

Cambridge University Press

978-0-521-47879-3 - A Practical Introduction to Electronic Circuits, Third Edition

Martin Hartley Jones

Index

[More information](#)

Index

absolute value circuit, 327

acceptor impurity, 10

Acorn computers, 446, 447, 450, 462

active components, 1

active filters, 306

band-pass, 317

high-pass, 316

low-pass, 306

active pull-up, 257, 381

A/D converter (ADC), 475

adder

analogue, 287

binary, 377, 428

full, 378

half, 377

parallel, 378

serial, 378

addition

analogue, 287

digital, 377, 428

operational, 287

address, 437

address decoder, 456

aliasing, 480

ALSTTL, 382

ALU, 428

ampere-hour, 201

amplification, 1

amplifier

bipolar transistor, 23

cascode, 162

class AB, 116

class B, 114

class C, 115

charge, 296

common base, 158

common collector, 97

common emitter, 24

differential, 72, 181, 286

feedback, 61

FET, 41

IC, 192

logarithmic, 323

low-noise, 92

operational, 273

pentode, 53

triode, 50

valve, 50, 53

voltage, 23

wideband, 165

analogue

adder, 287

computing, 328

differentiator, 298

divider, 336

integrator, 290

multiplier, 191, 332

signals, 272

simulation, 338

switch, 426

analogue to digital converter, 475

AND

gate, 370

wired, 438

anode, valve, 45

anti-coincidence gate, 377

Archimedes computer, 447

arithmetic and logic unit, 428

512 *Index*

- ASCII code, 399, 410
- ASIC, 425
- assembler, 452
- assembly code, 451
- astable multivibrator, 356
- asynchronous counter, 402
- attenuation
 - high frequency, 147
 - low frequency, 175
- audio mixer circuit, 289
- audio preamplifier, 92, 94
- audio power amplifier, 120
- automatic gain control, 139, 335
- automatic gate bias, 41
- avalanche breakdown
 - in diode, 15, 216
 - in transistor, 133
- balanced power supplies, 178
- bandgap voltage reference, 227
- band-pass filter, 317
- bandwidth
 - effect on noise, 86, 306
 - in op amp circuit, 301, 303
- Barkhausen criterion, 344
- base, 2, 16
- base stretching, 150
- BASIC, 454
- bass control, 322
- batteries, 200
- battery back up, 442
- battery charger (constant current), 132
- Baxandall tone controls, 322
- BBC Micro, 446, 450, 462
- BCD counter, 399
- bias, 24
 - on junction, 12
- bias current, 180
 - in IC, 273
- bibliography, 508
- bilateral switch, CMOS, 426
- binary
 - addition, 377, 428
 - counter, 361, 396
 - digit, 377
 - division, 434
 - multiplication, 434
 - subtraction, 430, 434
- bi-phase rectifier, 203
- bipolar transistor, 1
- biquadratic filter, 341
- bistable multivibrator, 355, 385
- bit, 377
- Bitstream conversion, 482
- Bode plot, 169
- Boltzmann's constant, 86, 124
- Boolean algebra, 373
- boost regulator, 237
- bootstrapping, 105
 - in audio power amplifier, 119
 - in IC amplifier, 283
- boron, 10
- bottoming, in transistor, 26, 31, 134
- bounce, contact, 387, 414
- breakdown
 - in diode, 14, 215
 - in transistor, 133
- bridge rectifier, 202
- buck regulator, 237
- buffer gate, 381
- bulk resistance, 126
- burst firing, of triac, 246
- bus, 436
 - contention, 456
 - PC, 460, 500
- byte, 393, 436
- capacitance
 - in FET, 156
 - in transistor, 147
- capacitor
 - charge/discharge, 251
 - colour code, 488
 - compensation, 70, 121, 173
 - coupling, 25, 174
 - current rating, 207
 - decoupling, 211
 - electrolytic, 26
 - filter, 210
 - reservoir, 204
- carry digit, 377
- cascaded
 - amplifier stages, 82
 - counters, 401
 - filters, 315, 320
- cascode circuit, 162
- cathode
 - indirectly heated, 49

Index

513

- valve, 45
- cathode-ray tube, 55
 - electrostatic deflection, 55
 - magnetic deflection, 56
 - phosphor, 56
 - shadowmask colour, 57
- CD-ROM, 440
- central processor unit, 444
- ceramic filter, 354
- characteristic impedance, 84
- charge amplifier, 296
- charge pump, 268
- charger, for NiCd battery, 132
- charging, capacitor, 251
- choke, in power supply, 211, 236
- chopper amplifier, 197
- chopper-stabilized amplifier, 197
- clamp diode, 260
- C language, 454
- class AB amplifier, 116
- class B amplifier, 114
- class C amplifier, 115
- clear input, 388
- clipping, of pulses, 269
- clock, digital, 401
- clock pulse, 388, 393, 444
- clocked flip-flop, 388
- closed loop gain, 62
- CMOS, 43, 382
 - bilateral switch, 426
- CMRR, 186
- coaxial cable, 106
- Cockcroft–Walton voltage multiplier, 209
- collector, 3, 16
- collector characteristics, 129
- Colossus computer, 380
- colour code, resistor, 486
- combinational logic, 385
- combinatorial logic, 385
- common-base amplifier, 158
- common-collector amplifier, 97
- common-emitter amplifier, 24
 - at high frequencies, 153
 - equivalent circuit, 140
 - voltage gain, 140
- common-gate circuit, 162
- common mode
 - gain, 184
 - input, 184
- rejection, 188
- common-source amplifier, 142
 - voltage gain, 144
- comparator
 - analogue, 329
 - digital, 456
- compact disc, 440
- compensation
 - capacitor in amplifier, 70, 121, 173, 301
 - in semiconductors, 11
- compiler, 455
- complementary Darlington pair, 119
- complementary MOS logic, 43, 258, 382
- complementary transistors, 20, 114
- computer
 - analogue, 338
 - digital, 428
- computer-aided design, 425
- conductance, output, 130, 141
- conduction overlap, 423
- conductivity
 - extrinsic, 9
 - in semiconductor, 7
 - intrinsic, 9
- constant current generator, 130
- contention, bus, 456
- control line, 437
- counter
 - asynchronous, 402
 - BCD, 399
 - binary, 361, 396
 - decimal, 395, 399
 - ring, 395
 - ripple through, 402
 - synchronous, 402
- coupling capacitor, 25, 174
 - in pulse circuits, 259
- CPU, 444, 464
- crash, 450
- crossover distortion, 64, 115
- crowbar, 223
- CRT, 55
- crystal oscillator, 353
- current
 - feedback, 70
 - gain, 6
 - input bias, 180
 - limiting, 229
 - mirror, 189

514 *Index*

- current—*cont.*
 to voltage converter, 300
 cut-off frequency (in transistor), 148
- D/A converter (DAC), 473
- Darlington pair, 6
 complementary, 119
 in emitter follower, 103, 214
- data
 bus, 436
 highway, 437
 selector, 420
- d.c. amplifier, 174, 178
 details, using IC, 279
- d.c. level, in pulse train, 259
- d.c. restorer, 260
- debouncer, switch, 387, 414
- decibel, 85
- decimal counter, 395, 399
- decimation, 483
- decoder
 address, 456
 4–16 line, 405
 hexadecimal, 430
 seven segment display, 407
- decoupling, 211
 with logic, 424
- deflection, in CRT, 56
- delay circuit, pulse, 414
- delta-sigma ADC, 481
- De Morgan's theorem, 376
- demultiplexing, 420
- depletion layer, 11
- depletion MOSFET, 38
- diamond, 7
- differential amplifier, 72, 181
 using IC, 286
 voltage gain, 182
 with balanced output, 190
- differential equation, solution by analogue
 simulation, 338
- differentiating circuit, 263
- differentiator, operational, 298
- digital audio, 479
- digital clock, 401
- digital filter, 472
- digital logic, 369
 IC connections, 494
- digital signal processing, 471
- digital to analogue converter, 473
- dimmer, using triac, 244
- diode
 characteristics, 123
 clamp, 260
 clipper, 269
 light-emitting, 21
 pn junction, 11
 rectifier, 201
 thermionic, 45
 transistor logic, 375
 valve, 45
 varactor, 15
 Zener, 15, 215
- diode pump ratemeter, 268
- direct memory access (DMA), 471
- discharge, capacitor, 254
- disk
 floppy, 440
 hard, 440
 optical, 440
 Winchester, 440
- display
 alphanumeric, 410
 hexadecimal, 430
 liquid crystal, 406
 multiplexed, 409
 seven segment, 406
 starburst, 410
- distortion, 64
 aliasing, 480
 harmonic, 65
 in common-emitter amplifier, 142
 in common-source amplifier, 145
- intermodulation, 66
- measurement, 66
 reduction by negative feedback, 67
 slew induced, 304
 transient intermodulation, 304
- dither, 477
- divider, analogue, 336
- division, binary, 434
- DMA, 471
- documentation (software), 452
- Dolby noise reduction, 139
- donor impurity, 10
- doping, 9
- doubler, voltage, 208
- drain, 34

- characteristics, 136
- conductance, 138, 144
- resistance, 138, 144
- DRAM, 441
- drift, 180
- droop, on rectangular wave, 261
- DSP, 471
- DTL, 375
- D-type flip-flop, 389
- dual gate MOSFET, 164
- ducking circuit, 336
- dynamic RAM, 441
- dynamic resistance
 - in pn diode, 125
 - in Zener diode, 218
- ECL, 424
- edge detector, 392
- edge-triggered flip-flop, 390
- EEPROM, 443
- efficiency of power amplifier, 115
- EHT supplies, 209
- EISA connector (PC), 500
- electrocardiograph, 194
- electromagnetic compatibility (EMC), 424
- electrometer, 42
- electron, 6
- electron lens, 56
- electronic thermometer, 193
- electrostatic
 - deflection, 56
 - discharge, 385
- EMI, 238, 246
- emission, thermionic, 44
- emitter, 2, 16
- emitter coupled logic, 424
- emitter follower, 97
 - at high frequencies, 155
 - high power, 114
 - in power supply, 213
 - input impedance, 101
 - output impedance, 102
 - voltage gain, 101
- end around shift register, 395
- enhancement MOSFET, 38
- EPLD, 426
- EPROM, 443
- E² PROM, 443
- equivalent circuit, 79, 127, 140
- ESD, 385
- error amplifier, in power supply, 223
- exclusive OR gate, 377
- EXOR gate, 377
- expansion slots (PC), 460, 500
- extrinsic conductivity, 9
- fall time, 255
- fan-in, 375
- fan-out, 375
- feedback amplifier, 61
- feedback
 - negative, 59
 - positive, 62, 344
- feedthrough capacitor, 161
- FET, 34
 - as integrator reset, 295
 - as voltage-controlled resistor, 138
 - at high frequencies, 156
 - drain characteristics, 136
 - electrometer, 42
 - high power, 121
 - square-law characteristics, 144
 - voltage amplifier, 41
- fibre, optical, 22
- field-effect transistor (FET), 34
- field-programmable gate array, 425
- FIFO memory, 393, 440
- filament, valve, 44
- filter
 - anti-alias, 481, 485
 - ceramic, 354
 - digital, 472
 - first order, 167
 - high pass, 175
 - in power supply, 210
 - low pass, 167
 - mains, 424
- filter, active, 306
 - band pass, 317
 - biquadratic, 341
 - Butterworth, 314
 - high pass, 316
 - low pass, 306
 - maximally flat, 314
 - Sallen & Key, 309
 - state-variable, 341
 - switched-capacitor, 341
- flash A/D converter, 475

- flash EEPROM, 443
- flicker noise, 87
- flip-flop, 355, 385
- floppy disk, 440
- flyback transformer, 237
- FM radio preamplifier, 162
- foldback current limiting, 229
- follower
 - emitter, 97
 - source, 106
 - voltage, 280
- Fourier analysis, 210, 250
- FPGA, 425
- frequency classifications, 146
- frequency division, 397
- frequency rejection circuits, 318
- frequency response, 63
- f_r , 148
- full adder, 378
- full-wave (FW) rectification, 202
- gain
 - current, 6
 - voltage, 29
- gallium arsenide, GaAs, 155
- gate
 - array, 424
 - in FET, 34
 - logic, 370
- generator, voltage, 79
- Gilbert cell, 191
- glitch, 399
- g_m , 40, 48, 128, 144
- Goldberg amplifier, 197
- governor, 59
- grid, 47
 - screen, 52
 - suppressor, 53
- ground plane, 165
- GW BASIC, 460
- h -parameters, 140
- half adder, 377
- half-wave (HW) rectification, 201
- hard disk, 440
- harmonic distortion, 65
- harmonic oscillator analogue, 338
- harmonics, 66, 250
 - in power supply ripple, 210
- HC logic, 383
- heat sink, 233
- hexadecimal
 - display, 430
 - numbers, 403
- HEXFET, 121
- h_{FE} , 6
- h_{fe} , 19
- h_{ie} , 126
- high frequencies, 146
- high pass filter, 175
- highway, data, 437
- h_{oe} (output conductance), 130, 141
- hold time, 393
- hole, 10
- hybrid π equivalent circuit, 140
- hyperbola, maximum power, 132
- hysteresis
 - in comparator, 331
 - in Schmitt trigger, 363
- IBM PC, 450
- IC (integrated circuit), 43
 - amplifier, 192, 273
 - application-specific, 425
 - logic, 380
 - pin connections, 492, 494
 - power amplifier, 122
 - regulator, 230
 - timer, 416
- IFL, 425
- IGBT, 43, 242
- impedance changing, 94
 - by transformer, 95
- impedance
 - input, 76
 - matching, 76, 81
 - output, 79
 - reflected, 96
- impurities, in semiconductor, 9
- inclusive OR gate, 377
- incremental resistance in pn diode, 125
- inductor
 - in filter design, 307
 - in power supply, 211, 236
- initialise, 462
- input
 - bias current, 180, 273
 - impedance, 76

- port, 460
- resistance, 76
- input/output (microcomputer), 456
- instability
 - at RF, 161
 - in feedback amplifier, 70
 - in power amplifier, 121
- insulated gate bipolar transistor, 43
- integral cycle control, 246
- integrated circuit, *see* IC
- integrated fuse logic, 425
- integrating circuit, 264
 - errors in, 266, 293
- integration of rectangular wave, 267
- integrator
 - Blumlein, 290
 - in analogue computer, 339
 - Miller, 290
 - operational, 290
- intermodulation distortion, 66
- interpolator, 485
- interpreter, 455
- interrupt, 445, 467
- intrinsic conductivity, 9
- inverter gate, 371
- inverting amplifier using IC, 284
- I/O, 456, 460
 - memory mapped, 456
 - request, 456
- ISA connector (PC), 460, 500
- jam-loaded flip-flop, 394
- JFET, 34
- JK flip-flop, 390
- Johnson noise, 86
- junction, pn, 11
- keyboard buffer, 468
- label, 452
- latch, transparent, 388, 408
- latch-up, 338
- LCD, 406
- LC oscillator, 353
- leakage inductance, 96
- least significant bit, 397
- LED, 21
- lens, electron, 56
- LIFO memory, 468
- light-emitting diode, 21
- limiter, 271
- line regulation, 217
- liquid crystal display, 406
- lithium battery, 200
- load line, 133
- load regulation, 207
 - in Zener stabilizer, 220
- lock range, of PLL, 367
- logarithmic amplifier, 323
- logic gate, 370
- long-tailed pair, 182
- low frequencies, 174
- low noise amplifiers, 92
- low-pass filter, 167
 - as integrator, 264
 - in power supply, 210
- LSB, 397
- LSTTL, 382
- LV logic, 383
- LVT logic, 422
- machine code, 447
- magnetic deflection, 56
 - disk storage, 440
- mains suppression filter, 424
- majority carriers, 11
- map, memory, 443
- master-slave flip-flop, 390
- maximum
 - power hyperbola, 132
 - power theorem, 84
 - ratings in transistor, 134
- MDAC, 475
- memory
 - map, 443
 - mapped I/O, 456
- microcomputer, 428, 444
- microprocessor, 444
- micropogram, 446
- microwaves, 146
- Miller effect, 151
- minimum phase circuit, 171
- minority carriers, 11
- mixer circuit, audio, 289
- mnemonic, 452
- mobility (in semiconductor), 155
- modulator, 191

- monostable
 - CMOS, 414
 - multivibrator, 360
 - TTL, 413
 - 555 timer, 416
- MOS
 - complementary, 43, 258, 382
- MOSFET, 36
 - dual gate, 164
 - enhancement and depletion types, 38
 - power, 43, 242
 - switching, 295
- most significant bit, 380
- MSB, 380
- multiple feedback filter, 319
- multiplexed display, 409
- multiplexer, 419
- multiplication, binary, 434
- multiplier, analogue, 191, 332
- multiplier, voltage, 209
- multitasking operating system, 468
- multivibrator
 - astable, 356
 - bistable, 355, 385
 - monostable, 360, 413
- mutual conductance, 48
- MUX, 420
- NAND gate, 372
- negative feedback, 59
 - and input impedance, 112
 - and output impedance, 111
 - experiments, 72
 - shunt, 113, 284
- negative logic, 373
- netlist, 425
- nibble, 436
- nickel-cadmium cell, 200
 - charger circuit, 132
- noise, 85
 - and bandwidth, 86, 306
 - dither, 477
 - figure (factor), 87
 - in FETs, 93
 - in logic circuits, 422, 424
 - in transistors, 87
 - rejection (with differential amplifier), 194
 - shaping (in ADC), 483
 - thermal, 86
- non-inverting amplifier using IC, 279
- non-maskable interrupt, 467
- NOR gate, 372
- not equivalent gate, 377
- NOT gate, 370, 372
- npn transistor, 16
- null control, offset, 179, 277
- Nyquist criterion, 70
 - plot, 169
 - sampling theorem, 479
- nybble, 436
- offset
 - in IC, 273
 - in integrator, 292
 - input, 277
 - input current, 277
 - null control, 179, 278
 - voltage, 179, 277
- ones catching flip-flop, 392
- op amp, 273
- op code, 448
- open collector, 406, 438
- open loop gain, 62
- operand, 448
- operating
 - point, 26
 - system, 449
- operational amplifier, 273
 - bandwidth, 301, 303
 - connections, 493
 - data, 492
 - FET input, 277
 - IC applications, 274
 - power, 122, 305
 - power supply requirements, 305
 - practical details, 278
- operational integrator, 290
 - accuracy of, 293
 - offset in, 292
- optical disk, 440
- optical fibre, 22
- optoelectronic devices, 20
- opto-isolator, 22
 - in thyristor control, 243
- OR gate, 370
 - exclusive, 377
- oscillator
 - crystal, 353

Index

519

- LC, 353
- phase shift, 345
- quadrature, 351
- voltage-controlled, 364
- Wien bridge, 348
- oscilloscope, 57, 158, 255, 295
- output characteristics of transistor, 129
- output impedance, 79
 - measurement of, 80
 - with negative feedback, 111
- output port, 458
- overflow, 431
- oversampling ADC, 481
 - DAC, 484
- overvoltage crow bar, 223
- PAL, 425
- parallel to serial conversion, 394
- passive components, 1
- PCB, multi-layer, 424
- PC, 450
 - expansion bus connector, 460, 500
 - I/O ports, 460
- peak
 - inverse voltage, 207
 - value of a.c., 205
- PEEK, 451
- pentode, 52
- persistence in CRT phosphor, 57
- phase comparator, 365
- phase, minimum, 171
- phase-locked loop, 364
- phase shift at high frequencies, 169
- phase shift at low frequencies, 176
- phase shift oscillator, 345
- phase splitter, 71
- phosphor, 57
- phosphorus, 9
- photocell, 4
- photodiode, 5, 21
- photo-electric switch, 244
- phototransistor, 5, 21
- physiological amplifier, 195
- picture tube, 55
- piezoelectric properties, 353
- pinch off, in FET, 138
- plate, tube, 45
- PLD, 425
- PLL, 364
- pn junction, 11, 123
- pnp transistor, 20
- POKE, 450
- poll, 462
- port
 - BBC Micro, 462
 - input, 460
 - output, 458
 - printer, 461, 466
- positive feedback, 62, 344
- potential barrier, 11
- potentiometer, in power supply, 212
- power amplifier, 114
 - IC, 122, 305
 - practical circuit, 120
 - temperature compensation, 117
- power dissipation
 - in transistor, 135, 233
 - in Zener diode, 219
- power supplies, 200
 - balanced (split rail), 178
 - for logic, 423
 - switch mode, 235
- power supply rejection ratio, 305
- power transfer, maximum, 83
- power transistor, 118, 214, 242
- preamplifier
 - low-noise audio, 92, 94
 - UHF TV, 160
 - VHF radio, 162
- precautions with logic, 421
- precision rectifier, 327
- preset input, 388
- printed circuit board, 424
- printer port, 461, 466
- priority level (interrupts), 467
- processor, 444
- program, 385, 444
- programmable
 - array logic, 425
 - interrupt controller, 467
 - logic devices, 425
- PROM, 443
- propagation time, in logic gate, 381
- protection, short circuit
 - in power amplifier, 121
 - in power supply, 228
- pull-up
 - active, 257, 381

520 *Index*

- pull-up (*cont.*)
 - resistor, 330, 422
- pulse
 - delay, 414
 - generator, TTL, 412
 - handling, 248
 - stretcher, 414
 - train, 248
- pulse triggered flip-flop, 392
- pulse-width modulation (PWM), 237
- pump, charge, 268
- push-pull output, 114
- Q* (of filter), 309, 314, 320, 341
- Q* BASIC, 460
- quadrac, 246
- quadrature oscillator, 351
- quantization noise, 477
- quasi-stable state, 360
- quiescent current, 25, 117
- radar, 57
- radio frequencies, 146
- RAM, 440
 - CMOS, 442
- ramp generator, 294
- random access memory, 440
- random logic, 425
- ratemeter, charge pump, 269
- ratings, maximum (transistor), 134
- ratio, transformer, 95
- r_b , $r_{b'}$, $r_{bb'}$, 127
- RC circuit, effect on square wave, 256
- read-only memory, 443
- rectangular wave, 248
- rectification, 201
 - full-wave, 202
 - half-wave, 201
- rectifier, precision, 327
- reference, voltage, 226
- reflected impedance, 96
- refresh cycle, DRAM, 442
- register, 393
- regulation
 - line, 217
 - load, 207
- regulator
 - boost, 237
 - buck, 237
- IC voltage, 230
- rejection, power supply, 305
- relay, 1
 - solid state, 244
 - transistor operated, 4
 - in logic gates, 371
- relocatable program, 452
- reservoir capacitor, 204
- reset (flip-flop), 385
- reset (microprocessor), 449
- resistance, dynamic, 125
- resistance, thermal, 234
- resistor
 - colour code, 486
 - light dependent, 4, 244
 - load, 23
 - network, 422
 - stopper, 346
 - voltage-controlled, 138
- resistor-transistor logic, 375
- resonant system, analogue, 338
- reverse saturation current, 124
- RF, 146
- ring counter, 395
- ringing, on square wave, 256
- ripple, 205
 - and voltage stabilizer, 225
- ripple-through counter, 402
- rise time, 253
- ROM, 443
- RS flip-flop, 385
- RTL, 375
- Sallen & Key filter, 309
- sample-hold circuit, 476
- sampling frequency, 479
 - theorem, 479
- sample rate conversion, 483
- saturation, in transistor, 26, 30, 134, 249, 382
- Schmitt trigger, 362
 - TTL, 411
- Schottky TTL, 382
- screen grid, 52
- screening at high frequencies, 161, 165, 423
- secondary emission, 53
- semiconductors, 6
 - mobility in, 155
- n-type, 10

Index

521

- p-type, 10
semi-custom IC, 425
sequential logic, 385
serial to parallel conversion, 394
series pass transistor, in power supply, 213
servo system, 60
set-reset flip-flop, 385
set-up time, 393
seven-segment display, 406
shadowmask CRT, 57
shift register, 393
shot noise, 87
shunt feedback, in op amp, 284
shunt peaking, 166
SID, 304
sigma-delta ADC, 481
signal, 1
signals on PC bus, 500
signal-to-noise ratio, 85, 478
silicon controlled rectifier (SCR), 238
slew rate, 303
slew induced distortion, 304
smoothing, 204
snubber, in triac circuit, 246
software, 447
source, 34
source follower, 106
 input and output impedances, 108
 voltage gain, 108
spectrum analyzer, use of, 67
spike, 399
split-rail power supplies, 178
spot noise figure, 88
square law characteristic in FET, 144
square wave, 248
SRAM, 441
stability, in feedback amplifier, 70
stabilization ratio, 217
 in Zener stabilizer, 221
stabilized voltage amplifier, 28
stabilizers, voltage
 design of, 215
 IC, 230
 with error amplifier, 223
stack, 468
staggering, of resonant frequencies, 320
standard cell, logic, 425
start address, 450
state machine, 388, 444
state-variable filter, 341
static precautions, 43
static RAM, 441
stopper resistor, 346
STTL, 382
substrate, 36, 38
subtraction, binary, 430, 434
successive approximation A/D, 476
summing junction, 288
super- β transistor, 277
super computer, 428
supermatch pair, 326
superposition principle, 100
suppressor grid (in pentode), 52
surface mount technology (SMT), 155, 487
switched-capacitor filter, 341
switching circuits, 32
 using valves, 54
switch-mode power supplies, 235
synchronous counter, 402
system crash, 450
temperature coefficient, in Zener diode, 226
temperature compensation, 117, 189
 in logarithmic amplifier, 326
temperature, effect on d.c. amplifier, 180
ten's complement, 430
termination, bus, 440
tetrode, 52
thermal
 circuit, 234
 noise, 86
 resistance, 234
thermionic emission, 44
theristor, as oscillator stabilizer, 350
thermometer, electronic, 193
Thévenin's theorem, 79
thyristor, 238
tilt, on rectangular wave, 261
TIM, 305
timebase, 294
time constant, 25, 252
timer (555), 416
toggle, 390
tolerance, 486
tone controls, 322
totem pole output, 381
train, pulse, 248
transceiver, bidirectional, 439

- transconductance
 - in bipolar transistor, 128
 - in FET, 39, 144
 - in triode, 48
- transformer, 95
 - flyback, 237
- transient intermodulation distortion, 304
- transistor
 - as constant current generator, 130, 189, 226
 - base, emitter, collector, 16
 - bipolar, 2, 16
 - common base circuit, 158
 - common emitter circuit, 16
 - connections, 491
 - field effect, 34
 - selection, 490
 - supermatch pair, 326
 - test circuit, 22
- transistor capacitance, 147
- transistor-transistor logic, 375, 380
- transition
 - frequency, 148
 - table, 387
- transparent latch, 388
- treble control, 322
- triac, 242
- triode, 47
- tri-state output, 438
- truth table, 375
- TTL, 375, 380
 - practical precautions, 421
- tube, vacuum, 44
- tunnelling, in Zener diode, 226
- turn-on time, 257
- twin-T network, 318
- two's complement, 432
- UART, 395
- UHF TV preamplifier, 160
- ULA, 425
- uncommitted logic array, 425
- unused inputs, on gates, 423
- vacuum tube, 44
- valence electrons, 6
- valve, 44
 - diode, 45
 - pentode, 52
- tetrode, 52
- thermionic, 45
- triode, 47
- varactor diode, 15
- $V_{CE(sat)}$, 31, 249
- vector, interrupt, 467
- VHF radio preamplifier, 162
- virtual earth, 285
- VMOS, 121
- voltage amplifier, 23, 41
- voltage-controlled amplifier, 191
- voltage-controlled attenuator
 - using analogue multiplier, 335
 - using FET, 138
- voltage-controlled oscillator, 364
- voltage follower circuit, 280
- voltage gain
 - of common-emitter stage, 140
 - of common-source stage, 142
 - of differential amplifier, 182
 - of emitter follower, 101
 - of feedback amplifier, 62
 - of source follower, 108
 - measurement, 29
- voltage multiplier, 209
- voltage reference, 226
- voltage regulator, 230
- voltage stabilizer, 215
 - IC, 230
- Walkman, power supply, 223
- wideband amplifier, 165
- Wien bridge oscillator, 348
- Williams ring of two, 226
- wired AND, 438
- wireless, 146
- wiring, in TTL circuits, 423
- Winchester disk, 440
- Windows, 468
- working point, 24
- Zener diode, 15
 - as clipper, 271
 - as voltage stabilizer, 215
 - characteristic, 216
 - limitations, 218
 - temperature coefficient, 226
- zero voltage switch, 247
- zinc chloride cell, 200