

# THE ARTIST'S AND PRODUCER'S GUIDE TO SUPER AUDIO CD

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You already know that SACD is a terrific-sounding high-capacity disc medium to deliver surround and high-resolution stereo.

Here is what you need to know to create and market Super Audio CD recordings.

Airshow Mastering has been in the forefront of studios working with SA-CD technology. Since 1999, Airshow has beta-tested workstations and other production gear, and mastered many of the first commercial releases in the format. Drawing upon our five years of experience and compiling up-to-the-minute information, we offer a guide to others ready to work in this new medium.



SUPER AUDIO CD

## Super Audio CD is one of two new high-resolution audio discs on the market.

**Super Audio CD** is the high-resolution music release format developed by Sony and Philips to deliver a new type of digital recording known as DSD – Direct Stream Digital. In contrast to PCM digital, DSD is a one bit digital stream sampled at a very high speed, 2.8 MHz. Absent are the artifacts and the “digital” sound found in 44.1kHz/16 bit (CD quality) or 24 bit digital systems. Engineers, artists, and reviewers have described DSD as sounding very “analog-like.” By sampling the signal with a single bit converter at a rate over 2.8 Megahertz, DSD offers an extremely wide dynamic range (over 120dB) and extended frequency response, rivaling or surpassing the best analog and 96kHz digital recording systems.

An SA-CD is, physically, a DVD disc, but one encoded in DSD. An SA-CD can hold a stereo mix and a multichannel mix; including a CD-format stereo mix on a separate layer makes these discs compatible with all existing CD players. (The separate layer makes it a “hybrid” SA-CD.)

The three audio streams – stereo DSD, multichannel DSD and CD – do not have to contain the same program material. In fact, some labels view the 4.7GB DSD layer as an ideal medium to issue several CDs’ worth of stereo recordings on one disc. Theoretically, the SA-CD can hold 256 minutes of high-resolution stereo; the longest-playing SA-CD we’ve heard is the Police “Live” at 144 minutes.

The SA-CD layer is accessed on disc players that are specifically equipped for SA-CD playback. Sony, Philips, Linn, Classe, Marantz, Accuphase, Denon, Kenwood, Aiwa, and Sharp all make SA-CD/CD and/or SA-CD/DVD-Video players; Pioneer, Marantz, Onkyo and Integra all offer “universal” players for CD, DVD-Audio, DVD-Video and SA-CD playback. The list of manufacturers grows daily, as the price range and options expand, with players now available under \$200 (US).

In addition to the benefits of high-resolution and multichannel sound, the SA-CD technology

is extremely secure, with multiple layers of copy-protection and encryption built into the format.

➔ *To summarize, a Super Audio CD is a high-capacity disc that plays back DSD audio. A variety of production scenarios using commonly available production gear can be employed to take advantage of the sonic benefits of DSD and the SA-CD. BUT to issue a SA-CD release, at some point your audio must become DSD data, and it must be specifically mastered for the SA-CD format. Mastering for SA-CD release is done with specialized equipment: recorders, converters, the mastering workstation, even the tape drive to record the master. This suite of equipment is found in the studios of major record labels worldwide and in a handful of commercial mastering labs in the U.S.*

**DVD-Audio** is a new member of the successful DVD family that brings high-fidelity sound to the format. DVD is a video-oriented medium that is capable of carrying surround audio and high-resolution stereo audio; DVD-Audio uses the same disc with encoding schemes that emphasize the audio elements. It’s a flexible format that enables the producer to include high-resolution stereo (up to 192k/24 bit PCM) and 5.1 surround (up to 96k/24 bit PCM). Because it is an A/V medium, menus and other visual elements become part of the production equation. DVD Audio players are needed to play back high-resolution audio on DVD-A discs.

➔ *To summarize, DVD-A is a higher-bit rate, multichannel implementation of the PCM digital technology represented by audio CDs.*

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For the full technical brief on this breakthrough technology, you may view this url:

<http://www.sel.sony.com/SEL/consumer/dsd/dsd.pdf>

SonicStudio offers a graphical presentation of similar information, plus the SA-CD project workflow, at

<ftp://www.sonicstudio.com/PDFs/DSD-SACD/Overview%20of%20SACD.pdf>

“DSD = Doesn't Sound Digital”

— Bob Dawson, Bias Recording

## Single-layer vs. Hybrid release

Most SA-CD titles are hybrid discs (with a DSD layer and a CD layer), playable on SA-CD-equipped players and CD players. Sony/Philips specifically developed the hybrid disc in recognition of the demand by consumers that the format be backward-compatible. Even as listeners invest in the SA-CD/home theater array, they still listen to CDs on portable players and in cars. The hybrid disc technology makes the music fully available to the listener in any setting.

The hybrid disc also solves the practical problem of maintaining dual inventory; one release serves many markets.

Because CD technology is not secure and its contents cannot be protected against piracy, the CD layer of any hybrid disc is as prone to theft as any standard CD, even as the SA-CD layer is robustly protected. If security is the most important consideration, a single layer disc may be the answer.

- The SADiE, Pyramix and Sonoma workstations all record multichannel DSD, with external A/DSD and DSD/A converters.
- Prism, dCS, Meitner and Genex all offer high quality external DSD converters.

All of the gear described here is available to buy or to rent. Airshow has the DS-D98 and Genex 8500 to play back mixes received from our clients, a Sony Sonoma, and Prism and Meitner converters.

For information on commercial rental of DSD gear, please visit [www.dmtrentals.com](http://www.dmtrentals.com)

**Record on the equipment of your choice, and then mix to DSD.** High-resolution PCM (24 bit/88 kHz, 96 kHz, 176.4 kHz, or 192 kHz sampling rates) can be produced on several popular workstations like ProTools HD, Nuendo, and Digital Performer. Use all of your favorite hi-res PCM and analog mixing tools, then use a DSD recorder to store the mixes for SA-CD mastering. The same recorders and converters described above can be used in this scenario.

**Mix to high-resolution PCM or analog (yes, it's hi-res, too!) and leave the final DSD conversion 'til mastering.** High-resolution PCM recorder options are numerous: high-res multitrack recorders like the Tascam DA-98HR; or hard disk recorders from Mackie, Radar, Alesis, Tascam and others. High resolution digital mixes can be delivered to the mastering studio as WAV, AIFF, or SDII files on CDR, DVD-R, hard drive, and other formats.

## What about DSD production tools?

Studio equipment manufacturers are working to give engineers and producers the full range of digital production tools they need in the DSD format. Sony has created modular "building blocks" for eq, i/o, mixing, etc, which will speed up the process of bringing DSD production and mastering tools to market.

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To illuminate the marketing aspect of this decision, visit [towerrecords.com](http://towerrecords.com) and view the tags that accompany the hybrid and the single-layer SA-CD releases.

## What are the ways to produce for SACD release?

### DSD as a master delivery format

The Producers and Engineers Wing of the Recording Academy released comprehensive guidelines for digital deliverables in 2003; titled "Master Delivery Recommendations," it acknowledges that DSD's high resolution is "future-proof," as source media for a variety of release media. The P&E guidelines find DSD is an acceptable delivery format, even for non-SA-CD releases. You may download a copy of the complete document at [http://www.grammy.com/pe\\_wing/guidelines/DeliveryRecs.pdf](http://www.grammy.com/pe_wing/guidelines/DeliveryRecs.pdf)

To take advantage of SA-CD's high resolution, your music should be recorded and mixed using high resolution systems. There are several strategies you can consider:

**Record using a DSD recorder.** This is referred to as "pure DSD" and is popular among audiophile record labels.

There are several recorders and workstations available that record directly in DSD format.

- The Genex 9000 series digital recorders are available with internal converters.
- The Tascam DS-D98 is an extension of the Tascam DA78 family; it uses standard DTRS tape for recording 2 channels of DSD, and includes built-in converters.

## What about SACD reissues?

Sony Music and Universal Music are making extensive use of SA-CD to generate new interest in catalog recordings. The high-profile release of the ABKCO Rolling Stones recordings, “Dark Side of the Moon,” and the early Dylan catalog have heightened listener – and label – interest. According to one label executive working on them, SA-CD reissues can be tricky. If it’s a well-known recording, and reissued on CD already, listeners will come to the SA-CD reissue familiar with a version that was probably digitally edited or noise reduced. The artist and label may want to evaluate the DSD-remastered version in comparison with existing remastered versions to choose an SA-CD reissue that best represents the music. (If the reissue is significant enough, a test pressing of a DSD-mastered version and a PCM-mastered version may be warranted.)

➤ *To summarize, for a stereo SA-CD release, the process is similar to that of a stereo CD release, though using specialized DSD gear in the process. Options range from end-to-end (or “pure”) DSD, to mixing (digital or analog) to DSD media, to DSD mastering of analog or digital mixes.*

## What issues does multichannel audio present?

**A compelling reason for listeners to invest in SA-CD and DVD players is surround.** SA-CD is a wonderful medium to experience surround. The Super Audio CD can hold both a high-resolution 5.1 surround master plus a high-resolution stereo master of 74 minutes of audio on its SA-CD layer (in addition to the stereo CD layer of the hybrid disc).

A surround release involves the following steps:

1. Record
2. Mix to high-res stereo
3. Mix to 6 channels (or fewer – the SA-CD reissue of Mike Oldfield’s classic

DSD is the first digital format I’ve heard that actually surpasses analog performance. We’ve made comparisons of the direct mic feed vs. analog tape vs. the DSD recorder. The sound of the DSD is virtually indistinguishable from the direct mic feed. It’s very exciting that the sound we capture at the session can be reproduced without compromise in the listener’s home.

—Joe Harley, Producer

“Tubular Bells” is in 4.0). The options described above for delivery of high-resolution digital stereo mixes are also appropriate for delivering multichannel mixes.

4. Master for stereo
5. Master for multichannel

For mastering and editing multichannel audio, DSD workstation options are the Sony Sonoma, SADiE, and Pyramix. SonicStudio’s will be available soon.

Multichannel production is beyond the scope of this brief. There are many good resources on the topic. The monthly *Surround Pro* is the primary publication for the working audio pro. Qualified subscriptions are free: [www.surroundpro.com](http://www.surroundpro.com).

Dolby Labs offers an extensive publication, “5.1 Channel Music Production Guidelines.” Among the useful topics covered in detail are the Center and LFE channels, monitors and subwoofers, delay and bass management. Dolby offers forms for documenting multichannel sessions. You may download a copy of Issue 2 at [www.dolby.com/tech/MultichannelMusicMixing.pdf](http://www.dolby.com/tech/MultichannelMusicMixing.pdf)

Bobby Owsinski of Surround Associates has written and taught extensively on the topic, and offers an instructional DVD: [www.surroundassociates.com](http://www.surroundassociates.com).

Rich Tozzoli is another prolific writer and active surround mixer. His site is [www.333entertainment.com](http://www.333entertainment.com).

Oliver Masciarotte offers an excellent reading list and comprehensive production resource links in his Info Annex: [www.seneschal.net](http://www.seneschal.net).

## Mastering in Greater Detail

The mastering process involves two parts:

- the creative aspect of equalization, making the disparate mixes flow like a record,
- the technical aspect of encoding for the release medium, and the creation and quality control of the master parts.

### *EQ*

SA-CD is a new format, and many of the tools that mastering engineers use every day to master CD releases still need to be developed for DSD. Fortunately, the EQ included workstations like the Sony Sonoma sounds very good. The Sonoma also includes a comprehensive virtual mixing desk and router, making it ideal for mastering SA-CDs totally in the DSD domain. Airshow is one of a handful of commercial studios with the Sonoma workstation.

Another option for SA-CD mastering is using the tried and true analog tools – EQ, compression, limiting, etc. A well-equipped mastering studio will be able to offer several options for mastering an SA-CD release: processing completely in the DSD domain, using analog processing and converting back to DSD, or converting from high-resolution PCM.

### *Master Parts*

When the mastering session is over, the reference recordings, masters and backups are created. For a CD release these typically are:

- A reference disc for the client to review,
- A master (disc or tape) for manufacturing,
- A safety master,
- An archive of the session data

“A paradigm shift creates new opportunities; with SA-CD, a newer and smaller label has a chance to get out in front. The future of multichannel listening is in SA-CD. It’s better than any competing format at capturing the character of each voice and instrument.”

— Warren Sampson, founder of Artega Records

SA-CD releases add several items to this list:

- A reference of the high-res master(s) (surround and/or stereo) for client approval,
- The SA-CD cutting master for the DSD stereo and multichannel elements (AIT format digital tape),
- Safety copy of the DSD master (AIT format digital tape),
- Archive of the DSD session data (AIT format digital tape).

### *Quality Control of the Masters*

Best practices for CD mastering involves QC at three stages of the process:

- An engineer listens to the real-time creation of the master,
- The master is analyzed by computer for data errors,
- The master is listened to end-to-end on headphones.

Best practices for SA-CD mastering involves all of those plus these additional steps.

- An engineer listens to the real-time creation of each of the masters (for example, 2 stereo and 1 multichannel),
- The multichannel master is played back through the workstation, and each pair of channels is listened to end-to-end on headphones; count three passes to QC the multichannel master.



## SACD Text

Remember CD Text? This little-used feature was designed into the original CD specification to provide the display of text information on the front of a CD player, describing the disc and the tune. It's back in the SA-CD spec. SA-CD Text display is included on most SA-CD players. Displayable text fields include Disc Title, Artist, Genre, Track Title, Track Performer and Track Time. ISRC codes, if used by the label, are encoded here. An SA-CD Text file is created using a simple, proprietary editing program, which displays pages where one keys in the information. Each playlist requires its own file: the hybrid CD layer, the hi-res stereo playlist and the multi-channel playlist. Plan into your production schedule the time to obtain and verify this information.

You may download the Sony SA-CD Text Editor software from [www.sonyoxford.co.uk/sacd-text-editor](http://www.sonyoxford.co.uk/sacd-text-editor)

## SACD Authoring

Authoring is the final step of the master creation process. Authoring combines the various elements - stereo DSD audio, surround DSD audio, and SA-CD text to create a "cutting master" which is sent to the SA-CD replication plant. Authoring is also the step where some of the encryption measures are added to the disc. Ask your mastering lab and your manufacturer for quotes on authoring.

Airshow Mastering provides SA-CD authoring services even if you've mastered your audio elsewhere.

For Airshow technical information on authoring and source file formats, please go to [www.airshowmastering.com](http://www.airshowmastering.com) and click on the "Surround and Hi-Res" button at the top of your screen.

Over 2,000,000  
SA-CD-capable players have  
been sold.

Over 1,500 SA-CD titles are  
available worldwide.

## SACD Test Pressing

Because Sony and Philips have precluded the availability of a "SA-CD-r," there is no chance to check a "ref" of the full product, except as the result of a test pressing. This is an optional service, generally offering around 10 check discs for your review. Check with your manufacturer to determine cost and the time this may add to your schedule.

## SACD Manufacturing

Disc manufacturers are gearing up to handle this new medium. Hybrid disc manufacturing is available from plants in Europe, Japan, and the U.S. Domestic hybrid disc manufacturing is available at DACD/Sony and Crest National.

To keep abreast of domestic manufacturing, check in with Oasis Disc Manufacturing at [www.oasiscd.com/sacd](http://www.oasiscd.com/sacd), or write to [sacd@oasiscd.com](mailto:sacd@oasiscd.com).

## Selling Super Audio CDs

Super Audio CDs are sold where regular CDs are sold – more or less. The “less” is physical retail; high-resolution sections are small, and SA-CDs share space in them with DVD-Audio discs. Because hybrid discs are single-inventory, most titles are found under the artist’s section with their CD releases.

The “more” is Internet sales. At the cutting edge of SA-CD acceptance, early adopters are often audiophiles, or other committed listeners who have grown accustomed to finding their music online. Sony helps the seeker find SA-CD titles with a well-organized on-line store (below). Per-disc prices for SA-CD releases range from \$16 to \$24 – and occasionally more.

“Our first multichannel releases were pristine recordings, and that’s what SA-CD is all about: sonic purism without the hassle of video and graphics content. We mixed in our familiar high-resolution PCM environment, then converted to DSD in mastering, a workable strategy that gave us world-class results – and a Surround Music Award nomination for “Un Segundo Una Vida.”

- Brian Mackewich,  
co-founder, 333 Entertainment

### ONLINE MASS MARKET MUSIC SITES:

When you visit [amazon.com](http://amazon.com), you can search by format; try SACD or Super Audio. Most of the currently available titles are on [amazon.com](http://amazon.com). [Towerrecords.com](http://Towerrecords.com) has an extensive list of titles, many as special order.

### SPECIALTY MUSIC SITES:

In addition to the mass market online music outlets, look for sales at these sites:

- [www.superaudio-cd.com](http://www.superaudio-cd.com) This is a Sony-operated site (not to be confused with Sony Music) which sells SA-CDs exclusively. The site has virtually every SA-CD title manufactured, and SA-CD players.
- [store.acousticsounds.com](http://store.acousticsounds.com) The online site for the Acoustic Sounds catalog, this audiophile retailer has many SA-CDs plus vinyl and audiophile CDs, as well as players and other listening gear.
- [www.amusicdirect.com](http://www.amusicdirect.com) The online site for the Music Direct catalog, this audiophile site has SA-CDs DVD-As, vinyl, CDs and various players and listening gear.
- [www.elusivedisc.com](http://www.elusivedisc.com) An audiophile site with SA-CDs, DVD-As, vinyl and CDs.
- [www.HighFidelityReview.com](http://www.HighFidelityReview.com) This online publication has updated information on high-res releases and playback gear all in one place; even better, it has links to all SA-CD label websites; at last count, HFR tallied almost 200 SA-CD record labels.

## Preparing a Budget for Your SACD Release

In this brief, we've identified a number of variables that will affect the budget for an SA-CD project: pure DSD vs. traditional production strategies, stereo vs. stereo + multi-channel, hybrid vs. single-layer. At some peril, we offer these broad guidelines for budgeting:

- For a hybrid stereo release, plan to spend 1.5X to 2X what you would spend with a pro mastering lab for a standard CD release.
- For a hybrid stereo and multichannel release, plan to spend 3X to 4X what you would spend with a pro mastering lab for a standard CD release.

The cost increments are due to increased studio time; the higher cost of the AIT tape used for master and archive parts; and the additional time to QC multichannel masters.

## SACD Manufacturing Costs

The categories of expense at the manufacturing stage are:

- Authoring (\$300-\$500 per title) This may also be available from your mastering lab; Airshow offers authoring.
- Glass Mastering (up to \$500 per title)
- Test pressing (optional, often bundled in the glass mastering charge)
- Manufacturing (hybrid or single-layer)
- Packaging ("super jewel box" or conventional)

As domestic manufacturing ramps up, prices will change. For now, expect to pay around \$2.00 per packaged disc, depending, as with CDs, on packaging choices and especially, on quantity. Check frequently for updates.

The best-planned budget is one developed following consultations on production, mastering and manufacturing. Because so many aspects of this new medium are in flux, we recommend a budget and schedule reality check for every project.

*Airshow Mastering engineers and staff welcome the opportunity to consult and work with you on your first – or next – SA-CD release. For a partial listing of Airshow's SA-CD credits and to review our comprehensive SA-CD and multichannel resources, please visit the website:*

*[www.airshowmastering.com](http://www.airshowmastering.com).*

*Please feel welcome to call Chief Engineer David Glasser or General Manager Ann Blonston at 888.545.9035.*

*To receive updates of SA-CD information, please email: [sacd@airshowmastering.com](mailto:sacd@airshowmastering.com).*

*For Airshow technical specifications and recommendations for high-res mixing and source file formats for SA-CD mastering and authoring, please go to [www.airshowmastering.com](http://www.airshowmastering.com) and click on the "Surround and Hi-Res" button at the top of your screen.*



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