Contents

Foreword     xvi
Preface to the Fifth Edition     xviii
About the Author     xx
1 What Is High-End Audio?     1
2 Choosing a High-End Audio System     7
   Introduction     7
   Choosing the System Best Suited to Your Needs     9
   Setting Your Budget     9
   The Complete vs. the Incremental Purchase     10
      Value vs. Luxury Components     12
   Allocating Your Budget to Specific Components     13
   Upgrading a Single Component     16
   How to Read Magazine Reviews     17
   System Matching     20
   Do’s and Don’ts of Selecting Components     22
   Your Relationship with the Retailer     23
   Used Equipment     24
   Product Upgrades     25
   Component Selection Summary     26
3 Becoming a Better Listener     27
   Audiophile Values     29
   Pitfalls of Becoming a Critical Listener     32
   Sonic Descriptions and their Meanings     32
      Tonal Balance     35
      Overall Perspective     36
      The Treble     37
      The Midrange     38
      The Bass     40
      Soundstaging     42
      Dynamics     45
      Detail     47
      Pace, Rhythm, and Timing     47
      Coherence     48
Contents

Output-Stage Topology and Class of Operation 106
How a Power Amplifier Works 108
  The Power Supply 109
  Input and Driver Stages 111
  Output Stage 112
  How a Tubed Power Amplifier Works 112

6 Loudspeakers 117

Introduction 117
How to Choose a Loudspeaker 118
  Other Guidelines in Choosing Loudspeakers 120
  Finding the Right Loudspeaker—Before You Buy 121
What to Listen For 122
Loudspeaker Types and How They Work 124
  The Dynamic Driver 124
  The Coaxial (Concentric) Driver 126
  Dynamic Compression 127
  Problems with Dynamic Drivers 128
  The Electromagnetic Dynamic Driver 128
  The Planar-Magnetic Transducer 129
  The Heil Air-Motion Transformer 133
  The Electrostatic Driver 134
The Dipolar Radiation Patterns of Ribbons and Electrostatics 137
  Bipolar and Omnidirectional Loudspeakers 138
The Horn Driver 139
  Waveguides 142
The Plasma Driver 143
The Full-Range Driver 143
Loudspeaker Enclosures 144
  Infinite-Baffle Loading 145
  Reflex Loading 145
  Passive Radiators 147
  Transmission-Line Loading 147
  Isobarik Loading 148
  The Finite Baffle 149
  System Q 149
Powered and Servo-Driven Woofers 150
Enclosure Resonances 151
  Enclosure Shapes 155
Crossovers 155
Digital Loudspeakers 158
DSP Loudspeakers 160
Subwoofers 160
  Subwoofer Technical Overview 164
Loudspeaker Stands 166
7  Digital Source Components, Part One: Disc Players, DACs, and Interfaces  167

Introduction  167
How to Choose a Digital Source—Overview  168
What to Listen For  169
Disc Players  173
  Super Audio Compact Disc (SACD)  173
  Universal Disc Players  175
  Blu-ray Disc  176
  Bass Management in SACD and Universal Players  176
How to Choose a Digital Source—Features and Specs  177
  Disc Player and DAC Features and Specs  178
Digital Interfaces  182
  The S/PDIF Interface  183
  The USB Interface  185
  Ethernet  186
  The IP Interface  187
  DSD over PCM (DoP)  187
  Proprietary Digital Interfaces  188
  Wireless Connection  188
  Jitter in the Digital Interface  189
  Outboard Clocks  190
  Asynchronous Sample-Rate Conversion  192
High-Resolution Digital Audio: Why 44.1kHz Sampling and 16-bit Quantization Aren’t Enough  192
  16 Bits, 20 Bits, 24 Bits  195
  A Caveat About High-Resolution Digital Audio  196
Technical Addenda  197
  Direct Stream Digital (DSD) Encoding on SACD  197
  High Definition Compatible Digital (HDCD)  199
How a DAC Works  201
  Custom Digital Filters  203
  Digital-to-Analog Conversion  203
  Delta-Sigma DACs  204
  Analog Stages  206
  Balanced Outputs  206

8  Digital Source Components Part Two: Music Servers  209

Music Server Sound Quality: Better than Disc  210
Downloads  211
  Download Caveats  211
Turnkey Music Servers vs. Computer-Based Servers  212
  The Turnkey Music Server  212
  Another Type of Turnkey Music Server  214
Turnkey Server Considerations 216
Using a Smartphone or Tablet with a Music Server 216
Internet Radio and Music Subscription Services 217
Metadata 219
File Formats 220
The Do-It-Yourself, PC-Based Music Server 221
  The Importance of Bit Transparency 222
  Computer Requirements 222
  Operating System and Playback Software 223
  Hard-Disk Storage 224
Loading Your Server with Music 227
Getting Music from the Server to Your Playback System 228
Networking 229
A Simple Do-It-Yourself Music Server 230
Transferring an LP Collection to a Server 232

9  Turntables, Tonearms, and Cartridges: The LP Playback System 235
  Introduction 235
  LP Playback Hardware Overview 236
  System Hierarchy: Why the LP Front End Is So Important 237
  How to Choose an LP Playback System 237
  What to Listen For 241
  Technical Aspects of Choosing an LP Front End 243
  The Turntable 246
    The Base and Plinth 246
    Sprung and Unsprung Turntables 247
    The Platter and Bearing Assembly 249
  Platter Mats, Record Clamps, and Vacuum Hold-Down Systems 250
  The Drive System 251
  The Tonearm 252
  The Phono Cartridge 256
    Moving-Magnet and Moving-Coil Cartridges 256
    The Strain-Gauge Cartridge 257
    Stylus Shapes and Cantilever Materials 258
  LP Playback System Setup 259
  Record Care and Cleaning 264
  Vinyl as Art: Half-Speed Mastering, 45rpm Pressings, 180-gram Vinyl, and Direct-
  to-Disc LPs 267

10  Cables and Interconnects 271
  Introduction 271
  How to Choose Cables and Interconnects 273
  How Much Should You Spend on Cables and Interconnects? 275
  What to Listen For 276
  Binding Posts and Cable Terminations 277
11 Audio for Home Theater 291

Introduction 291
Overview of Home-Theater Systems 292
Should You Choose a 5.1-, 7.1-, or 9.1-Channel System? 294
Home-Theater Controllers 295
   How to Choose a Controller 297
   Inputs, Outputs, and Source Switching 297
   Automatic Calibration 298
   DSP Speaker and Room Correction 299
   Analog Bypass Modes 299
   Bass-Management Flexibility 300
   8-Channel Analog Input 301
   Digital-to-Analog Conversion 301
   7.1-Channel and 9.1-Channel Playback from 5.1-Channel Sources 301
   THX Certification 302
   3D Capability, Network Connection, Wireless Streaming, and Multi-Zone 302
Multichannel Power Amplifiers 303
   How to Choose a Home-Theater Power Amplifier 303
Loudspeakers for Home Theater 304
   The Center-Channel Speaker 304
   Adding a Center Speaker to Your System 305
   Left and Right Speakers 306
   Surround Speakers 306
   Dipolar and Bipolar Surround Speakers 307
   Surround-Back Speakers 308
   Height Speakers 308
   Subwoofers 308
Setting Up a Home Theater 308
   Basic Setup 309
   Acoustical Treatment 309
   Speaker Placement 310
   Surround Speaker Placement 310
   Center Speaker Placement 310
Acoustical Dos and Don’ts 385
A Short Course in Acoustical Theory 386
  Listening-Room Resonance Modes 387
  Optimizing Dimensional Ratios 389
  Standing Waves 393
  Reverberation 394
Building a Listening Room from Scratch 397
  Isolating the Listening Room 398
  The Walldamp Technique 399
DSP Room Correction 400

15 System Setup Secrets, Part Two: Expert Tuning Techniques, Accessories, Equipment Racks, and AC Power Conditioners 403
Introduction 403
Accessories 404
  How to Choose Accessories 405
Analog Accessories 411
System Setup Techniques 414
  Equipment Placement 414
  Cables and Interconnects 415
  Tubed Equipment 418
  LP Playback 419
  Digital Playback 419
  Loudspeakers 419
  AC Power 421
  General 421
Equipment Racks and Isolation Devices 422
  Equipment Racks 422
  Vibration-Control Accessories: Spikes, Feet, and Cones 424
AC Power Conditioners and AC Cords 425
  AC Power Cords 428
  Dedicated AC Lines 428
A Final Note 431

16 Specifications and Measurements 433
Preamplifiers 433
Power Amplifiers 437
Loudspeakers 441
Digital Components 448

Appendix A: Sound and Hearing 455
Introduction: What is Sound? 455
  Period and Frequency 456
  Wavelength 457
  Phase 457
  Absolute Polarity 459
Complex Waves 460
Comb Filtering 461
Absorption, Reflection, and Diffusion 461
Diffraction 462
The Decibel (dB) 463
Frequency, Loudness, and Equal Loudness Contours 466
Weighting Filters 467
The Dynamic Nature of Music 468
Localization 469
Other Psychoacoustic Phenomena 470

Appendix B: Audio and Electronics Basics 471
Voltage, Current, Resistance, and Power 471
Ohm’s Law 472
Series and Parallel Circuits 474
Alternating Current (AC) 476
Electromagnetic Induction, Inductance, and Capacitance 477
Filters 479
Impedance 480
Loudspeaker Phase Angle 482
Capacitor Types 483
Anatomy of an Audio Product 483
The Power Supply 484
Amplifier Circuits 487
Amplifier Distortion 491
Vacuum Tube Amplifiers 492
Operational Amplifiers 493
Digital Electronics 494

Appendix C: Digital Audio Basics 495
Introduction 495
Binary Number System 496
Sampling and Quantization 497
Sampling Rate, Nyquist Theorem, and Aliasing 498
Quantization 501
Dither 503
Digital Audio Storage 505
Error Correction 506
Digital-to-Analog Conversion 506
Jitter Explained 507
Digital Signal Processing (DSP) 510
Perceptual Coding 510

Glossary 513

Index 545