

SONY



ES Receivers 2002 Technical Background

Version 3.0; July 29, 2002

Introduction

From the very beginning, ES receivers have benefited from Sony's comprehensive expertise in digital source components and Sony's thorough understanding of digital signals. Those insights led directly to significant Sony ES innovations:

- The world's first outboard D/A converter (DAS-702ES, 1985).
- The world's first Dolby® Surround decoder to operate in the digital domain (SDP-505ES, 1986).
- The world's first all-digital preamplifier (TA-E1000ESD, 1989).
- 24-bit Dolby Digital® decoding (SDP-EP9ES, 1997).
- Digital Cinema Sound™ processing (STR-DA90ESG, 1997).
- World's first floating-point 32-bit preamplifier (TA-E9000ES, 1998).

The ES receiver line—all new for 2002—is a worthy successor to these landmark components. The STR-DA7ES, DA4ES and DA2ES offer a host of new advantages:

- Seven separate channels of amplification (STR-DA7ES, DA4ES)
- Better "downmixing"
- More precise control over volume
- Higher-accuracy digital decoding and processing
- Full compatibility with the latest surround sound formats, including Dolby Digital® EX, Dolby® Pro Logic® II-movie, Pro Logic II-music, dts® ES discrete 6.1, dts ES matrix 6.1, dts 96/24, Neo6:cinema and Neo6:music.
- Better time-base accuracy
- Better analog direct facilities

These new ES receivers are worthy of the most sophisticated home theaters and ready for the most demanding listeners.

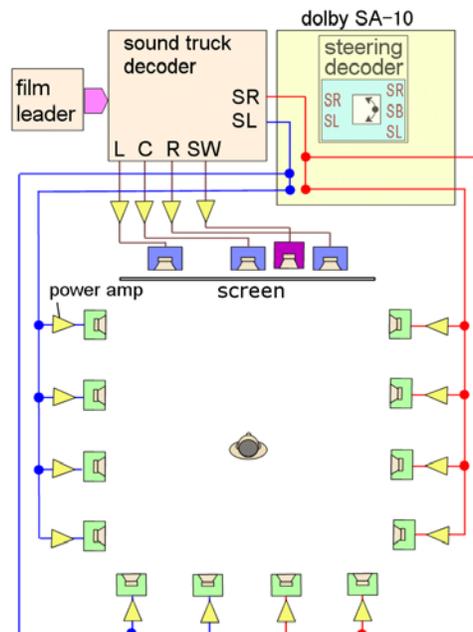
Seven-channel amplifiers (STR-DA4ES, DA7ES)

In the era of 5.1-channel sound, good A/V systems started including five-channel amplifiers to drive the Left, Center, Right, Surround Left (SL) and Surround Right (SR) speakers. The common practice is to drive the 0.1 Low-Frequency Effects (LFE) channel from the amplifier built into a powered subwoofer. In this way, five channels of power became the standard for 5.1-channel sound.

Now 6.1-channel surround sound is available through sources that include Dolby Digital EX, dts ES discrete 6.1 and dts ES matrix 6.1 encoding. These systems add a Surround Back (SB) channel, for even greater realism in surround sound effects and greater three-dimensionality in the reproduced soundstage.

At first glance, it would seem obvious that if five channel amps were best for 5.1-channel sound, then 6-channel amps must be best for 6.1-channel sound. However, the reality is slightly more complex. While 6.1-channel sources can be correctly handled with a single Surround Back speaker, 5.1-channel sources are best served by separate Surround Back Right (SBR) and Surround Back Left (SBL) speakers, driven by separate SBR and SBL amplifiers. Separate SBL and SBR channels enable correct spatial imaging of both 6.1 and 5.1-channel source material. For this reason, the STR-DA7ES and DA4ES have SBR and SBL channel amplifiers built in.

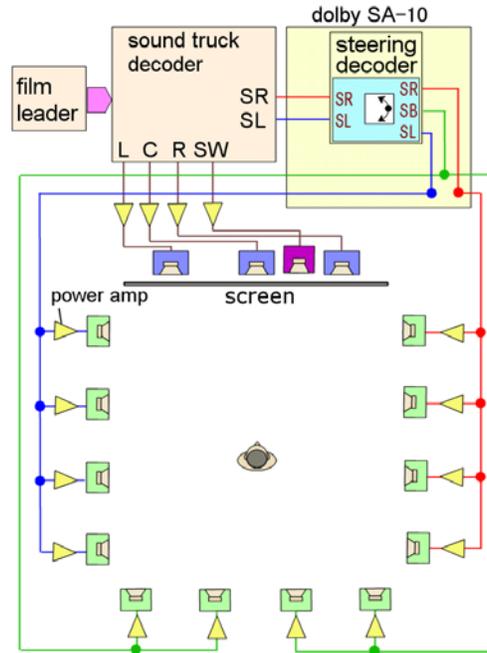
To appreciate the advance, it helps to consider movie theater sound for both 5.1 and Surround EX movie sound tracks. As you probably know, movie theaters feature speakers behind the screen (Left, Center, Right and Subwoofer), as well as multiple Surround speakers on the left, right and back walls. The Surround speakers are driven differently, depending on the type of movie sound track being reproduced.



5.1-channel movie theater reproduction. Note that the back wall speakers reproduce TWO signals (SL and SR). ,

In reproducing a "conventional" 5.1-channel movie, the Dolby SA-10 steering decoder is bypassed. In this case, the Surround speakers on the back wall are split into two groups. One group joins the left wall speakers in reproducing the Surround Left (SL) channel (the blue signal path in the diagram

above). The others join the right wall speakers in reproducing the Surround Right (SR) channel (the red signal path in this diagram).



6.1-channel Surround EX theater reproduction is different. Note that the back wall speakers reproduce ONE signal (SB).

Reproducing the latest 6.1-channel Surround EX sound tracks uses the same speakers in a completely different way. Here the Dolby SA-10 steering decoder is used to create a distinct Surround Back (SB) channel. So our second diagram indicates three Surround Channels: SR (signal path shown in red), SL (shown in blue) and SB (shown in green). As you can see from the diagram, SR signals come only from the right wall, SL only from the left wall and SB only from the back wall.

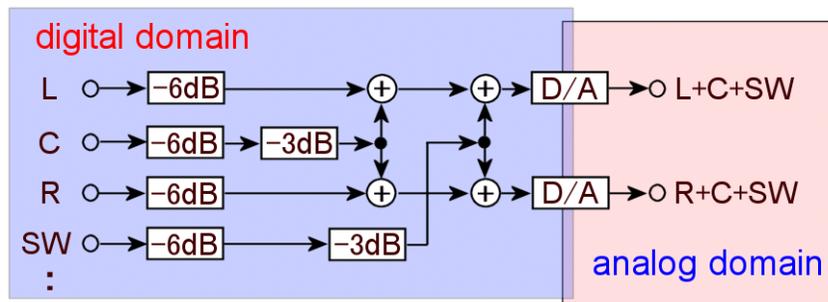
So when a 6.1-channel soundtrack plays, the back wall speakers reproduce ONE signal. And when movie theaters reproduce 5.1-channel sound, the back wall speakers reproduce TWO signals. That's why home theater systems require TWO Surround Back speakers to do full justice to both 5.1 and 6.1-channel sound. And that's what the STR-DA7ES and DA4ES are designed to support.

Analog downmix

As more and more customers discover the benefits of 5.1-channel home theater, the market is growing vigorously. However, there is also a population of two-channel stereo systems that are being upgraded to surround sound. These may include high-end full-range stereo speakers that the customer has chosen carefully and simply loves.

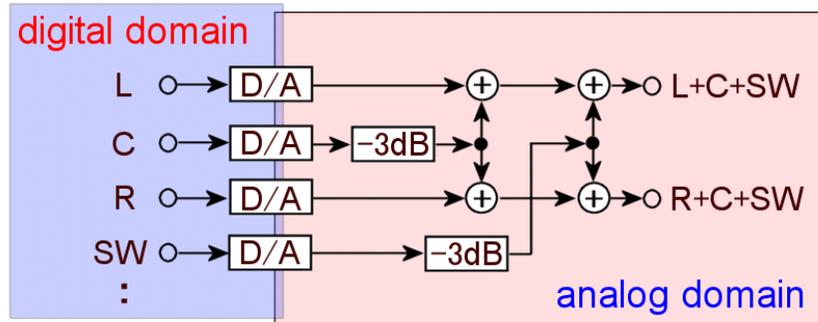
If the stereo pair can reproduce deep bass, the customer may not feel the need for a subwoofer. In addition, the customer may not want a center-channel speaker that could never match the sound quality of the existing stereo pair. For this customer, the best transition to home theater may well be to buy a pair of surround speakers only. In this case, the customer will be using four speakers to reproduce material designed for 5.1 speakers. The customer needs to "downmix" the 5.1 channels to four.

Fortunately, most A/V receivers—and even some DVD players—anticipate this need. They offer bass redirection circuits that accommodate the full range of potential playback systems. However, these downmix functions take place in the digital domain, and that can be a problem.



The problem: how to downmix the L, C, R and SW channels for customer systems that have no Center channel speaker and no Subwoofer. (This is often the case for customers migrating from high quality stereo speakers to multi-channel sound.) The conventional answer: digital downmixing circuitry. The -6 dB and -3 dB processes shown here are necessary. But they do tend to muddy the low-level sound quality. Signal-to-noise performance is also sacrificed. (Surround channels not shown.)

In order to maintain the correct output level, digital downmixing circuits must reduce the input volume levels. Otherwise, the downmixed signal would end up too loud, exceeding the digital full scale level and causing gross clipping distortion. For this reason, digital downmixing circuits always reduce the input volume levels. And in the digital domain, reducing the volume means manipulating the data. Unfortunately, this necessary step muddies some of the important low-level detail, especially during the quiet passages in music and movie sound tracks. This loss of information strips away some of the musical nuances, as well as the sense of soundfield and presence. And noise is also increased.



Sony has a better way. Our Analog Downmix accomplishes the goal without any manipulation of the digital data. So there's no degradation in sound quality. (Surround channels not shown.)

Sony was determined to offer a better way. With our new receivers, the data is not manipulated at all. It goes straight into the Digital-to-Analog converter, preserved in its original form. There's no data loss, no degradation in signal-to-noise ratio, no loss of nuance or acoustic presence.

Even Sony's multi-channel Super Audio CD players include on-board bass redirection/downmixing circuitry. These players have the advantage of operating on 1-bit Direct Stream Digital® signals, as opposed to the multi-bit Pulse Code Modulation signals of DVD players. However, even the 1-bit digital downmix can degrade the signal. The Analog Downmix of these Sony ES receivers is a better choice—no matter what your multi-channel source may be!

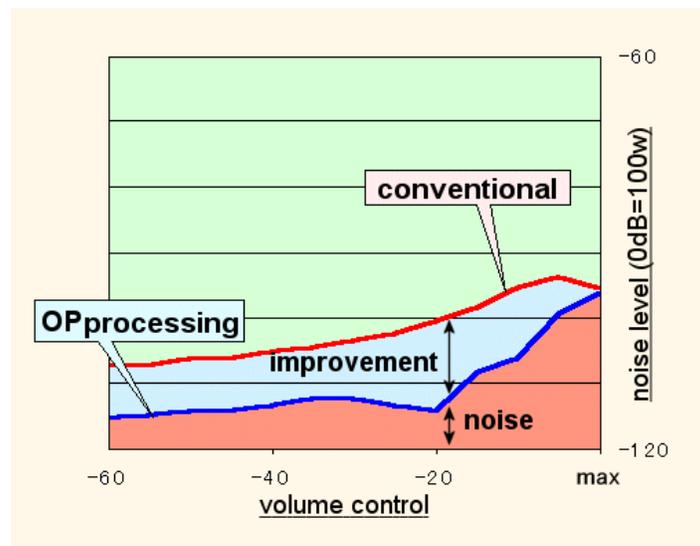
For listeners making the transition to multi-channel playback and using less than five speakers and a subwoofer, high-quality downmixing circuitry is essential. That's one more reason to choose the new Sony ES receivers.

Optimum Preamplification (OP) with 0.5 dB resolution

Sony's Optimum Preamplification (OP) design varies the preamp negative feedback according to the volume control setting. In this way, Sony balances gain and volume control settings to achieve a 10-dB improvement in signal-to-noise ratio across most of the volume control operating range. So high resolution audio is reproduced against a background of silky silence.



Optimum Preamplification is made possible by Sony's proprietary CXD9725 integrated circuit.



Sony's Optimum Preamplification (OP) circuit improves the signal-to-noise ratio across a broad range of volume control settings. The latest version of the OP design controls volume with twice the resolution of our previous design—0.5 dB steps instead of 1 dB.

In Sony's original OP design, users could vary the volume in 1-dB steps. Since 1 dB is the threshold of hearing, 1 dB steps are considered the smallest that people can hear as volume increases. But listening tests have confirmed that smaller differences are perceptible. That's why Sony's latest OP circuit now achieves higher volume control resolution. You can increase the volume in 0.5 dB steps, for exquisite sonic control.

Higher accuracy 32-bit decoding

Not only is Sony an expert in Digital Signal Processing (DSP), Sony is also a primary manufacturer of the Large Scale Integrated circuits (LSIs) that make DSP possible. That's how Sony ES components have consistently shown the way to greater DSP functionality and higher DSP accuracy. The 2002 ES receivers incorporate a new DSP decoder for Dolby Digital® and dts® signals, the CXD9718. Compared to the CXD9617 used in last year's ES receivers, the new LSI offers more memory and faster processing speed to offer more accurate decoding. This is also the first DSP in its class to offer multi-channel enhancement with the accuracy of 32 bits. In addition, the new CXD9718 retains the architectural advantages of its predecessor. To guard against the loss of accuracy during heavy computations, every multiplication and division takes place with 64-bit accuracy and all arithmetic results are accumulated with 64-bit accuracy.

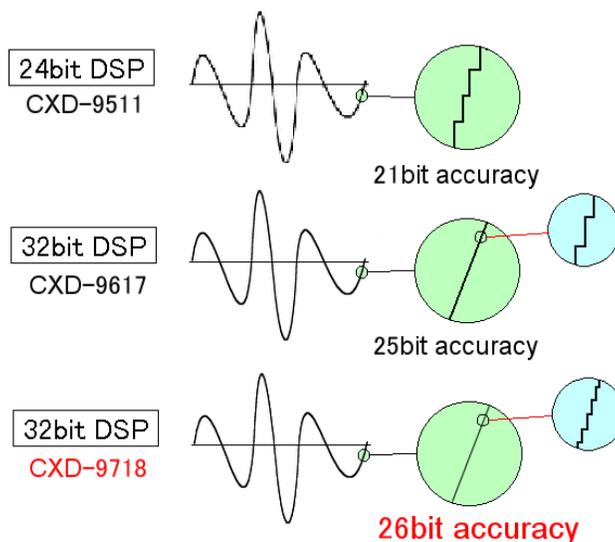


The latest expression of decoding accuracy is Sony's CXD9718 Large Scale Integrated circuit (LSI).

The increase in internal memory translates directly into increased accuracy in Dolby Digital and dts decoding. The CXD9718 achieves a startling 26 bits of accuracy. Compared to the CXD9617, decoder noise is cut in half. And compared to Sony's previous 24-bit architecture—which is similar to many DSPs in common use today—the new DSP exhibits just 1/32 the internal noise and distortion. So movie dialogue becomes clearer and more lifelike. Movie music retains the natural timbre of the instruments. And surround sound effects have greater richness and depth.

Year	DSP Name	Architecture	Decoding Accuracy
1999	CXD9511	24-bit	21 bits
2001	CXD9617	32-bit	25 bits
2002	CXD9718	32-bit	26 bits

With each passing year, Sony LSI manufacturing processes continue to push the state of the art. That's why Sony DSPs continue to get more powerful.



Today, many receivers still use 24-bit decoding, comparable to Sony's CXD9511 (top). Last year's 32-bit CXD9617 was far superior, with a spectacular decoding accuracy of 25 bits. The new CXD9718 is even better than still, achieving 26-bit accuracy for half the internal noise and distortion.

Support for more multi-channel formats

As the home theater revolution picks up speed, the installed base of multi-channel sound systems is growing vigorously. In response, surround sound encoding and decoding systems are also developing rapidly in two significant ways. Some systems seek greater realism through additional channels. Others seek to put the surround channels to use for two-channel source material. Sony's new ES receivers accommodate both developments, supporting the full range of surround sound technologies:

- **Dolby Digital® surround sound.** Sony receivers support the complete range of Dolby Digital signals from 2.0 channels all the way up to 5.1-channels.
- **Dolby Digital EX 6.1-channel sound.** Sony decodes the matrix Surround Back channel from material that uses this new encoding format.

- **Dolby Pro Logic surround sound.** Of course, this legacy surround sound format is supported. It's particularly important because it's often used in VHS Hi-Fi and analog stereo TV sources.
- **Dolby Pro Logic II-movie and Pro Logic II-music.** Sony offers these new decoding systems to derive 5.1 channels instead of the conventional 4 channels of Dolby Pro Logic surround sound. (Note that these are decode-only systems. By design, there is no Pro Logic II-movie or Pro Logic II-music encoding for source material.)
- **dts® 5.1-channel surround sound.** As in the past, Sony supports this important surround sound format.
- **dts 96/24.** The DVD-Video standard offers the possibility of a dts 5.1-channel signal with audio encoded at a 48 kHz sampling rate. However, dts has created a way to extend the sampling rate to 96 kHz while retaining full backwards compatibility. Older decoders can handle the new discs (although without the benefit of the 96 kHz sampling rate). Newer decoders, like the Sony CXD9718, can handle both old and new discs, delivering the extended frequency response and heightened realism of the 96 kHz signal.
- **dts ES discrete 6.1 and dts ES matrix 6.1.** Sony decodes the separate Surround Back channel from material that uses the new dts ES discrete 6.1 encoding format. And Sony can regenerate the matrix Surround Back channel, using the dts ES matrix 6.1 decoding system.
- **dts Neo6:cinema and dts Neo6:music.** Sony offers these new decoding systems to derive six channels from two-channel material. (Note that these are decode-only systems. By design, there is no Neo6:cinema or Neo6:music encoding for source material.)

When it comes to surround sound, the new ES receivers are ready for anything—and ready to make everything sound its best!

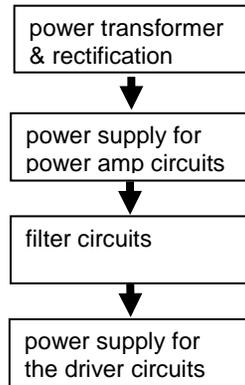
Enhanced Digital Concert Hall modes (STR-DA4ES, DA7ES)

Sony's Digital Concert Hall modes reproduce the precise acoustics of two legendary European concert venues, Amsterdam's Concertgebouw and Vienna's Musikvereinsaal. The STR-DA7ES and DA4ES now extend these modes with 6.0-channel processing, for an even more compelling soundstage. Sony ES receivers take two-channel stereo sound and transport you directly into the concert environment.

CSTD power supply

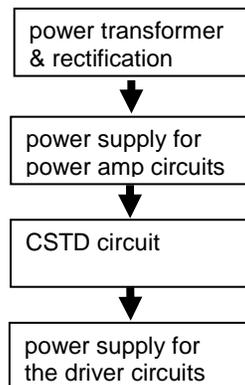
Because the power supply is the key to amplifier sound, Sony has always taken meticulous care to provide the ES receivers with high-current, low-noise power supplies. Our designs feature massive, low-radiation power transformers

and oversized filter capacitors, for example. The latest product of this thinking is Sony's new Clean Spontaneous Twin Drive (CSTD) power supply. It's an all-new version of a classic Sony ES design.



Typical receiver power supplies protect the driver circuits with filters.

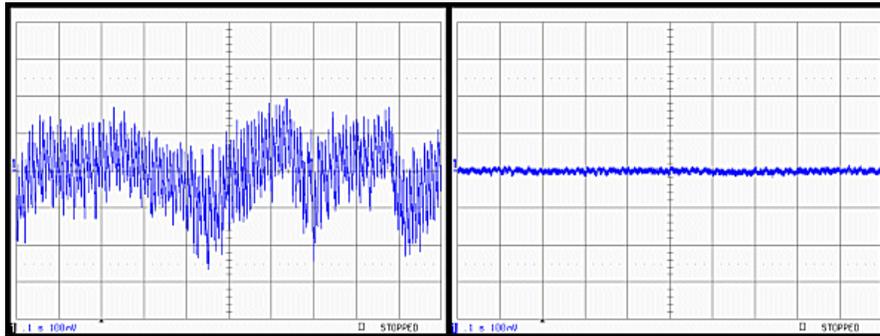
Receivers contain power output stages, which make massive and sudden demands for current, and sensitive low-level driver stages, which draw steady, continuous current. Designers must ensure that the demands of the power output stage do not interfere with the low-level driver stage power supply. This is typically accomplished by filter circuits that attempt to isolate the driver stage power supply. Sony has a better way.



Sony's Clean Spontaneous Twin Drive (CSTD) power supply is a much more effective solution.

Sony's new receivers replace the conventional, passive filter with CSTD. This is an active filter that ensures a stable supply of voltage to the driver circuits, free from voltage fluctuations and noise. In fact, the CSTD is one thousand times more effective than existing filters. Put another way, the power supply noise level of CSTD is *one tenth of one percent* of the noise level of conventional designs! Even during the most demanding car crashes and explosions, even

during the loudest musical passages, CSTD assures a calm, steady, noise-free supply of power to the driver stage circuitry.

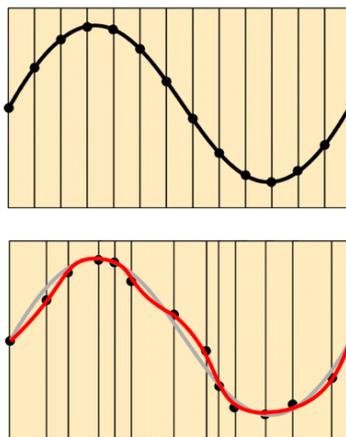


On the left: the driver stage power supply noise of conventional receivers. On the right, the corresponding noise of Sony ES receivers with CSTD. There's quite a difference.

CSTD helps explain why Sony ES receivers for 2002 sound so good. You'll hear clear, effortless sound, even at peak volume levels. While low-level sound retains all its characteristic nuances. Signal-to-noise performance is consistently excellent. So sound is reproduced against a backdrop of silence.

Pure digital interface circuitry

While digital signals are inherently resistant to noise and distortion, they are susceptible to time-base errors called jitter. Even if the instantaneous output voltage is completely accurate, jitter can still cause distortion. This is often heard as a narrowing of the stereo image, degrading the sense of space and muddying the sound.



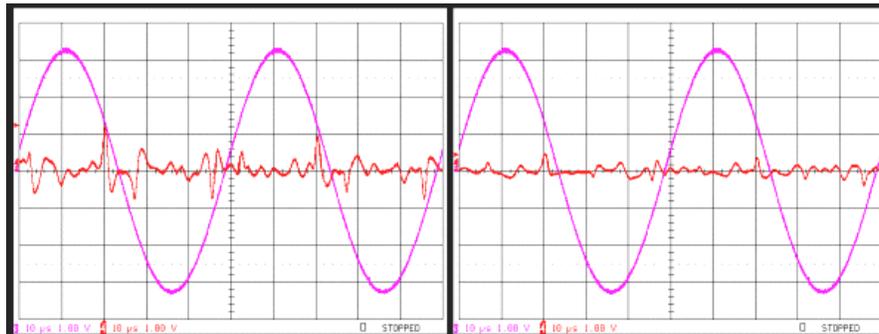
Simply by altering the time base, jitter can distort the audio output signal. Compare the correctly timed signal (top) with the distorted signal that results when the timing is corrupted (bottom).

Jitter can enter the signal during recording, playback and transfer. To suppress jitter at the digital input, Sony offers a powerful solution. Our Digital interface LSI regenerates the digital input signal to according to a highly accurate quartz clock. To boost precision further still, Sony controls the action of this LSI with a VCA stabilizer, reducing internal clock drift to a bare minimum.



The combination of the Digital Interface LSI and Sony's VCA stabilizer makes for an uncommonly consistent internal clock, for uncommonly accurate regeneration of digital input signals. So jitter is effectively suppressed.

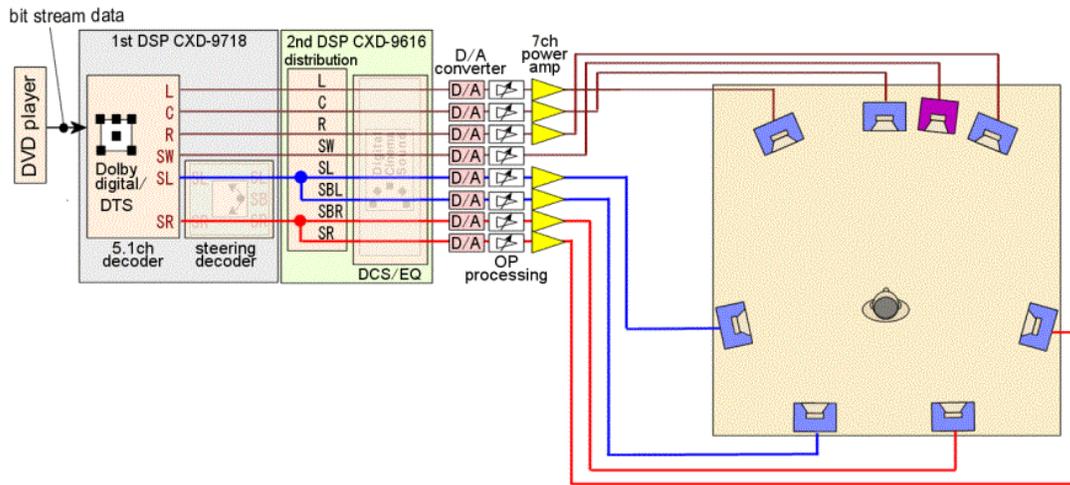
You get a higher level of time base accuracy for a higher level of audio reproduction. Distortion is measurably reduced. The stereo image is clear. The soundstage is spacious. And music is reproduced with transparency.



You can see the advantages of Sony's VCA stabilizer in this trace of 20 kHz signals. On the left are a low-level sine wave and the distortion it contains (smaller trace). On the right is the same sine wave as reproduced with Sony's VCA stabilizer in the circuit. Distortion is clearly reduced.

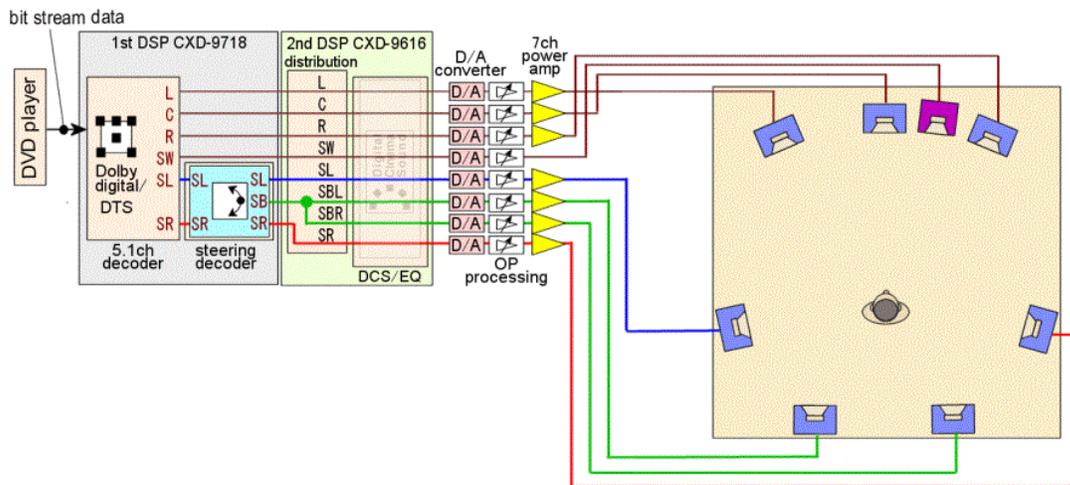
Auto Channel Grouping (STR-DA4ES, DA7ES)

We've seen that the new seven-channel power amplifier is a major new feature for the STR-DA4ES and DA7ES. In order to get correct reproduction from the seven-channel amplifier, the four surround speakers (SL, SR, SBL and SBR) must be properly grouped by the receiver's preamplifier.



Correct 5.1-channel home reproduction. As in the theater, the back wall speakers reproduce TWO signals (SL and SR).

In reproducing 5.1-channel sources, the four Surround speakers are driven in two groups. The Surround Left information goes to SL and SBL speakers, while the SR signal goes to SR and SBR speakers.



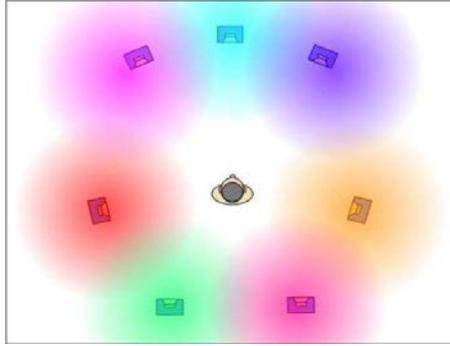
Correct 6.1-channel home reproduction. As in the theater, the back wall speakers reproduce ONE signal (SB).

In reproducing 6.1-channel sources, the four Surround speakers are driven in three groups: SL, SR and SB. The SB information goes to BOTH the SBL and SBR speakers.

The STR-DA7ES and DA4ES perform these groupings automatically. So you always get the right reproduction for every source. Even musical reproduction such as Dolby Pro Logic II-music decoding is automatically directed to the correct groups of surround speakers. You get denser, more convincing, more lifelike multi-channel sound.

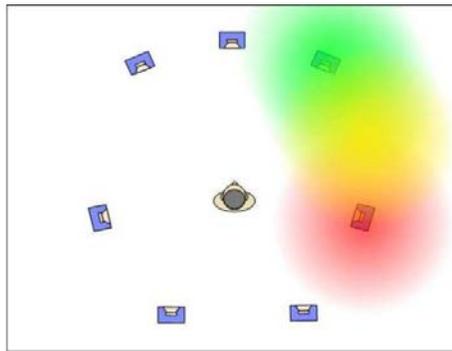
7.1-channel Cinema Studio EX modes (STR-DA4ES, DA7ES)

Sony Digital Cinema Sound™ modes are incredibly powerful in 5.1-channel sound, reproducing the conditions in Hollywood dubbing stages. Now they're even more compelling in 7.1-channel sound! The result is an even closer recreation of a reference-standard movie theater environment.



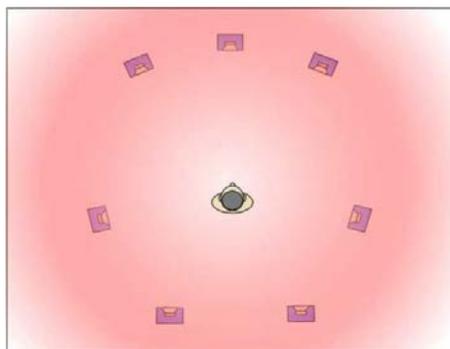
Conceptual diagram of 7.1-channel reverb, as provided by the Digital Cinema Sound™ Cinema Studio EX modes of the STR-DA7ES and STR-DA4ES.

Consider Sony's signature Cinema Studio EX reverberation. Since the ideal reverb would be different for each channel, Sony supplies 7.1 independent channels of Cinema Studio EX processing.



Signal differences between each pair of speakers (Right and Surround Right shown here) create a "stereo" image between and around the two. This tends to fill out the reverberant sound field.

In actual practice, as you go around the circle, each pair of speakers you see establishes a "stereo" image between them, filling in the reverberant sound field.

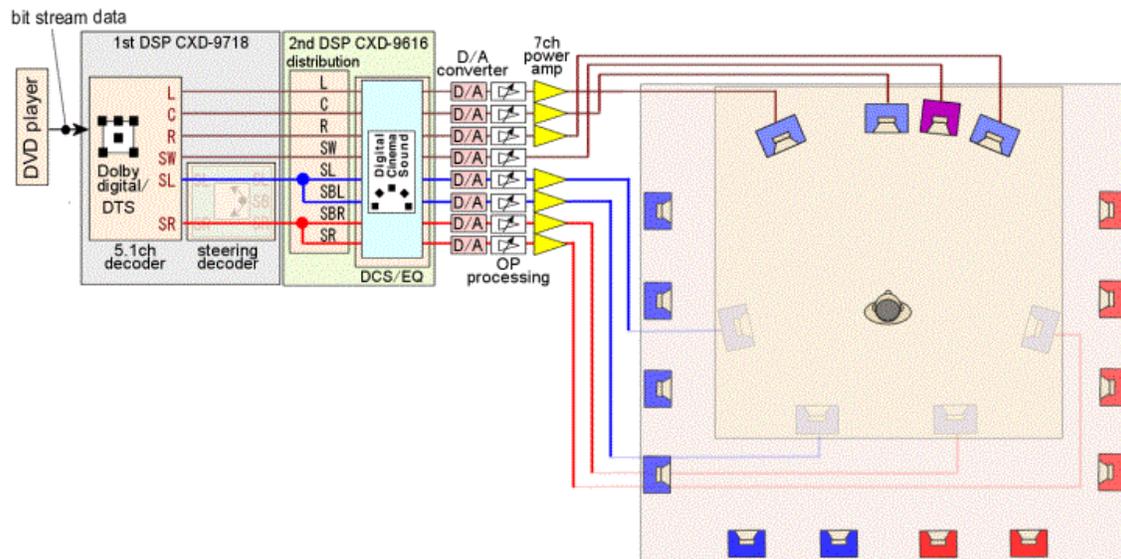


The final result is the closest approach yet to the original sound of a Hollywood dubbing theater—the ultimate reference for home theater sound!

This phenomenon combines with Screen Depth Matching, a Sony advancement that continues in the new receivers. The natural result is a 360 degree field of reverberant sound—the closest approach yet to the conditions in Hollywood dubbing theaters. Because this is where directors make the final surround sound mixdown decisions, this is the ultimate reference from home theater sound.

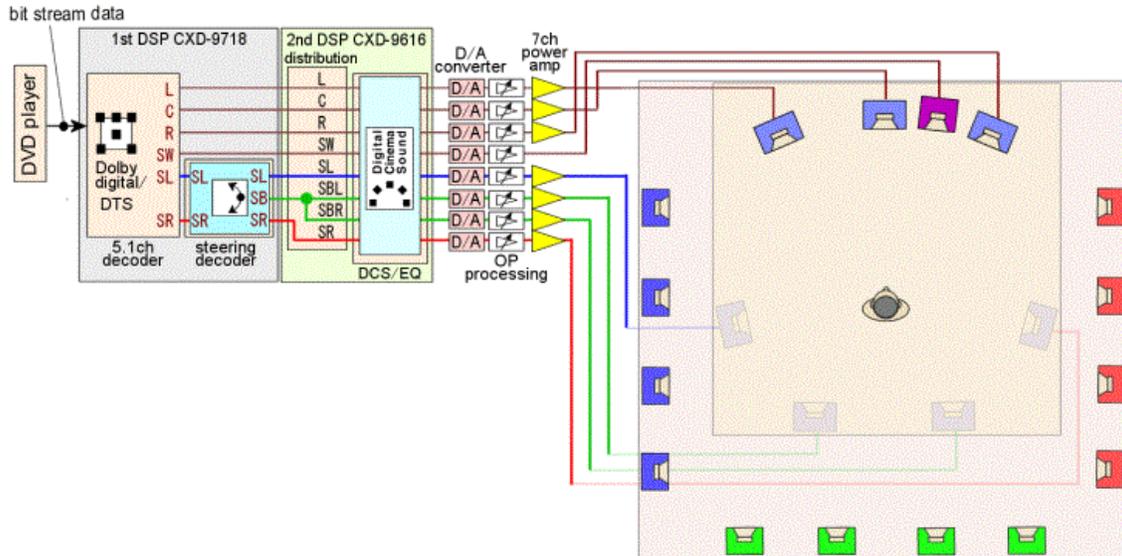
7.1-channel Virtual Multi Dimension (STR-DA4ES, DA7ES)

Seven channel amplifiers also enable Sony to increase the power and realism of our Virtual Multi Dimension modes.



Sony's Virtual Multi Dimension mode for 5.1-channel sources results in twelve virtual Surround speakers. This diagram shows the physical Surround speakers ghosted out, within the walls of the room. The virtual surround speakers appear from beyond the walls. The twelve operate in two banks of six, corresponding to the Surround Left and Surround Right channels of 5.1-channel sound.

Applying Sony's Virtual Multi Dimension mode to 5.1-channel sound transforms four physical surround speakers into twelve virtual surround speakers at a greater apparent distance from the listener. The twelve virtual speakers are driven in two groups of six, corresponding to SR and SL signals.

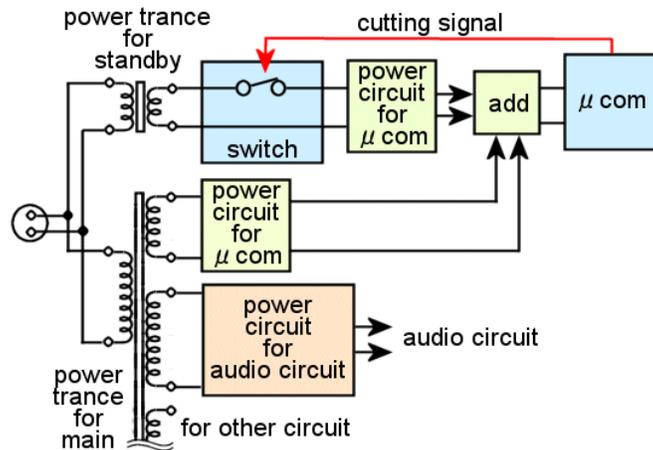


When Virtual Multi Dimension mode is applied to 6.1-channel sources, the twelve virtual Surround speakers are driven in three groups: Surround Left (blue), Surround Right (red) and Surround Back (green).

Virtual Multi Dimension mode for 6.1-channel sources also results in twelve virtual surround speakers. But the groupings are different: four for SL, four for SR and four for the SB channel. In this way, Virtual Multi Dimension applies the appropriate process for both 5.1 and 6.1-channel sources, eliciting the best performance from each!

Separate standby power transformer (STR-DA4ES, DA7ES)

The remote control power-on function requires that an A/V component must be in some sort of standby mode, even when the power is switched off. To protect the environment, Sony sought to limit the amount of power that these receivers consume in the standby mode. That's why the STR-DA4ES and DA7ES incorporate a special standby power transformer. In the standby mode, the main power transformer is disconnected and only the small standby transformer is used. This reduces standby power consumption to just 1 watt. Turning on the receiver activates the main power supply transformer and disconnects the standby transformer. This prevents electromagnetic noise, for uncommonly clear, effortless low-level sound.



The standby transformer enables remote control power on while limiting standby power consumption to a single watt. When you turn the receiver on, a switch isolates the standby transformer's load, to maintain sound quality.

Metal shaft rotary encoder (STR-DA4ES, DA7ES)

On these receivers, the volume control is mounted to a rotary encoder. It translates the turning into an electrical signal which is sent to the Optimum Pre-amplification (OP) integrated circuit. For a better tactile experience, the rotary encoder of the STR-DA4ES and DA7ES uses a metal shaft in place of the conventional plastic. It's another small touch that adds to the experience of owning an ES component.



Sony improves the tactile quality of the STR-DA4ES and DA7ES with this metal-shaft rotary encoder.

Operating features

In addition to impressive features for better sound, the new ES receivers also incorporate a wide range of controls, features and operating modes for enhanced convenience and flexibility.

- **12V triggers (STR-DA4ES, DA7ES).** The top ES receivers are destined to be used in custom installations where curtains, screens and lighting "scenes" may require 12-volt triggers. For this reason, the STR-DA4ES offers two 12V triggers, while the DA7ES provides three.
- **Infrared repeater ports (STR-DA4ES, DA7ES).** To accommodate installations where the stack of electronics is hidden away, the DA4ES and DA7ES offer one infrared repeater input and two outputs. This means you can place an inconspicuous IR "eye" in the home theater room and still control your components.
- **RS-232C interface (STR-DA4ES, DA7ES).** To communicate with third-party room automation systems, these receivers include RS-232C ports. The ports also enable future firmware upgrades. Sony has already offered one such upgrade, the VUCD-E9000A for the landmark TA-E9000ES preamplifier.
- **Front optical digital audio input (STR-DA2ES).** As part of the Video 3 input of the front panel, these receivers now accept optical digital audio, in addition to Left/Right analog audio.
- **Assignable digital input.** An optical or coaxial digital input can be flexibly assigned to any video input, providing greater versatility when connecting a second DVD player, an HDTV tuner or other digital video source component.
- **A/B speaker terminals.** Real estate on the back panel of modern A/V receivers is severely limited. At the request of ES dealers, Sony found a way to add a set of B speaker terminals.
- **Multi-channel and 2-channel direct switches.** At the request of ES dealers, Sony provides separate front panel switches for these two functions. The A.DIRECT button activates the 2-channel input. The MULTI CHANNEL DIRECT button toggles between 5-1 and 7.1-channel inputs.
- **S-Video converter.** Older video source components like some camcorders or VCRs only have composite video connections, not the higher-quality S-Video. Ordinarily, this requires a second video output from the receiver to the television (one for S-Video, another for composite). This would also require television input switching every time the receiver goes from an S-Video source to a composite video source. To simplify the connections and the switching, Sony provides a composite-video-to-S-Video converter.

- **Second-room audio output with volume control.** These receivers offer 2-channel preamp outputs to deliver sound from the main system into a second room. Separate electronic volume control means you can connect this output directly to a power amp. No preamp is required.
- **Third-room audio output with volume control (STR-DA7ES).** Another 2-channel preamp output delivers sound to a third room. Electronic volume control means no preamp is required.
- **Fast and slow volume control.** Turning the volume control slowly will adjust the sound in 0.5-dB increments, as the Optimum Pre amplification (OP) circuit minimizes noise. However, this type of adjustment is inappropriate when you want to reduce the volume control quickly. For this reason, a special logic circuit detects rapid downward adjustments and quickly reduces the volume to minus infinity dB, muting the output. Users get the benefit of both extremely fine and extremely rapid volume adjustment, according to conditions.
- **LCD remote control (STR-DA4ES).** The DA4ES comes equipped with a new LCD remote control that is preprogrammed for a wide variety of Sony and non-Sony A/V components*, can learn the commands of components not already pre-programmed, and can execute multi-step Macro commands. While this remote is uni-directional, the DA4ES does support bi-directional remote operations with optional remote controls.
- **Touch-screen LCD remote control (STR-DA7ES).** The DA7ES features a new remote two-way control with two-way communication between the receiver and the remote. This enables the remote to display receiver status information. The RM-TP1 also features context-sensitive touch-screen menus, a rechargeable battery and a dedicated AC adaptor/battery charger. The DA7ES also offers a second remote control, the conventional RM-US105.



Feature	STR-DA7ES	STR-DA4ES	STR-DA2ES
Power output, 8 ohms, 0.05% THD, 20 to 20,000 Hz	120 watts x7	110 watts x7	100 watts x6
Dolby Digital EX decoding	Yes	Yes	Yes
dts ES decoding	Yes	Yes	Yes
dts 96/24 decoding	Yes	Yes	Yes
Dolby Pro Logic II decoding	Yes	Yes	Yes
Dts Neo:6 decoding	Yes	Yes	Yes
Digital Cinema Sound processing	7.1-channel	7.1-channel	6.1-channel
32-bit Decoder	CXD9718	CXD9718	CXD9718
32-bit DSP	Yes (Two)	Yes (Two)	Yes
Auto channel grouping	Yes	Yes	-
VCA stabilizer	Yes	Yes	Yes
OP with 0.5 dB steps	Yes	Yes	Yes
Analog downmix	Yes	Yes	Yes
CSTD power supply	Yes	Yes	Yes
Separate standby power transformer	Yes	Yes	-
Metal shaft rotary encoder	Yes	Yes	-
A/B speaker terminals	Yes	Yes	Yes
Multi-channel inputs	Two: 7.1 and 5.1	Two: 7.1 and 5.1	Two: 6.1 and 5.1
Component video input with HD pass-through	Yes	Yes	Yes
S-Video converter	Yes	Yes	Yes
S-Video inputs/outputs	5/2	4/2	4/2
Optical/coaxial inputs	4/2	4/2	4/2
Optical output	1	1	1
Multi-channel preamp output	Yes, 7.1 channels	Yes, 7.1 channels	Yes, 6.1 channels
Front A/V input	Yes	Yes	Yes, with optical digital audio
Infrared repeater input/outputs	1/2	1/2	-/-
RS-232C interface	Yes	Yes	-
12-volt trigger outputs	3	2	-
On screen display	Yes	Yes	Yes
2nd Room output with volume	A/V out	A/V out	Audio out
3rd Room output with volume	Audio	-	-
Remote Features			
Preprogrammed	Yes	Yes	Yes
Learning	Yes	-	Yes
Macro	Yes	Yes	Yes
LCD	Yes	Yes	-
2-way	Yes	Receiver is capable	-
Touch-screen	Yes	-	-

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* Multi-brand remote not compatible with all brands and models.