

A close-up, high-angle photograph of a speaker driver, likely a tweeter or midrange driver, showing the internal mesh and the outer frame. The image is in black and white, with the speaker's components appearing as light gray and white against a dark background. The speaker is positioned on the left side of the cover, with its circular shape partially cut off by the edge of the frame.

The Complete Guide to High-End Audio

Fourth Edition

Robert Harley

Editor-in-Chief
The Absolute Sound

The Complete Guide to High-End Audio

Fourth Edition

The Complete Guide to High-End Audio

Fourth Edition

Robert Harley

Acapella Publishing

Carlsbad, California

Copyright © 1994–2010 by Robert Harley

Fourth Edition
First Printing—2010

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system without written permission from the publisher, except for the inclusion of brief quotations in a review.

International Standard Book Number:
0-9786493-1-1

Cover Concept and Design: *Torquil Dewar*

Printed in the United States of America

Trademark Notice

This book comments on and describes various audio and video components. Many such products are identified by their tradenames. In most cases, these designations are claimed as legally protected trademarks by the companies manufacturing the products. Use of a term in this book should not be regarded as affecting the validity of any trademark or service mark. You should investigate a claimed trademark before using it for any purpose other than to refer to the product.

Warning Disclaimer

This book is designed to provide the most current, correct, and clearly expressed information regarding the subject matter covered. It is sold with the understanding that the publisher and author are not engaged in rendering audio/video system design.

It is not the purpose of this manual to reprint all the information otherwise available to the author and/or publisher, but to complement, amplify, and supplement other texts. You are urged to read all available material and learn as much as possible about audio, video, and home theater to tailor the information to your individual needs. For more information, readers are encouraged to consult with professional specialty audio and video retailers or manufacturers for information concerning specific matters before making any decision.

Every effort has been made to make this manual as complete and accurate as possible. However, there may be mistakes both typographical and in content. Therefore, this text should be used as a general guide and not as the ultimate source of audio and video information. Furthermore, this text contains information current only up to the printing date.

The purpose of this manual is to educate and entertain. The author and Acapella Publishing shall have neither liability nor responsibility to any person or entity with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the information contained in this book.

If you do not wish to be bound by the above, you may return this book to the place of purchase for a full refund.

Contents

	Foreword	xvi
	Preface	xvii
	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	8
	Setting Your Budget	9
	The Complete vs. the Incremental Purchase	10
	Value vs. Luxury Components	12
	Allocating Your Budget to Specific Components	12
	Upgrading a Single Component	16
	How to Read Magazine Reviews	17
	System Matching	20
	Do's and Don'ts of Selecting Components	21
	Your Relationship with the Retailer	22
	Used Equipment	24
	Product Upgrades	25
	Component Selection Summary	25
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
	Musicality	48
	Notes on Learning Descriptive Terms	51
	Critical Listening Setup Procedures	52
	Single-Presentation Listening—What It’s All About	54
	Critical Listening Summary	55
	Level Matching	56
4	Preamplifiers	57
	Introduction	57
	How to Choose a Preamplifier	59
	Balanced and Unbalanced Connections	60
	Other Considerations in Choosing a Preamplifier	60
	What to Listen For	61
	Tubes vs. Transistors	64
	Tube Life and Replacement Options	65
	The Line-Stage Preamplifier	66
	The Phono-Stage Preamplifier	67
	RIAA Equalization	69
	Phono-Stage Gain	70
	Cartridge Loading	71
	The Digital Preamplifier	72
	Audio/Video Controllers and Multichannel Preamplifiers	73
	Passive Level Controls: Are They Right for Your System?	73
	How a Preamplifier Works	74
	Balanced and Unbalanced Preamplifiers	77
5	Power and Integrated Amplifiers	79
	Introduction	79
	How to Choose a Power Amplifier	81
	Integrated Amplifiers	81
	How Much Power Do You Need?	83
	The dBW Power Rating	84
	Why Amplifier Output Current Matters	85
	What to Look For when Comparing Power Ratings	86
	Why Amplifier Power Isn’t Everything	88
	Other Power-Amplifier Considerations	90
	Tubes vs. Transistors	90
	Balanced Inputs	91
	Bridging	92
	Bi-Amping	92
	What to Listen For	94
	A Survey of Amplifier Types	96

Single-Ended Triode Amplifiers	96
Single-Ended Solid-State Amplifiers	98
Switching (Class D) Power Amplifiers	99
Digital Amplifiers	101
Output-Stage Topology and Class of Operation	102
How a Power Amplifier Works	105
The Power Supply	105
Input and Driver Stages	106
Output Stage	107
How a Tubed Power Amplifier Works	108
6 Loudspeakers	111
Introduction	111
How to Choose a Loudspeaker	112
Other Guidelines in Choosing Loudspeakers	114
Finding the Right Loudspeaker—Before You Buy	115
What to Listen For	116
Loudspeaker Types and How They Work	118
The Dynamic Driver	118
Dynamic Compression	120
Problems with Dynamic Drivers	121
The Electromagnetic Dynamic Driver	122
The Planar Magnetic Transducer	122
The Heil Air-Motion Transformer	127
The Electrostatic Driver	127
The Dipolar Radiation Patterns of Ribbons and Electrostatics	131
Bipolar and Omnipolar Loudspeakers	131
Horn Loudspeakers	133
Waveguides	135
Loudspeaker Enclosures	136
Infinite Baffle Loading	137
Reflex Loading	137
Passive Radiators	139
Transmission-Line Loading	139
Isobarik Loading	140
Energy Multiplied Bandpass	141
The Finite Baffle	142
System Q	142
Powered and Servo-Driven Woofers	143
Enclosure Resonances	145
Enclosure Shapes	147
Crossovers	148
The Crossoverless Coaxial Driver	151
Digital Loudspeakers	151

	Subwoofers	153
	Subwoofer Technical Overview	155
	Loudspeaker Stands	157
7	Disc Players, Transports, and DACs	159
	Introduction	159
	How to Choose a Digital Source—Overview	161
	Should You Buy a CD Player, Universal Disc Player, or Transport and DAC?	162
	How to Choose a Digital Source—Features and Specs	164
	Disc Player and DAC Features and Specs	164
	Advanced Disc-Player Features: Two Examples	170
	Transport Features and Specs	172
	What to Listen For	174
	A Closer Look at Digital Interfaces	177
	The S/PDIF Digital Interface	177
	The I ² S Interface	180
	Jitter in the Digital Interface	180
	Outboard Clocks	180
	Asynchronous Sample-Rate Conversion	183
	High-Resolution Digital Interfaces	184
	High-Resolution Digital Audio: Why 44.1kHz Sampling and 16-bit Quantization Aren't Enough	184
	16 Bits, 20 Bits, and 24 Bits	186
	A Caveat About High-Resolution Digital Audio	187
	How to Get High-Resolution Digital Audio	188
	Super Audio CD (SACD)	189
	Hybrid SACD	189
	Direct Stream Digital (DSD) Encoding on SACD	191
	DSD Sound Quality	193
	DVD-Audio	194
	Bass Management in SACD and DVD-A Players	195
	Blu-ray Disc	196
	FireWire (IEEE1394) and Digital Transmission Content Protection (DTCP)	196
	High Definition Compatible Digital (HDCD)	197
	How a DAC Works	200
	Custom Digital Filters	201
	Digital-to-Analog Conversion	201
	Delta-Sigma DACs	202
	Analog Stages	204
	How a CD Transport Works	204
8	Music Servers and Computer-Based Audio	209
	Music Server Sound Quality: Better Than Disc	210
	High-Resolution Sound Quality from Music Servers	210
	High-Resolution Downloads—A Caveat	212

Turnkey Music Servers Vs. PC-Based Servers	213
The Turnkey Music Server	213
Another Type of Turnkey Music Server	216
Turnkey Server Considerations	217
Using an iPod as a Music Server	218
Internet Radio and Music Servers	218
File Formats	219
The Do-it-Yourself PC-Based Music Server	220
The Importance of Bit-Transparency	221
Computer Requirements	221
Operating System and Playback Software	222
Hard-Disc-Drive Storage	222
Loading Your Server with Music	225
Getting Music from the Server to Your Playback System	227
The USB Interface	228
Music-Management Software and User Interface	229
Transferring an LP Collection to a Server	229
9 Turntables, Tonearms, and Cartridges: The LP Playback System	233
Introduction	233
LP Playback Hardware Overview	234
System Hierarchy: Why the LP Front End Is So Important	235
How to Choose an LP Playback System	235
What to Listen For	238
Technical Aspects of Choosing an LP Front End	241
The Turntable	243
The Base and Plinth	244
Sprung and Unsprung Turntables	245
The Platter and Bearing Assembly	246
Platter Mats, Record Clamps, and Vacuum Hold-Down Systems	248
The Drive System	249
The Tonearm	250
The Phono Cartridge	254
Moving-Magnet and Moving-Coil Cartridges	254
The Strain-Gauge Cartridge	255
Stylus Shapes and Cantilever Materials	256
LP Playback System Setup	257
Record Care and Cleaning	262
Vinyl as Art: Half-Speed Mastering, 45rpm Pressings, 180-Gram Vinyl, and Direct-to-Disc LPs	64
10 FM Tuners, Satellite Radio, Internet Radio, and HD Radio	269
Introduction	269
How to Choose a Tuner	270
What to Listen For	273

	Tuner Specifications and Measurements	274
	Satellite Radio	275
	Internet Radio	276
	HD Radio	276
11	Cables and Interconnects	277
	Introduction	277
	How to Choose Cables and Interconnects	279
	How Much Should You Spend on Cables and Interconnects?	281
	What to Listen For	282
	Binding Posts and Cable Terminations	284
	Bi-Wired Loudspeaker Cables	284
	Balanced and Unbalanced Lines	286
	Cable and Interconnect Construction	289
	Conductors	289
	The Dielectric	290
	Terminations	290
	Geometry	291
	Terminated Cables and Interconnects	292
	Battery Bias in Cables and Interconnects	293
	Cable and Interconnect Specifications	295
	Cables in the Power Amplifier/Loudspeaker Interface	295
12	Audio for Home Theater	297
	Introduction	297
	Overview of Home-Theater Systems	298
	Should You Choose a 5.1-Channel or 7.1-Channel System?	300
	Home-Theater Controllers	301
	How to Choose a Controller	303
	Inputs, Outputs, and Source Switching	303
	Automatic Calibration	304
	DSP Speaker and Room Correction	305
	Analog Bypass Modes	305
	Bass-Management Flexibility	306
	8-Channel Analog Input	306
	Digital-to-Analog Conversion	307
	7.1-Channel Playback from 5.1-Channel Sources	307
	THX Certification	307
	Advanced Features: 3D Capability, Network Connection, Multi-Zone	308
	Multichannel Power Amplifiers	308
	How to Choose a Home-Theater Power Amplifier	309
	Loudspeakers for Home Theater	310
	The Center-Channel Speaker	310
	Adding a Center Speaker to Your System	311
	Left and Right Speakers	312

	Surround Speakers	312
	Dipolar and Bipolar Surround Speakers	312
	Surround-Back Speakers	313
	Subwoofers	314
	Setting up a Home Theater	314
	Basic Setup	314
	Acoustical Treatment	315
	Speaker Placement	315
	Surround Speaker Placement	315
	Center Speaker Placement	317
	Left and Right Speaker Placement	317
	Calibrating a Home Theater	318
	Bass Management	319
	Setting Individual Channel Levels	319
	Adding Home Theater without Compromising Music Performance	320
	Addendum: Surround-Sound Formats Explained	322
13	Multichannel Audio	325
	Introduction	325
	A Short History of Multichannel Audio	326
	Do We Want Multichannel Music Playback?	328
	How to Get Multichannel Audio in Your Home	332
	Loudspeaker Types and Placement	334
	Bass Management	334
	Calibration	336
	Multichannel Playback from 2-Channel Sources	337
	Ambisonics	338
14	System Set-Up Secrets Part One: Loudspeaker Placement and Room Acoustics	341
	Introduction	341
	Loudspeaker Placement	342
	Loudspeaker Placement in Asymmetrical Rooms	349
	Short-Wall vs. Long-Wall Placement	350
	Dipolar and Bipolar Loudspeaker Placement	352
	Subwoofer Setup and Placement	353
	Multichannel Loudspeaker Placement	356
	Loudspeaker Placement Summary	357
	Common Room Problems and How to Treat Them	358
	Acoustical Do's and Don'ts	367
	A Short Course in Acoustical Theory	368
	Listening-Room Resonance Modes	369
	Optimizing Dimensional Ratios	371
	Standing Waves	375
	Reverberation	376

	Building a Listening Room from Scratch	379
	Isolating the Listening Room	380
	The Walldamp Technique	381
	DSP Room Correction	382
15	System Set-Up Secrets Part Two: Expert Tuning Techniques and Audiophile Accessories	385
	Accessories	386
	How to Choose Accessories	386
	Analog Accessories	393
	Headphones and Headphone Amplifiers	396
	System Set-Up Techniques	397
	Equipment Placement	397
	Cables and Interconnects	398
	Tubed Equipment	400
	LP Playback	401
	Digital Playback	401
	Loudspeakers	402
	AC Power	403
	General	403
	Equipment Racks and Isolation Devices	404
	Equipment Racks	404
	Accessories to Control Vibration	406
	AC power conditioners and AC Cords	407
	AC Cords	411
	A Final Note	411
16	Specifications and Measurements	413
	Preamplifier Specifications and Measurements	413
	Power Amplifier Specifications and Measurements	417
	Loudspeaker Specifications and Measurements	421
	Digital Specifications and Measurements	428
	Appendix A: Sound and Hearing	435
	Introduction: What is Sound?	435
	Period and Frequency	436
	Wavelength	437
	Phase	437
	Absolute Polarity	439
	Complex Waves	440
	Comb Filtering	441
	Absorption, Reflection, and Diffusion	441
	Diffraction	442
	The Decibel (dB)	443
	Frequency, Loudness, and Equal Loudness Contours	446

Weighting Filters	447
The Dynamic Nature of Music	448
Localization	449
Other Psychoacoustic Phenomena	450
Appendix B: Audio and Electronics Basics	451
Voltage, Current, Resistance, and Power	451
Ohm's Law	452
Series and Parallel Circuits	454
Alternating Current (AC)	456
Electromagnetic Induction, Inductance, and Capacitance	457
Filters	459
Impedance	460
Loudspeaker Phase Angle	462
Capacitor Types	463
Anatomy of an Audio Product	463
The Power Supply	464
Amplifier Circuits	467
Amplifier Distortion	471
Vacuum Tube Amplifiers	472
Operational Amplifiers	473
Digital Electronics	474
Appendix C: Digital Audio Basics	475
Introduction	475
Binary Number System	476
Sampling and Quantization	477
Sampling Rate, Nyquist Theorem, and Aliasing	478
Quantization	481
Dither	483
Digital Audio Storage	485
Error Correction	486
Digital-to-Analog Conversion	486
Jitter Explained	487
Digital Signal Processing (DSP)	490
Perceptual Coding	490
Glossary	493
Index	519

Foreword

By Keith Jarrett

Music is the sonic motion of intention. With words, sound can be divorced from meaning by taking away the physical quality of speech. But music's meaning is *in* its physical quality: its sound. When a musician plays something a certain way and we can't hear the intent (the reason) behind it, we are hearing wasted motion, and register it as such because we haven't been given enough clues about the intent. We can then grow to think that everything is only gesture, and miss the real thing.

The media through which we hear music (our systems, rooms, etc.) cannot be separated from our ability to experience the music. It isn't the same *music* on a different system because we cannot separate music's rhetoric (its words) from its physical reality (its delivery). This makes the "delivery systems" (our stereos) more important than we might think they are. Can they *tell* us what the musicians on the recording are telling us?

As a musician, I often—too often—had the following experience: I would play a concert, hear the tape afterward, and wonder what was missing. I would remember incredible things in the concert that just weren't on the tape. The notes were there, but notes are not music. Where was the music, the *intention*?

We could think of it this way: On the tape, the rhetoric had no meaning. Had I trusted the tape and not my memory of the actual event, I would have never grown to understand that, even though the sound is on tape, it doesn't mean you've recorded the *music*. If you've heard a certain CD on a certain system, it doesn't necessarily mean that you've heard what's on the CD. We must learn to trust the responses of our own system—our ears—to music systems. Of course, this demands that we be in touch with ourselves—no easy thing.

People to whom music is important need to get close to the intention in a recording, and there's only one way to do this in the home: learn about the world of audio equipment. Use your (and others') ears to help remove whatever hinders you from the musical experience on the recording. Of course, it's not only the reproduction side that needs care—but that's the only side the listener has control over.

For instance, it's demonstrable that by merely flipping a two-pronged AC plug on a CD player, or even a turntable, a record you thought you didn't like can become a favorite—just because the polarity was wrong. Since music cannot be divorced from its emotional content,

the *sound* of a record can determine whether you think you like the *music*. And vice versa, when you can't listen to music you really think you like because of how it was *recorded*.

Obviously, the musical experience is a delicate, complex thing, and we humans are more sensitive than we sometimes think. But we have the option to tune our music systems to better balance the equation. We can get closer to what we want if we *know* what we want.

There are stereo components that approximate the musical experience at many different price levels. We all know what our financial limitations are; but, given the desire to improve our systems, we *can* do it.

It by no means follows that musicians have to be audiophiles. Though I've been recording since 1965, I didn't seriously think about much of this until the last decade. But audiophiles and music lovers push the envelope, and we all benefit. Also, the more serious audiophiles are determined to keep their minds and ears open, keep learning, and try to remain patient during the process. Doing this thing right can take time.

There are a lot of people out there listening to all of these components for us. I recommend *using* this fact, and *carefully* reading others' evaluations, until you can tell whether a reviewer's preferences in sound match your own priorities. You *can* sort of get to know these guys over a period of time.

But, of course, it's *your* ears that count. I think you should pay attention to their needs. After all, we're talking nutrition in an age of diet soft drinks.

Preface to the Fourth Edition

This new fourth edition of *The Complete Guide to High-End Audio* represents the most extensive overhaul of the book since its introduction in 1994. The reason is simple: today's music listener is faced with an unprecedented array of new technologies for acquiring, storing, and accessing music. As recently as 2004 (the book's last update), CD was the dominant medium, SACD and DVD-Audio were battling to be the CD's high-resolution successor, downloadable music was severely compromised in sound quality and thus of little interest to the audiophile, and only a few hardy souls dared to use a PC as a music server.

Just six years later, everything is different. Downloadable music is no longer synonymous with horribly compressed MP3 sound quality—it's the serious music lover's path to spectacular-sounding high-resolution digital audio. The format war between SACD and DVD-A was rendered moot by the death of physical media. Although SACD is still a great format with many years of life left, the Internet allows us to transcend physical formats and download high-resolution files, independent of the dictates of the mass market or the need to standardize on a disc format. Linn Products, the company that revolutionized high-performance audio in 1972 with its LP12 turntable, ceased production of CD players in early 2010. Its customers had moved on to accessing music via the Internet. Further evidence of this trend comes from the president of Polygram records, who stated that 90% of all CDs sold are played just once—to be ripped to a computer hard drive. We are in an exciting new age.

But it's not just high-res digital, music servers, downloadable music, and hard-drive storage that have dramatically changed the audiophile landscape. Technology advances have greatly improved the performance of the traditional cone-based dynamic loudspeaker. Switching amplifiers, with their cool operation, compact size, and high output power, are beginning to be taken seriously. That venerable old format, the vinyl record, is seeing a remarkable resurgence in popularity (LP sales doubled in 2009 over 2008). Today's turntables, tonearms, and cartridges extract even more musical information from the LP's grooves. And CD playback has improved immeasurably, largely the result of inventive new digital filters. The establishment of Blu-ray Disc as a mass-market format has wonderful implications for the music lover. The format can contain not only high-definition video, but also up to eight channels of high-resolution digital audio with perfect bit-for-bit accuracy to the source. Concert performances on Blu-ray are nothing short of spectacular. Finally, although the laws of physics haven't been repealed, this fourth edition incorporates new techniques and products for optimizing your listening room and tweaking your system for the best possible sound.

As has been the case with previous editions, each chapter progresses from the most basic information to deeper technical discussions. When you've reached your own comfortable depth, simply skip to the beginning of the next chapter where the material becomes easier. This book is meant to be used as a reference rather than read linearly from start to finish.

Keep in mind that you don't need to understand the technical aspects of audio to enjoy music in your home. I've presented the technical content for those readers interested in knowing how audio works, and to make this book truly *The Complete Guide to High-End Audio*.

Robert Harley
Carlsbad, California

About the Author

Robert Harley is the author of *Home Theater For Everyone*, *Introductory Guide to High-Performance Audio Systems*, and Editor-in-Chief of *The Absolute Sound* magazine. *The Absolute Sound*, founded in 1972, is the world's most respected journal of high-end audio. Robert Harley's more than 1000 published equipment reviews and articles on music and home-theater sound reproduction have helped thousands of enthusiasts improve their home-entertainment systems.

Robert Harley holds a degree in recording engineering and has taught a college degree program in that field. He has worked as a recording engineer and studio owner, compact disc mastering engineer, technical writer, and audio journalist. Before joining *The Absolute Sound* and *The Perfect Vision* in 1999, he was Technical Editor of *Stereophile* magazine for eight years, and also served in that capacity at *Fi: The Magazine of Music and Sound*.

1 What Is High-End Audio?

High-end audio is about passion—passion for music, and for how well it is reproduced. High-end audio is the quest to re-create in the listener’s home the musical message of the composer or performer with the maximum realism, emotion, and intensity. Because music is important, re-creating it with the highest possible fidelity is important.

High-end audio products constitute a unique subset of music-reproduction components that bear little similarity to the “stereo systems” sold in department stores. A music-reproduction system isn’t a home appliance like a washing machine or toaster; it is a vehicle for expressing the vast emotional and intellectual potential of the music encoded on our records and CDs. The higher the quality of reproduction, the deeper our connection with the music.

The high-end ethos—that music and the quality of its reproduction matter deeply—is manifested in high-end audio products. They are designed by dedicated enthusiasts who combine technical skill and musical sensitivity in their crafting of components that take us one step closer to the original musical event. High-end products are designed by ear, built by hand, and exist for one reason: to enhance the experience of music listening.

A common misperception among the hi-fi-consuming public is that high-end audio means high-priced audio. In the mass-market mind, high-end audio is nothing more than elaborate stereo equipment with fancy features and price tags aimed at millionaires. Sure, the performance may be a little better than the hi-fi you find at your local appliance store, but who can afford it? Moreover, high-end audio is seen as being only for trained, discriminating listeners, snobs, or gadget freaks—but not for the average person on the street.

High-end audio is none of these things.

First, the term “high-end” refers to the products’ *performance*, not their price. Many true high-end systems cost no more—and often less—than the all-in-one rack systems sold in department stores. I’ve heard many inexpensive systems that capture the essence of what high-quality music reproduction is all about—systems easily within the budgets of average consumers. Although many high-end components *are* high-priced, this doesn’t mean that you have to take out a second mortgage to have high-quality music reproduction in your home. A great-sounding system can be less expensive than you might think.

Second, high-end audio is about communicating the musical experience, not adding elaborate, difficult-to-operate features. In fact, high-end systems are much easier to use than

mass-market mid-fi systems. This is because the high-end ethic eliminates useless features, instead putting the money into sound quality. High-end audio is for music lovers, not electronics whizzes.

Third, *anyone* who likes music can immediately appreciate the value of high-quality sound reproduction. It doesn't take a "golden ear" to know what sounds good. The differences between good and mediocre music reproduction are instantly obvious. The reaction—usually pleasure and surprise—of someone hearing a true high-end audio system for the first time underscores that high-end audio can be appreciated by everyone. If you enjoy music, you'll enjoy it more through a high-end system. It's that simple.

Finally, the goal of high-end audio is to make the equipment "disappear"; when that happens, we know that we have reached the highest state of communication between musician and listener. High-end audio isn't about equipment; it's about music.

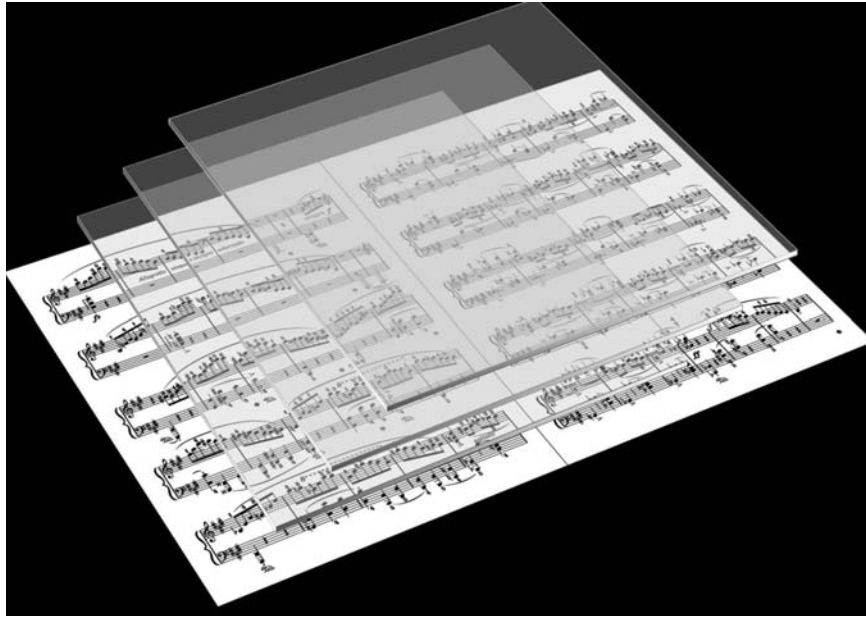
The high-end credo holds that the less the musical signal is processed, the better. Any electronic circuit, wire, tone control, or switch degrades the signal—and thus the musical experience. This is why you won't find graphic equalizers, "spatial enhancers," "sub-harmonic synthesizers," or other such gimmicks in high-end equipment. These devices are not only departures from musical reality, they add unnecessary circuitry to the signal path. By minimizing the amount of electronics between you and the musicians, high-end audio products can maximize the directness of the musical experience. Less is more.

Imagine yourself standing at the edge of the Grand Canyon, feeling overwhelmed by its grandeur. You experience not only the vastness of this massive sculpture carved deep into the earth, but all its smaller features jump out at you as well, vivid and alive. You can discern fine gradations of hue in the rock layers—distinctions between the many shades of red are readily apparent. Fine details of the huge formations are easily resolved simply by your looking at them, thus deepening your appreciation. The contrasts of light and shadow highlight the apparently infinite maze of cracks and crevasses. The longer and closer you look, the more you see. The wealth of sensory input keeps you standing silently at the edge, in awe of nature's unfathomable beauty.

Now imagine yourself looking at the Grand Canyon through a window made of many thicknesses of glass, each one less than perfectly transparent. One pane has a slight grayish opacity that dulls the vivid hues and obliterates the subtle distinctions between similar shades of color. The fine granular structure of the next pane diminishes your ability to resolve features in the rock. Another pane reduces the contrast between light and shadow, turning the Canyon's immense depth and breadth into a flat canvas. Finally, the window-frame itself constricts your view, destroying the Canyon's overall impact. Instead of the direct and immediate reality of standing at the edge of the Grand Canyon, what you see is gray, murky, lifeless, and synthetic. You may as well be watching it on television.

Hearing reproduced music through a mediocre playback system is like looking at the Grand Canyon through those panes of glass. Each component in the playback chain—CD player, turntable, preamplifier, power amplifier, loudspeakers, and the cables that connect them—in some way distorts the signal passing through it. One product may add a coarse, grainy character to instrumental textures. Another may reduce the dynamic contrasts between loud and soft, muting the composer's or performer's expression. Yet another may cast a thick, murky pall over the music, destroying its subtle tonal colors and overlaying all instruments with an undifferentiated timbre. Finally, the windowframe—that is, the electronic and mechanical playback system—diminishes the expanse that is the musicians' artistic intent.

Fig. 1-1 Each component in an audio system can be thought of as a piece of glass through which we experience music. (Courtesy AudioQuest)



High-end audio is about removing as many panes of glass as possible, and making those that remain as transparent as they can be. The fewer the panes, and the less effect each has on the information passing through it, the closer we get to the live experience and the deeper our connection with the musical message.

Why are high-end audio products more transparent windows on the musical event than mass-market “stereo systems”? High-end products are designed to *sound* good—that is, like the real thing. They’re not necessarily designed to perform “well” according to some arbitrary technical specification. The true high-end designer *listens* to the product during its development, changing parts and trying different techniques to produce the most realistic sound possible. He combines technical skill with musical sensitivity to create a product that best conveys the musical experience. This dedication often becomes a zealous pursuit, involving many hundreds of listening hours and painstaking attention to every factor that influences the sound. Often, a more expensive part will be included to improve the product’s sound, while the retail price remains the same. The higher cost of this musically superior part comes off the company’s bottom line. Why? Because the high-end designer cares deeply about music and its reproduction.

Conversely, mass-market audio components are often designed to look good “on paper”—on the specification sheet—sometimes at the expense of sound quality. A good example of this is the “THD wars” of the 1970s and ‘80s. THD stands for Total Harmonic Distortion, a specification widely used by uneducated consumers as a measure of amplifier quality. (If you’ve done this, don’t worry; before I learned more about audio, I, too, looked at THD figures.) The lower the THD, the better the amplifier was perceived to be. This led the electronics giants to produce products with vanishingly low THD numbers. It became a contest to see which brand had the most zeros after the decimal point in its THD specification (0.001%, for example). Many buyers bought receivers or amplifiers solely on the basis of this specification.

- [*click Net of Jewels*](#)
- [download online Morocco: A Culinary Journey with Recipes from the Spice-Scented Markets of Marrakech to the Date-Filled Oasis of Zagora pdf, azw \(kindle\)](#)
- [The Hoops Whisperer: On the Court and Inside the Heads of Basketball's Best Players pdf](#)
- [Elixir in Action online](#)
- [download online The "I Ching": A Biography \(Lives of Great Religious Books\)](#)
- [click The World Unseen pdf, azw \(kindle\), epub, doc, mobi](#)

- <http://academialanguagebar.com/?ebooks/Professor-Moriarty--The-Hound-of-the-D-Urbervilles--Professor-Moriarty-Novels-.pdf>
- <http://cavaldecartro.highlandagency.es/library/The-Dragon-s-Call--Merlin-.pdf>
- <http://flog.co.id/library/The-Hoops-Whisperer--On-the-Court-and-Inside-the-Heads-of-Basketball-s-Best-Players.pdf>
- <http://dadhoc.com/lib/Shadows-Return--Nightrunner--Book-4-.pdf>
- <http://transtrade.cz/?ebooks/Now-and-Forever.pdf>
- <http://fortune-touko.com/library/The-World-Unseen.pdf>