.16-17
  - gain nonlinearity
    - accuracy, XI.14-16
    - causes, XI.13-14
    - and load resistance, XI.13
    - temperature shift, XI.13-14
  - input offset voltage
    - calibration, II.19
    - chopper amplifier, II.19
    - drift, II.19-21
    - error, II.18-19
    - temperature effects, II.19
  - linear gain, XI.15-16
  - low noise
    - bandwidth limitation, II.26-27
    - characteristics, II.22-23
    - design, II.22
    - lowpass filter, II.27-27
    - offset voltage, II.22-23
    - source resistance, II.23-25
  - open-loop gain, nonlinearity, XI.15-16
  - precision bipolar, I.3
  - precision low-noise, III.1
  - precision wide dynamic range ADCs, low distortion drive circuit, VIII.21-22
  - process capabilities and direction, by market, I.5
  - programmable gain, V.3
  - rail-to-rail output swing, IV.18-21
  - RTD bridge circuit, input-offset voltage error, II.60-62
  - Sallen-Key, sensitivity, VI.25
  - and SAR clock period, VII.35
  - selection, by sampling ADC characteristics, VII.39
  - in sensor bridge, II.3
  - settling time, VII.34
    - digital sampling oscilloscope, VII.23
    - measurement
      - 16-bit ADC, XI.19-20
      - circuit board considerations, XI.21
      - oscilloscope, XI.19
      - overdrive-limiting test circuit, XI.19-20
      - Schottky diode, XI.19
    - specifications, VII.23-25
    - test setup, VII.23
      - and transient load current, VII.34
  - shunt-mode operation, X.14
    - applications, X.14
    - floating transmitter, X.14
  - simulation, XIII.1
  - single-supply, IV.1-34, IV.18-21
    - accuracy, IV.13
    - design, IV.1, IV.15-16
    - lateral pnp transistor, XI.7-8
    - linearity, IV.13-14
    - output phase reversal, XI.7
      - elimination, XI.9-10
      - Schottky diode, XI.10
    - PNP input, IV.10-11
    - precision
      - applications, IV.22
      - choices, IV.21
      - input offset voltage, IV.22
      - low-voltage application, IV.22
    - pull-down resistance, IV.15-16
    - voltage limits, IV.22
    - zero-in zero-out, IV.13-16
  - SNR degradation, IV.2
    - swing limitation, IV.2
  - source resistance, II.25
  - SPICE model,
    - ADC evaluation, VII.35
    - disadvantage, XII.22
  - SPICE simulation, XIII.1
  - stability, X.32-34
  - subtleties, XI.1-61
  - Super Beta, I.3
  - supply current,
    - decrease, IV.27-29
    - drop, IV.24
    - Johnson noise, IV.27
    - noise increase, IV.27-29
    - resistor thermal noise, IV.27
    - worst-case estimate, IV.24
  - supply sensing, X.15-17
    - differential input full-wave rectifier, X.16-17
    - instrumentation amplifier, X.15-16
    - voltage-to-current converter, X.15
  - supply voltage,
    - bandwidth reduction, IV.27
    - decrease, IV.24, IV.26-27
    - limits, IV.23
    - noise increase, IV.26-27
    - slew rate reduction, IV.27
  - thermocouple amplifier circuit, errors, II.52-54
  - three,
    - CCD imaging, VIII.36-37
    - high speed
      - harmonic distortion, VIII.37
      - instrumentation amplifier, VIII.36-37
      - settling time, VIII.37



high speed video, VIII.36-37  
 three-variable analog multiplier, AC response, XIII.18  
 total output voltage offset, calculation, VII.16-17  
 total RMS output noise, II.25  
 transient response, XIII.6  
   actual vs. simulated, XIII.20  
   circuit, XIII.19  
 transimpedance, VI.27, VI.29, VII.21  
 ultra-high speed,  
   amplifier, VIII.17-18  
   applications, VIII.17-37  
   buffers, VIII.22-28  
   capacitance and settling time, VIII.20  
   current feedback amplifier, VIII.18  
   distortion buffer, VIII.24-28  
   frequency response, VIII.19  
   harmonic distortion, VIII.20  
   layout and decoupling, VIII.18  
   series isolation resistor, VIII.21  
   settling time, VIII.19  
   signal buffer, VIII.22-29  
     bias current, VIII.28  
     decoupling, VIII.25  
     frequency response, VIII.25-26  
     harmonic distortion, VIII.27  
     isolation resistor, VIII.27  
     layout, VIII.25  
     offset voltage, VIII.28  
     open-loop gain, VIII.26, VIII.28  
     settling time, VIII.25-26  
   specifications, VIII.18  
 ultra-low noise, X.3-4  
   composite amplifier, X.4  
 uncompensated, comparator, X.10  
 VFB and CFB topology, VIII.24  
 video amplifier, VIII.5-6  
   bandwidth variance, XIII.11  
 video cable receiver/driver circuit, VIII.36  
 video difference amplifier, VIII.32-36  
   CMRR, VIII.33  
   frequency response, VIII.33  
   gain and phase, VIII.34  
   gain-of-N, VIII.35  
   harmonic distortion, VIII.34  
   line receiver, VIII.34  
   specifications, VIII.33  
 voltage feedback,  
   bandwidth, VII.18-20  
   closed loop gain equations, VII.20  
   inverting mode, VII.20  
   log-log Bode plot, VII.19  
   noise gain, VII.18  
   non-unity gain, at unity gain, VII.20

  unity gain bandwidth, VII.19  
   voltage noise, II.24  
   vs. comparator, speed, X.23  
   without feedback, X.10-11  
     disadvantages, X.11-12  
   zero-volt input, IV.10  
     MOSFET transistors, IV.10  
   zero-volt output, IV.12  
     limitations, IV.17-18  
     no inverting amplifier, IV.17  
     unipolar operation, IV.17  
 Operational amplifier. *See*: Op amp  
 Optoelectronics Data Book, III.59  
 Order, filter, VI.2-3  
 Oscilloscope, op amp, noise detection, XI.30-31  
 Ott, Henry W., III.59, VII.66  
 Output filter, input voltage noise reduction, III.28  
 Output offset voltage:  
   drift, III.10  
   nulling, drift, III.15  
 Output voltage noise:  
   high temperature effect, III.27  
   Johnson resistor effect, III.26  
   reduction by output filtering, III.27  
   sources, III.25  
   spectral densities, III.25, III.27

## P

PAL color video, NTSC comparison, VIII.4  
 Passband ripple, filter, VI.2-3  
 Passive and Active Network Analysis and Synthesis, VI.33  
 Passive filter, VI.1-2  
   characteristics, VI.2  
   implementation, VI.11  
   limitations, VI.2  
   normalized values, VI.10  
   output noise reduction, VII.30-31  
   values, VI.5  
 Patient monitoring equipment:  
   50/60 Hz notch filter, IV.7-9  
   portable, use of op amp, IV.9  
 Patterson log amp, IX.71  
 PCM Signal Codecs for Video Applications (SMPTE Journal), VIII.38  
 Peltier cooler, thermocouple, II.42  
 pH probe buffer amplifier, using precision op amp, III.47  
 Photodiode 1991 Catalog, III.59  
 Photodiode:  
   ac circuit, III.18-22

- Bode plot, III.18-20
  - bypass capacitor, III.18-19
  - noise gain, temperature effects, III.21-22
  - reactive portion, III.18-19
  - applications, III.1-4, III.2
  - bandwidth, III.30
  - characteristics, III.1-4
  - circuit design,
    - optimized, III.28-29
    - tradeoffs, III.30
  - circuit noise, III.24, III.26
  - current measurement, III.7
  - dark current, III.34
  - equivalent circuit, III.2
  - high bandwidth, equivalent circuit, III.33
  - leakage current path, III.6
  - modes of operation, III.2
  - noise sources, III.26
  - performance, III.29
  - photoconductive, III.2, III.34
  - photosensitivity specifications, III.3-4
  - photovoltaic operation, III.2
  - picoampere circuit, precautions, III.5-7
  - preamp,
    - analysis, III.1-31
    - Bode plot, III.36
    - characteristics, III.32, III.34
    - circuit frequency response, III.35-37
    - closed loop bandwidth, III.35
    - considerations, III.4-5
    - dark current, III.32
    - dc performance, III.16
    - design, III.32-33
    - for fiber optic receiver, III.46
    - final dc design, III.16-17
    - high speed, III.32-46
    - noise analysis, III.22-27
    - noise gain, III.35
    - optimized, III.28-29
    - precision, analysis, III.1-31
    - sensitivity, III.32
    - signal bandwidth, III.35
    - signal frequency response, conditions, III.37
    - SNR, III.4
    - reverse bias, dark current, III.3
    - sensitivity, III.1-2, III.30
    - shielding, III.7
    - short circuit photocurrent, III.1
    - short circuit vs. light intensity, III.3
    - signal, III.30
    - T feedback, III.31
    - wide bandwidth,
      - bar code readers, III.33
      - document scanners, III.33
      - fast scanners, III.33
      - fax machines, III.33
      - fiber optic receivers, III.33
      - ring laser gyro systems, III.33
      - wide bandwidth circuit, applications, III.33
      - zero bias, III.3
  - Photodiode detector, II.1
  - Photoelectric noise effects, XI.54-55
  - Picoampere circuit:
    - critical leakage paths, III.5-6
    - precautions, III.5-7
  - Piezoelectric device, II.1
  - Piezoelectric transducer amplifier, III.50-51
    - temperature effects, III.51
  - PiN photodiode, characteristics, III.34
  - PMI Application Note AN-25, X.19
  - Pontis, George D., V.22
  - Position sensor, photodiode, III.1
  - Preamp:
    - single-supply, low-noise, IV.28
    - single-supply low noise, performance, IV.29
  - Preamplifier. See: Preamp
  - Pressure sensor, transducer, sensor bridge, all-element varying, II.10
  - Pressure transducer, sensor bridge, two-element varying, II.8
  - Process controller, programmable, loop-controlled, IV.3
  - Programmable state variable filter:
    - digital control, VI.14
    - using DACs, VI.14
  - Pulse height analysis, op amp settling time, VII.23
- ## Q
- Quantization theory, VII.9
    - ENOB, VII.8
    - Nyquist bandwidth, VII.8
    - RMS noise, VII.8
- ## R
- Ragazzini, J.R., X.19
  - Randall, R.H., X.19
  - 4.5V reference, IV.20-21
  - Resistance temperature detector. See: RTD
  - Resistor:
    - discrete, features, VI.23
    - features, VI.23
    - matching, XI.43
    - model, XI.44
    - network, features, VI.23

- noise,  
 calculation, IX.5-6  
 composition, XI.39  
 Johnson, XI.39  
 self-heating, XI.43  
 skin effect, XI.41  
 temperature coefficient, XI.42  
 thermocouple, XI.40-41  
 parasitic components, XI.44  
 self-heating, gain variation, XI.43  
 types, comparison, XI.45  
 wirewound, XI.44
- Ring laser gyro system, wide bandwidth  
 photodiode, III.33
- RMS-DC converter, IX.41
- Roberge, J.K., III.59, VII.66
- RTD, II.1  
 bridge amplifier, II.61-62  
 bridge circuit, op amp input-offset voltage error, II.60-62  
 current source excitation, problems, II.59  
 lead wires,  
 Kelvin connection, II.60  
 measurement error, II.62  
 problems, II.59-60  
 passive temperature sensor, II.58  
 platinum, comparison with type S thermocouple, II.58  
 second-order effects, II.59-60  
 signal conditioning, II.58-63  
 temperature effects, II.59  
 thermometer amplifier, II.7  
 voltage drop, II.58
- Russell, F.A., X.19
- Ruthroff, C.L., XI.62
- Ruthroff transformer, XI.60
- Ryzhik, I.M., IX.69
- S**
- Sallen-Key filter:  
 active, design table, VI.6, VI.11  
 Butterworth response, VI.33  
 configuration, VI.5-7  
 current feedback, VI.29, VI.32-33  
 implementation, VI.12  
 lowpass, frequency response, VI.33  
 op amp,  
 frequency response, VI.24  
 sensitivity, VI.25  
 transimpedance, VI.29, VI.32-33
- SAR ADC:  
 encoder block diagram, VII.31  
 encoder input transient load currents,  
 VII.32  
 key specifications, VII.32  
 nonsampling, VII.30-36  
 driving, VII.30-36
- Schottky diode, IV.5, VII.62-65, VIII.15-16,  
 XI.10, XI.19  
 multiple card system, star ground, XII.17  
 in op amp, X.14
- Schottky noise, XI.25
- Schultz, Donald G., III.59
- SDLA, IX.60
- Seebeck coefficient, thermocouple, II.41,  
 II.43-45, II.48-52
- Seebeck effect, thermocouple, II.42
- Seebeck TC, thermocouple amplifier, IV.18
- Sensor bridge:  
 all-element, configurations, II.10-15  
 single-element varying, II.3-7  
 configurations, II.4-6  
 two-element varying, configurations, II.8-10  
See also Bridge amplifier
- Seven-pole FDNR antialiasing filter, design,  
 VI.15
- SFDR, VII.22  
 measurement, VII.8
- Shannon's information theorem, VII.4
- Sheingold, Dan H., II.70, III.59, V.22
- Sheingold, Daniel H., IX.104
- Signal buffer:  
 open-loop hybrid, VIII.22-23  
 distortion, VIII.24  
 ultra-high speed, VIII.22-29
- Signal compression:  
 AGC circuit, IX.9  
 VCA, IX.11  
 dynamic range, linear vs. nonlinear, IX.10-11  
 dynamic range compression, log amp, IX.58  
 log amp, IX.58  
 nonlinear amplifier, VCA, IX.11  
 nonlinear dynamic-range, IX.11  
 signal processing, IX.9-10  
 VCA, swept-gain applications, IX.11
- Signal conditioning for temperature measurement, II.40-69
- Signal processing:  
 amplifiers, VII.1  
 dynamic range,  
 random noise, IX.3  
 SNR, IX.3  
 dynamic range compression, linear vs. nonlinear, IX.10-11  
 dynamic range limitations, IX.8-9  
 fixed impedance, IX.1  
 input-noise limitations, IX.3

- linear impedance, IX.1
- noise,
  - amplifier specifications, IX.7
  - generator, IX.4-6
  - input, IX.6-7
  - low-pass filter, IX.4
  - sources, IX.4-6
- noise limitations, IX.3-7
- nonlinear dynamic-range compression, IX.11
- NSD, IX.3
- receiver, AGC circuit, IX.9
- signal compression, IX.9-10
- system dynamic range, IX.2
  - compression, IX.1-12
- third-order intercept, IX.8-9
- total harmonic distortion, IX.8
- variable-gain amplifier, IX.11
- Signal return currents:
  - grounding, XII.5-6
  - Kirchoff's law, XII.5
- Signal routing:
  - noise minimization, XII.17
  - signal separation, XII.17
- Signal transmission:
  - balanced differential driver and receiver, VIII.29
  - CMRR instrumentation amplifiers, VIII.29
  - differential, VIII.29
  - floating driver, VIII.31
    - and single-ended receiver, VIII.29
  - high speed video, VIII.30
  - Howland current source, VIII.31
  - single-ended driver and differential receiver, VIII.29
  - video difference amplifier, VIII.32
- Signal-to-noise ratio. See: SNR
- Silicon Detector Corporation, III.59
- Simulated THD, from signal-dependent input capacitance, VII.51
- Simulation:
  - audio circuit, CMR, V.6
  - and breadboarding, XIII.1, XIII.20-21
  - goals, XIII.1
  - model evaluation, XIII.1
- Simultaneous sampling data acquisition system, VII.2
- Skin effect, resistor, XI.41
- SL521 Application Note, IX.104
- Smith, Lewis, III.59
- SNR:
  - degradation, IV.2
  - photodiode preamp, III.4
  - reduced, IV.2
- Sockets, high-performance analog circuit, disadvantages, XII.22-23
- Some Broadband Transformers (Proc. I.R.E.), XI.62
- SPICE model:
  - AC parameters, XIII.23
  - analog circuit, noise analysis, XIII.9
  - analog circuit performance, XII.21-22
  - incomplete, XIII.22
  - limitations, XII.21-22
  - for simulation, XIII.1
  - simulation vs. breadboarding, XIII.20-21
  - voltage reference, temperature drift, XIII.13
- SPice simulation, bandpass, multiple feedback filter, VI.30-31
- Spurious free dynamic range. See: SFDR
- Standard temperature ohm-normalized noise-spectral density, IX.4
- Standoff insulator, virgin teflon, III.7
- Star ground, XII.8-9
- State variable filter:
  - configuration, VI.5, VI.7-8
  - implementation, VI.11, VI.13
  - op amp, frequency response, VI.24-26
  - programmable, VI.14
- Stopband frequency, filter, VI.2-3
- Strain gauge, II.1
  - transducer, sensor bridge, all-element varying, II.10
- Strain measuring instrument, transducer, sensor bridge, all-element varying, II.10
- Successive approximation. See: SAR
- Successive Detection Log Amp, IX.60
- Super Beta technology, I.2-3
- Supply, noise, XII.10
- Supply splitter reference generator, IV.6
- Switching power supplies:
  - decoupling, XI.57
  - electric field,
    - shielding, XI.57
    - suppressing, XI.56
  - noise generation, XI.55-58

## T

- T914 network, V.8
- T network:
  - analysis, III.31, III.32
  - noise gain, III.32
  - resistor noise, III.32
- Tables of Integrals, Series and Products, IX.69
- Tel Labs, Inc., temperature compensation resistor, III.47
- Television:

- amplitude variation,
  - differential gain, VIII.5
  - differential phase, VIII.5
- chrominance, VIII.5
- color matrix, VIII.3
  - composite color signal, VIII.3
  - luminance signal, VIII.3
- composite color signal,
  - amplitude variation, VIII.5
  - chrominance, VIII.5
- differential gain, VIII.5
- differential gain and phase, measurement, VIII.6
  - differential phase, VIII.5
  - interlace format, VIII.1
  - monochrome, VIII.2
- NTSC,
  - color subcarrier, VIII.3-4
  - composite signal, sync tip clamping, VIII.13
  - op amp, VIII.8
  - PAL, color subcarrier, VIII.3-4
  - picture frame, fields, VIII.2
  - SECAM, color subcarrier, VIII.3-4
- Temperature Measurements Gain from Advances in High-Precision Op Amps (Electronic Design), II.70
- Temperature sensor, thermistor, II.66
- Temperature transducer, RTD, II.58
- THD+N, audio circuit, V.4
- THD, Nyquist frequency, VII.8
- Thermistor:
  - fixed resistor shunting, II.66-67
  - fragility, II.65
  - linearization deviation vs. temperature, II.67
  - linearized, amplifier, II.68
- NTC,
  - linearization, II.66
  - resistance, II.64
  - temperature coefficient, II.65
- signal conditioning, II.64-69
- temperature sensor, II.66
- vs. RTD, II.64
- Thermocouple, II.1
  - amplifier circuit,
    - error sources, II.52-57
    - gain factors, II.53
    - op amp errors, II.52-54
  - amplifier design, II.43-51
  - circuit board, parasitic errors, II.56-57
  - cold-junction compensated,
    - errors, II.55-56
    - transferring, II.56
  - design considerations, II.40-42
  - electronic temperature sensor, II.43
  - grounded, II.46
  - linearization,
    - circuit gain, II.47
    - output digitizing, II.47
    - techniques, II.47
    - two-segment approximation, II.49-50
  - monolithic thermocouple amplifiers, II.68-69
  - non-linear temperature coefficient, II.41
  - non-linearity correction, II.47
  - op amp errors, II.52
  - op amp noise, II.53-54
  - potentiometers, selection, II.54-55
  - reference cold-junction, II.42-43
  - resistor noise, XI.40-41
  - resistors, selection, II.54-55
  - Seebeck coefficient, II.48-52
    - vs. temperature, II.41
  - signal conditioning, II.40-57
  - temperature, Seebeck coefficient, II.41, II.43-45
  - temperature-voltage characteristics, II.40-42
  - thermal gradients,
    - circuit board components, II.57
    - voltages, II.56-57
  - type J, output voltage, II.40
  - type K, output voltage, II.40
  - type S,
    - cold-junction compensated, two-segment approximation, II.51
    - comparison with platinum RTD, II.58
    - output voltage, II.40
  - type T,
    - approximations, II.44
    - cold-junction compensated, end-point approximation, II.45-46
    - end-point approximation, II.44
    - least-squares approximation, II.44
    - linearization, two-segment approximation, II.49-50
    - output voltage, II.40
    - vs. thermistor, II.64
- Thermocouple amplifier, cold junction compensated, IV.17-18
- Thermocouple Measurement (Linear Technology Application Note 28), II.70
- Thermoelectric potential, input offset voltage, III.16, III.18
- Total harmonic distortion. See: THD
- Toumazou, C., X.19
- Transdiode log amp, IX.71
- Transducer:
  - amplifier, bias currents, III.50-51
  - bridge amplifiers, II.2-3
  - charge-output,

- accelerometer, III.51
- balancing source impedances, III.50
- bias currents, III.50
- circuit configurations, III.49-50
- hydrophone, III.51
- input noise, III.50
- flow meter, two-element varying, II.8
- high impedance,
  - applications, III.47-58
  - charge output, III.48
- precision, interfaces, II.1-69
- pressure,
  - resistance, II.3
  - two-element varying, II.8
- relative humidity, resistance, II.3
- resistance, II.3
- resistive element, II.1
- RTD, resistance, II.3
- signal output, design considerations, II.2-39
- strain gauge, resistance, II.3
- thermistor, resistance, II.3
- voltage-output,
  - balancing source impedances, III.50
  - bias currents, III.50
  - input noise, III.50
- weigh-scale load cell, resistance, II.3
- Transducer Interfacing Handbook (Analog Devices, Inc.), II.70
- Transimpedance amplifier:
  - open loop gain, VIII.8
  - specifications, VIII.7
- Transistor:
  - cascode configured, IX.25
  - FET, 1/f noise, IX.5
- Transmission line, microstrip, XII.13-14
- Transmission line transformer, XI.60
- True Logarithmic Amplifier for Radar IF Applications (IEEE Journal of Solid State Circuits), IX.104
- Tsividis, Y.P., IX.12
- TTL logic, interface with op amp comparator, X.26-27
- TTL system, op amp, IV.1

## U

- Ultra-high speed buffers, VIII.22-28
- Ultrasonic AGC receiver:
  - ac-coupling, IV.10
  - false ground, IV.9-10
- Ultrasonic clamping receiver, false ground, IV.9-10
- Ultrasound receiver, biquad bandpass filter, VI.16

Using the AD834 in DC to 500 MHz Applications...(Analog Devices Application Note AN-212), IX.105-114

## V

Variables:

- real-world,
  - measurement, II.1
  - sensing elements, II.1

VCA, IX.13-57

- 20 Mhz,
  - dual op-amp
    - frequency response, IX.20
    - schematic, IX.19
- 60 Mhz,
  - dual op-amp
    - pulse response, IX.22
    - schematic, IX.21
- 90 Mhz,
  - dual op-amp
    - frequency response, IX.24
    - pulse response, IX.24
    - schematic, IX.23
- 480 Mhz,
  - dual op-amp
    - pulse response, IX.26
    - schematic, IX.25
  - analog divider, IX.17
  - controlled cascode,
    - decibel gain, IX.15
    - Johnson noise, IX.15-16
    - noise-spectral density, IX.16
  - design, IX.13-14
    - analog multiplier/divider, IX.17-29
  - dual-channel,
    - exponential gain, IX.29
    - X-AMP, IX.29-37
  - gain-control, analog multiplier/divider, IX.17
  - nonlinearity, IX.17
  - op amp, exponential gain control, IX.20
  - series-connected, RMS-converted, AGC circuit, IX.30
  - structure, IX.13-17
  - three,
    - 100 dB RMS/AGC system
      - gain linearity, IX.49
      - gain ripple, IX.49
      - input vs. output, IX.48
      - minimal gain error, IX.47-51
      - schematic, IX.47
    - in RMS-responding AGC circuit, IX.47

ultra-low noise, IX.56-57  
 op-amp modified, IX.57  
 schematic, IX.56  
 variable-gain, IX.17  
 controlled cascode, IX.14-15  
 video keyer, IX.27-29  
 two-input, IX.27  
 frequency response, IX.28  
 pulse response, IX.29  
 voltage-controlled attenuator, IX.17  
 X-AMP, IX.30-38  
 120 dB RMS/AGC system  
 logarithmic output, IX.53  
 optimal S/N ratio, IX.51-55  
 output vs. input, IX.52  
 sequential gain-control, IX.51  
 sequential mode, output S/N vs. gain,  
 IX.55  
 simultaneous mode, output S/N vs. gain,  
 IX.54  
 80 dB RMS-linear-dB measurement system,  
 IX.41-46  
 Very large scale integration (VLSI), I.2  
 Video cable driving, VIII.7-12  
 Video signal, transmission, XII.20  
 Video sync stripper circuit, VIII.15-16  
 Video VCAs and Keyers Using the AD834 and  
 AD811 (Analog Devices Application  
 Note AN-216), IX.115-121  
 Voltage, noise, XI.23  
 Voltage feedback amplifier:  
 of ADC, VII.10-11  
 Bode plot, VII.10-11  
 closed loop bandwidth, VII.13  
 dc gain accuracy, VII.12  
 dc loop gain, VII.13  
 gain accuracy, VII.13  
 gain stability, VII.13  
 loop gain, VII.10  
 Voltage feedback. See: VFB  
 Voltage noise test circuit, IV.26  
 Voltage-controlled amplifier. See: VCA

## W

Wainwright Instruments Inc., XII.26  
 Weigh scale:  
 load cell amplifier, II.14-15  
 transducer, sensor bridge, all-element vary-  
 ing, II.10  
 Whitney, Dave, VIII.1, VIII.7, VIII.13, VIII.15,  
 VIII.16  
 Williams, A.B., VI.33

Williams, J., II.70  
 Wong, James, II.1, II.70, IV.1, XI.1, XI.11  
 Wurcer, Scott, I.1, III.1, III.32

## X

X-AMP:  
 80 dB RMS-linear-dB measurement system,  
 gain control, IX.46  
 logarithmic error, IX.47  
 logarithmic output, IX.45  
 schematic, IX.42  
 signal output vs. input, IX.44  
 advantages, IX.35  
 applications, IX.35-38  
 basic circuitry, IX.31  
 bipolar differential pairs, IX.33  
 Johnson noise, IX.33  
 NSD, IX.33  
 block diagram, IX.34  
 characteristics, IX.30-35  
 controllable gm stages, IX.32  
 detector, in RMS-DC converter, IX.42  
 differential gain-control, IX.37  
 dual-channel VCA, IX.29-37  
 low-noise fixed-gain, broadband passive  
 attenuator, IX.30  
 medical ultrasound application, IX.30  
 output noise, IX.34  
 peak output voltage, IX.37  
 sequential gain, IX.35

## Z

Zero-volt swing output stage design, IV.12  
 Zumbahlen, Hank, VI.1  
 Zverev, A.I., VI.33

## ANALOG DEVICES PART INDEX

## A

- AD365, II.32  
 AD507, X.13  
 AD520, I.1-2  
 AD524, I.1-3, II.31, II.35-36  
 AD526, II.32  
 AD539, IX.17-20  
 AD540, I.3  
 AD549, I.1-2, XI.29, XII.3  
 AD574, VII.2, VII.30, VII.32  
 AD574A, VII.39  
 AD586, II.61, II.69  
 AD588, II.15, II.48-51, II.62-63, VII.36, VII.38  
 AD589, II.14, IV.17, IV.20, IX.27, IX.29  
 AD590, IX.38-39  
 AD592, II.45-48, II.50-51, II.57  
 AD594, II.68-69  
 AD595, II.68-69  
 AD596, II.68-69  
 AD597, II.68-69  
 AD600, IX.29-30, IX.32-43, IX.46-47, IX.50-53,  
 IX.55-57  
 AD602, IX.29-30, IX.32-37, IX.56-57  
 AD620, I.1, I.3, II.14-15, II.27, II.31-34  
 AD621, I.1, I.3  
 AD624, I.3, II.31  
 AD625, II.31  
 AD626, II.31-32  
 AD633, IX.17  
 AD636, IX.41-43, IX.46-47, IX.50-51  
 AD640, IX.63, IX.66, IX.70, IX.96-99  
 AD645, I.1-3, II.23, III.6-8, III.11-14, III.17,  
 III.19, III.21-23, XI.29,  
 III.28-29, III.38, III.47  
 AD648, II.21  
 AD648AQ, II.20  
 AD671, VII.36-38, VII.41  
 AD674A, VII.39  
 AD674B, VII.30-32  
 AD676, VII.5-7, VII.9, VII.28, VII.52-58  
 AD679, VII.28  
 AD684, VII.36, VII.38-39  
 AD704, II.30  
 AD705, I.3, II.54  
 AD705J, II.17  
 AD706, II.29, II.47-50, II.54, II.60-62, II.68-69  
 AD707, II.19, II.23, II.47-48, II.50, II.54,  
 XI.15-16  
 AD707/708, IV.21  
 AD707J, II.17  
 AD711, I.5-6, III.52, VII.13, XI.2, XI.6  
 AD711K, III.54  
 AD712, I.5, V.14-15, IX.42, IX.99, XI.6  
 AD713, I.5, VI.14-15, IX.47, IX.51  
 AD734, IX.17, XIII.14-20  
 AD741, VII.63, IX.7  
 AD743, I.3, II.23, III.38, III.53, III.55, V.19-20  
 AD743/AD745, III.49, XI.29  
 AD744, I.5, III.38, V.5, V.8-9, V.19-20, VII.13  
 AD744JN, V.19  
 AD745, II.23, II.25-26, III.38, III.49-58, V.20  
 AD745KN, III.55  
 AD746, I.5, V.14-15  
 AD773, VIII.16-17  
 AD774B, VII.30-33, VII.36  
 AD795, I.3  
 AD797, I.1-6, II.23, VII.56-58, IX.7  
 AD811, I.4-6, V.5, V.8-9, V.14-15, V.20, VIII.7-  
 12, VIII.13-17, IX.22-23,  
 IX.27-29, XIII.11  
 AD811A, VIII.7  
 AD811AN, V.8, V.14, V.19-20  
 AD811S, VIII.7  
 AD820, I.3  
 AD827, VIII.36-37, IX.18, IX.20  
 AD829, I.3, I.5, III.38, III.45, VII.13  
 AD830, VIII.32-36  
 AD834, IX.17, IX.19, IX.21-23, IX.25-28  
 AD840, I.2, I.5, XI.18  
 AD841, I.5, VII.13, VII.36, VII.38  
 AD842, I.5  
 AD843, I.5, III.38-39, III.41, III.45, VII.13,  
 VII.36, XI.17-18  
 AD844, I.5, VII.15, VIII.7, IX.17-19, IX.57,  
 IX.99  
 AD845, I.5, III.38, V.14-15, VII.13, VII.22-24,  
 VII.33-35, VII.36, VII.41-42,  
 VII.54-55  
 AD846, I.5, VII.15, VIII.7  
 AD847, I.5-6, VI.30-32, VII.13, VII.36, VIII.36-  
 37, X.7, XI.34-35  
 AD848, I.5, XI.35  
 AD849, I.5, XI.35  
 AD1382, VII.28  
 AD1671, VII.28, VII.39, VII.41, VII.43  
 AD1674, VII.28, VII.39-42  
 AD1862, III.57-58  
 AD1879, VII.58-61  
 AD5539, IX.21  
 AD7111, IX.13  
 AD7528, VI.14  
 AD7543, IV.3  
 AD7543/PM7543, IV.4  
 AD7871, VII.28  
 AD7874, VII.28



AD7886, VII.28  
 AD9005A, VII.28  
 AD9006, VII.28  
 AD9006/AD9016, VII.52  
 AD9014, VII.28, VII.44, VIII.21-22  
 AD9020, VII.52  
 AD9020/AD9060, VII.52  
 AD9028/AD9038, VII.28, VII.49-52  
 AD9032, VII.28  
 AD9060, VII.28, VII.52  
 AD9617, I.5, IX.25-26, VI.32-33, VII.15-16,  
 VII.21, VII.25, VII.44, VII.46-49,  
 VII.52, VII.64, VIII.17-22, VIII.30-31  
 AD9617/AD9618, VIII.7, VIII.18

AD9618, I.5  
 AD9620, I.4-6, VIII.24-28, VIII.31, XI.19-20  
 AD9630, I.4-6  
 ADG201HS, VII.36, VII.38  
 ADOP-07, III.7  
 ADOP-27, VII.25-26  
 ADOP-37G, III.55  
 ADOP-97, III.7  
 AMP-01, II.31, II.33  
 AMP-02, II.31-32, II.35-36  
 AMP-04, II.31-32  
 AMP-05, II.32

## B

BUF-03, VIII.22-23

## D

DAC-8043, IV.20

## H

HOS-100, VIII.22-23

## M

MAT-01AH, X.9  
 MAT-02, X.3-4, X.15  
 MAT-03, II.62-63, IV.28, X.15  
 MAT-04, X.15

## O

OP-06, X.10  
 OP-07, I.1-3, II.23, IV.21, X.29, XI.1

OP-07D, II.17  
 OP-15, X.4  
 OP-20, IV.21  
 OP-21, IV.6, IV.21  
 OP-27, I.1-3, II.23, IV.26, VII.13, X.5, XI.29,  
 XIII.8  
 OP-37, II.23, II.25-26, III.55  
 OP-41, X.17  
 OP-42, I.5, X.6-7, XI.2-6  
 OP-50, II.23  
 OP-77, II.23, IV.21  
 OP-80, IV.11-13, IV.21  
 OP-90, I.2, IV.6, IV.11-13, IV.15-17, IV.21,  
 IV.30, VI.30-32, X.8-9, X.14,  
 XI.7-10  
 OP-97, I.3, II.54, X.6-7, XI.13-14  
 OP-97F, II.17  
 OP-160, I.5, X.7  
 OP-160/OP-260, VIII.7  
 OP-177, II.7, II.14-15, II.19-21, II.23-24, II.27,  
 II.45-46, II.51, II.57,  
 IV.21-22, XI.15-16, XIII.22  
 OP-177E, IV.23-24  
 OP-177G, II.17, II.20, IV.25  
 OP-177GP, II.20  
 OP-220, IV.21  
 OP-221, IV.21  
 OP-249, I.5, XI.6, XIII.5-6  
 OP-260, I.5, VII.15  
 OP-270, II.23  
 OP-271, II.23, V.10  
 OP-275, V.1, V.3-5, V.8-9, V.12-15, VII.61  
 OP-275GP, V.2  
 OP-282, IV.8  
 OP-282/482, XI.6  
 OP-290, I.2, IV.15, IV.21  
 OP-295, IV.18-20, IV.21, IV.27-28  
 OP-297, II.51, II.54, II.62-63  
 OP-420, IV.21  
 OP-421, IV.21  
 OP-467, I.1, VI.16-17  
 OP-470, II.23  
 OP-471, II.23  
 OP-482, IV.7-9  
 OP-490, I.2, IV.21  
 OP-497, II.30

## R

REF-01, II.45-46, II.57  
 REF-02, X.14, XIII.12-13  
 REF-43, II.7, II.30, IV.20-21

**S**

SSM-2017, II.23, V.1-4  
SSM-2134, X.5-7  
SSM-2141, V.10-12, V.16-17  
SSM-2141/SSM-2142, VIII.29  
SSM-2142, V.16-17, VIII.29  
SSM-2143, V.10-12, V.13, V.16-17  
SW-06GP, II.20





# **1992 AMPLIFIER APPLICATIONS GUIDE**

## **First Printing Errata Sheet**



# 1992 Amplifier Applications Guide

## First Printing Errata Sheet-August, 1992

Front Cover, Top diagram: Remove short between pin 6 and pin 2 of AD843 and replace with a capacitor.

Front Cover, Bottom diagram: Pin 13 of U2 should be labeled: +5V.

Back Cover, Top diagram: Remove short between pin 6 and pin 2. Replace with a capacitor. Reverse positions of 2.2 $\mu$ F and 0.1 $\mu$ F capacitors.

Back Cover, Bottom diagram: Reverse the polarity of the inputs to U3A.

Copyright Page: "Herin" should be spelled "Herein"

Outline section: Under SECTION II outline, under the third bullet point, add "Monolithic Thermocouple Amplifiers" after "Thermistors".

Outline section: Under SECTION XI outline, change "Effect" to "Affect".

Figure 1.1: Add OP-295 to list of Low Power, Single Supply Amplifiers

Figure 1.2: Change OP27 to OP275, Add OP27 between AD624 and AD829

Figure 1.4: Add label "VIDEO" to section below "PROFESSIONAL VIDEO"

Figure 1.6: Add AD844 between OP-160 and AD811 in middle of diagram.

Figure 1.7: Add OP-275 dot above AD811 dot between AD9630 and AD9620

Outline Page, Section II: add "Monolithic Thermocouple Amplifiers" after Thermistors in outline.

Figure 2.10: Pin 3 of second OP-177 should go to ground.

Figure 2.21: Make "-" sign on first op amp horizontal.

Figure 2.22: Remove "1%" label from 499 $\Omega$  resistor and 27.4k $\Omega$  resistor.

Figure 2.23: Remove the erroneous "10" below Vout. Remove "1%" label from 475 $\Omega$  resistor.

Figure 2.26: Second column total error should be 116, third column should be 112, and fourth column should be 280.

Figure 2.29: Re-label S1, S2, S3, S4 as SW1, SW2, SW3, SW4 to be consistent with the text.

Figure 2.31: Add comment ... "and low peak-to-peak voltage noise in 0.1 to 10Hz bandwidth" to first bullet point.

Figure 2.34: Change 1000 to 100 on horizontal scale of left-hand graph of voltage noise.

Figure 2.35: Remove "Ultra" from title and first bullet point. Change Hz in first and third bullet points to  $\sqrt{\text{Hz}}$ .

Figure 2.38: Change title to "Choosing Instrumentation Amplifiers".

Page 2.28: In second paragraph, change "Bifet" to "Super-Beta".

Figure 2.42: Title of first column should be "Gain Accuracy". Title of fourth column should be: CMRR dB @ 60Hz. In title of fifth column change hZ to Hz.

Figure 2.43: For Single Supply chart, change CMRR dB to CMRR dB @60Hz. In "Input-Overvoltage Protected" chart, add AD626 with +54V Max Input Voltage.

Figure 2.44: Change Gain Accuracy of AD626 to 0.5. Change title of last column to CMRR, dB @ 60Hz.

Figure 2.45: Remove AD526 from selection table! It is not an instrumentation amplifier!!!

Figure 2.47: Change fifth bullet point to show +5 to  $\pm 15\text{V}$  specified supply range.

Figure 2.51: Add  $G=1000$ , and "Scope Synchronized to Chopper Frequency" to diagram.

Figure 2.52: Add "Scope Unsynchronized" to diagram.

Figure 2.53: Add "Scope Unsynchronized" to diagram.

Page 2.40: First column, line 12 should read: "When compared to other temperature sensors, thermocouples are quite linear. However, their low....."

Figure 2.60: AD592 should be shown as a current source.

Figure 2.61: AD592 should be shown as a current source. Label amplifiers from left to right: A1, A2, A3 since this is mentioned in text.

Page 2.59: In first paragraph,  $0.5^\circ\text{C}/\text{mW}$  should be  $0.5^\circ\text{C}/\text{W}$ .

Figure 2.67: "Guage" in title should be spelled "Gauge".

Figure 2.68: Drawn to show Kelvin connection better.

Page 2.68 2.69: Add section titled: "Monolithic Thermocouple Amplifiers with Cold Junction Compensation: The AD594/AD595/AD596/AD597. This is an extraction of the introductory remarks on the respective data sheets. **Complete text is attached to this Errata sheet.**

Figure 3.2: Ideal diode should be in parallel with photo current generator not in series.

Figure 3.9: Label the IC pin connect to the standoff as "Bent Lead".

Figure 3.16: Add pin numbers corresponding to AD645 pinouts. Show main amplifier connected to collector of current mirror. Output of amplifier goes to pin 6. **(Diagram attached to this errata sheet).**

Figure 3.18: Delete resistor network connected to bottom of 1000M $\Omega$  summing resistor. Connect bottom of 1000M $\Omega$  resistor to a 100 $\Omega$  resistor connected to ground. Connect a 1M $\Omega$  resistor to the junction of the 100 $\Omega$  and 1000M $\Omega$  resistor. The other end of the 1M $\Omega$  resistor should go to the wiper of a 100k $\Omega$  pot which is connected between + and - 15V. **(Diagram attached to this errata sheet).**

Figure 3.19: Delete R<sub>p</sub>. Change 1000M $\Omega$  resistor to R<sub>p</sub> = 15.4M $\Omega$ . Connect bottom of 15.4M $\Omega$  resistor to a 100 $\Omega$  resistor which goes to ground. Connect a 1M $\Omega$  resistor to the junction of the 100M $\Omega$  and 15.4M $\Omega$  resistor. The other end of the 1M $\Omega$  resistor should go to the wiper of a 100k $\Omega$  pot which is connected between + and - 15V. **(Diagram attached to this errata sheet.)**

Figure 3.21: Same correction as Figure 3.19. **(Diagram attached to this errata sheet).**

Figure 3.24: Same correction as Figure 3.19. **(Diagram attached to this errata sheet).**

Figure 3.28: In diagram, C2 should be 50pF, not 10pF.

Figure 3.30: "In<sup>+</sup>" in second term of long equation for V<sub>on</sub> should be squared.

Figure 3.37: Same correction as Figure 3.19. **(Diagram attached to this errata sheet.)**

Page 3.31: Second column, lines 5 and 6: "6" should be "5.6".

Second column, line 13,  $\sqrt{2}$  should be  $\sqrt{10}$ .

Figure 3.41: R4 should be 900k $\Omega$ . Equation on left-hand side should read:



WITH "T" NETWORK: 
$$\frac{1}{\beta_T} = \left(1 + \frac{100}{1000}\right)\left(1 + \frac{900}{100}\right)$$

$$= (1.1)(10) = 11.1$$

$$\frac{1/\beta_T}{1/\beta_1} = 5.6$$

Figure 3.48: Change third bullet point to read: "Minimize op amp input capacitance:  $C_{in} \leq C_d$ ."

Page 4.1: Add John Wynne, Faisal Ansari, Joe Buxton, Adolfo Garcia, and Steve Sockolov to the list of authors.

Figure 4.4: Reverse the polarity of the inputs of A2.

Page 4.5: Column 2, line 23: Change "goes" to "go".

Page 4.9: Last sentence: Change "control" to "compression".

Page 4.10: Last paragraph: "N-Channel" should be "P-Channel".

Figure 4.10: Add (A) to left-hand drawing and (B) to right-hand drawing.

Page 4.13: First column, line 11: Change "4.8(b)" to "4.10(b)".

Page 4.13: Second paragraph: "Figure 4.8(b)" should be "Figure 4.10(b)".

Figure 4.11: Delete "-5V". Connect bottom of this 10k $\Omega$  resistor to V- of the op amp.

Figure 4.15: Change 121k $\Omega$  resistor to 12.1k $\Omega$ .

Figure 4.16: Change offset voltage to 300 $\mu$ V max, Change supply current to 300 $\mu$ A max, change gain-bandwidth product to 85kHz.

Figure 4.17: Reverse the polarity of the inputs to the OP-295.

Figure 4.18: Reverse the polarity of the inputs to the OP-295.

Page 4.21: Upper right-hand paragraph should read "The amplifier is frequency compensated so that it can drive a 1 $\mu$ F to 10 $\mu$ F output capacitance without oscillation."

Page 4.21: Middle right-hand paragraph should read; "The OP-90/OP-290/OP-490 comes close to ....."

Figure 4.19: Change specs on OP-295 as follows: Max Vos = 300 $\mu$ V, Max Is/Amplifier = 150 $\mu$ A.

Add data for dual OP-213 into table as follows

Dual	OP-213	150 $\mu$ V	0.2 $\mu$ V/C	2mA
------	--------	-------------	---------------	-----

Figure 4.24: Reverse polarity of the inputs of the OP-27.

Page 4.31: Second column, line 1 should read: "...a few inches of conductor can have...."

Page 4.34: Add Reference: Fair-Rite Products, P.O. Box J, Wallkill, NY, 12589

Figure 4.31: Top trace is 100mV/div., Bottom trace is 5mV/div.

Figure 5.4: Invert the polarity of the inputs to U1.

Page 5.10: Second column, line 5: Change R4 to R2.

Figure 5.9: In diagram, change R3 to R1, R4 to R2, R1 to R3, and R2 to R4.  
In table, change R1,R2 to R1,R3 and R3,R4 to R2,R4. Change 12k $\Omega$  under R2,R4 for SSM-2143 to 6k $\Omega$ .

Figure 5.16: Change arrows to grounds.

Figure 5.18: Change equation for Gain to  $GAIN = 1 + R1/R2$

Page 5.22: Add Reference 3: Aavid Engineering Co., P.O. Box 400, Laconia, NH, 03247.

Page 6.19: Line 15 should read: ..." Furthermore, its success will still be limited by the number of parts that.....".

Page 6.21: Second column, line 15 should read: ..."They exist between....."

Figure 7.8: Change SFDR to 110 dBc.

Page 7.7: "Figure 710" in right-hand column should be "Figure 7.10".

Page 7.12: Last paragraph, third sentence should read: "The percentage change in closed loop gain,  $\Delta A_{cl}$ , for a percentage change in open loop gain,  $\Delta A$ , is approximately  $\Delta A/|A_o\beta|$ , where  $A_o$  is the nominal dc open loop gain at room temperature."

Figure 7.16: Change second bullet point to read: "Percentage Change in Open Loop Gain", and fifth bullet point to read: "Percentage Change in Closed Loop Gain".

Figure 7.27: Substitute curves from Figure 8.20. Table for Gain, BW, and Product remains the same.

Figure 7.85: Change 5.1k $\Omega$  resistors to 5.62k $\Omega$ . Change top 16k $\Omega$  resistor to 5.76k $\Omega$ . Parallel it with a 100pF capacitor. Change bottom 16k $\Omega$  resistor to 5.49k $\Omega$ . Parallel it with a 100pF capacitor. Change 270 $\Omega$  resistors to 51 $\Omega$ . Change differentially connected 0.01 $\mu$ F capacitor to 0.0047 $\mu$ F. Eliminate 120 $\Omega$  resistors to ground. Label top input to AD1879 "-IN" and bottom input "+IN". (Diagram attached to errata sheet).

Page 7.61: First column: Change last sentence to read: "The differentially connected 0.0047 $\mu$ F capacitor supplies most of the differential-mode transient currents, while the 0.01 $\mu$ F capacitors connected to ground absorb spike currents which are common mode. The 51 $\Omega$  series....."

Figure 8.20: First graph should be INVERTING FREQUENCY RESPONSE. Settling time photo should be the same as Figure 7.32.

Page 8.29: First column, line 19: "bully" should be "bulky".

Figure 8.36: R2 in the denominator of the equation for  $I_L$  should be changed to R4.

Figure 8.37: Reverse the input polarities for both AD9617s.

Figure 8.42: Show termination resistor between pins 1 and 2 of AD830. Do not connect to ground at AD830.

Page 9.19: Right-hand side of Equation 9.2.5 should be positive.

Figure 9.2.6: Change title to VCA WITH SQUARE LAW GAIN CONTROL USING THE AD539 MULTIPLIER. Input range should be 50dB, not 55dB.

Figure 9.2.11: Change " $R_F$ " to " $R_8 = R_9$ "

Page 9.38: Line 5 in first paragraph under 9.2.5: C1 should be C4.

Figure 9.2.25: First label on horizontal axis should be 0.1.

Figure 9.2.26: Extend horizontal axis back one decade to 100 $\mu$ V. The graph is basically flat back to this point.

Figure 9.2.28: Change label on vertical axis to mV RMS

Figure 9.2.29: Change vertical axis scale to Volts.

Page 9.51: Line 5 under 9.2.9: "increases" should be "decreases".

Page 9.71: Second paragraph, line 5: +100mV should be -100mV.

Page 9.72: The right-hand term of Eq. 9.3.24 should be negative. The phrase: "that is, a small *forward*-bias on the collector." should immediately follow the equation.

Page 9.82: In Eq. 9.4.13 the term " $A^{N-1}$ " in the last fraction should be moved to the left under  $E\sqrt{A}$ .

Page 9.86: In first equation, N-2 should be N-1. In Eq. 9.4.20, N-2 should be N-1. In Eq. 9.4.22, N-3 should be N-2. In the sentence between Eq. 9.4.22 and Eq. 9.4.23, 6.6438 should be 6.6435.

Figure 9.4.9: Delete "(NOT USED)" from output of last stage.

Figure 9.4.11: Add load resistor  $R_Y$  to ground.

Page 9.91: In Eq. 9.4.39, and 9.4.40 change + to - after the number "1".

Page 9.100: Change title to "Some Aspects of Log-Amps Based on Bipolar Differential Stages".

Page 10.3: Second column, line 7: "cascade" should be "cascode".

Page 10.15: Second column, line 9: Change generation to degeneration.

Page 10.27: First column, line 5: change "transistor" to "resistor".

Figure 10.34: Change "BIFET" to "BIFET and PNP Input" for both bullet points.

Section 11 Title Sheet: Change "Effect" to "Affect"

Figure 11.7: For AD712, Change series resistor to  $14k\Omega$  and noise to  $22nV/\sqrt{Hz}$

Page 11.11: In title, change "Effect" to "Affect".

Page 11.23: Last line of second column should read: " $1nV/\sqrt{Hz}$  in the best low noise op amps."

Page 11.26: First line should read: "If the impedance is resistive there is a..."

Figure 11.34: In equation F, change non-inverting to inverting.

Figure 11.35: RTI NOISE should be  $nV/\sqrt{\text{Hz}}$ .

Figure 11.36: Right-hand top graph should be for  $R_s = 10k\Omega$ .

Figure 11.56: Allow space between "Conduction" and "Electrostatic", and space between "Induction" and "Electromagnetic".

Figure 11.58: Add low and high frequency decoupling capacitors to left-hand node. Remove connecting line between A and B in right-hand diagram.

Page 11.56: First column, line 15: insert the word "formula" after the word "reactance".

Page 11.58: Second column: Change last sentence to read: "If sensitive circuitry is located close to a switching supply, its performance may be devastated - if it is further away problems will be minimized. "

Figure 12.28: Insert space between "Mount" and "adhesive" on next to last line.

Page 12.26: Change Wainwright address to: Wainwright Instruments Inc., 7770 Regents Rd., #113, Suite 371, San Diego, CA 92122, Tel: 619-558-1057. Wainwright Instruments GmbH, Widdersberger Strasse 14, DW-8138 Andechs-Frieding, Germany. Tel: +49-8152-2245, Fax: +49-8152-5174.

Page 13.6: Second column, line 16: change gm5 and C5 to gm2 and C4.

Figure 13.7: C4 in the "Noiseless" column should be  $159 \times 10^{-9}F$ .

Page 13.10: Second column, line 17: Change "By" to "because".

Page 13.28: Change last sentence to read: "The complete list of all 300 models on the "Release F, 4/92 version of the diskette is shown in Figure 13.30.

Figure 13.30: Replace with Release F listing which contains 300 macromodels. **(Figure attached to errata sheet).**

Index, Page 19: Add "monolithic thermocouple amplifiers, II.68-69"

Analog Devices Parts Index, Page 22: Add: AD594, AD595, AD596, AD597, pp. II.68-69.

**(Put at end of Section II)**

**MONOLITHIC THERMOCOUPLE AMPLIFIERS WITH COLD JUNCTION COMPENSATION:  
THE AD594/AD595/AD596/AD597**

The AD594/AD595 is a complete instrumentation amplifier and thermocouple cold junction compensator on a monolithic chip. It combines an ice point reference with a precalibrated amplifier to produce a high level ( $10\text{mV}/^\circ\text{C}$ ) output directly from a thermocouple signal. Pin-strapping options allow it to be used as a linear amplifier-compensator or as a switched output set-point controller using either fixed or remote set-point control. It can be used to amplify its compensation voltage directly, thereby converting it into a stand-alone Celsius transducer with a low-impedance output voltage.

The AD594/AD595 includes a thermocouple failure alarm that indicates if one or both thermocouple leads become open. The alarm output has a flexible format which includes TTL drive capability.

The AD594/AD595 can be powered from a single ended supply (including  $+5\text{V}$ ) and by including a negative supply, temperatures below  $0^\circ\text{C}$  can be measured. To minimize self-heating, an unloaded AD594/AD595 will typically operate with a total supply current of  $160\mu\text{A}$ , but is also capable of delivering in excess of  $\pm 5\text{mA}$  to a load.

The AD594 is precalibrated by laser wafer trimming to match the characteristic of type J (iron-constantan) thermocouples, and the AD595 is laser trimmed for type K (chromel-alumel) inputs. The temperature transducer voltages and gain control resistors are available at the package pins so that the circuit can be recalibrated for other thermocouple types by the addition of two or three resistors. These terminals also allow more precise calibration for both thermocouple and thermometer applications. The AD594/AD595 is available in two performance grades. The C and the A versions have calibration accuracies of  $\pm 1^\circ\text{C}$  and  $\pm 3^\circ\text{C}$ , respectively. Both are designed to be used from  $0$  to  $+50^\circ\text{C}$ , and are available in 14-pin, hermetically sealed, sidebraced ceramic DIPs as well as low cost cerdip packages.

The AD596/AD597 is a monolithic temperature set-point controller which has been optimized for use at elevated temperatures such as those found in oven control applications. The device cold junction compensates and amplifies a type J or K thermocouple input to derive an internal signal proportional to temperature. The AD596/AD597 can be configured to provide a voltage output ( $10\text{mV}/^\circ\text{C}$ ) directly from a type J or K thermocouple signal. The device is packaged in a reliability qualified, cost effective 10-pin metal can and is trimmed to operate over an ambient temperature range from  $+25^\circ\text{C}$  to  $+100^\circ\text{C}$ .

Operation over an extended ambient temperature range is possible with slightly reduced accuracy. The AD596 will amplify thermocouple signals covering the entire  $-200^\circ\text{C}$  to  $+760^\circ\text{C}$  temperature range recommended for type J thermocouples while the AD597 can accommodate  $-200^\circ\text{C}$  to  $+1250^\circ\text{C}$  type K inputs. The AD596/AD597 has a calibration accuracy of  $\pm 4^\circ\text{C}$  at an ambient temperature of  $60^\circ\text{C}$  and an ambient temperature stability specification of  $0.05^\circ\text{C}/^\circ\text{C}$  from  $+25^\circ\text{C}$  to  $+100^\circ\text{C}$ .

## BiFET OP AMP SIMPLIFIED INPUT CIRCUIT

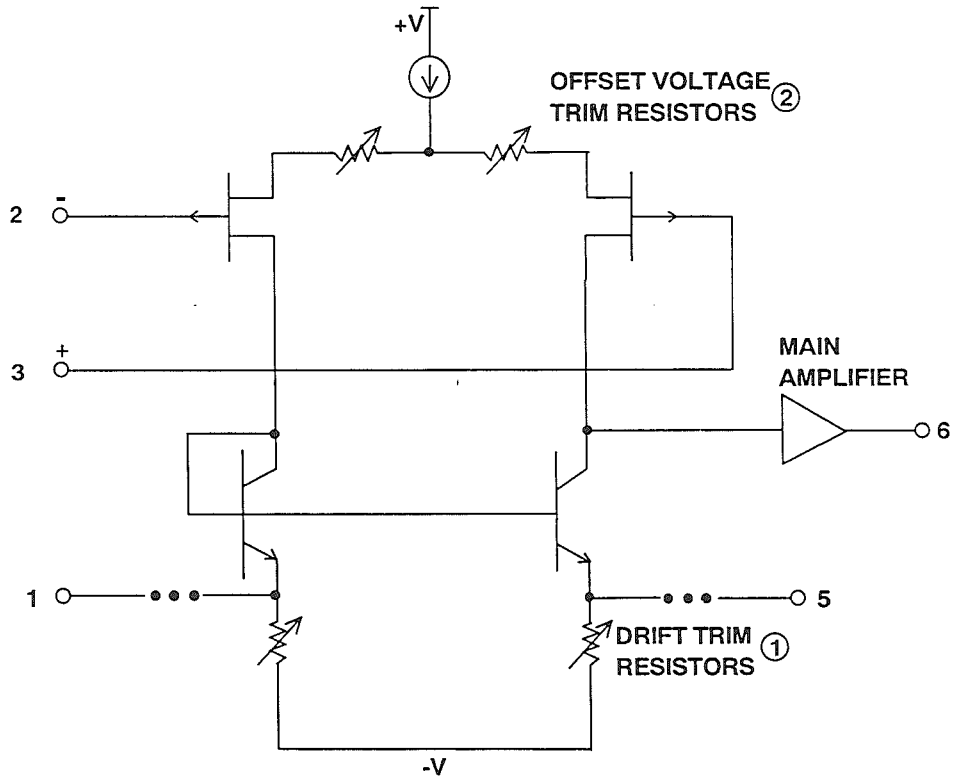


Figure 3.16

## OFFSET VOLTAGE NULLING USING INVERTING INPUT

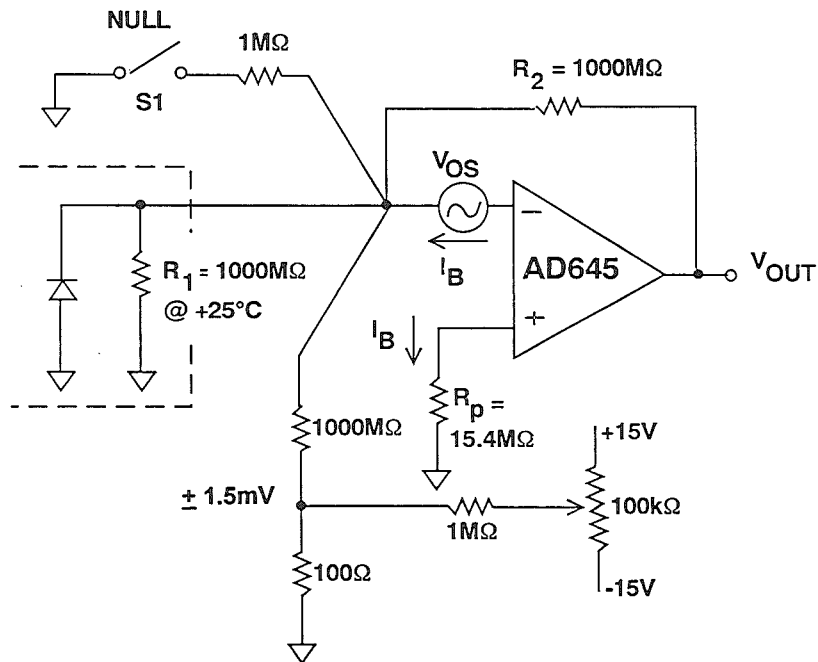


Figure 3.18

# OFFSET VOLTAGE NULLING USING NON-INVERTING INPUT

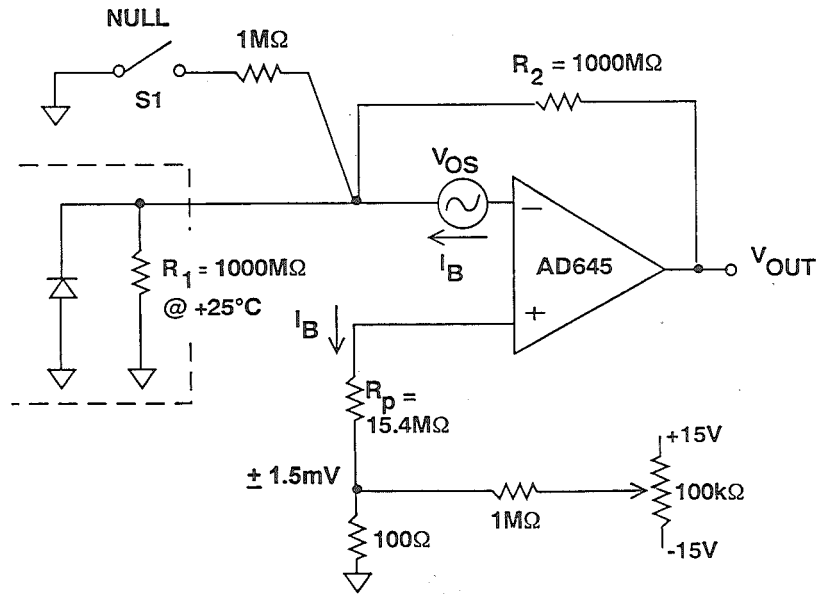


Figure 3.19

# FINAL DC DESIGN FOR PHOTODIODE PREAMP

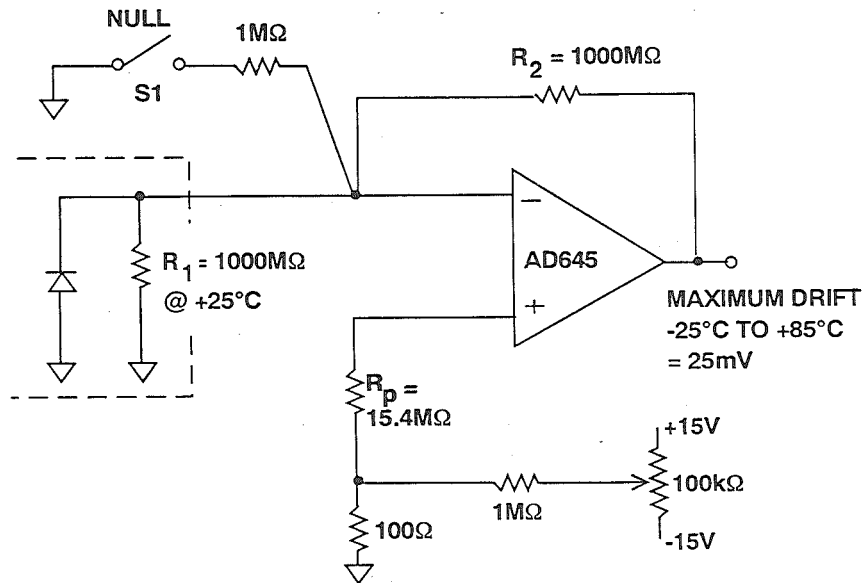


Figure 3.21



# REACTIVE PORTION OF PHOTODIODE CIRCUIT

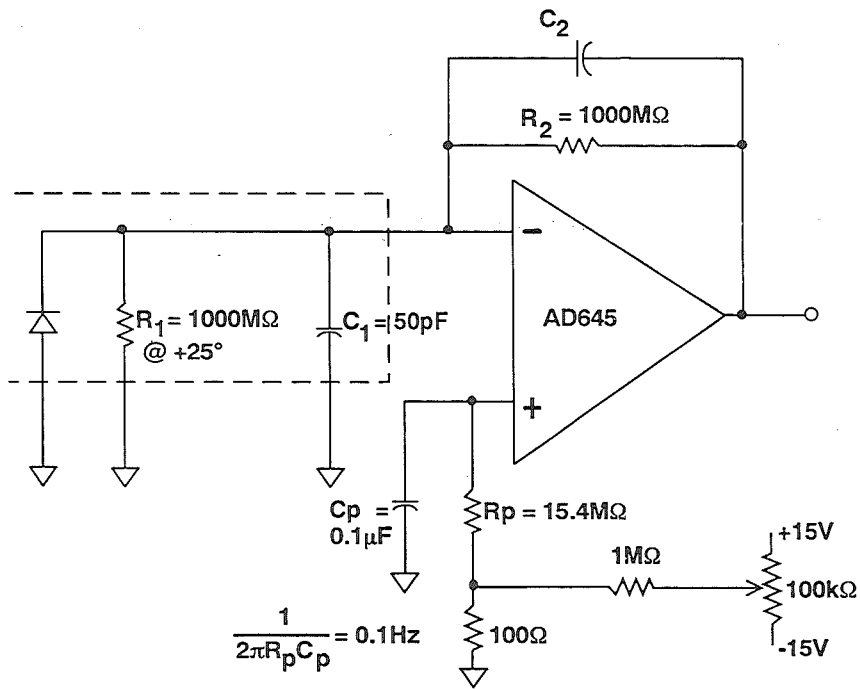


Figure 3.24

# OPTIMIZED PHOTODIODE PREAMP

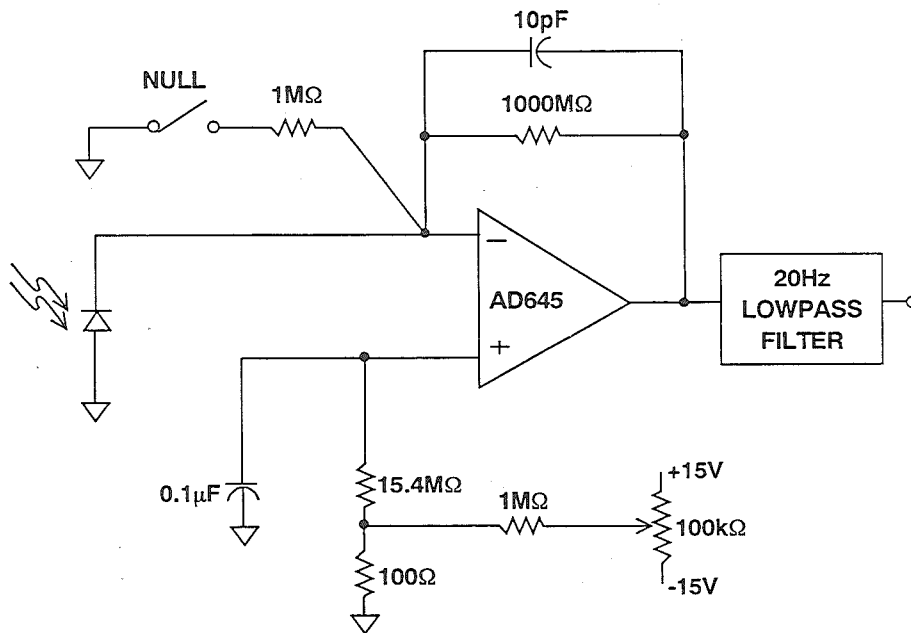


Figure 3.37

## DIFFERENTIAL DRIVER (ONE CHANNEL) FOR AD1879 SIGMA-DELTA AUDIO ADC

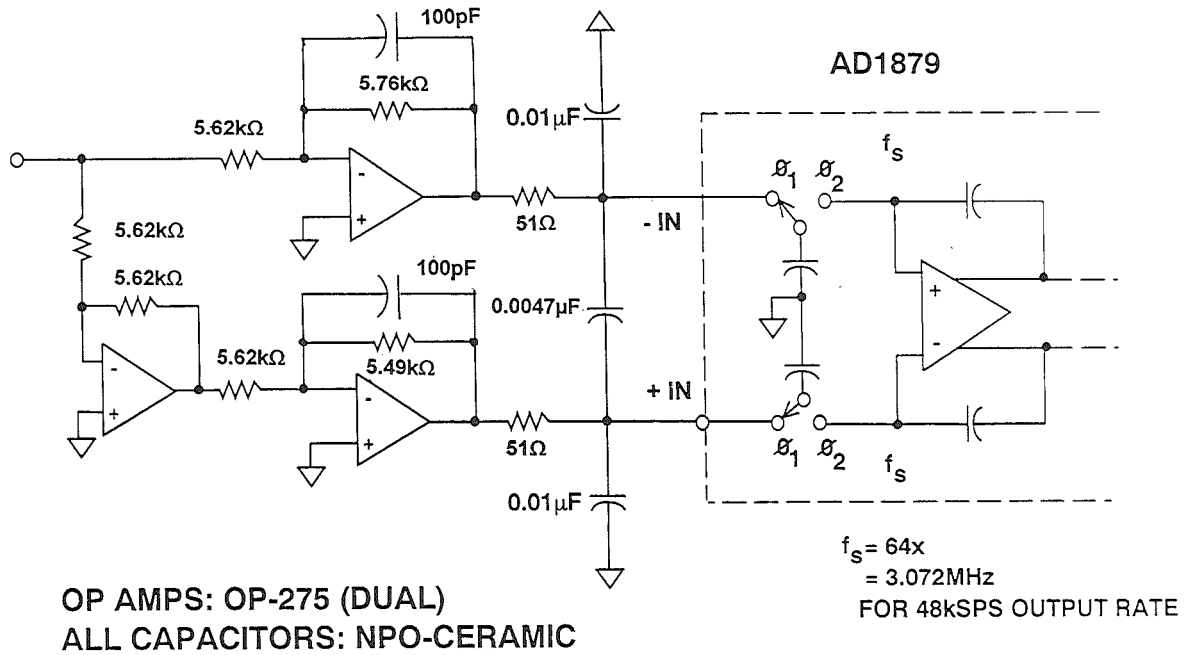


Figure 7.85

ADSpice Release F, 4/92

AD624	AD734B *	AD848	OP249E	OP42G
AD624A	AD734S *	AD848A	OP249F	OP43
AD624B	AD743 *(N)	AD848J	OP249G	OP43A
AD624C	AD743A *(N)	AD848S	OP260	OP43B
AD624S	AD743B *(N)	AD9617	OP27 (N)	OP43E
AD630 *	AD743J *(N)	AD9618	OP27A (N)	OP43F
AD630A *	AD743K *(N)	AD9630	OP27B (N)	OP43G
AD630B *	AD743S *(N)	AMP01	OP27C (N)	OP44
AD630J *	AD744	AMP02	OP27E (N)	OP470
AD630K *	AD744A	MAT02	OP27F (N)	OP482 *
AD630S *	AD744B	MAT03	OP27G (N)	OP482G *
AD645 *(N)	AD744C	MAT04	OP275 *(N)	OP490
AD645A *(N)	AD744J	OP160	OP275G *(N)	OP490A
AD645B *(N)	AD744K	OP160A	OP282 *	OP490E
AD645J *(N)	AD744S	OP160F	OP282G *	OP490F
AD645K *(N)	AD744T	OP160G	OP290	OP490G
AD645S *(N)	AD745 *(N)	OP177 (N)	OP290A	OP497
AD704	AD745A *(N)	OP177A (N)	OP290E	OP497A
AD704A	AD745B *(N)	OP177B (N)	OP290F	OP497B
AD704B	AD745J *(N)	OP177E (N)	OP290G	OP497C
AD704J	AD745K *(N)	OP177F (N)	OP297	OP497F
AD704K	AD745S *(N)	OP177G (N)	OP297A	OP497G
AD704T	AD746	OP200	OP297E	OP61
AD705	AD746A	OP200A	OP297F	OP64
AD705A	AD746B	OP200E	OP297G	OP77 (N)
AD705B	AD746J	OP200F	OP37 (N)	OP77A (N)
AD705J	AD746S	OP200G	OP37A (N)	OP77B (N)
AD705K	AD811	OP20	OP37B (N)	OP77E (N)
AD705T	AD829	OP20B	OP37C (N)	OP77F (N)
AD706	AD829A	OP20C	OP37E (N)	OP77G (N)
AD706A	AD829J	OP20F	OP37F (N)	OP90
AD706B	AD829S	OP20G	OP37G (N)	OP90A
AD706J	AD840	OP20H	OP400	OP90E
AD706K	AD840J	OP215	OP400A	OP90F
AD706T	AD840K	OP215A	OP400E	OP90G
AD711	AD840S	OP215B	OP400F	OP97
AD711A	AD843 *	OP215C	OP400G	OP97A *
AD711B	AD843A *	OP215E	OP400H	OP97E *
AD711C	AD843B *	OP215F	OP41	OP97F *
AD711J	AD843J *	OP215G	OP41A	PM1012
AD711K	AD843K *	OP21	OP41B	REF01 (N)
AD711S	AD843S *	OP21A	OP41E	REF01A (N)
AD711T	AD844	OP21E	OP41F	REF01C (N)
AD712 *(N)	AD844A	OP21F	OP41G	REF01E (N)
AD712A *(N)	AD844B	OP21G	OP420	REF01H (N)
AD712B *(N)	AD844S	OP21H	OP420B	REF02 (N)
AD712C *(N)	AD845	OP220	OP420C	REF02A (N)
AD712J *(N)	AD845A	OP220A	OP420F	REF02C (N)
AD712K *(N)	AD845B	OP220C	OP220G	REF02D (N)
AD712S *(N)	AD845J	OP220E	OP420H	REF02E (N)
AD712T *(N)	AD845K	OP220F	OP421	REF02H (N)
AD713	AD845S	OP220G	OP421B	REF05 (N)
AD713A	AD846	OP221	OP421C	REF05A (N)
AD713B	AD846A	OP221A	OP421F	REF05B (N)
AD713J	AD846B	OP221B	OP421G	REF10 (N)
AD713K	AD846S	OP221C	OP421H	REF10A (N)
AD713S	AD847	OP221E	OP42	REF10B (N)
AD713T	AD847A	OP221G	OP42A	SSM2131
AD734	AD847J	OP249	OP42E	SSM2210
AD734A *	AD847S	OP249A	OP42F	SSM2220

\* Indicates new model since release E, 10/91

(N) Indicates noise model

Figure 13.30

