Index

ABCD parameters 1, 10–13, 18
Active devices 58, 74, 130, 131, 137, 138, 182
Amplifier design
  balanced amplifier 181–3
  broadband amplifier design 181
  maximum gain amplifier design 179, 181, 241, 243, 245
  negative feedback amplifier design 183
Antennas
  dipole antenna 74, 130, 131, 133–6, 184–96, 245, 246, 248, 249
  resonant antenna 74, 134–7
  transmission between dipole antennas 74, 135, 136, 246
  transmission between resonant antennas 74, 136, 137
Attenuation constant 9, 81, 82, 84, 92–5, 97–100, 121, 154

Cascaded two-port networks 30
Characteristic impedance
  coplanar strips 99
  coplanar waveguide 96
  even mode 117
  microstrip line 91, 108, 111
  odd mode 117
  stripline 94
Characteristic impedance of the coaxial line 90
Chebyshev polynomials 146, 168
Circuit block construction panel 64–6, 69, 70
  add 64
  cancel 64
  circuit display area 64
  device type: D, T, M, S or O 64, 65, 69, 70
  save changes 64
Circuit menu 59, 61, 63, 68–70
  cancel 63, 64
  create holder 63
  new 63
  open 63
  print 63
  run 63, 64
  save 63
  save as 63
  show device list 63
Circuit simulation procedures 67
Circuit simulator 39, 40, 42, 57, 59, 61–3, 65, 68–70, 73, 141, 187, 189, 193–5, 198, 208, 209, 211, 213, 215, 219, 221

© 2007 John Wiley & Sons, Ltd

COPYRIGHTED MATERIAL

Coaxial line 58, 74, 89, 90, 101, 102
Coaxial line discontinuities 58, 74, 101, 102
  gap discontinuity 102, 103
  open-end discontinuity 103–4
  step discontinuity 101
Conducting loss 10, 81
Connected two-port networks 28, 29, 31
Connection Menu 67
  How to Connect function 67
Conversions between Z, Y and *ABCD* and *S*-parameters 18
Coplanar strips 98, 99
Coplanar waveguide 58, 74, 96–8, 100
Corporate feeds 148, 199–201
Coupled line 58, 74, 116, 117, 118, 119, 121, 122, 154, 155, 162–4, 176, 177, 210–16, 229, 239, 240
Couplers
  coupled line couplers 162
  coupler with flat coupling response 160, 161
  hybrid ring coupler 163, 165, 166
  rat-race hybrid ring coupler 225–8
  three-stub branch line coupler 161, 162, 221, 223
  two-stub branch line coupler 159, 160, 219–22
Coupling coefficient 150, 152, 153, 208
Current-controlled current source 130, 131
Current-controlled voltage source 130, 131

Device menu 57, 59–61, 64–6, 68–70
  copy 64, 65
  delete 64, 66
  new 64
  paste 64–6
  undo 64, 66
Device under test 39, 41, 57, 59–61, 74
Dielectric loss 81, 94, 121
Directivity 159
Discontinuities
  coaxial line discontinuities 58, 101, 102
  microstrip line discontinuities 58, 104, 105, 241
  stripline discontinuities 58, 111, 112
Discrete RLC components 78–80
  one-port impedance load 58, 74, 78, 205
  two-port series impedance 58, 70, 74, 79, 103
  two-port shunt admittance 58, 74, 80, 101

FET 182–5, 241, 242, 244, 245
Filters
  bandpass filter 173, 174–7, 232, 233, 235–41
  Chebyshev low-pass filters 171, 172
  Chebyshev response 168, 170
  coupled line filter 177, 239, 240
  end-coupled resonator filters 178
  equal ripple bandpass filter 232
  equal ripple low-pass filter 231
  maximally flat low-pass filter 229, 233
  maximally flat low-pass filters 169, 171
  maximally flat response 168, 169
  microstrip resonator filter 241
  step impedance low-pass filters 173, 174, 233–5
Filter transformations
  transformation to a bandpass filter 173
  transformation to a bandstop filter 173
  transformation to a high-pass filter 173
  transformation to a low-pass filter 173
FORMAT functions 44
  2PChart 45, 52, 56, 207, 208, 241
  linear magnitude 44, 56
  LinM 44, 52, 56, 57, 199
  LogM 44, 45, 52, 56
  log-magnitude in dB 44
  phase 44, 45, 47, 48, 52, 54, 56, 57
  phase in degrees 44, 52
  polar 44, 45, 56
  polar chart 44, 45, 56
  ShowY 45, 56
  ShowZ 45, 56
  Smith chart 44–6, 54, 56, 61
  two-port chart 44, 45, 56, 57
  VSWR 44, 52, 56, 57

General coupled lines 58, 74, 116–18
four-port coupled lines 58, 74, 116, 117, 222
four-port coupled microstrip lines 58, 74, 119, 225
two-port coupled lines 58, 74, 117, 118
two-port coupled microstrip lines 58, 74, 122, 239
General transmission line 58, 69, 74, 81, 82, 90, 93, 95, 98, 100, 189
GPIB 50

Ideal two-port components 58, 74, 85–9
1:N and N:1 transformer 86
attenuator/gain block 58, 74, 85
circulator 58, 74, 88, 89
gyrator 30, 58, 74, 87, 88
isolator 58, 84, 87, 89
Impedance matching
discrete element matching 141, 142, 194, 195
double stub matching 143, 144
matching of a half-wavelength dipole 194, 195
single stub matching 142, 143, 195, 196, 245, 249
Impedance transformers
Chebyshev multisection matching transformer 146, 147
quarter wave transformer 141, 142, 145, 194, 198, 199, 245
Incident current 3–5, 12, 33
Incident power 5, 14
Incident voltage 3–5, 12, 32
Input impedance 10, 145, 189, 194, 195, 197
Insertion loss 17, 18, 167–9
Installation of Software VNA 40
Isolation 68, 155, 157–9, 164, 214, 216, 219, 220, 221, 225, 229

Kuroda's identities 201, 203

Lossless transmission line 10, 58–60, 74–6, 81, 189
Lumped capacitors
interdigital capacitor 128, 129
thin film capacitor 127–9
Lumped elements 58, 73, 74, 123–5, 127–30
capacitors 58, 74, 114, 127, 128, 166, 169, 171
inductors 58, 74, 123–5, 166, 169, 171
resistor 129, 130
Lumped inductors
circular coil 123–5
circular spiral 123–6
single turn inductor 124, 126, 127
Lumped resistor 129, 130

MENU block 41, 48, 49, 51, 53
1_PortS11 48, 56
1_PortS22 48, 56
2_Ports 48, 56
AddMems function 51, 56
cal menu 48, 49, 56
CalcData function 48, 56
copy menu 55, 56
CopyGraf function 55, 56
DeltaM menu 53, 56
display menu 48, 49, 56
marker 1, 2, 3, 4, 5, 56
marker menu 51, 52, 56
MeasData function 48, 49, 56
MemData function 51, 56
off function 53, 54, 56
PrintData function 51, 56
PrintGraf function 55, 56
Q_0 and Q_L functions 53, 56
recall 1, 2 and 3 54, 56
SaveData function 50, 56
saves 1, 2 and 3 54, 56
setting menu 54, 56
Microstrip line 58, 74, 90–3, 104, 105, 108, 110, 111, 119, 120–3, 154, 156, 157, 192, 193, 201, 202, 208, 210, 213, 216, 221, 225, 235, 239, 241
Microstrip line discontinuities 104, 105, 241
bend discontinuity 109
gap discontinuity 107, 108
open-end discontinuity 110, 111
slit discontinuity 110
step discontinuity 104, 107

PARAMETER functions 43
S_{11} 43, 56
S_{12} 43, 56
S_{21} 43, 56
S_{22} 43, 56
Phase constant 9, 117, 154, 167, 174, 181

Phase shifters 141, 166, 167
  LC phase shifters 167
  Transmission line phase shifter 166, 167
Phase velocity 9, 59, 81, 82, 84, 188–90, 225
Physical transmission lines 89–91, 93–9, 235, 241
  coaxial line 58, 74, 89, 90, 101, 102
  coplanar strips 98, 99
  coplanar waveguide 58, 74, 96–8, 100
    stripline 58, 74, 94, 95, 111, 112, 114
Ports menu 66, 68, 70
  add Port1 66, 70
  add Port2 66, 70
  remove Port2 66
Power delivered to load 3, 5
Power dividers
  cascaded power divider 158, 217
  power divider with unequal splits 156, 157
  Wilkinson power divider 68, 69, 71, 155–7, 213, 215–17, 219
Power gain 17, 18
Power lost 15, 17, 18
Power received by the load 18
Properties of *S*-parameters 15

Q-factor measurements 27
Quality factor 26, 27

Radiation loss 10, 90, 96, 98, 121
Reference port admittance 73
Reference port impedance 73
Reflected power 5, 14
Reflected voltage 2–5, 12, 33
Reflection coefficient 4, 7–10, 17, 28, 117, 123, 145–7, 194
Resonance frequency 26, 27, 42, 134, 149–51, 153, 154, 205, 206, 208, 209, 213
Resonators
  coupled line resonator 154, 155, 210, 211
  microstrip line resonator 154, 208, 210
  one-port coupled resonators 151
  resonant circuit 28, 149–51, 205–9
  ring resonator 212–14
  transmission line resonators 154
  two-port coupled resonators 152
RESPONSE functions 45, 47
  auto 48, 56
  autoscale 45, 48, 56
  E_delay 47, 56
  electrical delay 45, 47, 48, 54–7
  P_offset 48, 56
  phase offset 45, 48, 54–7
  reference line position 45, 47, 56
  reference line value 42, 45, 47, 56
  Ref.P 47, 56
  Ref.V 47, 56
  scale 42, 45, 46, 56
  scale per division of the display 45, 56
Return loss 159, 219
Returned power 16, 17
RLC resonance 26, 27

Scaling property 25
Scattering parameters 1, 2, 12, 13, 33
Signal flow chart 15
Smith chart 1, 2, 7–9, 22, 28, 44, 45, 46, 54, 56, 61, 159
Software VNA 40, 41
  circuit key 41
  connection cables 41
  data input panel 41
  device shortcut key 41
  device under test (DUT) key 41
  FORMAT function block 41, 44
  labelled-key panel 41
  marker position control 41
  MENU block 41, 48, 49, 51, 53
  PARAMETER function block 41, 43
  port 1 41
  port 2 41
  preset key 41
  RESPONSE function block 41, 46, 47
  S-parameter display panel 41
  STIMULUS function block 41
  subdisplay panel 41
  turn-off switch 41
  unlabelled-key function display panel 41
  unlabelled-key panel 41

Source impedance 40, 142, 145, 146, 175, 181, 198
S-parameters
attenuator/gain block 86
bend discontinuity 109, 115
cascaded two-port networks 30
circular coil 125
circular spiral 126
coaxial line 90
common one- and two-port networks 28, 29
coplanar strips 100
coplanar waveguide 98
current controlled current source 130
current controlled voltage source 130
dipole antenna 134
four-port coupled lines 116
four-port coupled microstrip line 122
gap discontinuity 103, 108, 115
general transmission line 82
idealised circulator 88
idealised gyrator 87
idealised isolator 87
interdigital capacitor 129
microstrip line 93
microwave circuit 33
multi-port device 32
one-port impedance load 78
one-port lossless transmission line 76
open-end discontinuity 104, 111, 116
parallel transmission line stub with load impedance 84
resonant antenna 134
serial transmission line stub with load impedance 83
single turn inductor 127
slit discontinuity 110
standards 77
step discontinuity 101, 107, 114
stripline 95
T-junction 28
thin film 129
transformer 86
two-port coupled lines 117
two-port coupled microstrip line 123
two-port lossless transmission line 76
two-port networks in series and parallel connections 31
two-port series impedance device 79
two-port single admittance 80
user defined *S*-parameters: one-port device 137, 138
user defined *S*-parameters: two-port device 138, 139
voltage controlled current source 130
voltage controlled voltage source 130
Standards: one- and two-port standards 58, 74, 76, 77
STIMULUS functions 42
centre 43
centre frequency 43
frequency span 43
span 43
start 43
start frequency 43
stop 43
stop frequency 43
Stripline 58, 74, 94, 95, 111, 112, 114
Stripline discontinuities 58, 111, 112
bend discontinuity 115
gap discontinuity 114, 115
open-end discontinuity 116
step discontinuity 111, 114

T-junction 28, 30, 64, 69, 70
Total voltage and current 2, 4, 5, 10, 11
Transducer power gain 17, 18
Transmission line components 58, 74, 82–4
two-port parallel transmission line stub 58, 74, 83, 84, 189, 190
two-port serial transmission line stub 58, 74, 82
Transmission lines
open-circuited transmission line stub 190, 192
periodic transmission line structures 192
short-circuited transmission line stub 189, 191
terminated transmission line 9, 10, 188
two-port transmission line 189, 190
Two-port chart 22, 23, 25, 26–8, 44, 45, 56, 57, 208

Unconditionally stable conditions 179
User defined *S*-parameters
  one-port device 137, 138
  two-port device 138, 139

Voltage-controlled current source 130, 131
Voltage-controlled voltage source 130, 131
Voltage standing wave ratio 10

VSWR 10, 44, 52, 56, 57, 155, 158, 198, 201, 216, 219

Wireless transmission systems 187, 245, 247, 249

Y parameters 12

Z parameters 11