SUBJECT INDEX ANALOG DEVICES PARTS INDEX

SUBJECT INDEX

A	AD526:
Aasnaes, Hans Bent, 6.84	monolithic software PGA in-amp:
AAVID Thermal Technologies, Inc. General	circuit, 2.89
Catalog, 12.96	latched digital interface, 2.90
Absolute accuracy, definition, 6.122-123	AD534, four-quadrant multiplier based on
Absolute maximum ratings:	Gilbert cell, 4.17
data sheet, example, 6.189	AD536A:
op amp, 1.76-78	monolithic rms/dc converter, 2.85-86
typical, table, 1.90	diagram, 2.86
Absorption, shielding loss, 11.43-44	AD538, monolithic analog computer, block
AC coupling, 1.23	diagram, 2.57
AC current path, ground plane resistance,	AD539:
12.72	wideband dual two-quadrant multiplier,
ACCEL Technologies, Inc., 13.91, 13.92	2.77-78, 2.81, 4.13-14
Accelerometer, 3.15-18	block diagram, 2.78, 4.14
basic unit cell sensor building block,	AD549, FET input op amp, 1.51
3.15	AD574, industry-standard ADC, encoder, 5.22
Coriolis, 3.20-21	AD580, precision band gap reference, with
internal signal conditioning, diagram,	Brokaw Cell, 7.4, 7.5
3.16	AD586, buried zener reference, circuit, 7.9
low-g, tilt measurement, 3.16-17	AD587, buried zener reference, noise
Accuracy:	reduction pin, 7.15
absolute, definition, 6.122-123	AD588, load cell amplifier, 3.96
logarithmic, definition, 6.123	diagram, 3.96
relative, definition, 6.123	single supply load cell amplifier, 3.97
ACLR, see: Adjacent channel leakage ratio	diagram, 3.97
Acquisition time:	AD589, strain gage sensor amplifier, 3.95
definition, 6.173	Diaram, 3.95
SHA, 7.59	AD590:
Active feedback amplifier, 2.49-51	current output temperature sensor, 3.33
CMR independent of resistor bridge, 2.49	multiplexed, 3.33
Active feedback CMR/gain calculator, screen,	AD594, Type J thermocouple, 3.43
13.45	AD594/AD595, monolithic thermocouple
Active filter:	amplifier with cold-junction compensator,
antialiasing design, 8.121-127	diagram, 3.42-43
element, limitations, 8.114-115	AD595, Type K thermocouple, 3.43
Active inductor, diagram, 8.69 Active mixer:	AD598:
	LVDT signal conditioner, 3.3-4 diagram, 3.4
advantages, 4.7 basic operation, 4.8-9	AD598 and AD698 data sheet, 3.27
classic, circuit, 4.8	AD600, gain vs. differential control
gain, 4.9	voltage, 4.36
RF/IF circuit, 4.8-9	AD602, gain vs. differential control
AD2S90, integrated RDC, 6.79	voltage, 4.36
AD210:	AD620:
3-port isolator, 2.34-36	In-amp, in-motor control current sensing,
in motor control current sensing,	circuit, 2.35
circuit, 2.35	CMR vs. frequency, graph, 2.24
schematic diagram, 2.35	gain-bandwidth pattern, 2.27
AD215:	monolithic IC in-amp:
low distortion two-port isolator, 2.36-37	composite application, 2.15-16
block diagram, 2.37	schematic, 2.13-14
AD260/AD261, high speed digital isolators,	PSRR vs. frequency, graphs, 2.25
2.40-42	Strain gage sensor amplifier, 3.95

AD620B, bridge amplifier, dc error budget, 2.28	open loop gain, graph, 1.12 parasitics, circuit and graphs, 13.15
Load cell amplifier, 3.96	AD848, op amp, open loop gain, graph, 1.12
Diagram 3.96	AD849, op amp, open loop gain, graph, 1.12
AD621, pin-programmable-gain in-amp, 2.22	AD1879, dual audio ADC, 6.98
AD621B, load cell amplifier 3.96	AD813X, differential amplifier, 6.27-28
diagram. 3.96	AD1170, modular ADC, 6.72
single cell load cell amplifier, 3.97	AD1770, modular ADC, 0.72 AD1580:
diagram, 3.97	shunt mode IC reference, 7.5-6
AD623, fixed gain difference amplifier,	circuit, 7.6
12.12-13	AD1582-85 series:
AD624C, monolithic in-amp, gain error, 2.22	Band gap references:
AD629:	advantages, 7.7-8
difference amplifier, 12.12-13	circuit, 7.7
differential-to-single-ended amplifier,	connection diagram, 7.7
application circuit, 2.9	LDO, 7.7
AD641:	AD185X series, audio DACs, data scrambling,
	6.109-110
monolithic log amp: block diagram, 4.25	AD1853, dual 24-bit, 92 kSPS DAC, 6.110
error curve, 4.25	AD1871:
transfer function, 4.25	24-bit 96 kSPS stereo audio multibit
waveform effect on log linearity, 4.26	sigma-delta ADC:
AD645, FET input op amp, 1.51	block diagram, 6.99
AD698:	digital filter characteristics, 6.100
LVDT signal conditioner:	second order modulator and data
with half-bridge, 3.4-5	scrambler, 6.100
synchronous demodulation, 3.3-5	AD1955:
diagram, 3.4	multibit sigma-delta audio DAC
AD768, 16-bit BiCMOS precision DAC, 6.27	diagram, 6.110
AD780, reference, 2.63	AD1900/AD1902/AD19004/AD1906:
AD790:	Class-D audio power amplifier, 2.107-2.117
comparator with hysteresis, 2.68	AD3300 60 mA LDO regulator, evaluation
block diagram, 2.69	board, 9.18
AD797, low noise op amp, 2.90-91	AD3300, 60 mA LDO regulator, circuit, 9.16
AD811, CFB op amp, comparison with model,	AD5535, 32-channel, 14-bit, 200 V output DAC
graphs, 13.13	evaluation board, 13.73
AD817, video op amp driver, power	AD6645:
dissipation vs. power, graph, 12.89	14-bit, 80 MSPS wideband ADC:
AD822, JFET-input dual rail-to-rail output	noise figure calculation, 6.154
op amp, 2.15-16	Nyquist conditions, 6.153
AD825, 8-bit, dual, high speed FET input op amp,	SFDR, graph, 6.139
8.137-138, 8.141	SFDR vs. input power level, graph,
AD830, active feedback amplifiers, 2.49	6.140
AD830/AD8129/AD8130, active feedback	SNR performance, 6.160
amplifiers, circuit, 2.49	SNR vs. aperture jitter, graph,
AD831 data sheet, 4.10	6.160
AD834:	two-tone SFDR:
8-pin basic four-quadrant multiplier,	graph, 6.142
block diagram, 4.19	vs. input amplitude, graph, 6.142
multiplier, implicit conversion, circuit,	14-bit 80 MSPS/105 MSPS XFCB ADC,
2.84	6.182- 185, 6.188, 6.193-194, 6.202
transformer coupled multiplier, block	52-lead Power Quad 4 package, 12.94
diagram, 4.19	application circuit, 6.202
AD847:	14-bit 105 MSPS ADC, with SHA, circuit,
high frequency amplifier:	7.62
Bode plot, 8.120	encode command specifications, table,
Q-enhancement effects, 8.119	6.178
Op amp:	sample timing specifications, table,
convergence, circuit and graphs, 13.16	6.178

AD7111, LOGDAC, multiplying DAC, circuit, 6.38-39	high speed current-feedback amplifier: evaluation board, 13.70-71
AD7450, 12-bit, 1 MSPS ADC, evaluation board,	stray capacitance, pulse response,
13.74	12.32
AD7524:	maximum power chart, 1.77
CMOS DAC, block diagram, 6.14	op amp:
quad CMOS DAC, block diagram, 6.14	optimum feedback resistor vs.
AD7528, 8-bit dual MDAC, 8.137-138, 8.141	
AD7528, 8-011 duai MDAC, 8.157-158, 8.141 AD7677:	package, table, 1.18
	packages, recommended components,
16-bit 1 MSPS switched capacitor PulSAR	13.89
ADC, 6.48-49	AD8016:
circuit, 6.49	20-lead PSOP3 package, copper slug for
AD77XX series:	heat transfer, 12.88
24-bit high sigma-delta ADC, 6.101, 6.103	PSOP3 and BATWING packages, thermal
high resolution ADC:	characteristic curves, 12.87
in cold-junction compensation, 3.44	AD8017AR:
and RTD, 3.49-50	8-pin SOIC op amp, 12.83-86
AD7710:	maximum power dissipation data sheet,
sigma-delta ADC with PGA, 2.93-94	12.83
circuit, 2.94	standard and Thermal Coastline
AD7710-series, 22-bit ADC, 7.19	packages, thermal rating curves,
AD7711, sigma-delta ADC with PGA, 2.93	12.86
AD7712, sigma-delta ADC with PGA, 2.93	thermal rating curves, 12.86
AD7713, sigma-delta ADC with PGA, 2.93	AD8029, PSRR, 12.77
AD7730:	AD8036, and output clamp amplifier, graph,
24-bit bridge transducer sigma-delta ADC,	2.61
evaluation board, 13.72-73	AD8036/AD8037:
application circuit, 6.202	clamp amplifier:
direct conditioning of bridge circuit, 3.98	distortion near clamping region,
ratiometric AC or DC drive w. Kelvin sencing	graph, 2.62
3.85,3.96	equivalent circuit, 2.59
sigma-delta ADC, 6.115	overdrive recovery, graph, 2.62
configuration assistant, 13.46-48	performance, 2.60
screen, 13.47	AD8037, clamp amplifier, driving flash
digital filter response, graph, 6.101	converter, circuit, 2.62-63
single-supply bridge:	AD8051, op amp, phase margin, graph, 1.13
block diagram, 6.103	AD8051/AD8052/AD8054, high speed VFB op
bridge application, schematic,	amp, 1.83, 1.86
6.107	AD8054, phase margin, graph, 1.70
digital filter response, graph,	AD8055, single supply op amp, 6.26
6.105	AD8057, single op amp, thermal packaging,
digital filter settling time, 6.106	12.90
oversampling, 6.104	AD8058, dual op amp, thermal packaging,
resolution vs. output data and	12.90
gain, 6.104	AD8074, triple voltage feedback fixed-gain
AD7846, 16-bit converter, 2.91-92	video transmission line driver, 2.4
AD7943/AD7945/AD7948:	AD8074/AD8075, 500 MHz triple buffer, 2.3
2-quadrant multiplying DAC, schematic	AD8075:
diagram, 6.19	triple video buffer, 1.66
4-quadrant multiplying DAC, schematic	triple voltage feedback fixed-gain video
diagram, 6.19	transmission line driver, 2.4
AD8001:	AD8079A/AD8079B:
absolute maximum ratings, table, 1.76	260 MHz buffer, 2.4
	dual voltage feedback fixed-gain video
feedback resistor values, packages, chart, 1.68	transmission line driver, 2.4
high speed current feedback amplifier,	AD8108/AD9109, video 8 × 8 crosspoint switch
12.31-32	
evaluation board, 12.32	7.45 AD8110/AD8111, 260 MHz, 16 × 8 buffered
Cvaruation toaru, 12.32	crosspoint switch, 7.45
	crosspoint switch, 1.45

AD8113, audio/video 60 MHz, 16 × 16 crosspoint	AD8370:
switch, 7.45	VGA with precision gain control, 4.38-39
AD8114/AD8115, 225 MHz, 16 × 16 crosspoint	block diagram, 4.39
switch, 7.45	AD8531/32/34:
AD8116, 16 × 16, 200-MHz buffered video	ordering guide for packaging, 1.92
crosspoint switch, circuit, 7.45	single-supply op amp, 1.83, 1.92
AD8129, low noise, high gain active feedback	AD8551:
amplifier, 2.50-51	chopper-stabilized amplifier, 12.11
AD8129/AD8130:	in grounded circuit, 12.12
active feedback amplifiers, 2.49-51	
	AD8551/AD8552/AD8554:
differential input single-ended output	auto-zero amplifiers:
gain block, 2.5	noise comparison, 2.123
AD813X:	output spectrum, graphs, 2.122
differential ADC driver, block diagram	AD8571/AD8572/AD8574, auto-zero amplifiers,
and equivalent circuit, 2.31	output voltage, graphs, 2.122
differential amplifier, DAC buffer	AD9002, 8-bit, 125 MSPS flash converter, 2.62-63
circuit, 2.32	AD9042:
AD8130, CMR vs. frequency, graph, 2.50	12-bit, 41 MSPS ADC, 7.60-61
AD8152, 3.2 Gbps, 34 × 34 asynchronous digital	with SHA, circuit, 7.61
crosspoint switch, circuit, 7.46	AD9054A, 8-bit, 200 MSPS ADC, functional
AD8170:	diagram, 6.63
bipolar video multiplexer, block diagram,	AD9226, 12-bit, 65 MSPS ADC, SINAD and
7.42	ENOB,
dual source RGB multiplexer, using three	graph, 6.136-137
2:1 muxes, circuit, 7.43	AD9235:
AD8174:	12-bit, 65 MSPS pipelined ADC, 6.55
4:1 mux, 7.44	timing, graph, 6.55
bipolar video multiplexer, block diagram,	AD9245:
7.42	14-bit 80 MSPS 3V CMOS ADC:
AD8180, bipolar video multiplexer, block	lead-frame chip-scale package, 12.92
diagram, 7.42	power dissipation vs. sample rate,
AD8182, bipolar video multiplexer, block	graph, 12.91
diagram, 7.42	AD9410, 10-bit, 210 MSPS ADC, 6.51
AD8183/AD8185, video multiplexer, block	AD9430:
diagram, 7.43	12-bit, 170 MSPS ADC, noise/power ratio,
AD8183/AD8185/AD8186/AD8187, triple 2:1	graph, 6.148
mux, 7.43	12-bit, 170 MSPS/210 MSPS 3.3V BiCMOS
AD8184, 4:1 mux, 7.44	ADC, 12.92-93
AD8186/AD8187, video multiplexer, single-	100-lead 3-PAD TQFP, 12.93
supply, block diagram, 7.43	output driver, 12.49
AD8230, auto-zeroing in-amp with high CMR,	packaging, 12.93
3.45-46	supply current vs. sample rate,
AD8330, VGA, block diagram, 4.34	graph, 12.93
AD8345, silicon FRIC quadrature modulator,	12-bit, 210 MSPS pipelined ADC, 6.55
block diagram, 4.11	AD9510:
AD8350, differential in/differential out	Clock distribution circuit 7.73-83
gain block, 2.6	AD9514
AD8354, gain block fixed-gain amplifier,	Clock generation circuit 7.67-72
circuit, 2.5	AD9620, monolithic open-loop buffer, 2.3
AD8362:	AD9630, monolithic open-loop buffer, 2.3
true rms-responding power detector:	AD9631, op amp, inadequate decoupling
block diagram, 4.29	effects, 12.79
internal structure, 4.30	AD976X, TxDAC, 6.24
typical application, 4.31	AD977X, TxDAC, 6.24
AD8367:	AD9772, TxDAC, DAC harmonic images
high performance 45dB VGA:	calculator, screen, 13.51
block diagram, 4.38	AD9773, 12-bit Transmit DAC (TxDAC), 6.34
linear-in-dB gain, 4.37	, , , , , , , , , , , , , , , , , , , ,

AD9775:	ADC (cont)
14-bit 160 MSPS TxDAC, 6.34	counting and integrating architectures, 6.64
14-bit 160 MSPS/400 MSPS TxDAC, core,	digital output, handling, 12.62-64
diagram, 6.21-22	DNL, typical, graph, 13.20
AD9777:	dual slope/multislope, 6.73-75
16-bit, 160 MSPS dual interpolating DAC, 12.94	dynamic performance analysis, diagram, 6.129
16-bit, 160 MSPS transmit DAC (TxDAC),	error corrected, 6.52-57
6.34	gain and ENOB vs. frequency, graph,
SFDR, graph, 6.171	6.138
AD985X series, DDS ICs, 12.94	generalized bit-per-stage architecture,
AD9850:	diagram, 6.58
DDS, 13.48-50	Gray coded (folding), 6.58-63
register configuration assistant,	high resolution, with VFC and frequency
screen, 13.49	counter, 6.68
DDS/DAC synthesizer, 4.46-47	high speed:
diagram, 4.46	CMOS buffer/latch, diagram, 12.30
AD9870, IF digitizing subsystem, 6.109	logic noise, 12.29-30
AD22100, temperature sensor, ratiometric,	high impedance, differential input, 12.14
3.34 AD22105 the amount of the 2.59.50	input and output definitions, 5.1
AD22105, thermostatic switch, 3.58-59 AD22151:	input structures, typical, diagrams, 13.20
linear output magnetic field sensor: diagram, 3.8	internal reference, 6.40-41 metastable states, 6.163-166
using Hall technology, 3.7-8	model, showing noise and distortion
AD22151 data sheet, 3.27	sources, 6.131
Adams, R., 6.113	multibit and 1-bit pipelined core
Adams, Robert, 2.127, 6.113	combination, diagram, 6.57
Adams, Robert W., 6.113	no specification of IMD, 6.145
Adams, R.W., 6.113	noise figure, calculation, 6.149
ADC:	output, with error codes, graph, 6.164
1-bit, comparator, 6.44	overvoltage, 11.1
3-bit binary ripple, input and residue	pipelined, 6.52-57
waveforms, graph, 6.60	ramp run-up, 6.65-66
3-bit serial, binary output, diagram,	reference and buffer, diagram, 6.41
6.59	sampling:
5-bit counting, circuit, 6.64	containing SHA, 7.51
10-/11-/12-bit ADC, theoretical noise	using integral SHA, 6.161
power ratio, graphs, 6.147	sampling clock, 6.42
12-bit:	SAR, 6.42, 6.45-47
noise floor, graph, 6.130	selection guide, samples, 6.209-211
SFDR, ratio of sampling clock to	serial bit-per-stage binary, 6.58-63
input frequency, graphs, 6.129	SFDR specification, 6.138
analog bandwidth, 6.137-138	sparkle codes, 6.163-166
antialiasing suppression assistant,	subranging, 6.52-57
screen, 13.53	trimming error, graphs, 6.121
architectures, 6.40-84	successive approximation, 6.37
basic function, diagram, 6.40	supply voltage, 6.43
binary, single-state transfer function,	total SNR, equation, 6.160-161
graphs, 6.58	tracking, 6.66-67
bit error rate, 6.163-166	transfer function, graph, 13.23
buffering, logic noise, 12.29-30	transient response and overvoltage
charge run-down, 6.65	recovery, 6.161-163
converter analog bandwidth, graph, 13.22	ADC Analyzer, 13.74-75
converter performance vs. analog	ADC FIFO Evaluation Kit:
input frequency, graph, 13.22	functional block diagram, 13.76
converter performance vs. sample rate,	illustration, 13.77
graph, 13.21	ADF439F, trench-isolated LLCMOS multiplexer,
	7.50

ADF4112, PLL, 4.67 ADG200 series, CMOS switches/multiplexers,	ADP1148, buck PWM regulator with variable frequency, 9.62
7.23	ADP3000:
ADG201 series, linear-compatible CMOS	switching regulator, 9.48
switches/multiplexers, 7.23	switching regulator IC using PBM, 9.52
ADG438F, trench-isolated LLCMOS multiplexer, 7.50	ADP330X, LDO anyCAP regulator, schematic, 9.13
ADG508F, trench-isolated LLCMOS multiplexer, 7.50	ADP3300 series, LDO pre-regulators, 7.15 ADP3310:
ADG509F, trench-isolated LLCMOS multiplexer, 7.50	PMOS FET 1A LDO regulator controller: diagram, 9.21
ADG511, single-supply switch, 2.92-93	external current sense resistor, 9.23-25
ADG528F, trench-isolated LLCMOS multiplexer,	ADP3603/ADP3604/ADP3605, regulated –3V
7.50	output
ADG708:	voltage inverters, application circuit, 9.93
8-channel multiplexer:	ADP3603/ADP3604/ADP3605/ADP3607:
crosstalk vs. frequency, graph, 7.33	regulated -3V output voltage inverters,
off-isolation vs. frequency, graph, 7.30	9.91-93
ADG8XX-series, CMOS switch, 7.26	circuit, 9.92
ADG801/ADG802, CMOS switch, in-resistance	ADP3607, regulated -3V output voltage
vs. input signal, graph, 7.26	inverter, resistor value, 9.93
ADG918, 1GHz CMOS MUX/SPDT absorptive	ADP3607-5:
switch, circuit, 7.40-41	regulated 5 V output voltage inverter:
ADG918/ADG919, 1GHz switch, isolation and	circuit, 9.95
frequency response, graphs, 7.40	voltages, 9.94
ADG919, 1GHz CMOS MUX/SPDT reflective	ADR380, 7.7
switch, circuit, 7.40	ADR381, 7.7
ADIsimADC:	ADSP-21060L SHARC, output rise times and
data converter modeling, 13.18-25	fall times, graph, 12.43
behavioral model, 13.18	ADSP-21160 SHARC, internal PLL, grounding
distortion, 13.22-23	12.69-70
gain, offset, and dc linearity, 13.19-20	ADSpice macromodel:
hardware considerations, 13.18-19	characteristics, 13.4-5
jitter, 13.24-25	model transient response, 13.9-10
latency, 13.25	op amp, 13.5
sample rate and bandwidth, 13.21	CFB, 13.5, 13.11-13
ADIsimPLL, 13.26-29	input and gain stages, circuit,
advantages, 13.26	13.12
frequency domain results, 13.30	frequency shaping stages, 13.7-8
graphs, 13.28	noise model, 13.10-11
and phase noise, 13.26	output stages, 13.8-9
schematic output, circuit, 13.29	circuit, 13.8
software, version 2.5, enhancements, 13.27	pulse response comparisons, graphs,
time domain results, 13.29	13.9
graphs, 13.28	stages, circuits, 13.7
Adjacent channel/leakage ratio, definition,	VFB, 13.5
6.145	input and gain/pole stage,
Adjacent channel/power ratio, definition,	circuits, 13.6
6.145	support, 13.17
ADLH0033, bipolar open-loop hybrid buffer	ADT45/ADT0, sensor, packaging, 3.34
amplifier, circuit, 2.1	ADT70:
ADM1201:	RTD signal conditioner, 3.49-51
microprocessor temperature monitor, 3.61-	diagram, 3.50
63	ADT71, RTD signal conditioner, packaging,
block diagram, 3.63	3.51 A DvM120V/A DvM140V
input signal conditioning circuits,	ADuM130X/ADuM140X:
diagram, 3.62	multichannel isolator, 2.46-48
ADP1147, switch modulation, 9.47	multichannel products, 2.46-48 ADuM140X, die photograph, 2.47
	ADUVITAUA, GIE DHOLOGIADH, Z.4 /

ADuM1100:	Amplifier Applications Guide, 2.114, 2.115,
architecture, single-channel digital	4.28, 11.50
isolator, 2.42-46	Amplifier input stage overvoltage, 11.1-4
single-channel 100 Mbps digital isolator,	Amplifier output phase reversal, caveats,
2.42-46	11.4
cross-section, 2.43	Amplifier output voltage phase reversal,
magnetic field immunity, 2.45	11.4-9
performance, 2.44	Amplitude, EMI, 11.28
ADuM1400, block diagram, 2.48	Amplitude modulation, in DDS system, RF/IF
ADuM1401, block diagram, 2.48	circuit, 4.47
ADuM1402, block diagram, 2.48	AN-309: Build Fast VCAs and VCFs with
ADXL-family micromachined accelerometer,	Analog Multipliers, 4.20
diagram, 3.15	Analog bandwidth, ADC, 6.137-138
ADXL202, dual-axis $\pm 2g$ accelerometer,	Analog comparator, overvoltage, 11.1
diagram, 3.17-18	Analog computing circuitry, 5.2
ADXRS gyro, 3.19-26	Analog delay circuit, using SHA, 7.51
capacitance change resolution, 3.23-24	Analog Devices commitment to ESD protection,
die, photograph, 3.25	11.20-21
mechanical sensor, 3.24	Analog Devices Precision Converter:
shock and vibration resistance, 3.26	communications, 13.80
ADXRS150, packaging, 3.25	evaluation board, 13.79
ADXRS300, packaging, 3.25	hardware description, 13.80
Akazawa, Yukio, 6.81	output connector, 13.80
Alice image 5.25	power supplies, 13.80
Alias, image, 5.25	software, 13.81
Aliasing:	Analog filter, 8.1-144
in DDS system, RF/IF circuit, 4.45-46	design examples, 8.121-142
in time domain, 5.25 All bits off, definition, 6.125	filter realization, 8.63-108 frequency transformation, 8.55-62
All bits on, definition, 6.125	practical problems, 8.109-120
All-0s, definition, 6.125	standard responses, 8.21-54
All-1s, definition, 6.125	time domain response, 8.18-20
All-digital PLL, 4.52	transfer function, 8.5-17
All-parallel (flash) converter, diagram, 6.50	Analog filter wizard, 13.61-67
All-pole filter, response, comparisons, 8.25	operation modes, 13.61
Allen, P.E., 8.143	schematic page, 13.67
Allpass filter, 8.13	screens, 13.62-63, 13.65-66
definition, 8.12	Analog ground, 12.55
delay, 8.61	in mixed-signal IC, 12.60-61
purpose, 8.12	Analog ground pin, circuit, 12.56
Alternate loading DAC, 6.29-30, 6.30	Analog input variable, 5.1-2
Aluminum electrolytic capacitor, 9.72-73	Analog integrated circuit, overvoltage
characteristics, 10.4-5, 10.5	effects, 11.1-51
comparison chart, 8.113	Analog isolation:
Ammann, Stephan K., 6.84	high speed logic isolator, 2.40-42
AMP 5-330808-3, 13.87	isolation barrier, 2.33
pin socket, 12.58	optional noise reduction filter, 2.36
AMP 5-330808-6, 13.87	techniques, 2.33-34
pin socket, 12.58	two-port isolator, 2.36-37
AMP03, precision four-resistor differential	Analog multiplexer, 7.23-50
amplifier, 12.12-13	Analog multiplier, 2.77-82
Amplifier:	bipolar output, 4.13
band limited, 8.114	block diagram, 4.13
current-voltage characteristic, 11.3	definition, 2.77
intercept points and 1 dB compression	four-quadrant, 4.13
points, definition, 6.143	RF/IF circuit, 4.13-20
programmable gain, 2.87-94	single-quadrant, 4.13
Amplifiers (cont,)	Analog multiplier (cont.)
speed, saturation, graph, 2.72	two-quadrant, 4.13

Analog switch, 7.23-50	Audio amplifier, 2.95-105, 2.95-98
application, 7.35-40	auto-zero, vs. chopper, 2.121-110
dummy switch in feedback, minimizing	implementation, 2.11
gain error, circuit, 7.38	line drivers and receivers, 2.101
ideal, 7.24	operation description, 2.124-113
minimizing on resistance, 7.36	types, 2.95-97
using large resistor values, circuit,	VCAs, 2.98-100
7.37	Audio line driver, 2.103-105
using noninverting configuration,	Audio line receiver, 2.101-103
circuit, 7.38	definition, 2.101
overvoltage, 11.1	Audio system, differential/balanced
parasitic capacitance, 7.37	transmission, block diagram, 2.101
switching time, dynamic performance,	Auto-zero amplifier, 2.119-113
circuit, 7.35	auto-zero phase, circuit, 2.124
unity gain inverter with switched input,	implementation, 2.123
circuit, 7.36	output phase, circuit, 2.124
Analog-to-digital converter, see: ADC	schematic diagram, 2.120
Anderson, Robin N., 6.84	vs. chopper amplifier, 2.121
Andreas, D., 6.113	Automatic zero, definition, 6.173
ANSI/EIA-656, 13.31	Automotive equipment:
Antialiasing filter:	components, RF field immunity limits,
design example, 8.121-127	11.25
for undersampling, 5.30	EMC, 11.25
anyCAP LDO family, 9.13-15	Avalanche diode, circuit, 7.2-3
merged amplifier-reference design, 9.13	AVX Corporation, 9.79
pole-splitting topology, 9.15-16	AVX TPS-series, electrolytic capacitor, 9.75
regulator controller, diagram, 9.20	
standard lead frame SOIC, 9.19	В
Thermal Coastline packaging, 9.18	Bainter notch filter:
Thermal Coastline SOIC, 9.19	design equations, 8.102
Aperture:	diagram, 8.82
SHA, effects on output, graph, 7.57	prototype, 8.132
SHA specification, 7.54	Bainter, J.R., 8.144
Aperture delay, 6.156-157	Baker, Bonnie, 12.51, 12.82
SHA specification, 7.56	Balanced audio transmission system, circuit,
Aperture delay time, 6.156-159	2.104
SHA specification, 7.56	Ball grid array, PCB, 12.6
measurement, 7.56	Ball, W.W. Rouse, 6.81
Aperture jitter, 6.156-159, 12.64	Band gap reference, 7.3-8
error, 7.53	architecture, table, 7.11
and sampling clock jitter:	basic, circuit, 7.4
graph, 6.158	Band gap temperature sensor:
SNR, graph, 6.159	cell reference voltage, 3.33
SHA, 7.56	diagram, 3.32
Aperture time, 6.156-159	Band-pass filter, 5.30, 8.2, 8.13
SHA specification, 7.54	bandwidth, 8.9-10
Aperture uncertainty, 6.157	definition, 8.10
SHA, 7.56	delay curve, denormalization, 8.29
Application circuit, data sheet, example,	peaking vs. Q, 8.10
6.202	pole frequencies, 8.57
Application specific integrated circuit, 4.2	response, graph, 8.131
The ARRL Handbook for Radio Amateurs, 4.73	response envelope, 8.29
Ask the Application Engineer-33: All About	transformations, 8.29
Direct Digital Synthesis, 4.50	transfer function, 8.9-10
Ask the Applications Engineer, 4.28	wideband or narrowband, 8.56
Aspinall, D., 6.82, 7.63	Band-pass sampling, 5.28
Asymptotic response, 1.16	Band-pass sigma-delta converter, 6.108-109
Asynchronous VFC, 6.68	replacing integrators with resonators,
Attenuation curve, filter, 8.7	diagram, 6.108

Band-pass transformation, circuit, 8.131	Binary-weighted voltage mode resistor DAC,
Bandreject filter, 8.2, 8.13	diagram, 6.12
definition, 8.10-12	Bipolar 3-bit ADC, transfer function, 5.8
response, graph, 8.133	Bipolar 3-bit DAC, transfer function, 5.7
transfer function, 8.11	Bipolar code, 5.6-10
transformation, circuit, 8.131-132	4-bit converter, 5.6
Bandwidth:	conversions among other codes, table, 5.9
for 0.1dB flatness, 1.66-67	offset binary, 5.6
SHA, 7.54	ones complement, 5.6
Barber, William L., 2.115, 4.28	sign magnitude, 5.6
Barney, K. Howard, 6.83	twos complement, 5.6
Barrow, Jeff, 12.51, 12.75	Bipolar converter, 5.12-13
Base-10 code, and binary, 5.3	Bipolar junction transistor, 3.31
Baseband, sampling, 5.26	bias current, 1.38
Baseband antialiasing filter, 5.26-28	Bipolar output, two-quadrant operation, 2.77
oversampling, 5.27	Bipolar power supply, op amp, 1.7
Basic diode log amp, 2.56	Bipolar process, for switches/multiplexers, 7.23
BAV199, diode, 3.46	Bipolar switch, in voltage converter, 9.87
Bell Laboratories, 6.37	Bipolar-FET transistor, in op amp, 1.26
Benjamin, O.J., 6.113	Biquadratic filter, 8.79
Bennett, W.R., 6.175	diagram, 8.79
Bernardi, Scott, 1.79	tunable, 8.79
Bessel filter, 8.3	Biquadratic filter (A), highpass, design
amplitude response, 8.25	equations, 8.98
design prototype, 8.134	Biquadratic filter (B), notch and allpass,
design table, 8.48	design equations, 8.99
•	
impulse response, 8.18-19	Bird's nest breadboard wiring, 13.83 Bit error rate:
poles, 8.23	
response curves, 8.37	ADC, 6.163-166
standard response, 8.23	vs. average time between errors,
step and impulse response, 8.25	sampling, table, 6.166
Bessel function, 8.134	Black, H.S., 6.175
Best straight line, 6.117-118	Blattner, Rob, 9.26
for integral linearity error, 5.14-15	Bleaney, B., 12.51, 12.75
Best, R.E., 4.73	Bleaney, B.I., 12.51, 12.75
Best, R.L., 4.73	Blinchikoff, H.J., 8.143
Bi-FET, in op amp, 1.26	Boctor notch filter, 8.83-84
Bias current, 1.38	High-pass, diagram, 8.84
compensation, SHA, 1.40	High-pass (A), design equations, 8.104
error, 6.74	High-pass (B), design equations, 8.105
minimizing, 1.41-42	Low-pass:
Bias-compensated input structure, circuit,	design equations, 8.103
1.39	diagram, 8.83
Bias-compensated op amp, 1.43	Boctor, S.A., 8.144
BiFET op amp:	Bode plot, 1.9, 1.14, 1.16, 1.30, 1.31,
input behavior, 2.75	7.29, 8.120, 13.35
phase reversal, 11.4-5	Bode, Hendrick W., 1.79
Billings, Keith, 9.78	Boltzmann's constant, 1.55, 2.79, 3.31,
Binary code, 5.12	4.15, 4.62
and base-10, 5.3	Bonadio, Steven, 4.40
and hexadecimal, relationship, 5.3	Bondzeit, Frederick, 6.84
Binary R-2R DAC, 6.6	Boost converter, 9.36-41
Binary-coded-decimal code, table, 5.9-10	basic:
Binary-weighted capacitive DAC, in	circuit, 9.37
successive approximation ADC, diagram, 6.13	waveforms, 9.37
Binary-weighted current mode DAC, diagram,	constant frequency PWM, graph, 9.64
6.13	discontinuous inductor current, 9.38-39
Binary-weighted current source, 6.12-14	discontinuous mode, waveform, 9.39

Boost converter (cont.) gated oscillator (PBM), inductance	Buck converter (cont) input/output capacitors, rms ripple
calculation, graph, 9.60	current, graphs, 9.75
input/output capacitors, RMS ripple	input/output current, waveforms, 9.70
current, graphs, 9.75	input/output relationships, 9.33
input/output current, waveforms, 9.70	negative in/negative out, circuit, 9.41
input/output current, waveforms, 9.70	NPN switches in IC regulator, circuit,
negative in/negative out, circuit, 9.41	9.54
NPN switches in IC regulator, circuit,	point of discontinuous operation, 9.36
9.54	synchronous switch, with P- and N-
point of discontinuous operation, 9.40	channel MOSFETS, circuit, 9.57
See also: Step-up converter	waveforms, discontinuous mode, 9.34
Borlase, Walter, 1.79	see also: Step-down converter
Boser, B., 6.113	Buck regulator, gated oscillator control,
Bowers, Derek, 13.31, 13.91, 13.92	output voltage waveform, 9.53
Bowers, Derek F., 2.114	Buck-boost converter:
Boyle model, 13.8-9	cascaded, 9.43
Boyle, G.R., 13.31, 13.91	circuits, 9.42-43
Brahm, C.B., 6.112	flyback, circuit, 9.45
Brandon, David, 4.50	topologies, 9.42-43
Brannon, Brad, 6.175, 7.84, 13.31	Bucklen, Willard K., 6.81
Breadboarding, 13.3	Budak, Aram, 8.143
and simulation, 13.13	BUF03, monolithic open-loop buffer, circuit, 2.2
Bridge circuit:	BUF04, unity gain buffer, 2.3
1-element, 3.71-72	Buffer:
2-element, 3.71-72	definition, 2.1
AC excitation, 3.85	frequency compensated, circuit, 2.3
All-element, 3.71-73	simple unity-gain monolithic, circuit, 2.3
Current drive, 3.73, 3.79, 3.82	Buffer amplifier, 2.1-4, 6.6
Driving, 3.90-83	Buffer register, 12.62
Kelvin sensing, 3.82	Buffered Kelvin-Varley divider, 6.6
Linearizing, 3.76-79	Bulk metal resistor, table, 10.21
Ratiometric operation, 3.77	Bulk metal/metal foil resistor, comparison
Thermocouple effect, 3.84	chart, 8.112
Voltage drive, 3.76	Buried zener, drift, 7.13
Bridge output, 5.2	Buried zener reference, 7.8-9
Broadband Amplifier Applications, 2.115,	architecture, table, 7.11
4.28	noise performance, 7.8-9
Brokaw band gap cell, 7.6	Burton, L.T., 8.144
Brokaw Cell, 3.32, 7.4	Busy, 6.42
Brokaw, Paul, 3.64, 7.21, 9.26, 11.50,	Butterworth filter, 5.27, 8.3, 8.23-24, 6.172, 13.65
12.51, 12.75, 12.82	amplitude response, 8.25
Brown, Edmund R., 2.115, 4.28	design table, 8.42
Brown, Marty, 9.78	disadvantages, 8.128
Brushless resolver, 6.76	impulse response, 8.18
Bryant, James, 12.51, 12.75	noise bandwidth, 6.150
Bryant, James M., 2.114, 4.10, 6.84	order, 8.109
Buck converter:	response, 8.121-122
basic:	response curves, 8.31
diagram, 9.31	standard response, 8.21
waveforms, 9.32	step and impulse response, 8.25
constant frequency (PWM), inductance	Buxton, Joe, 13.31, 13.91, 13.92
calculation, graph, 9.61	Bypass capacitor, voltage reference, 7.17, 7.19
constant off-time variable frequency PWM,	J1 ,
graph, 9.63	C
fixed off-time variable frequency pulse	Cable:
width modulation, 9.47	electrically long, 11.34
gated oscillator (PBM), inductance	EMI, 11.29
calculation, graph, 9.59	radiation, and EMI, 11.27

Cable (cont)	Capacitor (cont)
shielded, as antenna, 11.33-35	parasitics, 8.111, 10.10, 10.13-14
shielding, 11.47-49	best types, 10.13
electrical length, 11.46-47	and dissipation, 10.13-14
and precision sensors, 11.49	passive filter component, problems,
CAD files, 12.4	8.109-113
CAD layout files, 13.72	response to current step, 9.71
Cage jack, 12.58, 13.87	selection guide, chart, 9.72
Calculator, not a simulator, 13.48	stored charge, diagram, 9.83
Candy, J.C., 6.112, 6.113	temperature coefficient, 10.9
Capacitance:	tolerance, temperature, and other effects, 10.9
parallel plates, 12.27	voltage coefficient, 10.9
stray, 12.27-28	Carbon composition resistor, 10.15
symmetric stripline, calculation, 12.41	comparison chart, 8.112
Capacitive binary-weighted DAC, in	table, 10.21
successive approximation ADC, diagram, 6.13	Carrier, 6.136
Capacitive coupling:	Cascaded network, two-stage, example, 6.155
DAC, 6.168	Cattermole, K.W., 5.20, 6.175
equivalent circuit model, 12.28	Cauer filter, definition, 8.26-27
Capacitive load:	Cauer, W., 8.143
large, stable reference, circuit and	Caveney, R.D., 6.82
graph, 7.18	CCD, 3.65-68
reduces phase margin, 1.70	applications, 3.65
Capacitive noise, 12.28-29	linear array, diagram, 3.65
Capacitive reactance, definition, 10.3	noise source, 3.66
Capacitively applied in lating applifican 2.22	output waveform, 3.66
Capacitively-coupled isolation amplifier, 2.33	pixels, 3.65
Capacitor, 10.3-14	sample-to-sample variation, 3.66
basics, 10.3	CD reconstruction filter:
characteristics, 8.110	design, 8.134-136
table, 10.5 charge redistribution, 9.85	final filter design, 8.135 normalized FDNR, 8.135
charge transfer, 9.83-87	passive prototype, 8.135
charging from voltage source, diagrams,	performance, graphs, 8.136
9.84	transformation in S-plane, 8.135
comparison, table, 8.113, 10.5	CDMA, measurement, Tru-Power detector, 4.29
considerations, 9.69-75	Centripetal motion, 3.21
damping components, 10.4, 10.6	Ceramic capacitor, 9.72, 9.74
for decoupling, 12.77	CFB:
definition, 10.3	advantages, 1.19
dielectric absorption, 7.58, 10.11-13	frequency response, graph, 1.18
dielectric types, 10.3-9	CFB op amp, 1.17
dissipation factor, 10.13	common-mode input impedance,
electrolytic:	specification, 1.42-43
characteristics, 10.4-5	current noise, 1.49
impedance vs. frequency, graph, 9.71	difference from VFB, 1.17-19
equivalent circuit:	frequency dependence, 1.68-69
diagrams, 8.111	noise model, 1.59
parasitics, 10.10	open-loop:
equivalent series inductance, 9.83	gain, 1.68
equivalent series resistance, 9.83	graph, 1.32
fundamentals, 9.28-30	transresistance, 1.32
graph, 9.29	Chadwick, P.E., 2.114, 4.10
insulation resistance, 10.10	Channel separation, op amp, 1.75
manufacturers, 9.79	Channel-to-channel isolation, definition,
maximum working temperature, 10.9	6.173
organic types, advantages, 10.9	Charge control, 9.51
	Charge injection, CMOS switch, 7.31

Charge pump:	Circuit board:
continuous switching, circuit, 9.85	layout issues, 9.25
leakage current, 4.70-71	printed, copper resistances, chart, 9.24
in PLL, 4.52	Circuit design, considerations, 10.14
Charge run-down ADC, 6.65	Circuit diagram, data sheet, example, 6.198
diagram, 6.65	Clamping amplifier, high speed, 2.59-63
Charge transfer, definition, 6.173	Clamping diode, unnecessary on OPX91 family,
Charge-balance VFC, 6.68	11.6
diagram, 6.69	Class-D audio power amplifiers, 2.105-117
Charge-coupled device, see: CCD	Clelland, Ian, 9.78, 10.27
Charge-redistribution DAC, 6.47	Clock distribution:
Charged device model, ESD, 11.12-13	end-of-line termination, 12.47
Charpentier, A., 6.113	source terminated transmission lines, 12.47
Chasek, N.E., 6.82	Clock generation and distribution, 7.65-83
Chebyshev filter, 13.61	Clock driver, PCB, 12.3
0.01dB:	Closed-loop bandwidth, 1.57
design table, 8.43	and noise gain, 1.68
response, 8.32	Closed-loop gain, 4.52
0.1dB:	op amp, 1.13
design table, 8.44	op amp circuit, stabilizing, 13.36
response, 8.33	in VCO, 4.64
0.25dB:	CMOS:
design table, 8.45	latched buffer, 12.30
response, 8.34	for switches/multiplexers, 7.23
0.5dB:	CMOS ADC, differential SHA, equivalent
design table, 8.46	input circuit, 7.60
response, 8.35	CMOS buffer/latch, for high speed ADC IC, 12.62
1dB:	CMOS DAC Application Guide, 8.144
design table, 8.47	CMOS multiplexer, parasitic latchup, 7.47-50
response, 8.36	CMOS op amp, 1.26
amplitude response, 8.25	lower supplies, 1.44
bandwidth chart, 8.23	CMOS switch:
impulse response, 8.18-19	1GHz, 7.40-41
low-pass prototype:	adjacent, equivalent circuit, 7.27
circuit, 8.128	basic, complementary pair, circuit, 7.25
disadvantage, 8.129	basic considerations, 7.24-26
normalization, 8.22	bipolar transistor equivalent circuit,
poles, 8.22	with parasitic SCR latch, 7.48
relative attenuation, 8.22	Bode plot, transfer function in on-state,
standard response, 8.21-23	graph and equations, 7.29
step and impulse response, 8.25	charge coupling, dynamic settling time
transition region, 8.21-22	transient, circuit, 7.32
Chesnut, Bill, 12.82	charge injection model:
Chevyshev, see: Chebyshev	dynamic performance, circuit, 7.31
Chip cap, low inductance, 10.6	effect on input, circuit, 7.31
Chip select, 6.42	crosstalk, 7.33
Choke, EMI protection, 11.35	diode protection scheme, 7.48
Chop mode, 6.104	dynamic performance:
Chopper amplifier, 2.119-108	off isolation, graph and equation, 7.29
schematic diagram, 2.119	transfer accuracy vs. frequency,
Chopper-stabilized op amp, 1.26, 2.119	graph, 7.28
compared with precision amps, 2.123	error sources, 7.26-34
Christie, S.H., 3.60	feedthrough, 7.30
Chryssis, George, 9.78	input protection, using Schottky diode, 7.49
Circuit:	junction-isolation, cross-section, 7.47
tuned:	model, with leakage currents and
formed from inductor/capacitor, 12.25	junction capacitances, 7.26-27
Q, 12.25	off condition, dc performance, circuit, 7.28

on condition, de performance, circuit	Complementary bipolar process, for
and equations, 7.27	switches/multiplexers, 7.23
on resistance vs. signal voltage,	Complementary code, 5.10
graph, 7.25	uses, 5.10
CMOS switch (cont)	Complex impedance, definition, 10.23
overcurrent protection, using external	Compliance-voltage, DAC output, 6.24
resistor, circuit, 7.49	Compliance-voltage range, definition, 6.125
parasitic components, 7.28	Compound input stage, 1.22
parasitic latchup, 7.47-50	Computer equipment, radiated emission
in poorly designed PGA, circuit, 7.39	limits, table, 11.24
single-pole, settling time, constants,	Conduction, EMI, 11.27
table, 7.34	Conductivity, infinite, 12.9
CMR, definition, 6.124	Conductor, resistance, 12.5-6
CMRR:	Configuration assistant, 13.46-58
in bias current compensation, 1.40	Connector leakage, and EMI, 11.27
op amp:	Connelly, J.A., 12.51, 12.75, 12.82
calculation, 1.71	Continuous switching:
output offset voltage error, 1.71	charge pump, circuit, 9.85
CMV, definition, 6.124	pump capacitor, circuit, 9.86
Code, 5.2	Controller, set-point, 3.58-60
conversion relationship, 5.2	Conversion relationship, code, 5.2
hexadecimal, 5.3	Converter:
natural, 5.3	ideal step-up (boost), 9.36-41
straight binary, 5.3	rms to dc, 2.83-86
Code centers, 5.12	Copper resistance, printed circuit, chart, 9.24
CODEC, grounding, 12.67	Core, electronic, manufacturers, 9.79
Coding and quantizing, 5.1-20	Coriolis acceleration:
COG capacitor, characteristics, 10.6	definition, 3.20
Coilcraft, 9.79	example, 3.20
Coiltronics, 9.79	measurement, 3.22-23
Cold-junction:	to measure angular rate, 3.20-21
compensation, 3.36-44	Coriolis accelerometer, 3.20-21
diagram, 3.40	Coriolis effect:
temperature sensor, 3.40-41	demonstration, 3.22
definition, 3.37, 3.39	displacement, 3.23
Colton, Evan T., 6.82	Correlated double sampling, 3.66
Commercial equipment, EMC, 11.23-24	diagram, 3.67
Common-mode error, definition, 6.124	Couch, L.W., 4.73
Common-mode range, definition, 6.124	Counts, L., 2.114
Common-mode rejection, see: CMR	Counts, Lew, 2.115
Common-mode rejection ratio, see: CMRR	Coupling:
Common-mode voltage, see: CMV	EMI, 11.37
Communication theory, classic paper by	and mutual inductance, within signal
Shannon, 5.24	cabling, 12.24
Companding, 6.37	Coussens, P.J.M., 3.27
Comparator, 2.65-76	Coxeter, H.S.M., 6.81
1-bit ADC, 2.65, 6.44	Crosstalk, 7.33
definition, 2.65	definition, 6.173
latch and compare, 2.69	EMI, 11.37
logic types, 2.72	op amp, 1.75
op amp, 2.71	PCB, 12.3
input circuitry, 2.75-76	Crowbar, EMI protection, 11.35
output, 2.72-74	Crystal Oscillators: MF Electronics, 12.52
speed, 2.71-72	Crystal Oscillators: Wenzel Associates,
output, 72-74	Inc., 12.52
response, hysteresis, 2.68	Cűk converter, 9.44
speed, 2.71-72	Current feedback input resistance, circuit, 1.43
symbol, diagram, 2.65	Current feedback integrator, noninverting, 8.117
window, 2.69	

Current feedback op amp:	DAC (cont.)
choosing between VFB and CFB, 1.19	multiplying:
differences from VFB, 1.17-19	in feedback loop, 2.91-92
effects of overdrive on inputs, 1.27-28	performance, 2.92
low power and micropower, 1.25-26	nonlinear 6-bit segmented, diagram, 6.38
phase reversal, 1.25	output:
rail-to-rail, 1.25	buffered with op amps, 6.23
single supply:	graph, 6.36
circuit design, 1.23-24	output compliance voltage, 6.24
considerations, 1.20-22	ping-pong, 6.29-30
supply voltage, 1.19-20	settling time, 6.167-168
see also: CFB	SFDR, 6.167, 6.170-172
Current noise, op amp, 1.47, 1.49	test setup, 6.171
Current source:	SNR, 6.170-172
schematic and layout:	measurement, analog spectrum analyzer, 6.172
PCB, 12.71	string, 6.4-5
dc current flow, 12.71	switched-capacitor, 6.47
Current-mode binary weighted DAC, diagram,	thermometer, 6.9-11
6.13	transitions, with glitch, graph, 6.168
Current-mode control, 9.50	DAC-08, block diagram, 6.16
Current-mode R-2R ladder network DAC,	Dale Electronics, Inc., 9.79
diagram, 6.17	Damped oscillation, 1.64
Current-out temperature sensor, 3.33	Damping ratio, 8.7
Current-steering multivibrator VFC, 6.68	Damping resistor:
diagram, 6.69	fast logic, minimizing EMI/RFI, circuits, 12.44
Current-to-voltage converter, see: I/V	series, high speed DSP interconnections, 12.45
,	
Curtin, Mike, 4.73	Daniels, R.W., 8.143
Cutler, C.C., 6.112	Darlington NPN, pass device, 9.6
Cut-off frequency, filter, 8.1-2	Darlington pass connection, 9.7
D.	Data bus:
D	interface, example, 6.199
DAC:	parallel vs. serial, 6.206
3-bit switched-capacitor, circuit, 6.47	Data converter, 6.1-211
8-bit, nonlinear transfer function, 6.37-38	ac errors, 6.129-176
12-bit, SFDR, FFT, 4.48	ac specifications, 6.173-174
architecture, 6.3-39	analog switches and multiplexers, 7.23-50
R-2R ladder, 6.14-18	choosing, 6.205-211
basic, diagram, 6.3	code transition noise and DNL, graphs, 6.122
charge-redistribution, 6.47	dc and ac specifications, 6.115
current-output architecture, 6.9	dynamic performance, 6.133
deglitcher, using SHA, 7.51	table, 6.134
digital interfacing, 6.28-32	gain error, 5.14
distortion, 6.167, 6.170	intercept points, significance, 6.144
double buffered, 6.28	least significant bit, for 2 V full scale
complex input structures, diagram, 6.29	input, table, 6.116
dynamic performance, 6.167	logic, timing, 6.33
fully decoded, 6.9-11	metastable comparator output, error
gain, in R-2R ladder, 6.16	codes, diagram, 6.165
general nonlinear, diagram, 6.39	offset error, 5.14
glitch impulse area, 6.168-169	offset and gain error, graphs, 6.117
high speed:	parameters, 6.205-206
alternate loading, diagram, 6.30	part selection, 6.206-211
buffering using differentia amplifier,	primary dc errors, 6.117
6.28	resolution, 6.205
output, model, 6.24	table, 6.116
ideal 12-bit, SFDR, output spectrum, 4.44	sample rate, 6.205
input and output definitions, 5.1	SHA circuits, 7.51-63
intentionally nonlinear, 6.37-39	specifications, defining, 6.115-116

Data converters (cont.)	DDS (cont)
static transfer functions and dc errors,	fundamental, 4.41
6.117-127	harmonics, 4.46
support circuits, 7.1-63	RF/IF circuit, 4.41-44
thermal considerations, 12.90-95	sampled data system, 4.41
timing specifications, 6.177-179	tuning equation, 4.43
transfer functions for nonideal 3-bit	vs. PLL-based system, 4.46
DAC and ADC, graphs, 6.119	DDS Design, 4.50
voltage references, 7.1-21	DDS system:
Data directed scrambling, 6.110	ADC clock driver, 4.46-47
Data distribution system, using SHA, 7.51	amplitude modulation, 4.47
Data ready, 6.42	dither, for quantization noise and SFDR, 4.49
Data scrambling, 6.110	harmonics, 4.47
Data sheet:	SFDR considerations, 4.47-49
absolute maximums, 1.89-91, 6.188-189	De Jager, F., 6.112
application circuits, 6.202	Dead time, DAC settling time, 6.167
circuit description, 6.198	Decimation, 6.90-91
defining the specifications, 6.192	Decoupling, 12.77-82
equivalent circuits, 6.193	inadequate, effects, 12.78-79
evaluation boards, 6.203	local high frequency, 12.77-80
front page, 1.83, 6.181	supply filter, circuits, 12.78
graphs, 1.92, 6.194-197	PCB, 12.77-82
how to read, 6.181-203	power line, forms resonant circuit, 12.80
interface, 6.199-200	surface-mount multilayer ceramics, 12.77
main body, 1.93, 6.198	voltage reference, 7.2
for op amp, 1.93-94	Decoupling capacitor, in-amp, 2.24
ordering guide, 1.92, 6.189-190	Decoupling point, 12.63
pin description, 6.191-192	Del Signore, B.P., 6.113
reading, 1.83-94, 6.181-203	Delay constant, surface microstrip, 12.39
register description, 6.201	Delay dispersion, graph, 2.66
specification tables, 1.83-89, 6.181-188	Delay skew, 12.50
Data Sheet for AD815 High Output Current	Deloraine, E.M., 6.112
Differential Driver, 12.96	Delta modulation, 6.85
Data Sheet for AD8011 300 MHz, 1mA Current	circuit, 6.85
Feedback Amplifier, 1.82	quantization, graph, 6.86
Data Sheet for AD8016 Low Power, High	Delta phase register, 4.42
Output Current xDSL Line Driver, 12.96	Delyiannis, T., 8.143
Data Sheet for AD8017 Dual High Output	Dempsey, Dennis, 6.7
Current High Speed Amplifier, 12.96	Demultiplexed data bus, 12.50
Data Sheet for AD8551/AD8552/AD8554 Zero-	Denormalization, filter, 8.29
Drift, Single-Supply, Rail-to-Rail	Derating curves, 12.85
Input/Output, 1.82	Derjavitch, B., 6.112
Data Sheet for AD8571/AD8572/AD8574 Zero-	Design development:
Drift, Single-Supply, Rail-to-Rail	evaluation boards and prototyping,
Input/Output, 1.82	13.69-92
Data Sheet for OP777/OP727/OP747 Precision	online tools and wizards, 13.33-68
Micropower Single-Supply Operational	simulation, 13.3-32
Amplifiers, 1.82	tools, 13.1-92
Data Sheet for OP1177/OP2177/OP4177	Design wizard:
Precision Low Noise, Low Input Bias	analog filter wizard, 13.61-67
Current Operational Amplifiers, 1.82	photodiode wizard, 13.58-60
Dattorro, J., 6.113	Designing for EMC (Workshop Notes), 11.50
DC error source, in-amp, 2.22-25	Detecting, architecture, 4.21
DC errors, 6.117-127	Detecting Fast RF Bursts Using Log Amps, 4.28
DDS, 6.170	Detecting log amp, 2.55-56
aliasing, 4.45-46	Detector, True Power, RF/IF circuit, 4.29-31
basic system, high resolution, 4.44	Development of an Extensive SPICE
configuration assistant, 13.49	Macromodel for "Current-Feedback"
flexible system, diagram, 4.42	Amplifiers, 13.31, 13.91

Dickinson, Arthur H., 6.83	Differential transformer coupling, circuit, 6.25
Dielectric, types, 10.3-9	Digi-Trim, in op amp, 1.26
Dielectric absorption, 10.10-13	Digiphase, 4.59
capacitor, 10.11-13	Digital corrected subranging, 6.54
circuit example, 10.11	Digital crosspoint switch, 7.46
material characteristic, 10.12	Digital crosstalk, definition, 6.173
PCB, 12.19	Digital current, high, multiple PCB,
circuit, 12.20	diagram, 12.68
sample-and-hold errors, 10.12	Digital data bus noise, immunity in high-
SHA, 7.58	speed ADC IC, 12.62
circuit and graph, 7.59	Digital error correction, 6.54
Dielectric hysteresis, 10.11	Digital filter, in sigma-delta ADC, 6.100- 101
Difference amplifier:	Digital filtering, 6.90
circuit, 2.9	Digital ground, 12.55
definition, 2.8	in mixed-signal IC, 12.60-61
Differential amp:	Digital ground pin, circuit, 12.56
calculator, manual and automatic modes,	Digital interface, 6.28-32
13.44	Digital isolation:
CMR/gain/noise calculator, screen, 13.44	AD260/AD261 high speed logic isolators,
Differential amplifier, 2.31-32	2.40-42
advantages, 2.31	ADuM130X/ADuM140X multichannel products,
Differential analog input capacitance,	2.46-48
definition, 6.125	ADuM1100 architecture, 2.42-46
Differential analog input impedance,	in data acquisition system, 2.41
definition, 6.125	<i>i</i> Coupler technology, 2.42
Differential analog input resistance,	techniques, 2.39-48
definition, 6.125	using LED/photodiode optocoupler, 2.40
Differential analog input voltage range,	using LED/phototransistor optocoupler, 2.39
definition, 6.125	Digital noise, in mixed-signal IC, 12.60-61
Differential current-to-differential	Digital phase wheel, 4.43
voltage conversion, 6.27-28	Digital phase-frequency detector:
Differential DC-coupled output:	in PLL synthesizer, 4.54
with dual-supply op amp, circuit, 6.25	using D-type flip flops, circuit, 4.54
with single-supply op amp, circuit, 6.26	waveforms, 4.55
Differential gain:	Digital phosphor scope, acquisition time
definition, 1.73, 6.173	measurement, 7.59
example, 1.74	Digital PLL, 4.52
Differential input voltage, op amp, 1.44	Digital pot, 6.7-9
Differential linearity error, 6.117	two times programmable, diagram, 6.9
Differential nonlinearity, 6.118	Digital potentiometer, 6.7-9
ADC, 5.17	advantages, 6.8
graph, 6.120	internal timer, 6.8
and code transition noise, 5.19	Digital sampling scope, acquisition time
converter, 5.15	measurement, 7.59
DAC:	Digital signal processor, see: DSP Digital switch, crosspoint, 7.46
details, 5.16	C , 1
graph, 6.119 distortion effect, 6.133-135	Digital word, 6.1 Digital-output temperature sensor, 3.56-58
	Digital-output temperature sensor, 5.36-38 Digitally controlled VGA, 4.38-39
Differential nonlinearity error, in ADC/DAC, graphs, 6.134	RF/IF circuit, 4.38-39
Differential nonlinearity temperature	DigiTrim technology:
coefficient, 6.123-124	circuit offset adjustment, 1.34-35
Differential PCM, 6.85	schematic, 1.35
circuit, 6.85	Diode:
Differential phase:	input protection, 11.2
definition, 1.75	junction capacitance, 11.8
specifications, 1.74	for parasitic SCR latch-up protection, 7.48
Differential phase, definition, 6.173	101 parasitie sere atom up protection, 7.40
r,,	

Diode-ring mixer:	Dual amplifier band-pass filter:
diagram, 4.7	design equations, 8.100
performance limitations, 4.7	diagram, 8.80
RF/IF circuit, 4.3-6	Dual slope ADC:
Diode/op amp log amp, disadvantages, 4.21	advantages, 6.74
DiPilato, Joe, 6.114	diagram, 6.73
Direct Digital Frequency Synthesizers, 4.50	integrator output waveforms, 6.73
Direct digital synthesis, see: DDS	Dual slope/multislope ADC, 6.73-75
Direct IF to digital conversion, 5.28	Dual-modulus prescaler, 4.57-58
Discrete time sampling, 5.22	Duff, David, 6.175
Dispersion, comparator, 2.65	Dummer, G.W.A., 12.51
Dissipation factor, definition, 10.13-14	Duty cycle, waveform, 1.24
Distance, EMI, 11.28	Dynamic range, log amp, 4.24
Distortion:	Dynamic settling time, transient, charge
CFB op amp, 1.19	coupling, graph, 7.32
harmonic, 1.60	00 up 8, 8, up , 2
intercept points, 1.60	E
intermodulation distortion, 1.60	E-Series LVDT Data Sheet, 3.27
multitone power ratio, 1.60	Early effects, 3.31
op amp, definition, 1.60	Earnshaw, J.B., 6.80
SFDR, 1.60	Eckbauer, F., 6.113
SHA, 7.54	ECL, 5.2
static and dynamic, 13.22-23	EDN Magazine, 11.23
total harmonic, 1.60	EDN's Designer's Guide to Electromagnetic
plus noise, 1.60	Compatibility, 11.50
Distortion products, location, graph, 6.135	Edson, J.O., 1.80, 5.20, 6.80, 6.82, 6.175,
Dither, 4.48	7.63
Dither signal, 6.130	Edwards, D.B.G., 6.82, 7.63
Divider:	Effective aperture delay time, 6.156-157
circuit, 2.82	and ADC input, graph, 6.157
with multiplier and op amp,	graph, 7.56
inverting/noninverting modes, circuit,	SHA specification, 7.56
2.81	Effective input noise, definition, 6.126
DNL:	Effective number of bits, see: ENOB
and sampling clock jitter, quantization	Effective resolution, 6.132
noise, SNR, and input noise, graph,	Effective temperature differential,
6.160	calculation, 12.84
see also: Differential nonlinearity	EIAJ ED-4701 Test Method C-11,
Dobkin, Robert C., 9.26	Electrostatic Discharges, 11.51
Doeling, W., 12.51	EIAJ Specification ED-4701 Test Method
Dominant pole frequency, 1.30	C-111 Condition A, 11.13
Dorey, Howard A., 6.84	Eichhoff Electronics, Inc., 10.27
Dostal, J., 1.81	80C51, microcontroller, 3.57
Doublet glitch, 6.168	Electric-field intensity, RFI, 11.30
Downing, Salina, 13.31	Electrically long, cable, 11.46-48
Drift:	Electrically short, cable, 11.46-47
reference temperature, table, 7.14	Electrolytic capacitor:
voltage reference, 7.13	characteristics, 10.4-5
Drift with time, op amp, 1.33	impedance vs. frequency, graph, 10.7
Drift/gain error, 13.39, 13.41	life, 10.14
Droop:	polarized, 9.72
hold mode, 7.58	ripple current, 9.74-75
rate, 7.53	types, 9.72
Dropout voltage, 9.5	Electromagnetic compatibility, see: EMC
DSP:	Electromagnetic interference, 9.66
grounding, 12.67	Electrostatic discharge, see: ESD
output rise times and fall times, graph,	Electrostatic potential, modeling, 11.12-17
12.43	Elliott, Michael, 6.83, 7.63

Elliott, Michael, R., 6.83	Error budget calculator (cont)
Elliptical filter, 5.27	for op amp, 13.39-42
definition, 8.26	screen, 13.40-41
Embedding:	Error corrected ADC, 6.52-57
advantages and disadvantages, 11.39	Error vector magnitude, 13.27
traces, 12.42	Error voltage, from digital current flowing
EMC:	in analog return path, 12.58
regulations:	ESD:
design impact, 11.25	catastrophic failure, 11.1
industries, 11.23-25	damage, 11.17
EMC Test and Design, 11.50	considerations, 11.18
EMI:	prevention in ICs, 11.18
diagnostic framework, table, 11.27	definitions, 11.1
generated by power line disturbances,	effects, 11.11-21
11.35	elimination, keys, 11.1
model, source/receptor/path, 11.26-27	failure threshold, 11.1
regulation:	generation, 11.12
by FCC and VDE, 11.23	IC protection, protocols, 11.20
radiated emissions, 11.23	integrated circuit protection, 11.11-21
troubleshooting, philosophy, 11.48-49	model:
waveguide, via enclosure openings, 11.43	comparison, table, 11.15
EMI/RFI:	discharge waveforms, comparison,
and analog circuit, 11.23-49	11.15-16
considerations, 11.23-49	schematic representation, and
Emitter-coupled logic, see: ECL	discharge waveforms, 11.14
Encoder, early ADC, 5.22	models, 11.12
Encoding process, differential nonlinearity,	sensitive devices:
6.133	handling, workstation, 11.19
End point, 6.117-118	recognition, 11.19
End point method, for integral linearity	ESD Association Draft Standard DS5.3 for
error, 5.14-15	Electrostatic Discharge (ESD) Sensitivity
End termination:	Testing-Charged Device Model (CDM)
both ends, for single transmission line,	Component Testing, 11.51
12.48	ESD Association Specification S5.2, 11.13
microstrip transmission lines, 12.46	ESD Association Standard S5.2 for
End-of-conversion (EOC), 6.42	Electrostatic Discharge (ESD) Sensitivity
Engelhardt, E., 6.113	Testing-Machine Model (MM)-Component Level
ENOB, 6.90, 13.54	11.51
definition, 1.63, 6.136-137	ESD Prevention Manual, 11.50
Equivalent input referred noise, 6.131-132	European cordless telephone system DECT,
Equivalent noise bandwidth, 1.48	with open-loop modulation, 4.70
Equivalent number of bits, see: ENOB	Evaluation board, 13.69
Equivalent pin circuit, data sheet, example,	clocking description, 13.76-78
6.193	clocking with interleaved data, 13.78
Equivalent series inductance, 10.10, 10.13	data converter, 13.72-73
capacitor, 9.69, 9.83	data sheet, 6.203
capacitor loss element, 10.3	full prototype board, 13.89
Equivalent series resistance, 10.10, 10.13	high speed FIFO system, 13.74-75
capacitor, 9.69, 9.83	ADC Analyzer, 13.74-75
filter loss element, 10.3	theory of operation, 13.75-76
temperature dependence, 10.7	versions, 13.75
Erdi, George, 1.79-80, 2.114	Op amp
Error:	dedicated, 13.70-71
ADC/DAC DNL, graphs, 6.134	illustrations, 13.71
in design, strategy, 12.26	general purpose, 13.69-81
drift/gain, 13.39	illustration, 13.69
resolution, 13.39	PCB, 12.3
Error budget calculator:	layout, 12.4
for in-amp, 13.42	precision ADC, 13.79-81

Evaluation boards (cont)	Fiedler, Udo, 6.83
prototyping, 13.82-87	Film capacitor, 9.72
additional information, 13.88-89	characteristics, 10.4-5, 10.6
sockets, 13.87-88	poor temperature coefficient, graph,
Excess noise, resistor, 10.21-22	8.110
Exclusive-or (EXOR) gate, in PLL	Filter:
synthesizer, 4.54	60 Hz notch, 8.141-142
Expandor, 6.37	active, antialiasing, design, 8.121-127
Explicit method, conversion by analog	analog, 8.1-144
circuit, 2.83	antialiasing, 5.26
Exponential amplifier, X-AMP, 4.35	requirements, 5.28
External clock jitter, 12.64	in undersampling, 5.29-31
External current, 12.9	for undersampling, 5.30
External offset adjustment, circuits, 1.36	attenuation curve, 8.7
External trim, 1.36-37	band-pass, 5.30, 8.2
	band-reject, 8.2
F	baseband antialiasing, 5.26-28
Fague, D.E., 4.74	Butterworth, 5.27
Failure, resistor, effects, 10.20	circuit and component quality factors,
Fair-Rite Linear Ferrites Catalog, 10.27	8.63
Fall time:	components, passive, problems, 8.109-113
graph, 6.177	cut-off frequency F_0 , 8.7
op amp, 1.70	damping ratio, 8.7
timing specification, 6.177	definition, 8.1
Faraday screen, 12.27	design equations, 8.88-107
Faraday shield, 12.3, 12.24, 12.28-30	design examples, 8.121-142
definition, 12.28	design tables, 8.42-52
in isolation transformer, EMI protection,	design wizard, 13.54
11.36-37	elliptic, 5.27
model, 12.29	frequency response vs. DAC control
Farrand Controls, Inc., Inductosyn, 3.13	word, graph, 8.138
Fast Fourier transform, 5.21, 6.129	frequency transformation, 8.55-62
FAST Step mode, in AD7730 digital filter	low-pass to all-pass, 8.61-62
settling time, 6.106	low-pass to band-pass, 8.56-59
FAT-ID concept, for EMI problems, 11.28 FDMA, noise/power ratio, 6.146	low-pass to band-reject (notch), 8.59-61 low-pass to high-pass, 8.55-56
FDNR, 8.70-71	high-pass, 8.2
FDNR, 8.70-71 FDNR filter:	implementation, problems, 8.109-120
for CD reconstruction, 8.134	inductive and/or resistive, 11.33
op amp requirements, 8.115	inverse Chebyshev, 8.27-28
Feedthrough protection, 11.32	key parameters, 8.3
Feedback counter:	leakage, RFI, 11.31
N-divider, 4.56	low-pass:
in PLL synthesizer, 4.53, 4.56-58	and high-pass response, graph, 8.130
Feedback divider, in PLL, 4.52	idealized, 8.2
Feedthrough:	and RFI, 11.32
CMOS switch, 7.30	maximally flat delay with Chebyshev
definition, 6.174	stopband, 8.27
Feedthrough error, definition, 6.174	multistage, and RFI, 11.32
Ferguson, P.F., Jr., 6.113, 6.114	nonzero, 11.33
Ferguson, P., Jr., 6.113	notch, 8.2
Ferrite, 10.25	order, determination, graph, 8.121
impedance, 10.25	passive, normalized implementation,
inductor core, 9.68	circuit, 8.122
leaded, 10.25	phase response, 8.14-16
nonconductive ceramics, 10.25	practical applications, 8.1
FET input amp, 1.41	quality factor Q, 8.7
capacitance, 8.115	realization, 8.63-108
Fetterman, Scott, 6.82	reconstruction, 6.35

Filter (cont)	Frequency synthesizer:
response curve, low-pass prototype, all-	definition, 4.41
pole, 8.29-41	using PLLs, 4.41
S-plane, 8.5-7	Frequency-to-voltage converter, as receiver, 2.42
second-order responses, chart, 8.13	Friend, J.J., 8.143
selection, using configuration assistant,	Friis equation, 6.154
13.54	Front page:
standard responses, 8.21-54	data sheet:
theory, low-pass prototype, 8.128	example, 6.182
time domain response, 8.18-19	for op amp, 1.83
transfer function, 8.18	F (subzero), definition, 8.7
transformation, 8.128-133	Fu, Dennis, 3.27, 6.84
table, 8.67	Full wave rectifier, 3.3
Finite amplitude resolution due to	Full-power bandwidth, 6.138
quantization, 5.22	definition, 1.65-66
First order all-pass filter:	Full-scale, definition, 6.125
design equations, 8.106	Full-scale range, definition, 6.125
diagram, 8.86	Fully decoded DAC, 6.9-11
Fisher, J., 6.113	current-output thermometer, simplest,
Flash ADC, 6.50-51	diagram, 6.10
Flash converter, 6.50-51	Fundamental frequency, 6.137
3-bit all-parallel, diagram, 6.50	
disadvantages, 6.50	G
interpolation, 6.51	Gaalaas, Eric, 2.127
Flett, F.P., 3.27	Gailus, Paul H., 6.114
Flicker, eliminated in-tracking ADC, 6.67	Gain:
Flicker noise, op amp, 51-52	definition, 6.126
Flicker-free code resolution, 6.132-133	definitions, 1.15
calculation from input-referred noise,	SHA, 7.54
6.133	variation vs. DAC control word, graph, 8.139
Flyback converter, circuit, 9.45	Gain block, 2.5-6
Flyers, 6.164	Gain error, 5.13, 6.117
Folding converter, 6.59	Gain tempco, definition, 6.123
Folding stage:	Gain-bandwidth product:
functional equivalent circuit, 6.60	definition, 1.67
transfer function, 6.60	not in CFB op amp, 1.17
Forward-biased diode, circuit, 7.2	op amp, 1.11
Fourier analysis, 8.14	Gallium-arsenide diode, 4.6
Fourier transform, 8.18	Ganesan, A., 6.113
Fractional binary code, 5.3	Garcia, Adolfo, 13.91, 13.92
Fractional-N synthesizer, 4.59-60	Gardner, F.M., 4.73
diagram, 4.59	Gas discharge tube, EMI protection, 11.35
disadvantages, 4.60	Gated oscillator control:
Franco, S., 8.143	buck regulator, output voltage waveform, 9.53
Franco, Sergio, 1.79, 1.81	pulse burst modulation, 9.51-54
Fraschilla, J.L., 6.82	Gauss, magnetic flux density, 9.65
Frederiksen, Thomas M., 1.81	Gaussian distribution, 4.37
Frequency, EMI, 11.28	Gaussian filter, 4.71, 8.24
Frequency dependent negative resistance	6 dB:
filter, implementation, circuit, 8.125	design table, 8.52
Frequency dependent negative resistor:	response, 8.40
1/s transformation, 8.71	12 dB:
versions, 8.70	design table, 8.51
Frequency division multiple access, see:	response, 8.40
FDMA	Gaussian modeled jitter, 13.25
Frequency response, log amp, 4.24	Gaussian noise, 1.54, 6.146
Frequency synthesis, RF/IF circuit, 4.41-50	source, 1.48

Gaussian system, noise, 7.15	Ground plane, 12.36, 12.56-59, 12.70
Gay, M.S., 2.115, 4.28	breaks, 12.73-74
Geffe, P.R., 8.143	circuit inductance, 12.73
General impedance converter, block diagram,	low-impedance, 12.57
8.68	slit, and current flow, advantage, 12.59
General Instrument, Power Semiconductor	Grounded-input histogram, 6.131-132
Division, 9.80	Grounding, 12.53-75
Gerber files, 6.203, 12.4, 13.72, 13.86	high frequency, 12.70-73
Germano, Antonio, 13.92	improper, 12.53
Gilbert cell, 2.79-81, 4.15-16	mixed-signal, confusion, 12.66
disadvantages, 2.80, 4.16	mixed-signal devices:
four-quadrant, circuit, 2.80	high digital currents, multicard
Gilbert, Barrie, 2.79-80, 2.114, 2.115,	system, 12.68-69
4.10, 4.15, 4.40	low digital currents, multicard
Gilbert, Roswell W., 6.84	system, 12.67-68
Giles, James N., 6.80	mixed-signal ICs, evaluation board, 12.66
Ginzton, Edward L., 1.80	PCB, 12.53-75
Glitch:	summary, 12.70
code-dependent, 6.170	Grounding point, 12.63
effect on spectral output, graph,	Grounding system, source-to-load, 12.10
6.170	Group delay, filters, equations, 8.16
Glitch energy, 6.168	Guarding, PCB, 12.17
Glitch impulse area:	Gyroscope:
DAC, 6.168-169	angular-rate-sensing, 3.19-26
net, DAC, calculation, 6.169	applications, 3.19-20
Goodall, W.M., 6.81	axes of rotational sensitivity, 3.19
Goodenough, Frank, 3.28, 9.26	<i>i</i> MEMS angular-rate-sensing, 3.19-26
Gorbatorko, G.G., 6.82	description, 3.19-20
Gordon Bornard M. 6.81, 6.82, 6.83	mechanical schematic, 3.22
Gordon, Bernard M., 6.81, 6.82, 6.83	11
Gorman, Christopher, 6.7	H
Gosser, Roy, 1.81, 2.3, 6.82, 7.63	HAD-ADC-EVALA-SC, high speed FIFO system
Gosser, Royal A., 1.80, 2.114	13.75
Goto, E., 6.80	Hageman, Steve, 10.27
Gottlieb, Irving M., 9.78	Halford, Phillip, 4.40
Gowanda Electronics, 9.79	Hall effect, 3.6
GPS navigation, using gyroscopes, 3.20	applications, 3.6-7
Graham, Martin, 12.51, 12.75	magnetic sensor, 3.6-8
Grame, Jerald, 12.51, 12.82	as rotational sensor, 3.7
Graphs:	Hall switch, 3.6
data sheet, for op amp, 1.92	Hall voltage, 3.6
performance, op amp, 1.93	Handbook of Chemistry and Physics, 3.64,
Gray bit, 6.60-61	3.68
Gray code, 5.12, 6.62-63	Hard limiter, 6.144
Gray, Frank, 5.20, 6.80	Harmonic distortion:
Gray, G.A., 6.175	DAC, 6.170
Gray, J.R., 6.82, 7.63	definition, 6.135-136
Gray, Paul R., 1.81	inadequate decoupling effects, 12.78- 79
Grift, Rob E.J. van der, 6.83	Harmonic images calculator, spurs and SFDR,
Gross, George F., Jr., 6.82	13.52
Ground, filter effectiveness reduction,	Harmonic sampling, 5.28
11.33-35	Harmonics, converter, 13.23
Ground isolation, 12.11-14	Harrington, M.B., 3.28
amplifier, 12.12	Harris, Ted, 7.84
Ground loop, 12.9-11	Harrison, R.M., 6.82
circuit, 12.11	Hartley, R.V.L., 5.24, 5.32
Ground noise, 12.9-11	Hauser, Max W., 6.112
in high frequency system, 12.71	Hayes, John, 13.92

Heat sink:	Hysteretic current control, 9.51
definition, 12.85	T
thermal resistance, case to ambient air,	I
12.85 Haisa B. 6.112	I/O Buffer Information Specification, see: IBIS
Heise, B., 6.113	I/V converter, 6.23-28
Henderson, K.W., 8.143	differential current-to-differential
Hendriks, Paul, 6.114	
Henning, H.H., 1.80, 5.20, 6.80, 6.82, 7.63	voltage conversion, 6.27-28
Henry, J.L., 6.113 Hensley, Mike, 6.83, 7.63	differential to single-ended conversion, 6.24-25 single-ended current-to-voltage
Hexadecimal code, and binary, relationship,	conversion, 6.27
5.3	IBIS model, advantage, 13.17
High mega-ohm resistor:	Ice point junction, definition, 3.39
comparison chart, 8.112	Ichiki, H., 6.80
table, 10.21	<i>i</i> Coupler technology:
High-side downconverter, 4.3	air core technology, 2.45
High-side injection, 4.3	chip scale transformers, 2.42
High-speed clamping amplifier, 2.59-63	electromagnetic radiation, 2.46
High-speed logic, 12.43-48	isolation technology, 2.42-48
isolator, transformer-coupled isolation,	Idle tone, considerations, 6.96-97
2.40-42	IEC Standard 801-2, 11.24
PCB, 12.43-48	IEC Standard 801-2, 11.24 IEC Standard 801-4, 11.24
Higher order loop, considerations, 6.98	IEEE Standard 1596-1992, 6.31
High-pass filter, 8.2, 8.13	IEEE Standard 1596.3, 6.31
definition, 8.56	IEEE Standard C62.41, 11.24
transfer function, 8.8-9	IF sampling, 5.28
Hindi, David, 13.31, 13.91	Ikeda, K., 6.80
Hobbs, W., 13.31	IMD:
Hold mode, 6.48	1 dB compression point, 6.143-145
Hold mode droop, 7.58	definition, 1.61
Hold mode settling time, SHA specification,	intercept points, and gain compression, 1.62
7.54	products, graph, 1.61
Hold mode specification, SHA, 7.58-59	second- and third-order:
Hold signal, definition, 6.173	graph, 6.141
Hold time, timing specification, 6.177	intercept points, 6.143-145
Hold-to-track transition specification, SHA, 7.59	third-order products, 1.61-63
Horna, O.A., 6.82, 7.63	<i>i</i> MEMS angular-rate-sensing gyroscope, 3.19- 26
HOS-100, FET input open-loop hybrid buffer	Immunity, definition, 11.30
amplifier, circuit, 2.1	Impedance:
HP8561E, 4.68	common ground, current, errors, 12.10
HP8562E, 4.68	comparison, wire vs. ground plane, 11.26
HP8563E, 4.68	controlled, 12.35
HSC-ADC-EVALA-DC, high speed FIFO system,	PCB traces, 12.36-37
13.75	definition, 10.3
HSpice, 13.1	EMI, 11.28
Huelsman, L.P., 8.143	ferrite, 10.25
Hughes, Richard Smith, 2.115, 4.28	high circuit, noise, 12.30-32
Human body model, ESD, 11.12-13	input, definition, 6.126
Hunt, W., 8.144	microstrip transmission line,
Hurricane Electronics Lab, 9.79	calculation, 12.38
Hygroscopicity, PCB, 12.1	op amp, 1.9
Hysteresis, 6.44	skin depths, shielding materials, table, 11.45
application, circuit, 2.67	symmetric stripline, calculation, 12.40
calculation, 2.68	Implicit method, conversion by analog circuit, 2.84
comparator, 2.66	Impulse function, filter, 8.18
comparator response, 2.68	Impulse response, related to filter order, 8.19
effects, graph, 2.67	In-amp, 2.7-28
fast comparator, 2.70	bridge amplifier error budget amplifier, 2.28
loss, 9.67	CMR. 2.8-9. 2.23

In-amp (cont) CMR/gain/noise calculator, screen, 13.43	Inductor current: core saturation, graph, 9.66-67
DC error sources, 2.22-25	equations, switch, and diode voltage
DC errors RTI, table, 2.25	effects, 9.55
definitions, 2.7-8	Inductosyn:
error budget calculator, screen, 13.42	diagram, 3.13-14
gain calculator, 13.43	linear position sensor, 3.13-14
generic, circuit, 2.7	operation, like resolver, 3.14
input overvoltage considerations, 2.29	rotary, 3.14
input overvoltage considerations, 2.29	Innovative Mixed-Signal Chipset Targets
noise sources, 2.26-27	Hybrid-Fiber Coaxial Cable Modems, 4.50
offset voltage model, 2.23	Inose, H., 6.112
overvoltage, 11.1	Input bias current, 1.38
precision closed-loop gain block, 2.7	In-amp, 2.23
precision single-supply composite, 2.15- 17	compensation, 1.39-41
PSR, 2.24	Input capacitance:
subtractor or difference amplifier, 2.8- 11	large, 1.47
three op amp:	modulation:
advantages, 2.12	compensation, 8.116
in-amp topology, 2.12-14	distortion, 8.116
circuit, 2.12	filter distortion, 8.115-117
two op amp in- amp topology, 2.18-21	op amp, 1.43
In-amp/op amp, functionality differences, 2.8	Input circuitry, comparator, 2.75-76
In-band region, spectrum, 6.139	Input common mode voltage range, op amp, 1.43
In-band SFDR, 6.139	Input impedance:
Inductance:	definition, 6.126
mutual, 12.22-24	op amp, 1.42-43
PCB, 12.21-34	Input noise, and sampling clock jitter, DNL,
stray, 12.21	SNR, and quantization noise, graph, 6.160
wire and strip, calculations, 12.21	Input offset current, 1.38
Inductive coupling:	Input overvoltage protection:
basic principles, 12.23	In-amp, 2.29
reduction, by proper signal routing and	circuit, 1.28
layout, 12.23	Input protection:
Inductive loop, 12.72	CMOS switch, using Schottky diode, 7.49
Inductive resistance, definition, 10.23	diode, overvoltage, 11.2
Inductor, 10.23-27	op amp, 1.77
basics, 10.23-24	Input stage:
calculations:	configuration, and overvoltage, 11.2-3
buck and boost regulators, 9.58-61	overvoltage, chart, 11.2
caveats, 9.58, 9.61	Input voltage noise, sources, 2.26
considerations, chart, 9.58	Input-referred noise:
core materials, 9.68	definition, 6.126
definition, 10.23	effect on ADC grounded input histogram, 6.132
energy transfer, 9.29	Instrumentation amplifier, see also: In-amp
equations, 9.30	Insulation resistance, capacitor, 10.10
ferrite, 10.25	Integral linearity error, 6.117
fundamentals, 9.28-30	measurement, graphs, 6.118
graph, 9.29	Integral nonlinearity, distortion effect, 6.133-135
manufacturers, 9.79	Integrated Micro Electro Mechanical Systems,
parasitic effects, 12.24-25	see: iMEMS
passive filter component, problems,	Integrated VGA Aids Precise Gain Control, 4.40
8.109-113	Integrating ADC, frequency response, graph, 6.74
power loss, 9.67-68	Integrator, diagram, 8.67
chart, 9.68	Intentionally nonlinear DAC, 6.37-39
Q, 12.25	Intercept point, log amp, 4.24
self-resonant frequency, 9.69	Intercept voltage, 2.54
in switching regulator, 9.57-69	Interconnection stability, resistor, 10.17
synthetic, circuit, 10.24	Interconnects, and EMI, 11.27

Interface, data sheet, 6.199-200	K
Interference:	Kaiser, Harold R., 6.81
EMI:	Kaufman, M., 1.81
circuit/system immunity, 11.27-28	Kautz, W.H, 8.143
conduction/radiation, 11.27	Kelp, Jeff, 7.84
emission, 11.27	Kelvin connection, 3.48-49, 3.52
internal, 11.28	Kelvin DAC, and digital potentiometer, 6.8
susceptibility, 11.27-28	Kelvin divider, 6.4-5, 6.9
frequency bands, separation, 11.32	drawback, 6.4
Intermodulation distortion, see: IMD	low glitch architecture, 6.4
Internal aperture jitter, 12.64	thermometer DAC, diagram, 6.5
Internal SHA, for IC ADC, 7.59-62	variation, 6.5-7
International Rectifier, 9.79, 9.80	Kelvin feedback, 12.7
Interpolating DAC, 6.33-35	Kelvin sensing, 9.25
Interpolating TxDAC, 6.33-35	circuit, 7.14
Interpolation, 4.35	Kelvin-Varley divider, 6.5-7
in flash converter, 6.51	Kemet Electronics, 9.79
Intersymbol distortion, DAC, 6.11	KEMET T491C, tantalum capacitor, 9.18
An Introduction to the Imaging CCD Array,	Kerr, Richard J., 4.73
3.68	Kester, Walt, 1.79-82, 3.64, 3.68, 6.80,
Inverse Chebyshev filter, 8.27-28	6.176, 12.51, 12.75, 12.82, 12.96, 13.31
Inverse function, generation, circuit, 2.82	Kettle, P., 3.27-28
Inverting mode guard, circuit, 12.16	Key, E.L., 8.72, 8.143
Isolated switching regulator:	Kimmel Gerke Associates, 11.23
forward topology, circuit, 9.46	Kimmel-Gerke, 11.26, 11.32
topologies, 9.45-46	Kinniment pipelined ADC architecture, 6.57
Isolation amplifier, 2.33-38	Kinniment, D.J., 6.82, 7.63
AD210 3-port isolator, 2.34-35	Kirchoff's Law, 8.5, 12.7-8, 12.22
analog isolation techniques, 2.33-34	Kitchin, C., 2.114
Isolation amplifier (cont)	Kitchin, Charles, 2.115
capacitive coupling, 2.33	Kitsopoulos, S.C., 6.82, 7.63
motor control, 2.35-36	Kiyomo, T., 6.80
optional noise reduction post filter,	Klonowski, Paul, 6.84
2.36	Koch, R., 6.113
two-port isolator, 2.36-37	Kool μ, inductor core, 9.68
Isolation barrier, 2.33	Kovacs, Gregory T.A., 9.26
Isothermal block, for thermocouple	Kroupa, Venceslav, 4.50
terminated leads, 3.41	Kwan, Tom W., 6.113
J	L
J-K Flip-Flop, in PLL synthesizer, 4.54	Lane, Chuck, 6.81
Jager, F. de, 6.112	Laplace transform, 8.18
Jantzi, S.A., 6.114	Laser trimming, 1.34-35
Jitter:	Latch-enable to output delay, comparator, 2.70
data converter modeling, 13.24-25	Latency, data converter modeling, 13.25
Gaussian modeled, 13.25	LCR latchup, protection, using trench-isolation,
sources, 13.24-25	7.50
vs. SNR vs. input frequency, graph, 13.24	LDO linear regulator, 9.92
Jitter Reduction in DDS Clock Generator	LDO pre-regulator, 7.15
Systems, 4.50	LDO regulator, 9.9-12
Johnson noise, 1.57-58, 5.11	dominant pole, 9.11
definition, 1.49	ESR zones, 9.11-12
resistor, 1.55	traditional architecture, 9.9-10
Johnson, Howard W., 12.51, 12.75	Leaded ferrite bead, 10.25
Jung, W., 8.144	Leakage:
Jung, Walt, 1.79, 6.84, 7.21, 9.78, 10.27,	filter, RFI, 11.31
12.82, 12.96 Jung, Walter G., 1.79, 1.81, 6.175	resistance, in PCB, 12.17
Jung, watter G., 1.77, 1.81, 0.173	Leakage current, output, definition, 6.126 Least significant bit, 5.2, 5.11

Lee, Seri, 12.96	Linear voltage regulator (cont)
Lee, Stephen, 4.40	comparisons, 9.6
Lee, Wai Laing, 6.113	selection, 9.22
Lee, W.L., 6.113	tradeoffs, 9.5-9
Leeson, D.B., 4.74	pole splitting, 9.15-16
Leeson's equation, noise in VCO, 4.62	power management, 9.3-25
Lenk, John D., 9.78	sensing resistors for LDO controllers,
Lewis, Stephen H., 6.82	9.23-25
LH0033, 2.1	thermal design, 9.23
Li, Alan, 9.26	Linear-in-dB Variable Gain Amplifier
Lindesmith, John L., 6.84	Provides True rms Power Measurements, 4.40
Line driver, 2.101	Linearity error:
Line receiver, with 4-resistor differential	differential, 5.13, 6.117
amplifier, circuit, 2.102	integral, 5.13, 6.117
Line sensitivity, voltage reference, 7.14-15	measurement methods, 5.14
Line termination, PCB trace, 11.40	Linearity tempco, definition, 6.123
Linear circuit, 2.1-115	Link trimming, 1.35
analog multiplier, 2.77-82	Liu, Bill Yang, 2.124
audio amplifier, 2.95-105	LM309, fixed 5 V/1 A three terminal regulator,
auto-zero amplifier, 2.119-113	schematic, 9.7
buffer amplifier, 2.1-4	LM317, adjustable three terminal regulator,
comparator, 2.65-76	schematic, 9.8
differential amplifier, 2.31-32	Load cell, 3.93-95
digital isolation techniques, 2.39-48	Load, large capacitive, stable reference,
gain block, 2.5-6	circuit and graph, 7.18
high speed clamping amplifier, 2.59-63	Load sensitivity, voltage reference, 7.14
instrumentation amplifier, 2.2-29	Local high frequency bypass/decoupling,
isolation amplifier, 2.33-38	12.77-80
logarithmic amplifiers, 2.53-57	Local high frequency supply filter,
PGA, 2.87-94	decoupling, circuits, 12.78
RMS to DC converter, 2.83-86	Log amp, 2.53-57
Linear phase with equiripple error, filter	basic:
design, 8.134	graph, 2.55
Linear phase filter:	multi-stage:
equiripple error of 0.05°, 8.38	architecture, 4.21
design table, 8.49	response (unipolar), 4.22
equiripple error of 0.5°, 8.39	detecting, graph, 2.55
design table, 8.50	diode/op amp, circuit, 2.56
with equiripple error, 8.24	negative input, 2.54
Linear PLL, 4.52	RF/IF circuit, 4.21-28
Linear settling time, DAC settling time,	specifications, 4.24
6.167	transfer function, graph, 2.54
Linear variable differential transformer,	transistor/op amp, circuit, 2.56
see: LVDT	true, graph, 2.55
Linear voltage regulator:	waveform, log response, 4.26
any CAP LDO regulators, 9.13	Log linearity, log amp, 4.24
basic 5 V/1 A LDO controller, 9.21	Log video, 2.56
basic three terminal regulator, circuit, 9.3	graph, 2.55
basics, 9.3-5	Log-Ratio Amplifier Has Six-Decade Dynamic
block diagram, 9.4	Range, 4.28
controller differences, 9.20-21	Logarithmic accuracy, definition, 6.123
design:	Logarithmic amplifier, see: Log amp
and AC performance, 9.15	Logarithmic converter, or log amp, 2.53-57
and DC performance, 9.13-15	Logarithmic video, 2.56
dropout voltage, 9.5	LOGDAC, 17-bit voltage-mode R-2R DAC, 6.38
LDO architecture, 9.9-12	39
LDO thermal considerations, 9.17-19	Logic, high-speed, 12.43-48
pass device:	Logic high level, timing specification,
circuits, 9.6	6.177

Logic low level, timing specification, 6.177	MagAMP, 6.59
Lohman, R.D., 6.80	3-bit folding ADC:
Long-term drift, op amp, 1.33	block diagram, 6.61
Looney, Mark, 13.31	input and residue waveforms, 6.61
Loop, 12.9-11	advantages, 6.63
Loop bandwidth, in VCO, 4.66	current-steering gain-of-two folding
Loop filter, in PLL, 4.52	stage, diagram, 6.62
Loop gain:	Magnetic field:
and frequency, filter response, 8.117	lines, 12.72
op amp, definition, 1.15	shielding, 12.24
Low dropout, see: LDO	Magnetic flux density, vs. inductor
Low ESR electrolytic capacitor, 2.24	current, graph, 9.66
Low inductance ceramic capacitor, 2.24	Magnetics, 9.79
Low noise reference, high resolution	Magnetism, fundamental theory, 9.65
converter, 7.19-20	Magnetization current, 9.46
Low-pass filter, 13.64	Magnetizing inductance, 9.46
Low power:	Magnitude amplifier, 6.59
definition, 1.45	Mangelsdorf, Christopher W., 6.80, 6.175
op amp, 1.25-26	Mark, W., 12.51
Low voltage differential signaling, see:	Marsh, Dick, 9.78, 10.27
LVDS	Martin, Steve, 6.84
Low-side downconverter, 4.3	MASH sigma-delta ADC, block diagram, 6.102
Low-side injection, 4.3	MASH sigma-delta converter, 6.101-102
Low-pass filter, 8.2, 8.13	Matsuya, Y., 6.113
elliptical function, 8.58	Matsuzawa, A., 6.175
integrator in modulator, 6.93	Maximally flat delay with Chebyshev
Low-pass filter (cont)	stopband filter, 8.27
peaking, vs. Q, 8.8	MDAC, 6.17-20
Low-pass prototype, 8.8	as variable gain amplifier, 6.18
LPKF Laser & Electronics, 13.91, 13.92	Meacham, L.A., 6.81, 7.63
Lucey, D.J., 3.28	Medical equipment, EMC, 11.24
LVDS, 12.49-50	Melsa, James L., 1.80, 1.81
current output technology, 6.32	Metal film resistor:
driver and receiver, circuit, 12.49	burn-in period, 10.20
high-performance ADC, outputs, 12.50	comparison chart, 8.112
logic, 5.2	table, 10.21
output levels, diagram, 6.31	Metal foil resistor, table, 10.21
reduced EMI, 12.50	Metal-oxide varistor, EMI protection, 11.35
specifications, 6.31	Metastability, 6.164
vs. ECL, 12.49	Metastable comparator output, error codes,
LVDT, 3.1-6	diagram, 6.165
advantages, 3.2	Metastable states, ADC, 6.163-166
definition, 3.1	Meyer, Robert G., 1.81
diagram, 3.1	MF Electronics, 12.64
half-bridge, diagram, 3.5	Mica capacitor:
improved, diagram, 3.2	characteristics, 10.5
signal conditioning circuit, 3.2	comparison chart, 8.113
Lyne, Niall, 3.28, 11.51	Micromodel, differences from macromodel, 13.4-5
	Microphonics, in capacitors, 8.111
M	Micropower:
McClaning, Kevin, 6.175	definition, 1.45
McDaniel, Wharton, 9.26	op amp, 1.25-26
Machine model:	Microprocessor temperature monitoring, 3.61-63
ESD, 11.12-13	Microstrip:
worst-case, 11.13	PCB layout, for two pairs of LVDS
Machine tools, using resolvers and synchros,	signals, 12.50
6.76	PCB transmission line, 12.35, 12.38
Macromodel, differences from micromodel,	Mid-scale glitch, DAC, graph, 6.169
13.4-5	Mierlo, S. van. 6.112

MIL-STD-461, 11.24 MIL-STD-883 Method 3015, Electrostatic	Most significant bit, 5.2 Motchenbacher, C.D., 12.51, 12.75, 12.82
Discharge Sensitivity Classification,	Motion, two-dimensional, 3.21-23
11.13, 11.17, 11.51	Motorola MC1496, mixer, 4.7
classifying and marking ICs, 11.17	Motorola Semiconductor, 9.79, 9.80
Military equipment, EMC, 11.24	MQE520-1880, Murata VCO, 4.67
Miller capacitance, 2.57	Mu-metal, 12.24
Miller, Stewart E., 1.80	Multitone SFDR, 6.142
Mini-Mount prototyping board, 13.85	Multilayer ceramic chip-cap, 9.74
MINIDIP, sample guard layout, 12.17-18	Multiple feedback filter, 8.75-76
Minimum pass-band attenuation, 8.2	Band-pass:
Missing code, 6.120-122	circuit, 8.118
subranging ADC, 6.53	design equations, 8.94
Missing codes, in ADC, 5.16	diagram, 8.76
Mixed-signal devices, grounding, 12.53	high-pass, design equations, 8.93
Mixed-signal grounding, confusion, 12.66	implementation, circuit, 8.124
Mixed-signal IC, grounding and decoupling,	low-pass:
using low digital currents, 12.60-61	design equations, 8.92
Mixer:	diagram, 8.75
active, advantages, 4.7	Multiple feedback topology, 8.130
high performance, diode-ring, 4.6	Multiple ground pins, PCB, 12.3
high level, 4.11	Multiplexer:
mixing process, 4.3	analog, 7.23-50
Mixer (cont.)	Multiplexer (cont.)
RF/IF circuit, 4.3-10	parasitic latchup, 7.47-50
switching:	settling time:
diagram, 4.4	calculator, 13.38
ideal, inputs and output, diagram, 4.5	circuit and equations, 7.34
output spectrum, diagram, 4.6	video, 7.42-44
Model accuracy, 13.3	Multiplexing, charge coupling, dynamic
Model verification, 13.3	settling time transient, circuit, 7.32
Modulator:	Multiplication:
balanced, 4.11	four-quadrant operation, 2.77
doubly-balanced, 4.11	using log amps, 4.14
RF/IF circuit, 4.11	Multiplier:
definition, 4.11	analog, 4.13-20
sign-changer, 4.11	definition, 2.77
Moghimi, Reza, 2.114	block diagram, 2.77
Moghimi, Rheza, 4.28	definition, 4.13
Molypermalloy, inductor core, 9.68	input/output relationships, table, 2.77
Monolithic ceramic (high K) capacitor:	mathematical, 4.4
characteristics, 10.5	in op amp feedback loop, uses, 2.82
comparison chart, 8.113	quadrants, definition, 4.13
Monte Carlo analysis, 13.64	simple, circuit, 2.79
Spice option, 13.16	transconductance, basic, circuit diagram, 4.15
Montrose, Mark, 12.52, 12.75	translinear, four-quadrant, circuit
Morajkar, Rajeev, 2.124	diagram, 4.17
Moreland, Carl, 6.83, 7.63	using log amps, diagrams, 2.78
Moreland, Carl W., 6.83	Multiplying DAC, 6.17-20
Morrison, Ralph, 3.68, 11.50, 12.51, 12.75	as variable gain amplifier, 6.18
Morrow, P., 2.124	Multistage filter, and RFI, 11.32
MOSFET, manufacturers, 9.79	Multistage noise shaping, see: MASH
MOSFET switch, in voltage converter, 9.87	Murakami, J., 6.112
MOSFET transistor:	Muranyi, A., 13.31
in analog switch, 7.24	Murden, Frank, 6.82, 6.83, 7.63
bilateral, voltage controlled resistance,	Murphy, Troy, 13.92
7.24	Murray, Aengus, 3.27-28
on resistance vs. signal voltage, graph, 7.24	Mutual inductance, 12.22-24 and coupling, within signal cabling, 12.24
grapn, 1.27	and coupling, within signal capiling, 12.24

N	Noise figure, 6.148-155
Nagel, L.W., 13.31, 13.91	for ADC:
Narrow-band filter:	from SNR, sampling rate, and input
as notch filter, 8.59	power, calculation, 6.152
pole frequencies, 8.60	using RF transformers, 6.154
power line frequency (hum) elimination, 8.60	cascaded, using Friis equation, 6.154
Nash, Eamon, 4.40	op amp, 1.48
NDP6020P (Fairchild), 9.21-23	Noise model:
NDP6020P/NDB6020P P-Channel Logic Level	design considerations, 13.10-11
Enhancement Mode Field Effect Transistor, 9.26	pole/zero cell impedance reduction, 13.10
Neelands, Lewis J., 6.84	Spice, components, circuit, 13.11
Negative feedback, op amp input, 2.76	Noise/power ratio, 6.146-148
Negative temperature coefficient, see: NTC	measurements, 6.146
Nielsen, Karsten, 2.124	theoretical maximum, for 8-bit to 16-bit
Nelson, David A., 1.80	ADCs, 6.148
Neper frequency, 8.5	Noise-free code resolution, 6.132-133
Newman, Eric, 4.40	calculation from input-referred noise, 6.133
Newton, A.R., 13.31, 13.91	definition, 6.126
Nguyen, Khiem, 6.113	Noise-gain manipulation, op amp circuit,
Nicholas, Henry T., III, 4.73	circuits, 13.36
Nishimura, Naoki, 2.125	Nonideal 3-bit ADC, transfer function, 5.15
Noise:	Nonideal 3-bit DAC, transfer function, 5.15
in ADC with SHA, 6.131	Noninverting mode guard, circuit, 12.16
bandwidth:	Nonmonotonic ADC:
and 3-dB bandwidth, Butterworth	missing code, 5.17
filter, table, 6.150	graph, 6.120
filter, 6.150	Nonmonotonic DAC, 5.16, 6.119
op amp, 1.48	Nonsampling ADC, input frequency
calculation, 13.55	limitations, 5.22
capacitive, 12.28-29	Nonlinear phase, filter, effects, 8.16-17
comparison, precision amps vs.	Nonlinearity:
chopper-stabilized amps, 2.123	definition, 2.22
conducted, 9.28	error, resistor, 10.16
dominant source, input impedance, 1.50	SHA, 7.54
equivalent input referred, 6.131-132	Norsworth, S.R., 2.124
excess, resistor, 10.21-22	North Carolina State University, 13.32
gain, 1.57	Notch filter, 8.2, 8.13
and closed-loop bandwidth, 1.68	construction, 8.59
op amp, 1.10, 1.14-15	definition, 8.10-12
circuits, 1.15	high-pass, 8.11
gate, 2.96	low-pass, 8.11
index, resistor, 10.22	as narrow-band filter, 8.59
log amp, 4.24	phase response, graph, 8.15
model, in-amp, 2.26	standard, 8.11
op amp, 1.47	transfer function, 8.11
peak-to-peak, 6.132	width vs. frequency, 8.12
quantization, 6.37	NPO ceramic capacitor:
radiated, 9.28	characteristics, 10.5-6
reduction pin, in buried zener reference, 7.15	comparison chart, 8.113
referred to the input, 1.55	Nulling amplifier, 2.123
SHA, 7.54	Nulling stage, 2.120
sources:	Number, 5.2
in-amp, 2.26-27	Numerically Controlled Oscillator, see: NCO
sum, 1.49	Nyquist band, 6.90
spectral density, function of frequency, 1.53	Nyquist bandwidth, 4.41, 4.46-47, 5.25-26,
uncorrelated, 2.26	6.138, 6.151, 6.172
voltage reference, 7.15-16	Nyquist conditions, 6.153
Noise factor, 6.148-155	

Nyquist criteria, 4.45, 5.24-26, 5.29 aliasing, 5.24	Offse1 Voltage (cont) 1N829, temperature-compensated zener
sampling frequency requirements, 5.24	reference, 7.3
Nyquist criterion, 6.91	1N5712, Schottky diode, 2.63
Nyquist frequency, 4.45, 5.26, 6.36, 8.3,	1N5818, Schottky diode, low forward drop, 9.54
8.121, 13.48, 13.52	Ones complement code, 4-bit converter, 5.6, 5.8
Nyquist rate, 6.86	Ones-density, 6.92
Nyquist zone, 5.25-26, 5.28, 5.29-31, 6.145-	Op amp, 1.1-99
146, 6.205, 13.50, 13.52	ac specifications:
undersampling and frequency translation,	1/f noise, 1.51-52
5.28-29	1dB compression point, 1.63
Nyquist, H., 5.32	-3 dB small signal bandwidth, 1.66
Nyquist, Harry, mathematical basis of	absolute maximum rating, 1.76-78
sampling, 5.24	bandwidth for 0.1dB flatness, 1.66-67
	CFB frequency dependence, 1.68-69
0	CFB model, 1.17-28
O'Brien, Paul, 4.73	channel separation, 1.75
Octave, definition, 1.30	CMRR, 1.71
Oersted, magnetic field strength, 9.65	current noise, 1.49
Offset:	differential gain, 1.73-74
DAC control, circuits, 1.37	differential phase, 1.75
servo control, circuits, 1.37	distortion, 1.60
SHA, 7.54	ENOB, 1.63
Offset adjustment pins, circuit, 1.34	full power bandwidth, 1.65-66
Offset binary code, 4-bit converter, 5.6-7	gain-bandwidth product, 1.67
Offset code, 5.12	intercept points, third and second
Offset current, specification, 1.40	order, 1.61-63
Offset error, 5.13, 6.117	intermodulation distortion, 1.61
Offset step, definition, 6.173	noise, 1.47
Offset tempco, definition, 6.124	bandwidth, 1.47
Offset voltage:	figure, 1.48
aging, 1.33	flicker, 1.51-52
correction, 1.34	rms, 1.53-54
minimizing, 1.41-42	total, 1.49-51
model, in-amp, 2.23 op amp, 1.33	total output, 1.55-59
drift, 1.33	phase margin, 1.70-71
Ohm's law, 8.5	phase reversal, 1.75
and error in conductor, 12.6	popcorn noise, 1.52-53
Oliver, Bernard M., 6.83	PSRR, 1.72-73 rise time and fall time, 1.70
Oliver, B.M., 6.175	settling time, 1.69-70
Olshausen, Richard, 6.84	SFDR, 1.64
Omega Temperature Measurement Handbook, 3.64	slew rate, 1.64-65
Online tools and wizards:	SNR, 1.63
configuration assistants, 13.46-58	THD + N, 1.60
design wizards, 13.58-67	THD, 1.60
simple calculators, 13.33-45, 13.33-68	voltage noise, 1.47
0.1 dB gain flatness, 1.67	basic operation, 1.4-5
1-band-pass notch filter:	capacitive load:
diagrams, 8.85	circuit stabilizing, 13.35-36
inverting and non-inverting, 8.85	noise-gain manipulation, 13.36
1 dB compression point, definition, 1.63,	out-of-loop compensation, 13.36
6.143-144	choices, 1.95-99
1/F corner frequency, 1.51	determining parameters, 1.95
1/F noise:	prioritizing parameters, 1.96
bandwidth, 1.51	selecting the part, 1.96-99
op amp, 51-52	comparator, 2.71
1N821, temperature-compensated zener	CMOS driver, 2.74
reference, 7.3	driving ECL logic, circuit, 2.73

Op amp (c0nt)	Op Amps Combine Superb DC Precision and
driving TTL or CMOS logic, circuit, 2.73	Fast Settling, 1.80
data sheets, 1.83-94	OP07, bias-compensated op amp, 2.75
DC specifications, 1.30-46	OP90:
compensating for bias current, 1.39-40	DC precision amplifier:
correction for offset voltage, 1.34	Bode plot, 8.120
differential input voltage, 1.44	Q-enhancement effects, 8.119
DigiTrim technology, 1.34-35	OP177:
drift with time, 1.33	CMRR, graph, 1.71
external trim, 1.36-37	Load Cell amplifier, 3.96
input bias current, 1.38	Diagram, 3.96
input capacitance, 1.43	Strain gage sensor, 3.95
input common mode voltage range, 1.43	Diagram, 3.95
input impedance, 1.42-43	Single supply load cell amplifier, 3.97
input offset current, 1.38	Diagram, 3.97
offset voltage, 1.33	precision op amp, 10.19
drift, 1.33	OP213:
open-loop gain, 1.30-32	low-drift low-noise amplifier, 2.91
open-loop transresistance, 1.32-33	noise in 0.1 Hz to 10 Hz bandwidth:
output current, 1.47-48	graph, 1.52
output voltage swing, 1.45	peak-to-peak, 1.54
quiescent current, 1.44-45	Single supply load cell amplifier, 3.97
short circuit current, 1.47-48	Diagram, 3.97
supply voltages, 1.44	OP284, dual IC op amp, 2.18
total offset error calculation, 1.41-42	OP291, rail-to-rail input/output op amp,
error budget calculator, screen, 13.40	circuit, 11.7
filter element, limitations, 8.114-115	OP297, dual IC op amp, 2.18
gain, definition, 1.10	OPX91 family:
ideal, attributes, 1.4	input stage, circuit, 11.5
impedance, and filter response, 8.117	rail-to-rail input/output op amp, 11.5
input structure, protection, circuit, 2.75	overvoltage protection, graph, 11.6
inverting:	OP1177/OP2177/OP4177, precision op amp,
circuit, 1.5	1.83-84, 1.93
gain, 1.7	Open-loop modulation, block diagram, 4.71
negative feedback, 1.8	Open-loop nonlinearity, graph, 1.31
noninverting:	Open-loop gain, 6.62
circuit, 1.6	Bode plot, 1.9
gain, 1.8	CFB op amp, graph, 1.32
open-loop gain, 1.30-32	graph, 1.30
open-loop response, 13.64	op amp, 1.9, 1.30-32
operation, 1.3-28	Openings, EMI, 11.29
overvoltage, 11.1	Optical measurements, 5.2
parameters, 1.95-96	Optocoupler:
processes, bipolar transistors, 1.26	architecture, 2.40
selection, 1.96-99	for digital isolation, 2.39-40
settling time, definition, 1.69-70	typical, 2.39
single-supply, input overvoltage and	Optoelectronics Data Book, 3.68
output voltage phase reversal,	Optoisolator, 2.33, 3.56
protection, circuit, 11.7	see also: Optocoupler
specifications, 1.29-82	Order, filter, 8.2
ac, 1.47-78	Ordering guide:
dc, 1.30-46	data sheet, example, 6.190
topology dependent, 1.29	for op amp, 1.92
stability tool, screen, 13.37	OS-CON, electrolytic capacitor, 9.75
standard symbol, 1.3	OS-CON Aluminum Electrolytic Capacitor
standard topology, 1.20	93/94 Technical Book, 9.78, 10.27
VFB model, 1.3-16	OS-CON electrolytic capacitor, 9.21, 9.72
characteristics, 1.3-4	characteristics, 10.4-5
voltage phase reversal, 11.4	impedance characteristics, 10.7

Oscillation, op amp, 1.11	Parasitic inductance, 11.26
Oscillator system:	Parasitic latch-up, 1.27
long-term frequency stability, 4.60	Parasitic SCR, in CMOS switch, 7.47
noise, 4.60	Parasitic thermocouple, 10.18
phase noise, 4.60	Parasitics:
short-term stability, 4.60	capacitor, 10.10, 10.13-14
Ott, Henry, 10.27, 11.50	PCB, 13.14-16
Ott, Henry W., 3.68, 12.51, 12.75, 12.82	pin socket, 13.88
Out of range message, 13.39, 13.43, 13.55	Partitioning, PCB, 12.3-4
Out-of-band region, spectrum, 6.139	Parzefall, F., 6.113
Out-of-band SFDR, 6.139	Pass device:
Output current, op amp, 1.45-46	comparisons, 9.6
Output impedance, load sensitivity, 7.14	Darlington NPN, 9.6
Output lack, effects, 2.70	PMOS, 9.6
Output leakage current, definition, 6.126	PNP/NPN, 9.6
Output propagation delay, definition, 6.126	single NPN, 9.6
Output ripple current, 9.76	single PNP, 9.6
Output stage, op amp, 1.22 Output voltage ripple, 9.70, 9.82	Pass-band filter, 8.1-2 Pass-band ripple, 8.2
Output voltage rippie, 9.70, 9.82 Output voltage tolerance, definition, 6.126	
Overdrive, effects on op amp input, 1.27-28	Passive component, 10.1-28
Overlap bits, 6.54	capacitor, 10.3-14 EMI protection, 11.25-29
Overload, definition, 6.126	filter construction:
Overrange, overvoltage, definition, 6.126	circuit analysis, 8.109-110
Oversampling, 5.27, 6.90, 6.205	parasitic capacitance, 8.11
ADC noise figure, 6.153	problems, 8.109-113
filter requirements, 6.33	temperature effects, 8.110
graphs, 6.34	inductor, 10.23-27
ratio, 6.90	potentiometer, 10.15-22
Overshoot, 1.65	resistor, 10.15-22
filter, 8.19	Passive filter:
Overvoltage:	impedances, 8.66
amplifier input stage, 11.1-4	normalized implementation, circuit, 8.122
analog circuit, 11.1-51	Passive LC section, passive blocks, 8.65-66
effects, 11.1-9, 11.3	Pattavina, Jeffrey S., 12.51, 12.82
op amp, 1.76	PCB:
protection, 1.77	copper, resistance, calculation, 12.5-6
worst-case condition, 11.4	decoupling, 12.77-82
Overvoltage overrange, definition, 6.126	design:
Overvoltage recovery time:	considerations, 12.1-96
definition, 6.126, 6.163	and EMI, 11.41
graph, 6.163	dynamic effects, 12.19-20
8 4	embedding, 11.39
P	EMI protection, 11.37-42
Package dimension drawing, op amp, 1.94	grounding, 12.53-75
PADS Software, 13.91, 13.92	guard, implementing, 12.17
Pallas-Areny, Ramon, 3.27, 3.64	guard pattern:
Palmer, Wyn, 1.80	using MINIDIP package, 12.18
Panasonic, 9.79	using SOIC package, 12.18-19
Parallel ADCs, 6.50-51	hook, 12.20
Parametric search, data sheet, example, 6.211	hygroscopicity, 12.1
Parasitic capacitance, 12.30-32	impedance, calculation, 11.41
analog switch, 7.37	inductance, 12.21-34
filter, 8.111	layout, analog/digital circuit
op amp, 1.7	partitioning, layout, 12.4
Parasitic component, CMOS switch, 7.28	multilayer, embedding traces, 12.42
Parasitic coupling, 13.89	partitioning, 12.3-4
Parasitic effect, 2.123	for EMI protection, 11.39
in inductor, 12.24-25	static effects, 12.15-17

PCB (cont)	Phase reversal (cont)
thermal management, 12.83-96	and input common mode, 1.75
trace spacing, diagram, 6.32	Phase shift, filter, 8.12
traces, 12.5-52	Phase-frequency detector, in PLL
termination, rule, 12.43	synthesizer, 4.53
track length, maximum, calculation, 12.44	Phase-Locked Loop Design Fundamentals, 4.73
PCM, voiceband digitization, 6.37	Photodiode 1991 Catalog, 3.68
Peak clipping, 6.86	Photodiode, 1.17
Peak detector, using SHA, 7.51	error budget analysis tool, 13.55
Peak glitch, 6.168	screen, 13.56-57
Peak spurious spectral content, 6.138	Photodiode amp, input capacitance, 1.43
Peak-to-peak noise, specification, 1.54	Photodiode wizard, 13.58-60
Pease, Bob, 13.83	amplifier solution, 13.59-60
Pease, Robert A., 13.91, 13.92	parametric values, 13.58
	•
Pederson, D.O., 13.31, 13.91	screens, 13.58-60
Pedestal error, SHA specification, 7.54	Photolithography, 6.47
Performance graph, data sheet, example,	Photosite, in CCD, 3.65
6.194-197	Pierce, J.R., 6.175
Permeability, ferromagnetic core, 9.65	Pilot tube, 3.95-96
Peterson, E., 6.81, 7.63	Pin description, data sheet, example, 6.191- 192
Peterson, J., 6.81	Pin socket, 12.58, 13.87-88
PFD chargepump, output current pulses, 4.69	diagram, 13.88
PGA, 2.87-94	Ping-pong DAC, 6.29-30
alternate configuration:	Pipeline delay, 6.56
circuit, 2.89	Pipelined ADC, 6.52-57
minimizing on-resistance, circuit, 7.39	basic, identical stages, 6.56
caveats, circuit, 2.88	clock issues, 6.55
definition, 2.87	Pipelined architecture, 6.54
diagram, 2.87	Pipelined subranging ADC, timing diagram, 6.55
noninverting circuit, 2.92	Pixel, in CCD, 3.65
poor design, using CMOS switches,	Plassche, R.J. van de, 6.112
circuit, 7.39	Plassche, Rudy J. van de, 6.83
single-supply in-amp, circuit, 2.93	Plated-through holes, 13.70
very low noise, circuit, 2.90	none in milled PCB prototyping board, 13.87
within sigma-delta ADC, circuit, 2.94	PLL:
Phase accumulator, 4.42	basic model, 4.52, 4.69-70
Phase detector, in PLL, 4.52	charge pump leakage current, RF/IF
Phase-locked loop, see: PLL	circuit, 4.70-71
	closing the loop, RF/IF circuit, 4.64-66
Phase margin:	
op amp, 1.13, 1.70-71	components for loop gain, 4.52
op amp circuit, 13.35	definition, 4.51
Phase noise:	feedback counter N, RF/IF circuit, 4.56-58
definition, 4.67	fractional-N synthesizer, RF/IF circuit, 4.59-60
free-running and PLL-connected VCO, 4.66	internal grounding DSPs, 12.69
measurement, 4.67-69	Leeson's equation, RF/IF circuit, 4.62-63
with spectrum analyzer, 4.68	noise in oscillator system, RF/IF circuit, 4.60
in oscillator, 4.60	phase noise, in voltage-controlled-
phasor representation, 4.61	oscillator, RF/IF circuit, 4.61
in VCO, 4.61	phase noise measurement, RF/IF circuit, 4.67-69
closing the loop, 4.64-66	reference counter, RF/IF circuit, 4.56
minimizing, 4.63	reference spur, 4.69-70
Phase response:	reference spurs, RF/IF circuit, 4.69-70
filters, equations, 8.14-16	RF/IF circuit, 4.51-73, 4.51-74
and inadequate decoupling, 12.79	synthesizer basics, RF/IF circuit, 4.53-56
notch filter, graph, 8.15	PLL prototype, using Solder-Mount, 13.85
vs. frequency, graph, 8.15	PLL synthesizer:
Phase reversal:	basic building blocks, 4.53-56
with JFET input amplifier, 11.4	fractional-N, 4.59-60
op amp, 1.25	
1 T2	

PLL-phase-noise contributor, 4.64	Precision single-supply composite in-amp (cont)
overall, equations, 4.65	performance summary, 2.16
PNP input stage, 1.21	rail-to-rail output, circuit, 2.15
Pole splitting, 9.15-16	Precision voltage reference, 7.1-2
Polycarbonate capacitor, 9.73	Prescaler, 4.56-57
characteristics, 10.5	dual-modulus, 4.57-58
comparison chart, 8.113	Pressman, Abraham I., 9.78
Polyester capacitor:	Printed circuit board, see: PCB
characteristics, 10.5	Process control equipment, EMC, 11.24-25
comparison chart, 8.113	Process gain, ADC noise figure, 6.153
Polyester film capacitor, 9.72	Processing gain, Fast Fourier transform, 6.130
Polypropylene capacitor:	Programmable gain amplifier, see: PGA
characteristics, 10.5	Propagation delay:
comparison chart, 8.113	comparator, 2.65
Polystyrene capacitor:	graph, 2.66
characteristics, 10.5	symmetric stripline, calculation, 12.41
comparison chart, 8.113	timing specification, 6.178
Popcorn noise, 1.52-53	Protective packaging, for ESD-sensitive
Popping, 2.95	devices, 11.19
Positive-emitter-coupled-logic, 5.2	Prototyping, 13.3
Positive-true, definition, 6.125	deadbug, 13.82-84
Potentiometer, 5.2, 10.22	breadboard illustration, 13.83
trimming, 10.22	pre-drilled copper-clad printed board, 13.84
Power dissipation, vs. percent full	full board, 13.89
scale, graph, 1.91	limitations, 13.88-89
Power dissipation calculator, 13.33-34	milled PCB, 13.86-87
screen, 13.34	illustration, 13.86-87
Power line:	solder-mount, 13.84-86
disturbances, EMI, 11.35	systems, 13.82-87
filter, schematic, 11.36	PSpice, 13.1
Power loss, in switched capacitor voltage	Spice support, 13.17
converter, 9.90-91	PSpice ferrite model, 10.25
Power management, 9.1-96	PSpice Simulation Software, 13.92
circuit components, 9.1	PSRR:
definition, 9.1	of ADC, 12.77
linear voltage regulator, 9.3-25	definition, 6.126
switch mode regulator, 9.27-80	op amp, definition, 1.72-73
switched capacitor voltage converter,	PulSAR, charge redistribution SAR ADC, 6.48
9.81-96	Pulse burst modulation, 9.48
Power MOSFET switch:	disadvantages, 9.53
boost converter, circuit, 9.56	gated oscillator control, 9.51-54
buck converter, circuit, 9.56	Pulse code modulation, see: PCM
Power supply:	Pulse Engineering, 9.79
filtering and signal line snubbing, EMI	Pulse skipping, 9.48
protection, 11.38	Pulse width modulation, 9.31, 9.47
RFI coupling, 11.31	current feedback, circuit, 9.50
separate for analog and digital circuits,	voltage feedforward, 9.49
12.63	voltage-mode control, 9.48-49
Power supply decoupling, 1.73	circuit, 9.49
Power-down, 6.42	Pulse-frequency modulation, see: Pulse
Power-saving operation, 9.51	burst modulation
Power-supply rejection ratio, see: PSRR	Pulsewidth high, timing specification, 6.178
Power-supply sensitivity, definition, 6.127	Pulsewidth low, timing specification, 6.178
Precision absolute value circuit, 3.3	Pump capacitor, continuous switching,
Precision ADC controller/evaluation board,	circuit, 9.86
functional block diagram, 13.79	
Precision single-supply composite in-amp,	
2.15-17	
capacitor, 2.17	

Q	Recirculating ADC, 7-bit 9 MSPS pipelined
Q:	architecture, 6.57
definition, 8.7	Recirculating subranging ADC, 6.56
of inductor, 12.25	Reconstruction filter, 6.35
in tuned circuit, 12.25	Rectification, EMI, sensitive circuits, 11.29
variation vs. DAC control word, graph,	Rectifier, full wave, 3.3
8.139	Redundant bits, 6.54
Q enhancement, 8.117-120	Reeves, A.H., 6.64
effects, 8.119	Reeves, Alec Harley, 6.81, 7.63
graph, 8.118	REF195. single supply load cell amplifier, 3.97
Q peaking, 8.117-120	Diagram, 3.97
Quadrature amplitude modulation, 4.2	Reference bypass capacitor, 7.17, 7.19
Quality factor, see: Q	Reference counter, in PLL synthesizer, 4.53, 4.56
Quantization:	Reference noise bandwidth, 7.15
error, 5.12	for various systems, table, 7.16
size of least significant bit, 5.11	Reference spur, 4.69-70
uncertainty, 5.6, 5.12	on output spectrum, 4.70
Quantization error, 6.90	Referred to the input, see: RTI
Quantization noise, 6.37, 6.90	Reflection, shielding loss, 11.43-45
and sampling clock jitter, SNR, DNL,	Register description, data sheet, example, 6.201
sampling clock jitter, and input noise,	Regulated output switched capacitor,
graph, 6.160	voltage converter, 9.92-95
Quantization noise shaping, 6.90	Regulation, line sensitivity, 7.14-15
Quiescent current, op amp, 1.44-45	Reichenbacher, P., 12.51
	Reine, Steve, 13.92
R	Relative accuracy, definition, 6.123
R-2R DAC, 6.38	Remote sensing, current output temperature
R-2R ladder, 6.14-18	sensor, 3.33
4-bit network, diagram, 6.14	Rempfer, William C., 12.51, 12.75
current mode DAC, 6.16	Residue output, 6.58
voltage mode DAC, 6.16	Resistance temperature detector, 3.47-51
Rabbits, 6.164	Resistance temperature device, see: RTD
Radiated emission:	Resistor, 10.15-22
EMI regulation, 11.23	aging, 10.20
limits for commercial equipment, table,	basics, 10.15-17
11.24	as circuit error source, 10.15
Radiation, EMI, 11.27, 11.37	comparison, table, 8.112, 10.21
Ragazzini, John R., 1.79	discrete:
Rail-rail input stage op amp, model, 13.9	comparison chart, 8.112
Rail-rail output stage op amp, model, 13.9	table, 10.21
Rail-to-rail:	excess noise, 10.21-22
configuration:	failure mechanisms, 10.20
definition, 1.25	metal types, 10.16
op amp, 1.22	network:
op amp, in LDO references, circuit, 7.17	comparison chart, 8.112
voltage, 1.43, 1.45	table, 10.21
Rainey, Paul M., 6.80	noise, 1.55
Ramachandran, R., 6.82	nonlinearity error, 10.16
Ramp run-up ADC, 6.65-66	op amp, 1.9
diagram, 6.66	orientation, and thermocouple voltage,
Randall, Robert H., 1.79	10.19-20
Random noise, error generation, 6.163	parasitics, 10.17-18
Ratiometric, definition, 6.127	inductance, 8.112
RDC:	types, 10.17-18
functional diagram, 3.10-11, 6.78	passive filter component, problems,
see also: Resolver-to-digital converter	8.109-113
Reactance error, resistor, 10.17	power dissipation, temperature-related
Reay, Richard J., 9.26	gain errors, 10.16
Receiver, 2.101	standard value, effects, graph, 8.126

Resistance (cont)	RFI (cont)
temperature change as error source, 10.15	protection techniques, summary, 11.34
temperature-related error, minimizing,	sensitivity, terminology, 11.30
10.17	RGB signal, digitizing, with 4:1 mux,
thermocouple formation, 10.19	circuit, 7.44
thermoelectric effects, 10.18-20	Rich, A., 11.50
value ranges, 8.110	Rich, Alan, 12.51, 12.75
voltage sensitivity, 10.20	Ringing, 1.65, 7.18, 9.34, 9.39, 12.32,
wirewound, disadvantages, 2.68	12.80-81, 13.15, 13.35
Resolution error, 13.39, 13.41	filter, 8.19
Resolver, 3.9-12, 5.2	Ripple, 1.66
diagram, 3.9, 6.76	Ripple current:
	**
modern, brushless, 3.9	electrolytic capacitor, 9.74-75
uses, 3.9	input, 9.77
Resolver-to-digital converter, 6.76-79	output, 9.76
see also: RDC	Rise time:
Resonant circuit, from power line	graph, 6.177
decoupling, 12.80	op amp, 1.70
Response curves, filters, 8.31-41	timing specification, 6.177
RF/IF circuit, 4.1-74	RLC circuit, diagram, 8.6
analog multiplier, 4.13-20	RMS:
digitally controlled variable gain	definition, 2.83
amplifier, 4.38-39	explicit computation, circuit, 2.83
frequency synthesis, 4.41-50	noise:
aliasing in DDS system, 4.45-46	op amp, 1.53-54
amplitude modulation in DDS system,	vs. peak to peak voltage,
4.47	comparison chart, 1.53
DDS, 4.41-44	wideband measurement, circuit, 2.84
DDS system as ADC clock driver,	RMS-to-dc converter, 2.83-86
4.46- 47	Roberge, J.K., 1.81
SPDR considerations, 4.47-49	
	Robotics, using resolvers and synchros, 6.76
logarithmic amplifier, 4.21-28	Roche, P.J., 3.28
mixer, 4.3-10	Root-mean-square, see: RMS
basic operation, 4.8-9	Root-sum-of-squares, total noise, 1.49
diode-ring, 4.6-8	Rosenbaum, R., 13.31
ideal, 4.3-6	Rotary variable differential transformer, 3.5
modulator, 4.11	Rotational sensor, 3.7
PLLs, 4.51-74	Rouse Ball, W.W., 6.81
charge pump leakage currents, 4.70-71	RTD, 3.47-51, 3.96
closing the loop, 4.64-66	current excitation warning, 3.48
feedback counter N, 4.56-58	definition, 3.47
fractional-N synthesizer, 4.59-60	interfaced to high resolution ADC,
Leeson's equation, 4.62-63	diagram, 3.50
noise in oscillator system, 4.60	Kelvin connection, 3.48-49
phase noise measurement, 4.67-69	resistance vs. temperature, 3.47
phase noise in voltage-controlled-	temperature sensor, characteristics, 3.30
oscillator, 4.61	voltage drop error, 3.48
reference counter, 4.56	RTI CMR, calculation, 2.24
reference spurs, 4.69-70	Ruscak, Steve, 6.175
synthesizer basic building blocks,	Russell, Frederick A., 1.79
4.53-56	Ruthroff transformer, 4.18
True Power detectors, 4.29-31	Ruthroff, C.L., 2.114, 4.10
variable gain amplifier, 4.33	Rutten, Ivo W.J.M., 6.83
voltage controlled amplifier, 4.33-34	RVDT, 3.5
X-amp, 4.35-38	
RFI:	S
analog circuit sensitivity, 11.31	S Series Surface Mount Current Sensing
and circuitry, 11.30-33	Resistors, 9.26
coupling, 11.31	

S-plane:	Sampling theory, 5.21-32
filter, 8.5-7	Samueli, Henry, 4.73
pole and zero plot, 8.6	Sanyo Corporation, 9.79
Saber model, advantage, 13.17	SAR ADC, 6.42, 6.45-47
SAE Standard J113, 11.25	algorithm, 6.49
SAE Standard J551, 11.25	basic:
Sallen-Key filter, 8.72-74, 8.85, 13.63	diagram, 6.45
Band-pass:	timing diagram, 6.46
design equations, 8.91	missing codes, 6.121
diagram, 8.73	Sauerwald, Mark, 12.51, 12.75, 12.82
High-pass:	Scaled references, voltage, 7.16-17
design equations, 8.90	Scannell, J.R., 3.28
diagram, 8.73	Schaevitz, Herman, 3.27
implementation, circuit, 8.123, 8.126	Schelleng, John C., 6.81
limitations, 8.114-117	Schindler, H.R., 6.80
low-pass, 13.66-67	Schmidt, Ernest D.D., 3.27
design equations, 8.89	Schmitt trigger circuit, 2.41
diagram, 8.72	Schottky diode, 1.27, 1.77, 2.29, 6.30,
notch, 8.74	7.49-50, 9.54-55, 9.57, 9.93-94, 11.5,
Q-sensitive, 8.72	11.8-9, 12.69
voltage control voltage source, 8.72	manufacturers, 9.80
Sallen-Key topology, highpass	Schottky noise, 1.49
transformation, 8.128-129	Schottky-barrier diode, 4.6
Sallen, R.P., 8.72, 8.143	Schreier, R., 2.127
Sample mode, 6.48	Schreier, Richard, 6.114
Sample-and-hold amplifier, see: SHA	Schultz, Donald G., 1.80, 1.81
Sample-to-hold offset, definition, 6.173	Schwartz, Tom, 1.79
Sample-to-sample variation, in CCD, 3.66	Scott-T transformer, 6.77
Sampled data system:	SCR, 1.76
baseband antialiasing filters, 5.26-28	Sears, R.W., 5.20, 6.80
block diagram, 5.21	Second and third-order intercept points,
coding and quantizing, 5.1-20	definition, 6.144
bipolar codes, 5.6-10	Second-order allpass filter:
complimentary codes, 5.10	design equations, 8.107
DAC and ADC static transfer functions,	diagram, 8.87
5.11-19	Second-order intercept point, distortion, 1.61-63
DC errors, 5.11-19	Second-order noise, model, 1.56
unipolar codes, 5.4-6	Second-order system:
fundamentals, 5.1-32	noise gain, 1.57
Nyquist criteria, 5.24-26	noise and signal gain, graph, 1.58
sampling theory, 5.21-32	Seebeck coefficient, 3.47
SHA, 5.22-23	thermocouple, 3.37, 3.41
undersampling, 5.28-29	Segmentation, 6.20
Sampling, and bandwidth, 5.29	Segmented current-output DAC:
Sampling ADC, 5.22	6-bit, based on 3-bit thermometer DACs,
Sampling aperture, 6.156-159	diagram, 6.21
Sampling clock:	resistor and current-source based,
distribution, ground planes, circuit,	diagrams, 6.20
12.65	Segmented DAC, 6.20-22
grounding, 12.64	Segmented string DAC, 6.5-7
PCB, 12.3	with cascaded Kelvin DACs, 6.20
Sampling clock jitter:	unbuffered, diagram, 6.7
and aperture jitter:	Segmented voltage-output DAC, diagrams, 6.6
graph, 6.158	Seitzer, Dieter, 6.83
SNR, graph, 6.159	Selection guide:
effect on ADC SNR, 12.64	for data converter, 6.207
effect on SNR, 7.57	data sheet, example, 6.210
and SNR, quantization noise, DNL, and	Selection tree, op amp, 1.97-98
input noise, graph, 6.160	

Semiconductor:	SHA (cont)
junction temperature, 1.89	circuit, 7.51-63
temperature sensor, 3.31-33	internal timing, 7.55
advantages, 3.31	feedthrough, definition, 6.174
basic relationships, diagram, 3.31	function, 5.22-23
characteristics, 3.30	hold mode, 7.60
Sense connection, and feedback, 12.7	specification, 7.58-59
Sensor, 3.1-102	internal, for IC ADC, 7.59-62
accelerometer, 3.15-18	overvoltage, 11.1
fault, 11.1	in SAR ADC, 6.45-46
Hall effect magnetic, 3.6-8	specifications, 7.53-62
Inductosyn, 3.13-14	track mode, 7.60
positional, 3.1-28	specifications, 7.53-54
precision, and cable shielding, 11.49	waveforms, graph, 7.55
resolver, 3.9-12	waveforms and definitions, 6.156
semiconductor temperature, 3.31-33	Shannon, C.E., 5.32, 6.175
synchro, 3.9-12	Shannon, Claude, 5.24
temperature, 3.29-64	Shannon, Claude E., 6.83
current and voltage output, 3.34-35	SHARC DSP, output rise times and fall times,
current-out, 3.33	graph, 12.43
digital output, 3.56-58	Sheingold, Dan, 1.79, 1.80, 2.114, 2.115, 3.27,
nonlinear transfer functions, 3.29	3.64, 4.20, 4.28, 5.20, 6.84, 6.88, 6.176, 7.21
Separate analog and digital grounds, 12.55	Shielding:
SEPIC converter, circuit, 9.44	cables, 11.47-49
Serial timing diagram, DAC, example, 6.200	connection, low frequency threats, 11.47
Serial-Gray converter, 6.59	effectiveness:
Setpoint controller, 3.58-61	calculation, 11.46
resistor, equation, 3.58	compromised by openings, 11.43
Settling time, 6.161-162	materials, skin depths and impedance,
ADC, feedthrough, 6.174	table, 11.45
critical in multiplexed applications,	mechanism, 11.42-46
diagram, 6.162	reflection and absorption, 11.42
DAC, 6.167-168	Shock, immunity, 3.25-26
definition, 6.167	Short-circuit current, op amp, 1.45-46
graph, 6.167	Short Form Designers Guide, 1.96, 6.207
function of time constant, various	Shunt, voltage reference, 7.2-3
resolutions, table, 6.162	Sigma-delta, vs. delta-sigma, 6.88-89
graph, 1.69	Sigma-delta ADC:
multiplexer, circuit and equations, 7.34	basics, 6.90-96
op amp, definition, 1.69-70	decimation, graph, 6.91
PCB, dielectric absorption, 12.20	digital filtering, graph, 6.91
SHA, 7.54	first-order, circuit, 6.92
Settling time calculator, 13.38	grounding, 12.67
Setup time, timing specification, 6.177	high speed clock, grounding, 12.54
74ACTQ240, Fairchild part, 12.46	internal digital filter, 7.17
74FCT3807/ 74FCT3807A, IDT part, 12.46	multibit, circuit, 6.87
SFDR, 6.138-140	noise shaping, graph, 6.91
DAC, 6.170-172	oversampling, graph, 6.91
test setup, 6.171	as oversampling converter, 5.27-28
definition, 1.64	second-order, circuit, 6.95
graph, 6.139	single bit, circuit, 6.87
in-band, 6.139 out-of-band, 6.139	switched capacitor input, reference load,
	circuit, 7.18
RF/IF circuit, 4.47-49 SHA, 5.22-23	Sigma-delta converter, 6.85-114 Band-pass, 6.108-109
basic circuit, 7.52	high level of user programmability, 6.11
basic operation, 7.52-53	high resolution measurement, 6.103-107
bias current compensation, 1.40	historical perspective, 6.85-89
capacitor, 7.52	MASH, 6.101-102
oupuottot, 1.52	1111 1011, 0.101 102

Sigma-delta converter (cont)	Singer, Larry, 6.175
multibit, 6.98-100	Single-pole filter:
block diagram, 6.98	High-pass, design equations, 8.88
Sigma-delta DAC, 6.22, 6.109-110	Low-pass, design equations, 8.88
multibit, diagram, 6.109	Single-pole RC:
single-bit, diagram, 6.109	active blocks, 8.64
Sigma-delta modulator:	construction, 8.64
Class-D audio power amplifier, 2.107-08	Single-pole response, op amp, 1.11-12
first-order, idling patterns, 6.97	Single-supply:
higher order loops, 6.98	biasing:
output, repetitive bit pattern, 6.97	circuit, 1.23
oversampling vs. SNR, graph, 6.96	headroom issues, 1.24
quantization noise, 6.96	op amp, 1.20-22
second-order, idling patterns, 6.97	circuit design, 1.23-24
shape quantization noise, graph, 6.95	Single-channel digital isolator, 2.42-46
simplified frequency domain linearized	Single-Chip Direct Digital Synthesis vs. the Analog
model, 6.94	PLL, 4.50
waveforms, 6.93	Single-ended current-to-voltage conversion, 6.27
Sign magnitude code, 4-bit converter, 5.6, 5.9	Single-ended primary inductance (SEPIC)
Sign magnitude converter, 5.13	converter, circuit, 9.44
Signal, phase, filter effect, 8.3	Sin(x)/x (sinc), 6.36
Signal gain, op amp, 1.14	60 Hz notch filter, 8.141-142
Signal input, RFI coupling, 11.31	response, graph, 8.142
Signal lead, voltage drop, 12.7	60 Hz twin-T notch filter, circuit, 8.141
Signal output, RFI coupling, 11.31	68HC11, microcontroller, 3.57
Signal return current, 12.7-9	Skin effect, 12.33-34, 12.73
Signal to noise ratio, see: SNR	PCB conductor, diagrams, 12.33-34
Signal trace routing, nonideal and improved,	Slattery, B., 11.50
diagrams, 12.22	Slattery, W., 8.144
Signal-to-noise ratio, see: SNR	Sleep, 6.42
Signal-to-noise-and-distortion ratio,	Sleep operation, 9.51
see: SINAD	Slew rate:
Signore, B.P. Del, 6.113	CFB op amp, 1.19
Silicon controlled rectifier, see: SCR	converter, 13.23
Silicon Detector Corporation, 3.68	and full-power bandwidth, 1.66
Silicon junction diode, 4.6	op amp, 8.127
Silicon switch, in PGA, 2.87	definition, 1.64-65
Siliconix Inc., 9.79	SHA, 7.54
Simple calculators, 13.33-68	Slewing time, DAC settling time, 6.167
Simpson, Chester, 9.26	Slope clipping, 6.86
Simulation, 13.3-32	Slot antenna, EMI, 11.29
ADIsimADC, 13.18-25	Slot and board radiation, EMI, 11.27
ADIsimPLL, 13.26-29	Small signal bandwidth, ADC, 6.137
ADSpice op amp macromodels, 13.5-13	Smith, B.D., 6.37, 6.59, 6.81, 6.82
IBIS model, 13.17	Smith, Lewis, 1.80
macromodel vs. micromodel, 13.4-5	Smith, Paul, 7.84
model familiarity, 13.14	Snelgrove, M., 6.114
model support, 13.17	SNR:
not breadboarding replacement, 13.13	DAC, 6.170-172
parasitics, 13.13	measurement, analog spectrum analyzer,
PCB parasitics, 13.14-16	6.172
SABER model, 13.17	definition, 1.63, 6.136-137
Spice, 13.3	and sampling clock jitter, quantization
Spice support, 13.17	noise, DNL, and input noise, graph,
Simultaneous sampling system, using SHA,	6.160 SNB without harmonics 6.127
7.51	SNR-without-harmonics, 6.137
SINAD, definition, 6.136-137	SNR/THD/SINAD calculator, 13.34-35
Sinc (sin(x)/x) curve, normalized, graph, 6.36	screen, 13.35
Sine wave, aliased, 5.24-25	Snubber, 9.35, 9.39

Soakage, 10.11	SSM-2211:
Socket, 13.87-88	speaker driver power amplifier:
Soderquist, Donn, 1.80	application circuit, 2.97
Sodini, C.G., 6.113	performance, 2.97
SOIC, sample guard layout, 12.17-19	Stable-dielectric ceramic, capacitor, 10.14
Solder-Mount prototyping board, 13.85	Stacked-film capacitor, 9.72-73
advantages, 13.85	characteristics, 10.4-6
illustration, 13.85	Staffin, R., 6.80
Solomon, Jim, 9.26	Standard input stage, differential pair, 1.21
Solutions bulletin, front page, sample,	Standard negative-feedback control system
6.208	model, diagram, 4.51
Sonet/SDH OC-48 with Forward Error	Standard response:
Correction, using AD8152, 7.46	Butterworth filter, 8.21
SOT23, amp footprint, 12.17	filters, 8.21-54
Source termination:	Standby, 6.42
bidirectional transmission between	Star connection, damping resistor, 12.45
SHARC DSPs, 12.48	Star ground, 12.54
microstrip transmission lines, 12.46	mixed-signal ICs, 12.66
Span, definition, 6.125	Stata, Ray, 1.79
Sparkle codes:	State variable filter, 8.77-78
ADC, 6.163-166	(A), design equations, 8.95
definition, 6.164	advantages, 8.137
Specification page, data sheet, example,	(B), notch, design equations, 8.96
6.183-184	(C), all-pass, design equations, 8.97
Specification tables, for op amp, 1.83-89	diagram, 8.77
Specifications, defining, 6.115-116	digitally controlled, circuit, 8.138
Spectrum analyzer:	digitally programmable, 8.137-140
measuring DAC SNR, 6.172	implementation, circuit, 8.124
output, 4.68	op amp functions, 8.114
for phase noise measurement, 4.68	redrawn, circuit, 8.137
Spice, 13.3	Static transfer function, 6.117-127
definition, 13.1	Step response:
SPICE2-G, 13.1	filter, 8.19
Sprague 595D-series, electrolytic capacitor, 9.75	definition, 8.19
Sprague, 9.79	Step-down (buck) converter:
Spurious-free dynamic range, see: SFDR	basic:
SSM-2018:	diagram, 9.31
low-noise low distortion VCA, 2.98	waveforms, 9.32
block diagram, 2.98	Step-up (boost) converter, 9.36-41
distortion characteristics, 2.98	basic:
SSM-2019:	circuit, 9.37
microphone preamplifier:	waveforms, 9.37
circuit, 2.95	discontinuous mode, waveform, 9.39
input, 2.95	input/output relationship, 9.38
SSM-2141:	point of discontinuous operation, 9.40
monolithic IC line receiver, 2.102	Stopband:
gain accuracy, 2.103 SSM-2141/2143, THD + N performance, 2.104-105	filter, 8.1 frequency, 8.2
SSM-2141/2145, 111D + 10 performance, 2.104-105	Stop, Russell, 6.83, 7.63
balanced line driver, 2.103-104	
block diagram, 2.104	Storch, L., 8.143 Stout, D., 1.81
SSM-2143:	Straight binary code, 5.4
monolithic IC line receiver, 2.102	Strain gage, 3.69-70, 5.2
CMR and THD, graphs, 2.103	Bonder wire, 3.90-91
SSM-2160, VCA with DAC, block diagram, 2.100	Foil, 3.90-91
SSM-2165:	Semiconductor, 3.92
microphone preamplifier:	Also see load cell
block diagram, 2.96	Stray capacitance, 9.34
transfer characteristics, 2.96	in mixed-signal IC, 12.60-61

String DAC, 6.4-5 segmented, 6.5-7	Switch mode regultators (cont) limitations, 9.27
Stripline transmission line, in PCB, 11.39	power management, 9.27-80
Subranging ADC, 6.52-57	ripple currents, 9.28
improper trimming, errors, 5.18	topology, basic, 9.27
input residue waveforms, diagram, 6.53	Switch modulation, 9.47-48
missing codes, graph, 6.53	control techniques, 9.48-51
N-bit two-stage, diagram, 6.52	pulse width modulation, 9.47
pipeline stage, error correction,	Switched capacitor:
diagram, 6.54	unregulated, inverter and doubler, 9.87-88
trimming error, graphs, 6.121	voltage converter, 9.81-96
Subtractor:	advantages, 9.82
definition, 2.8	inverter and doubler, circuits, 9.81
op amp, circuit, 2.9	power loss, 9.90-91
Successive approximation register, see: SAR	power management, 9.81-96
Successive detection log amp, 2.56, 4.23	voltage inverter, circuit, 9.87
linearity, graph, 4.24	Switched-capacitor DAC, 6.47
with log and limiter outputs, diagram, 4.23	Switcher, nonisolated, topologies, 9.44
Successive approximation ADC, 6.12, 6.37	Switching capacitor, characteristics, 10.4-5
grounding, 12.54	Switching electrolytic capacitor, 9.72-73
transient load, graph and circuit, 7.19	Switching regulator:
Sumida, 9.79	capacitor role, 9.69
Super-beta op amp, 1.43	inductor choice, 9.57-69
Super-beta transistor, input, 1.39	input filtering, diagram, 9.77
Superheterodyne radio receiver, diagram, 4.1	output filtering, diagram, 9.76
Superheterodyne radio transmitter, diagram, 4.1	Switching time, DAC settling time, 6.167
Superposition, filter, 8.5	Sylvan, John, 2.114
Supply range, voltage reference, 7.13-14	Symmetric stripline, PCB transmission line,
Supply voltage, op amp, 1.19-20, 1.44	12.40-41
Surface microstrip, 12.38	Symmetrical bipolar voltage, 1.44
delay constant, 12.39	Synchro, 3.9-12, 5.2, 6.76-79
rules of thumb, 12.39	diagram, 3.9, 6.76
Surface zener, 7.8	uses, 3.9
Surface-mount multilayer ceramics,	Synchronous rectifier, 9.28
decoupling, 12.77	Synchronous VFC, 6.68
Swanson, E.J., 6.113	diagram, 6.70
Swartzel, Karl D., Jr., 1.79	nonlinearity, graph, 6.72
Sweetland, Karl, 2.124, 6.113	quantized, 6.72
Switch:	waveforms, 6.71
analog, 7.23-50	System Applications Guide, 2.114, 11.50
digital, crosspoint, 7.46	
duty cycle, 9.33	T
duty ratio, 9.33	T-Tech, Inc., 13.91, 13.92
parasitic latchup, 7.47-50	Tadewald, T., 12.51
power MOSFET, buck and boost converters,	Talambiras, Robert P., 6.81, 6.83
circuits, 9.56	Tantalum capacitor:
thermostatic, 3.58-60	advantages, 10.14
video, 7.42-44	characteristics, 10.4-5
crosspoint, 7.45	impedance vs. frequency, graph, 10.8
in voltage converter, 9.87	Spice model, 10.8
Switch capacitance, retained charge, 7.32	Tantalum electrolytic capacitor, 9.72-73
Switch control, gated oscillator, circuit, 9.52	characteristics, 10.5
Switch mode power supply, 10.23	comparison chart, 8.113
Switch mode regulator, 9.27-80	Tantalum Electrolytic Capacitor SPICE
advantages, 9.27-28	Models, 10.27
diode and switch considerations, 9.54-57	Tantalum Electrolytic and Ceramic Capacitor
ideal step-down (buck) converter, 9.31-36	Families, 9.78, 10.27
inductor and capacitor fundamentals,	Tant, M.J., 6.175
9.28-30	Tchevvsheff, see: Chebyshev

A Technical Tutorial on Digital Signal Synthesis, 4.50	Thermocouple (cont) cold-junction compensation, 3.36
Teflon capacitor:	junction materials, table, 3.36
characteristics, 10.5	output, 5.2
comparison chart, 8.113	output voltages for Types J, K, and S, graph, 3.37
Telian, D., 13.31	principles, 3.36-44
Temes, Gabor C., 2.127, 6.113	Seebeck coefficient vs. temperature,
Temperature:	graph, 3.38
change, error source, 10.15	temperature measurement, 3.39
measurement, 3.29-30	temperature sensor, characteristics, 3.30
microprocessor monitoring, 3.61-63	terminated leads, isothermal block, 3.41
monitoring, by microprocessor, 3.61-63	Type J, 3.36-37
passive component, filter, 8.110	Type K, 3.37, 3.41
Temperature coefficient:	Type S, 3.36-37
definition, 6.123-124	Seebeck coefficient, 3.47
see also: Tempco	vs. temperature, 3.47
Temperature retrace, resistor, 10.17	Thermocouple effect, resistor, 10.18
Temperature sensor:	Thermoelectric effect, resistor, 10.18-20
current and voltage output, 3.34-35	Thermoelectric emf, 3.39
digital output, 3.56-58	Thermometer code, 6.50
Temperature-related gain error, from	Thermometer DAC, 6.9-11
mismatched resistor, 10.15	current-output, current sources, diagram, 6.10
A 10.7 MHz, 120 dB Logarithmic Amp, 4.40	diagram, 6.5
Terman, Frederick E., 1.79, 1.80	high speed, complementary current
Termination, microstrip transmission lines,	outputs, diagram, 6.11
circuits, 12.46	Thermostatic switch, 3.58-60, 3.58-61
THD + N, definition, 1.60, 6.135-136	Thevenin equivalent output voltage, 2.63
THD, definition, 1.60, 6.135-136	Thevenin equivalent resistance, 13.8
Thermal Coastline packaging, 9.18-19	Thevenin impedance, 12.45
internal details, 9.19	Thevenin resistance, 9.14
for op amp, 12.85	Thevenin source, 13.45
Thermal EMF, resistor, 10.18	Thick film resistor:
Thermal hysteresis, XFET reference, 7.10	comparison chart, 8.112
Thermal management, 12.83-96	table, 10.21
PCB, 12.83-96	Thin film laser trimming, for DAC, 6.99
Thermal noise, resistor, 10.21-22	Thin film resistor:
Thermal performance, comparison of op amp	comparison chart, 8.112
packaging, graph, 12.90	table, 10.21
Thermal relationships, basic, table, 12.84	Third order intercept point:
Thermal resistance, 12.83-84	determination, 1.63
design considerations, 12.88	distortion, 1.61-63
LDO regulators, 9.17-19	variation with frequency, 1.62
measured between junction and ambient	13dB small signal bandwidth, op amp,
air, 12.85	definition, 1.66
op amp, 1.78 package-dependent, 12.85	Thomas, L.C., 8.79, 8.143 Three op amp in-amp, 2.12-14
Thermistor, 3.52-55	single +5 V supply restrictions, circuit, 2.14
amplifier, linearized, diagram, 3.55	Three-terminal voltage reference, 7.2
definition, 3.52	Time, EMI, 11.28
Kelvin connection, 3.52	Time domain response:
nonlinearity and temperature range, 3.53	filter, 8.18-19
NTC, linearization, graph, 3.54	impulse response, 8.18-19
resistance characteristics, 3.52	step response, 8.19
temperature coefficient, graph, 3.53	Timing specifications, 6.177-179
temperature coefficient, graph, 5.33 temperature sensor, characteristics, 3.30	data sheet, example, 6.185-187
Thermocouple:	TMP01:
auto-zero amplifier, 3.45-46	dual setpoint temperature controller,
sampling phase diagrams, 3.45-46	3.59-60
basic principles, diagrams, 3.38	diagram, 3.60
r - r,,,	• • • • • • • • • • • • • • • • • • •

TMP03/TMP04:	Transient power-line disturbance, 11.35
digital out temperature sensor:	Transient response:
diagram, 3.56	ADC:
output format, 3.57	definition, 6.161
TMP04, interfacing to microcontroller, 3.58	graph, 6.161
TMP35:	Transient voltage suppressor, 2.29
temperature sensor, for cold junction	Transimpedance, definition, 1.32
compensation, 3.42	Transimpedance amp, 1.17, 1.32
voltage output sensor, 3.41-42, 3.44	Transistor, input, 1.27
TO-99 metal can package device, 12.17	Transistor/op amp log amp, disadvantages, 4.21
Tolerance, voltage reference, 7.13	Transitional filter, characteristics, 8.24
Toomey, P., 8.144	Translinear multiplier, four-quadrant, circuit
Total effective input noise, for ADC,	diagram, 4.17
calculation from SNR, 6.151	Translinear variable gain cell, diagram, 4.33
Total harmonic distortion, see: THD	Transmission line, 12.35
Total harmonic distortion plus noise, see:	driving, 13.37
THD + N	microstrip, 12.35
Total input offset voltage, in-amp,	PCB, symmetric stripline, 12.40-41
definition, 2.23	termination:
Total noise:	
	ECL, 12.48
calculation, 1.50, 1.56	and propagation delay, rule, 12.43
op amp, 1.49-51	Transmit TxDAC family, 6.172
Total offset voltage, calculation, 1.41	Transresistance, definition, 1.32
Total output noise:	Travis, Bill, 3.27
calculation, 2.27	Trefleaven, D., 8.144
calculations, 1.55-59	Trench-isolation, LLCMOS switch, 7.50
Total output offset error, calculation,	Triboelectric charging, 11.13-14
1.41-42	Triboelectric effect, 11.1
Total output rms noise, op amp, 1.59	Trietley, Harry L., 3.27
Total rms jitter, 6.159	Trimming:
SHA, 7.57	errors, 6.121
Total unadjusted error, definition, 6.127	voltage reference, 7.13
Tow, J., 8.79, 8.143	Trimming potentiometer, 10.22
Trace:	Trimpot, 10.22
conductor, resistance, 12.5	True Power circuit, 4.2
embedding, 12.42	True Power detector, RF/IF circuit, 4.29-31
PCB, 12.5-52	True log, architecture, 4.21
Track mode, 6.48	True log amp, 2.56
Track mode linearity, ADC with SHA, 7.61	structure and performance, diagram, 4.23
Track-and-hold circuit, 7.51	Tschebychev, see: Chebyshev
Track-to-hold mode:	Tschebyscheff, see: Chebyshev
SHA:	TTE, Inc., 5.32
errors, graph, 7.54	Tuned circuit, ringing, 12.80
specifications, 7.54-57	Turney, William J., 6.114
Tracking ADC, 6.66-67	Twin-T notch filter:
diagram, 6.67	design equations, 8.101
Transconductance multiplier, basic, circuit	diagram, 8.81
diagram, 4.15	Two op amp in-amp:
Transducer, temperature, characteristics,	circuit, 2.18
table, 3.30	CMR, 2.19
Transfer characteristic slope, log amp, 4.24	Two amp ion amp (cont)
Transfer function, high-pass filter, 8.8-9	input impedance, 2.18
Transformer:	single-supply restrictions, circuits, 2.19-20
common-mode power line isolation, EMI	Two-terminal voltage reference, 7.2
protection, 11.37	Two-tone IMD, 6.141
in isolation amplifier, 2.33-34	Two complement code, 4-bit converter, 5.6, 5.8
reset, 9.46	TxDAC, 6.34
rotating, 3.10	oversampling interpolating, block
Transient load, voltage reference, 7.1	diagram, 6.35

TxDAC series, high-speed CMOS DACs, 12.94	VFB op amp:
Type 5MC Metallized Polycarbonate Capacitor,	basic operation, 1.4-5
9.78, 10.27	Bode plot, 1.16, 1.31
Type 5250 and 6000-101K chokes, 10.27	Closed-loop gain, 1.13
Type EXCEL leaded ferrite bead EMI Filter,	common-mode input impedance,
and type EXC L leadless ferrite bead, 10.27	specification, 1.42
Type HFQ Aluminum Electrolytic Capacitor	current noise, 1.49
and Type V Stacked Polyester Film	gain-bandwidth product, 1.11, 1.67
Capacitor, 9.78, 10.27	inverting and noninverting
Type-2 servo loop, 6.79	configurations, 1.5-9
Type 2 serve 100p, 0.79	loop gain, 1.15
U	noise gain, 1.14-15
Undersampling, 5.28-29	open-loop gain, 1.9-10
antialiasing filters, 5.29-31	phase margin, 1.13
within Nyquist zone, 5.31	signal gain, 1.14
	stability criteria, 1.11-12
Unipolar 3-bit ADC, transfer function, 5.5, 5.12	VFC:
Unipolar 3-bit DAC, transfer function, 5.5,	
• • • • • • • • • • • • • • • • • • • •	architecture:
5.12	charge-balance, 6.68
Unipolar code, 5.4-6	current-steering multivibrator, 6.68
binary, 4-bit converter, 5.4	definition, 6.68-72
quantization uncertainty, 5.6	waveforms, 6.71
Unipolar converter, 5.12-13	VFO, architecture, 6.68
Unipolar power supply, 9.1	VGA:
Unlooped ground, 12.9	digitally controlled, 4.38-39
**	RF/IF circuit, 4.33-40
V	voltage controlled amplifier, 4.33-34
Valkenburg, M.E. Van, 8.143	VHDL.org, 13.31
Valley control, 9.51	Vibration, immunity, 3.25-26
Van de Plassche, R.J., 6.112	Video:
Van de Plassche, Rudy J., 6.83	applications, differential gain, 1.73
Van de Weg, H., 6.112	crosspoint switch, 7.45
Van der Grift, Rob E.J., 6.83	flat bandwidth, 1.66
Van der Veen, Martien, 6.83	multiplexer, 7.42-44
Van Mierlo, S., 6.112	switch, 7.42-44
Van Valkenburg, M.E., 8.143	crosspoint, 7.45
Variable gain amplifier, see: VGA	Video DAC, 6.23
Variable Gain Amplifiers Enable Cost	Video Op Amp, 1.79
Effective IF Sampling Receiver Designs,	Virtual ground, op amp, 1.7
4.40	Viswanathan, T.R., 6.82
Variable integrator, digital, improved,	Vito, Tom, 6.175
circuit, 8.140	Vizmuller, P., 4.73
VCA:	Vladimirescu, A., 13.31, 13.91
audio application, 2.98-100	Vladimirescu, Andrei, 13.31, 13.91
liner-in-dB gain, 4.35	Voltage controlled amplifier, see: VCA
RF/IF circuit, 4.33-34	Voltage controlled oscillator, see: VCO
translinear, 4.33	Voltage doubler:
VCO, 3.12	circuit, 9.81
phase noise vs. frequency offset, 4.63	operation, 9.88-89
in PLL, 4.52	power losses, circuit, 9.91
in resolver, 6.78	waveforms, 9.89
transfer function, graph, 4.53	Voltage drop:
VCO Designers' Handbook, 4.73	coupled circuit, 12.8
VDE 0871 compliance, 11.23	and grounding, 12.8
Vector Electronic Company, 13.91, 13.92	Voltage feedback, see: VFB
Vectorscope, signal displays, 1.74	Voltage feedforward, 9.49
Veen, Martien van der, 6.83	Voltage inverter:
Verster, T.C., 6.82	circuit, 9.81
VFB. advantages. 1.19	operation, 9.88-89

voltage inverter (cont)	White noise, 1.54
power losses, circuit, 9.90	source, 1.48
use, 9.83	White noise signal, input bandwidth limit, 13.52
waveforms, 9.88	Wide codes, in ADC, 5.18
Voltage noise, op amp, 1.47	Wideband amplifier, 2.123
Voltage output sensor:	Wideband CDMA:
packaging, thermal response, 3.35	adjacent channel leakage ratio, 6.145-146
ratiometric, diagram, 3.34	graph, 6.145
Voltage plane, advantages, 12.56-57	adjacent channel power ratio, 6.145-146
Voltage reference:	Widlar, Bob, 7.21, 9.26
architectures, characteristics, table,	Williams, A.B., 8.143
7.11	Williamsen, M., 8.144
diode, circuits, 7.2	Williams, Jim, 13.91, 13.92
diode-based, circuits, 7.2	Window comparator, 2.69
noise, 7.1	Wire microstrip, 12.36
precision, 7.1-2	transmission line, 12.36
pulse current response, 7.17-19	impedance, calculation, 12.37
shunt, 7.2	Wirewound resistor:
specifications, 7.13-16	comparison chart, 8.112
three-terminal, 7.2	parasitics, 10.17-18
three-terminal hookup, schematic diagram,	table, 10.21
7.11-12	Witte, Robert A., 6.175
two-terminal, 7.2	Wold, Ivar, 6.84
types, 7.2-3	Wong, James, 3.64
Voltage sensitivity, resistor, 10.20	Woodward, Charles E., 6.80, 6.175
Voltage standing wave ratio, filters, 8.26	Woofer-midrange-tweeter analogy, for RFI
Voltage-mode R-2R ladder network DAC,	low-pass filter design, 11.32
diagram, 6.18	Wooley, B.A., 6.113
Voltage-output DAC, diagram, 6.5	Wooley, Bruce, 6.113
Voltage-to-frequency converter, as	Word:
transmitter, 2.42	parallel, 5.2
Voluntary Control Council for Interference,	serial, 5.2
11.23	Worst harmonic, definition, 6.135-136
V rms/dBm/dBu/dBv calculator:	Wynne, J., 11.50
screen, 13.33	
use, 13.33	
	X
W	X-AMP, 4.35-38
Wagner, Richard, 1.80	block diagram, 4.35
Wainwright Instruments, 13.84	RF/IF circuit, 4.35-38
Wainwright Instruments GmbH, 13.91, 13.92	schematic, 4.36
Wainwright Instruments Inc., 13.91, 13.92	total input-referred noise, 4.37
Waldhauer, F.D., 6.82	transfer function, 4.36
Waltman, Ron, 6.175	X-AMP, A New 45 dB, 500 MHz Variable-Gain
Watkins, Tim, 13.92	Amplifier (VGA) Simplifies Adaptive
Waveform:	Receiver Designs, 4.40
bipolar, 1.23	XFET reference, 7.9-12
Waveform, (cont)	architecture, 7.10
effects on intercept point, chart, 4.26	table, 7.11
nonlinear, equation, 8.16-17	basic topology, circuit, 7.10
Weaver, Lindsay A., 4.73	drift, 7.13
Webster, John G., 3.27, 3.64	pinchoff voltages, 7.9
Weg, H. Van de, 6.112	thermal hysteresis, 7.10
Welland, D.R., 6.113	
Wenzel Associates, Inc., 12.65	Y
West, Julian M., 1.79	Yasuda, Y., 6.112
Wheable, Desmond, 6.84	Yester, Francis R., Jr., 6.114
Wheatstone bridge, 3.70-71	Young, Joe, 6.83, 7.63

Z	surface, 7.8
Zang, Lingli, 2.127	Zener zapping, 1.34-35
Zener, buried, drift, 7.13	Zeoli, G.W., 6.175
Zener diode, 1.34, 11.35	Zero TC (unipolar converter), definition,
break-down, 7.3	6.124
circuit, 7.2-3	Zeta converter, 9.44
EMI protection, 11.35	Zhang, K., 13.31, 13.91
monolithic, 7.3	Zkazawa, Yukio, 6.175
temperature-compensated, 7.3	Zoned load capacitor ESR, graph, 9.12
Zener reference:	Zumbahlen, H., 8.144
buried, 7.8-9	Zverev, A.I., 8.143

ANALOG DEVICES PARTS INDEX

AD2S90, 6.79	AD743, 13.65
AD210, 2.34-36	AD743/AD745, 1.47
AD215, 2.36-37	AD768, 6.27
AD260, 2.40-42	AD775, 6.210
AD260/AD261, 2.40-42	AD780, 2.63, 7.4, 7.12, 7.13, 7.14, 7.19
AD38X, 7.12	AD781, 7.51
AD39X, 7.12	AD783, 7.51
AD482, 13.65	AD790, 2.68-69
AD524, 2.29, 13.43	AD795, 13.65
AD526, 2.89-90	AD797, 2.90-91, 2.95
AD534, 4.16-17	AD811, 13.12
AD536A, 2.85-86	AD817, 12.89, 13.8
AD530A, 2.65-66 AD538, 2.57	AD817, 12.89, 13.8 AD820, 1.98-99, 13.65
AD538, 2.57 AD539, 2.77-78, 4.13-14	AD822, 1.98-99, 2.15-16, 13.65
AD548, 13.65	AD824, 1.09, 00, 12, 65
AD549, 1.51, 13.65	AD824, 1.98-99, 13.65
AD550, 6.3, 6.12	AD825, 8.137-138, 8.141
AD574, 5.22, 6.42, 7.20	AD829, 1.74
AD580, 7.4	AD830, 2.49
AD584, 7.5	AD834, 2.83-84, 4.17-19
AD586, 7.8-9, 7.13	AD847, 1.12, 1.83, 1.85, 8.118-120, 13.14-16
AD587, 7.15	AD848, 1.12
AD588, 3.95, 3.97, 7.8, 7.13-14	AD849, 1.12
AD589, 3.95, 7.5, 7.16, 7.17	AD850, 6.3
AD590, 3.33	AD8152, 7.46
AD594, 3.42-43	AD1170, 6.72
AD594/AD595, 3.42-43	AD1580, 7.5-6, 7.16, 7.17
AD595, 3.42-43	AD1582 to AD1585 series, 7.4, 7.8, 7.12
AD598, 3.3	AD1582 to AD1585 series, 7.13-14
AD600, 4.35-36	AD185X series, 6.109-110
AD602, 4.35-36	AD1853, 6.110
AD620, 2.13-16, 2.22, 2.24-25, 2.28,	AD1871, 6.99-101
2.35-36,3.95	AD1879, 6.98
AD620B, 2.28, 3.96, 13.42	AD1955, 6.110
AD621, 2.22	AD1990/ AD1902/ AD1904/AD1906, 2.107-117
AD621B, 3.96, 3.97	AD5535, 13.73
AD623, 12.13	AD5570, 6.181, 6.190, 6.197
AD624C, 2.22	AD6600, 6.210
AD627, 2.14	AD6644, 6.210
AD627, 2.14 AD629, 2.9-10, 12.12-13	AD6645, 6.139-140, 6.142, 6.145, 6.152- 154,
AD629B, 2.9-10, 12.12-13 AD629B, 2.10	
	6.160, 6.178-179, 6.181-185, 6.188, 6.193-194,
AD636, 2.85	6.202, 7.61-62, 12.94
AD641, 4.24-27	AD7111 LOGDAC, 6.38-39
AD645, 1.47, 1.51	AD7450, 13.74-75
AD648, 13.65	AD7524, 6.14
AD680, 7.4, 7.14	AD7528, 8.137-138, 8.141
AD684, 7.51	AD7677, 6.48-49
AD688, 7.14	AD7678, 6.181, 6.196, 6.199
AD698, 3.3-5	AD7684, 6.190
AD704, 13.65	AD77XX series, 6.101
AD711, 13.65	AD77XX family, 3.44, 3.49-50
AD711/12/13, 2.95	AD7710, 2.93-94
AD712, 1.44, 13.65, 13.67	AD7710-series, 7.19
AD713, 13.65	AD7711, 2.93
AD737, 2.85	AD7712, 2.93

AD7713, 2.93	AD8512, 13.65
AD7730, 3.85, 3.86, 3.98 6.101, 6.103-107,	AD8517, 1.98
6.115, 6.181, 6.198, 6.201-202, 13.46-48,	AD8519, 1.98-99
13.72-73	AD8527, 1.98
AD7846, 2.91-92	AD8529, 1.98-99
AD789X, 6.40	AD8531/ AD8532/ AD8534, 1.83, 1.94
AD7943/ AD7945/ AD7948, 6.19	AD8534, 1.46, 1.90-91
AD8001, 1.18, 1.68, 1.76-77, 1.83, 12.31,	AD8541, 1.98
13.70-71, 13.89	AD8542, 1.98
AD8016, 12.87-89	AD8544, 1.98
	AD855X, 2.121, 2.123, 2.125
AD8017AR, 12.83-86	
AD8021, 13.40-41	AD8551, 1.98, 12.11-12, 12.19
AD8029, 12.77	AD8551/ AD8552/ AD8554, 2.122
AD8033, 1.98-99, 13.59	AD8552, 1.98
AD8034, 1.98-99, 13.59	AD8554, 1.98
AD8036, 2.59-63	AD8565, 1.98-99
AD8036/AD8037, 2.59-63	AD8566, 1.98-99
AD8037, 2.59-63	AD8567, 1.98-99
AD8051, 1.13	AD857X, 2.121, 2.123
AD8051/ AD8052/ AD8054, 1.83, 1.86-88	AD8571, 1.98
AD8054, 1.70-71	AD8571/72/74, 2.122
AD8055, 6.26-27	AD8572, 1.98
AD8057, 12.90	AD8574, 1.98
AD8058, 12.90	AD8603, 1.98
AD8065, 1.98-99, 13.56-57, 13.59	AD8614, 1.98
AD8066, 1.98-99, 13.59	AD8620, 13.65
AD8067, 13.59-60	AD8621, 1.98
AD8074, 2.4	AD8622, 1.98
AD8074/AD8075, 2.3	AD8624, 1.98
AD8075, 1.66, 2.4	AD8625, 1.99
AD8079A/AD8079B, 2.4	AD8626, 1.98-99
AD8079A/ AD8079B, 2.4	AD8627, 1.98-99, 13.65
AD8108/AD9109, 7.45	AD8631, 1.98
AD8110/AD8111, 7.45	AD8632, 1.98
AD8113, 7.45	AD8644, 1.98
AD8114/AD8115, 7.45	AD9002, 2.62-63
AD8116, 7.45	AD9042, 6.210, 7.60-61
AD8129, 2.50-51, 13.45	AD9051, 6.210
AD8129/AD8130, 2.5, 2.49-51	AD9054A, 6.63
AD813X, 6.27-28, 2.31-32	AD9057, 6.210
AD8130, 2.50-51, 13.45	AD9200, 6.210
AD8138, 13.44	AD9200, 0.210 AD9203, 6.210
AD8170, 7.42-43	AD9216, 6.208
AD8174, 7.42-44	AD9220, 6.210
AD8180, 7.42-43	AD9224, 6.210
AD8182, 7.42-43	AD9225, 6.210
AD8183/AD8185, 7.42-44	AD9226, 6.136-137
AD8184, 7.44	AD9235, 6.55
AD8186, 7.43	AD9238, 6.208
AD8187, 7.43	AD9240, 6.210
AD8230, 3.45-46	AD9245, 12.91-92
AD8330, 4.33-34	AD9248, 6.208
AD8345, 4.11	AD9280, 6.210
AD8350, 2.6	AD9283, 6.210
AD8354, 2.5	AD9410, 6.51
	AD9410, 0.31 AD9430, 6.55, 6.148, 12.49, 12.92-93
AD8362, 4.29-31 AD8367, 4.37-38	
AD8367, 4.37-38	AD9432, 6.210
AD8370, 4.38-39	AD9510, 7.73-83
AD8510, 13.65	AD9514, 7.67-72

AD9620, 2.3	ADR03, 7.4, 7.12
AD9630, 2.3	ADR29X series, 7.12, 7.14
AD9631, 12.79-80	ADR38X series, 7.4, 7.13-14
AD976X, 6.24	ADR39X series, 7.4, 7.13-15
AD977X, 6.24	ADR43X, 7.12
AD977x-family, 6.21	ADR43X series, 7.13, 7.14-15
AD9772, 13.50	ADR510, 7.17
AD9773, 6.34	ADR512, 7.16, 7.17
AD9775, 6.21-22, 6.34	ADSP-2106X, 12.48
	ADSP-2189M, 13.79-80
AD9777, 6.34, 6.171, 6.181, 6.186-187,	
6.191-192, 6.195, 6.198, 12.94	ADSP-21160 SHARC, 12.43
AD985X series, 12.94	ADSP-21160 SHARC, 12.69-70
AD985x-family, 6.21	ADT45/ADT50, 3.34
AD9850, 4.46-47, 13.48	ADT70, 3.49-51
AD9870, 6.109	ADT71, 3.51
AD10677, 6.210	ADuM130X/ADuM140X, 2.46-48
AD12400, 6.210	ADuM1100, 2.42-46
AD22100, 3.34	ADuM140X, 2.46-47
AD22105, 3.58-59	ADuM1400, 2.48
AD22151, 3.7-8	ADuM1401, 2.48
ADF439F, 7.50	ADuM1402, 2.48
ADF4111, 4.58	ADXL202, 3.17-18
ADF4112, 4.67	ADXRS150, 3.19-20
ADF41167/ ADF41168, 13.29	ADXRS300, 3.19-20
ADG200-series, 7.23	AMP02, 2.29
ADG200 series, 7.23 ADG201-series, 7.23	AMP03, 12.12-13
	AMP04, 2.92-93
ADG432F, 7.50	
ADG438F, 7.50	BUF03, 2.2
ADG508F, 7.50	BUF04, 2.3
ADG509F, 7.50	DAC-08, 6.16, 6.18
ADG511, 2.92-93	HOS-100, 2.1
ADG528F, 7.50	OP07, 2.75
ADG708, 7.30	OP27, 1.49-51, 1.77, 13.8
ADG8XX-series, 7.26	OP42, 13.65
ADG801/ADG802, 7.26	OP90, 1.98, 8.118-120, 12.31
ADG918, 7.40-41	OP113, 1.98-99
ADG919, 7.40-41	OP162, 1.98-99
ADLH0033, 2.1	OP176, 8.116
ADM1201, 3.61-63	OP177, 1.71, 2.123, 3.95, 3.96, 3.97, 10.19
ADP1073, 9.52, 9.54	OP177F, 1.33
ADP1108, 9.54	OP179, 1.98
ADP1109, 9.54	OP183, 1.98-99
ADP1110, 9.54	OP184, 1.98
ADP1111, 9.54	OP191, 1.98, 11.5
ADP1147, 9.47	OP193, 1.98, 3.42
ADP1148, 9.62	OP196, 1.98
ADP1173, 9.54	OP213, 1.52, 1.98-99, 2.91, 3.97, 3.98, 7.32
ADP3000, 9.48, 9.52, 9.54-55, 9.58-59	OP249, 13.9, 13.65
ADP330X, 9.13-15	OP262, 1.98-99
ADP3300, 9.15-16	OP275, 13.65
ADP3300-series, 7.15	OP279, 1.98
ADP3310, 9.20-25	OP281, 1.98
ADP3603, 9.82, 9.91-93	OP282, 13.65
ADP3604, 9.82, 9.91-93	OP284, 1.98, 2.18
ADP3605, 9.82, 9.91-93	OP290, 1.45
ADP3607, 9.82, 9.91-93	OP291, 1.98, 11.5, 11.7
ADP3607-5, 9.94	OP292, 1.98-99
ADR01, 7.4, 7.12	OP293, 1.98
ADR02, 7.4, 7.12	OP295, 1.98-99, 2.95

INDEX

OP296, 1.98 REF02, 7.4 OP297, 2.18 REF03, 7.4 OP413, 1.98 REF43, 7.12, 7.14 OP418, 1.99 REF19X, 7.4, 7.12, 7.13-14 OP462, 1.98-99 REF195, 3.97, 7.13, 7.14 OP481, 1.98 SSM-2018, 2.98 OP484, 1.98 SSM-2019, 2.95 OP490, 1.98 SSM-2135, 1.98-99 OP491, 1.98, 11.5 SSM-2141, 2.103 OP492, 1.98-99 SSM-2141/ SSM-2143, 2.101, 2.104 OP493, 1.98 SSM-2142, 2.101, 2.103-104 OP495, 1.98-99 SSM-2143, 2.102-103 OP496, 1.98 SSM-2160, 2.99 OP727, 1.98 SSM-2165/ SSM-2166/ SSM-2167, 2.95-96 OP747, 1.98 SSM-2211, 2.97 OP777, 1.98 TMP01, 3.59-60 TMP03/TMP04, 3.56-58 OPX91 family, 11.5-7 OP1177/OP2177/OP4177, 1.83-84 TMP04, 3.58 REF01, 7.4 TMP35, 3.41-42, 3.44