

SURROUND OPTION

Brief Instructions Set

Version 1.0 May 2003

DDX3216

AUTOMATED DIGITAL MIXING CONSOLE



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1. INTRODUCTION

Once upon a time...

... in the year 1978, DOLBY® Laboratories developed a new cinema surround format that was first featured in George Lucas' space adventure *Star Wars*, causing an uproar among audiences worldwide. After 25 years of continuous improvements, surround formats DOLBY® Digital (or AC-3 as well) and the technically more advanced DTS® (Digital Theater System) are nowadays standard-issue content of cinema and DVD productions. More and more Hi-Fi amplifiers and receivers offer corresponding decoders, while numerous Hi-Fi surround speaker sets support the 5+1 speaker configuration requirement.

Until now, only well-to-do studios with massive digital consoles could produce "Professional Surround". Today, all DDX3216 users can do it too!

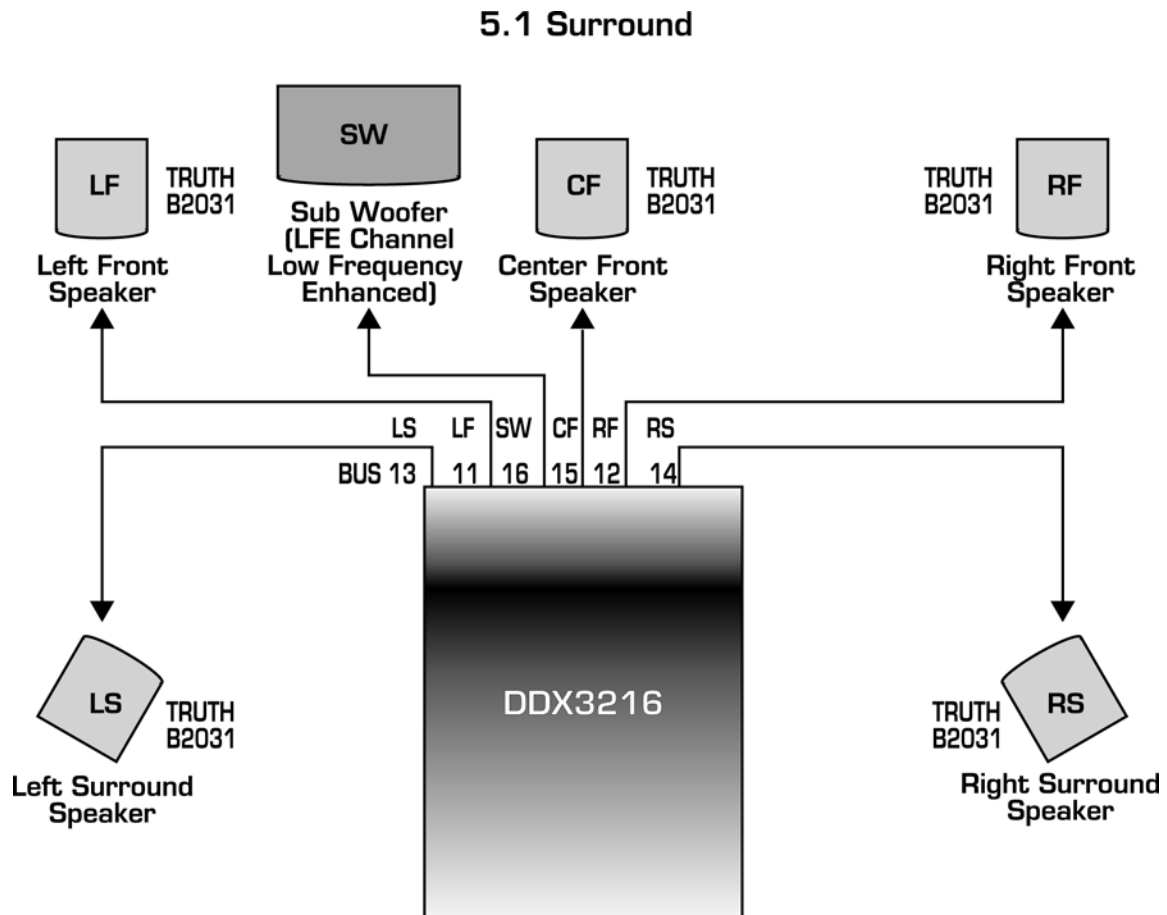
The new surround update transforms the DDX3216 automated digital mixing console into a full-fledged surround mixer with extensive control possibilities.

Surround-specific settings such as divergence, angle and listener-source distance can be adjusted, you can implement circular movement through the room, and you can record your sound mix using internal automation.

The only thing you will still need in case you wish to play your surround creations on standard DVD players is an encoder that can encrypt data in the desired DOLBY®

Digital or DTS® format, and you'll also need a DVD burner. Alternatively, you can connect your DDX3216 directly to your home surround unit or to 6 active loudspeakers.

When you select surround mode on the DDX3216, busses 11 through 16 are used for the 6 surround channels, giving you a true 5.1 mix.



You can alternate between the standard stereo and 5.1 surround mix at any time, or you can use them both at the same time. Therefore, you don't have to do without any "old" functions; rather, think of it as if you simply got extra surround functions added to your system.

2. INSTALLATION

Uploading the update is very simple:

Either upload the update file the same way you would an operating system update via the “DDX3216 File Exchange” PC software (WINDOWS®) or load it in using a PC card.

The update procedure is described in detail in ch. 16.1 in the DDX3216 user’s manual.

3. NEW FEATURES

The following new features are available upon installing the surround update:

- Activating the SURROUND function on the display page SETUP/OSC > PREFS (On/Off Select).
- Dialing in surround panning on the desired channel via a second PAN display page labeled SURROUND.
- Live “movements” of a selected sound source (channel) through the surround space.
- Saving surround pan/automating via SNAPSHOT and DYNAMIC AUTOMATION possible (controlled using the PAN parameter).
- New MIDI control possibilities using DIRECT PAR SYSEX for expanded surround parameters on channels 1-32 and FX return channels 1-8. Activate this function via display page MMC/MIDI > RX/TX > DIRECT PAR SYSEX as well as > PAN (also see ch. 13.3).

SysEx #:	Parameter:
○ 100	surround mute
○ 101	surround pre/post
○ 102	surround volume
○ 103	surround angle
○ 104	surround distance

- 105 surround divergence
- 106 surround subwoofer pre/post
- 107 surround subwoofer volume

If TX/RX is active, the DDX3216 sends the corresponding parameter or receives it as a MIDI SysEx file.

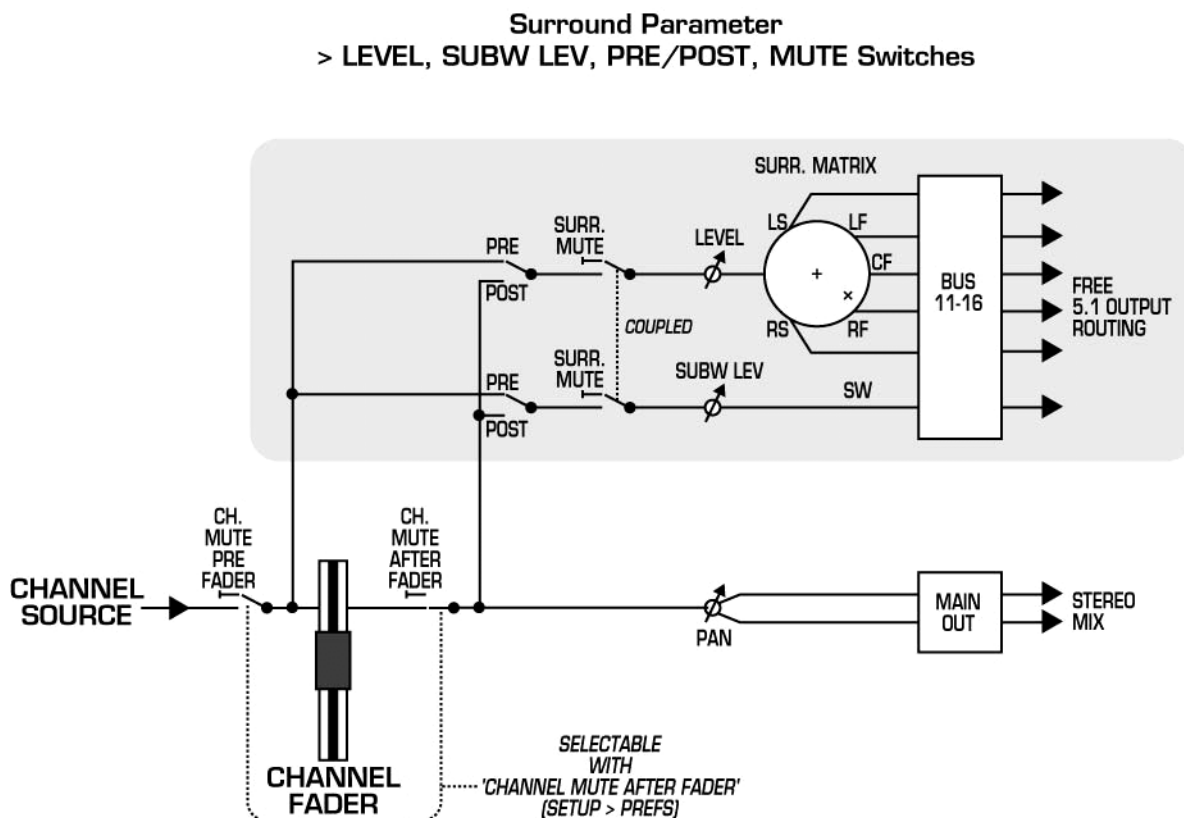
- additional new update features:
 - **100 markers** (previously 10) as well as an EMPTY indicator in case marker storage is empty. You can recall the marker menu via MMC/MIDI > MACHINE CONTROL > LOCATE (also see ch. 13.2).
 - **TIME COUNTER RELATIVE** (display page MMC/MIDI > SETUP, also see ch 13.1) can now be activated at the MIDI setup page (on/off). You're dealing with an SMPTE timecode offset, i.e. there is no time delay. If you for example have a continuous time code on an external multitrack tape over several songs, you can set TIME COUNTER RELATIVE to ON at the start position of the song (or song segment) you wish to modify. This way, the actual current locator value is assigned 00:00:00:00 on the DDX3216 as its new time position. All locator operations such as forward, return, play etc. still remain in sync with one another; it is only the time code display that is relative to the actual tape position.

4. SURROUND PARAMETERS

Only a few (however effective) parameters are needed to control the surround option:

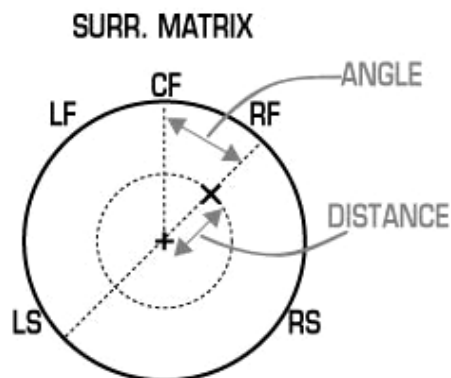
- Send signal level in the selected channel (surround source) can be adjusted to the surround outputs by using **LEVEL** ($-\infty$ to +12 dB).
- You can use the **PRE** or **POST** switch to send the signal to the surround outputs independently from the stereo mix (PRE), or you can additionally control the signal's volume via the channel fader (POST), together with the signal portion for the conventional stereo mix.

- Use the **SUBW LEV** to adjust the level of the signal relayed to the subwoofer output (bus 16). The **PRE** switch or the **POST** fader have the same function as described above (see also ch. 4.1).
- The functioning (and the switch position) of these parameters is identical to the ROUTING LEVEL and PRE/POST parameters in channel routing menu (see ch 4.1).
- Additionally, the display has a surround **MUTE** switch per channel, and is active in the factory default (i.e. mute = on).
Even when MUTE is deactivated, the signal may still be inaudible. Either the CHANNEL MUTE key is active or the CHANNEL MUTE AFTER FADER function (see chapter 12.3.2) under Setup Preferences is not correctly set.
If the latter is active, POST fader signals (sends/busses) and non-PRE fader signals are muted through the CHANNEL MUTE key.



- The actual positioning of the sound source and its movement throughout the surround space take place in the **circle** with the positions of surround speakers indicated.

Surround Parameter > ANGLE, DISTANCE

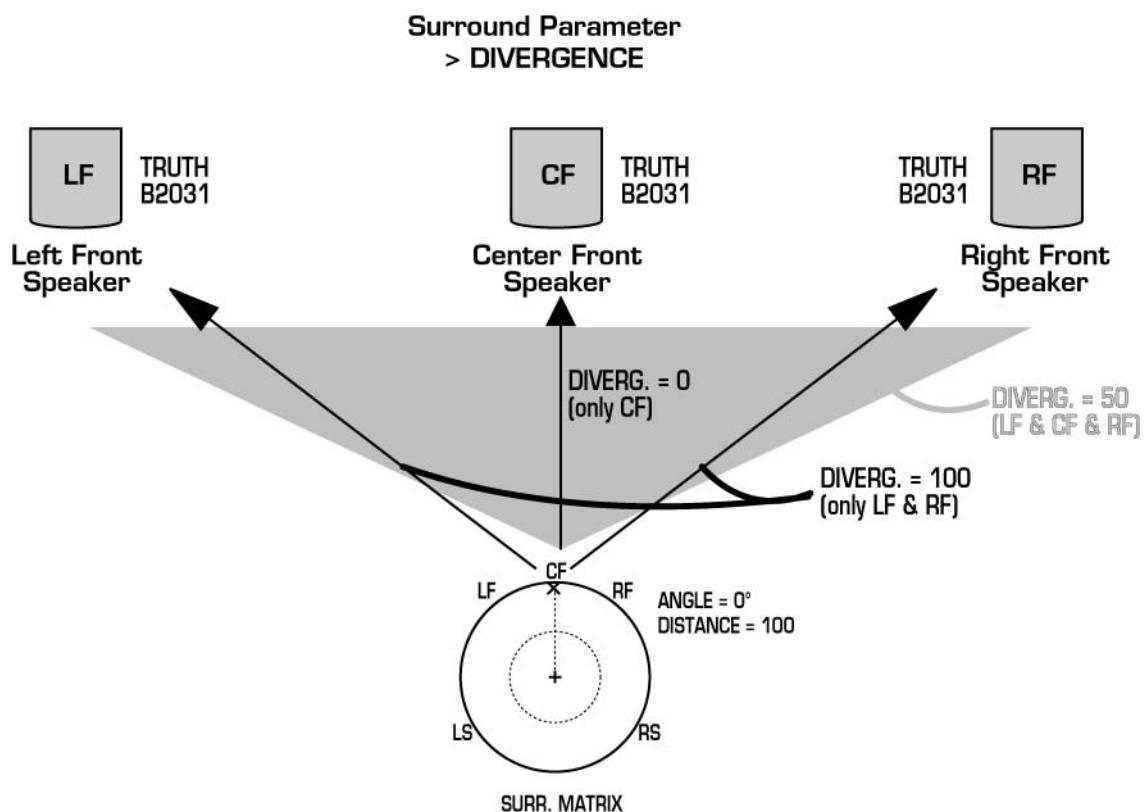


- The "+" in the middle represents the central point, that is, the optimal listening position.
 - The "x" indicates the current position of the sound source within the surround space.
 - The positioning of the sound source is done using both the ANGLE parameters (Angle, $-180^\circ \longleftrightarrow 0^\circ \longleftrightarrow 180^\circ$) and **DIST** for DISTANCE (distance from middle point, $-100 \longleftrightarrow 0 \longleftrightarrow 100$).
 - If you *only* change the ANGLE parameter, you can let the sound source circle in the surround space. This is done with the distance from the middle point that was set using DISTANCE.
 - If you want to move the sound source diagonally through the surround space, you have to *simultaneously* modify the ANGLE and DISTANCE parameters.
 - If the DISTANCE value is *smaller* than 100 ("100" corresponds to 100% front, that is, completely in front, when ANGLE = 0°), the channel signal is emanated out of *all* speakers, corresponding to the selected share according to the positioning in the surround space.
- The **DIVERG.** parameter stands for "divergence" and controls stereo width on all 3 *front* speakers.

Divergence is dependent on both ANGLE and DISTANCE parameters and only stands out **when ANGLE = 0° and DIST = 100** (“100% in front in the middle”)! In this case, the 3 DIVERG. corner values have the following ramifications:

- When DIVERG. = 0, the signal *only* comes out of the center speaker.
- When DIVERG. = 100, the signal *only* comes out of the left and right speakers.
- When DIVERG. = 50, the signal comes from the front left, front right *and* the center speaker simultaneously.

Divergence lets you for example widen the sound of the voice of a singer whose voice comes from the front middle, thus leading to a much more pleasant-sounding voice than the sound that is otherwise dominated by the center-front speaker.

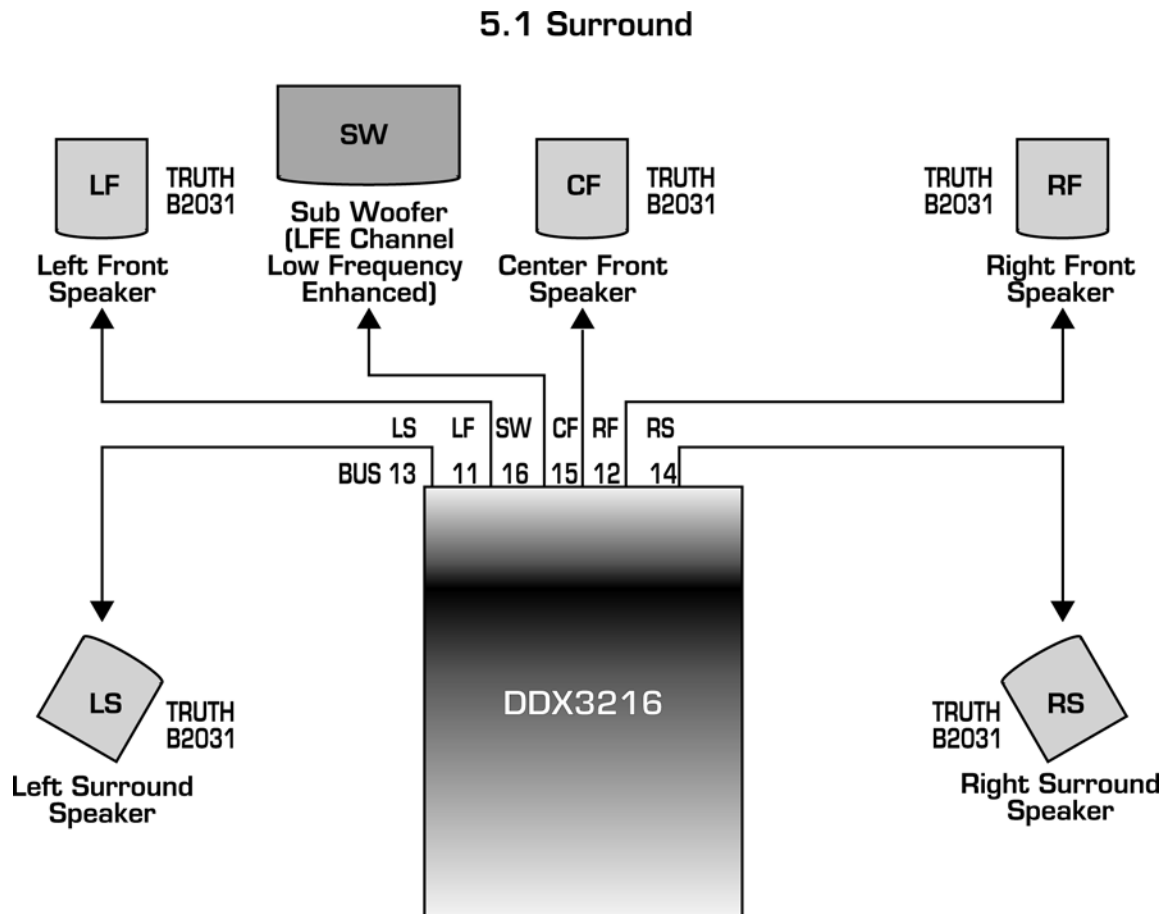


5. ROUTING, TIPS & TRICKS (FAQ):

- ROUTING

If the SURROUND mode is activated, busses 11 to 16 are allocated as follows:

- Bus 11 = LF = Left Front
- Bus 12 = RF = Right Front
- Bus 13 = LS = Left Surround
- Bus 14 = RS = Right Surround
- Bus 15 = CF = Center Front
- Bus 16 = SW = Sub Woofer



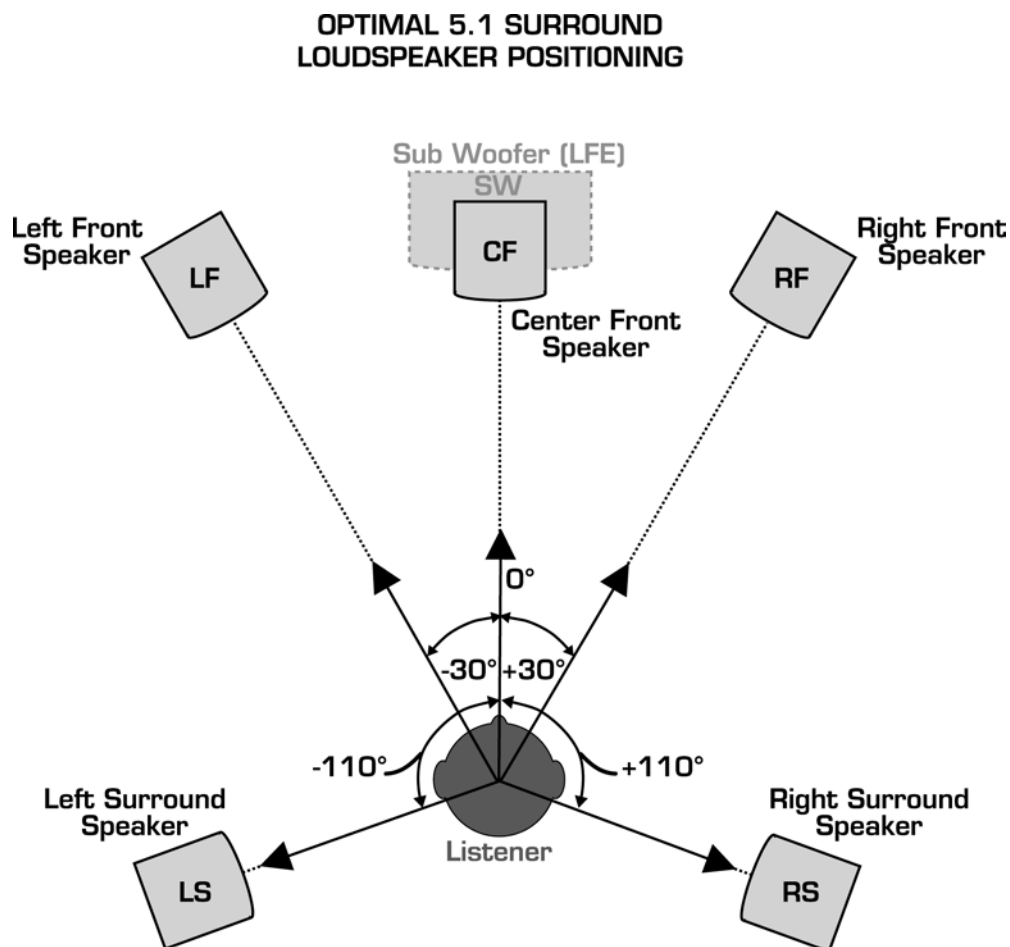
- PHYSICAL OUTPUTS

All physical outputs can be used for the surround option, ideally an 8-channel or a multi-channel output module, or for example the 4 integrated multi-outputs together with the control room out L/R.

- OPTIMAL SPEAKER ARRANGEMENT

The optimal 5.1 surround speaker arrangement assumes an angle of 30° off the 0° axis to the left/to the right for the front left and right speakers; for the back surround speakers, this angle should be 110° to the left/to the right.

The subwoofer does not necessarily have to be in the middle; it can also be placed halfway left or right in the front listening area, provided that the critical frequency is not too high. The human ear can not physically locate low frequencies (under 100 Hz); therefore, the position of the subwoofer is not so critical.



- SURROUND & STEREO MIX

Surround mix and conventional mix can be run simultaneously.

- MAIN OUTS for STEREO MIX

To create the most manageable surround/stereo setup, use the main outs L/R for your stereo mix and an additional I/O module for the 5.1 surround output/mix.

- MAIN FADER

Warning: Controlling the master volume of the surround mix with proportional balance of individual channels is *not* possible with the MAIN fader. Instead, this fader can be used to control the additional stereo mix (in addition to the 5.1 surround mix) needed for DVDs. Usually, the 6 surround channels are controlled with the 6 bus faders numbered 11 to 16.

- SURROUND GROUPING/FADE OUT

Fading out a surround track is more complicated than fading out a conventional stereo mix, where you basically only have to pull down the fader. To achieve a proportional fade out while still keeping the individual signal level balance of single surround tracks, you can simply group the surround busses/faders (hit GROUP key > select faders with SELECT, also see chapter 7.1) and then use any one of the group faders to control the master volume. The other faders will follow proportionally.

- MONITOR ROUTING

Warning: Monitor Routing (Control Room Out) is *not* saved under *Snapshots*!

- SAVING SNAPSHOTS

Warning: Surround settings referring to channels are all saved under *Snapshots*, but it will *not* be saved if the SURROUND mode is universally ON or OFF! PREFS (Preferences) or universal settings as well as monitor routing (see above) can *not* be integrated into the presets.

- PC CARD ADVICE

If you need to toggle between stereo and multi-channel configuration, you can store an entire surround project on a PC card. Since preferences are also stored on the PC card, your DDX3216 will automatically go into surround mode as soon as the surround project is uploaded from the PC card.

- I/O-SETTING

The last in/out or bus setting active before powering up the SURROUND function (display page SETUP > PREFS) is stored and can be recalled again as soon as the surround option is switched off.

6. BRIEF SURROUND SUMMARY

- **DOLBY® DIGITAL & DTS® IN THE DDX3216?
GOING FROM SURROUND MIX TO A CD/DVD**

To avoid any confusion:

With the newest surround update, the DDX3216 offers the option to implement the 5.1 surround mix live and also record it multi-channel, for example in an audio sequencer software.

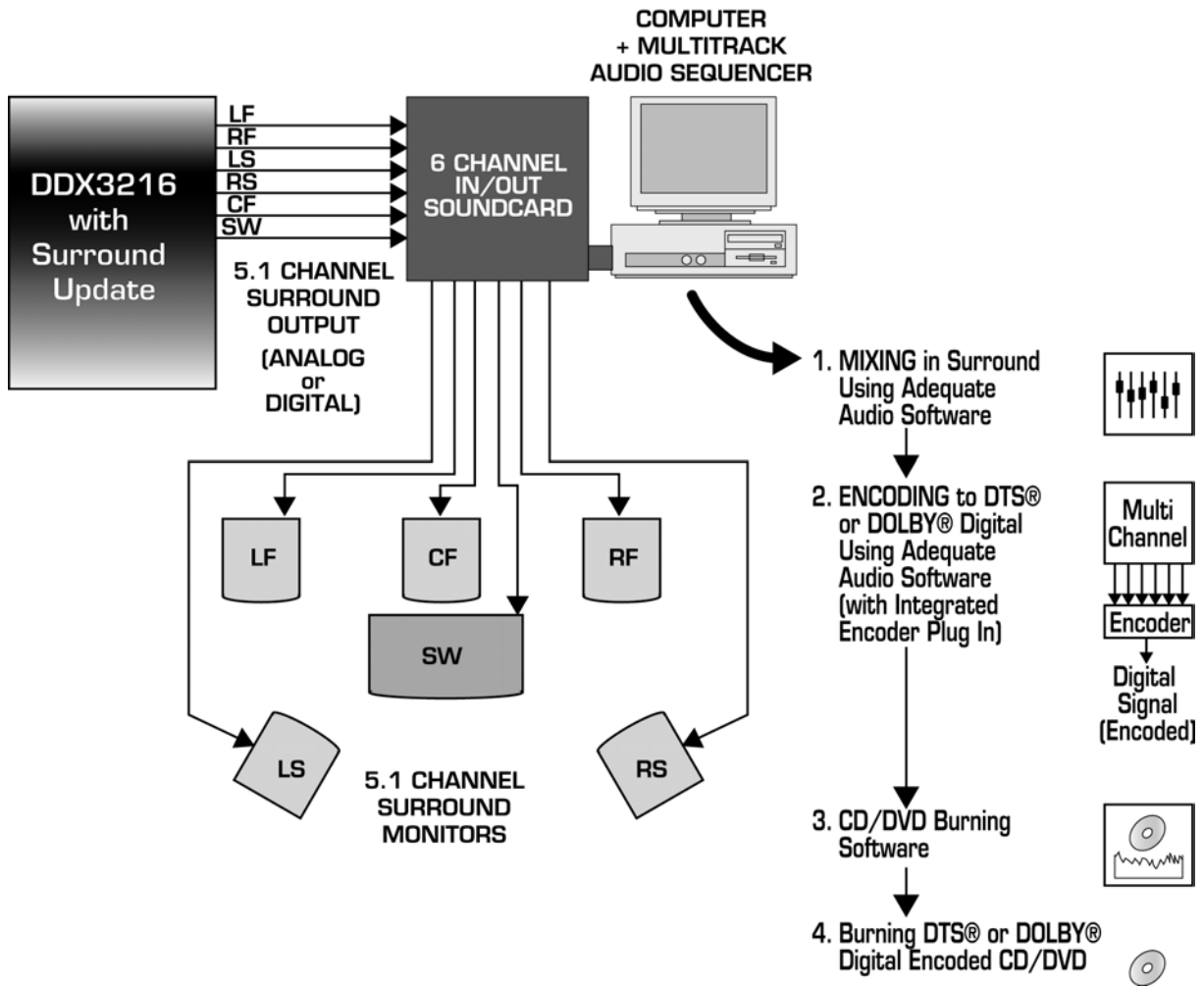
However, the DDX3216 has *no* internal encoder necessary for encrypting into DOLBY® Digital or DTS® formats! Encoders are not exactly inexpensive, and you can get them from various hardware and software suppliers. More information on the subject can be found under www.dolby.com or www.dtsonline.com.

If you want to encrypt your own multitrack surround mixes in the above mentioned standard formats, you need a DTS® or DOLBY® digital *encoder*. They are available either as hardware or software solutions, for example as plug ins for audio software such as Nuendo from STEINBERG®.

After encrypting your surround mix into the desired format using the *encoder*, you can burn this file onto a CD-R/W or DVD. Then, you can play this CD/DVD on most ordinary DVD players. In this case, the encrypted signal is *decoded* either in the DVD unit itself or in the surround receiver/amplifier. Only then are separate audio channels accessible again and are reproduced on the speakers, the same way they were originally mixed on the DDX3216.

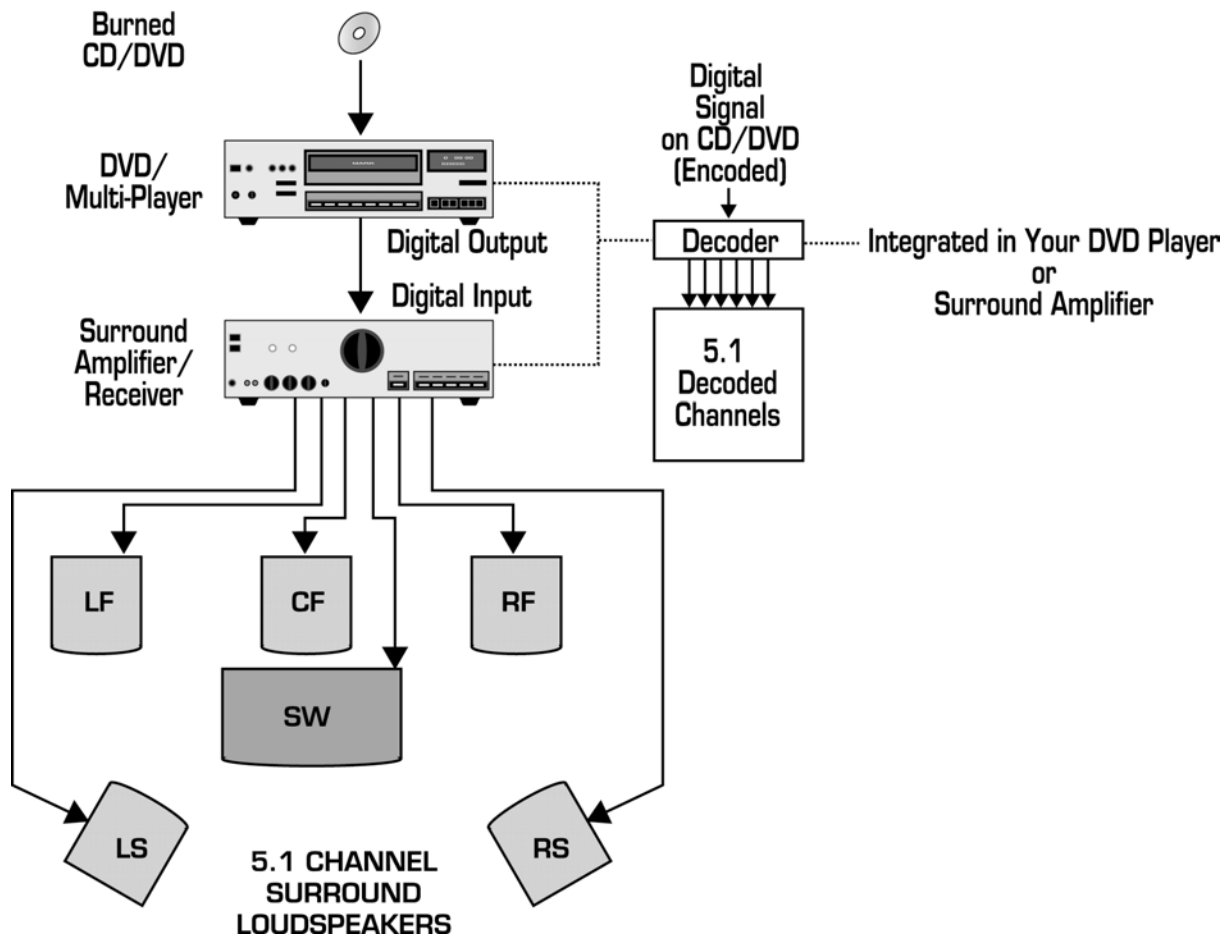
From Surround Mix to CD/DVD

1. MIXING & RECORDING



From Surround Mix to CD/DVD

2. PLAYBACK



➤ SURROUND SOUND WITHOUT AN ENCODER?

Of course, you can burn surround mixes onto CDs/DVDs even without special encoders; you burn your mix as a multitrack file (or as individual audio tracks). However, such CDs/DVDs can only be played in the respective computer drive so you can import the file into the computer and play it on the (multi-track) software you used to initially produce the surround mix.

A **freeware encoder** that supports the surround function is also available. You can get the "WINDOWS® Media Encoder 9" at the MICROSOFT® homepage (www.microsoft.com) under "WINDOWS® Media" (WMEncoder.exe, v. 9). Use this encoder to produce surround recordings with data compression. The software player decodes the surround signal correspondingly. This multi-channel surround encoding/decoding is indeed available for free and accessible to anyone, but it is

not compatible to DOLBY® Digital or DTS®. The WINDOWS® Media files can also (still) not be reproduced on standard multi DVD players since they do not support this WINDOWS® format.

➤ **CONNECTING TO A SURROUND AMPLIFIER**

At first sight, how to connect the DDX3216 to a 5.1 surround Hi-Fi amplifier and Hi-Fi speakers seems self-explanatory. However, there are several precautions:

1. CONNECTING TO *DIGITAL IN*

Connecting a digital output of the DDX3216 to a digital input of an amplifier does not let you control the mixed surround signal! Conventional Hi-Fi surround amplifiers can only accept stereo signals in the S/PDIF format or encoded DTS® or DOLBY® Digital signals, and the DDX3216 alone can not output these. Similarly, connecting a multi-channel ADAT® signal does not help the matter, as no Hi-Fi receiver/amplifier supports this format.

2. CONNECTING TO THE 6-CHANNEL ANALOG IN

Some high-end home cinema receivers/amplifiers have a separate 6-channel analog input for connecting external decoders (e.g. those found in DVD players).

You can use this 6-channel input for connecting 6 DDX3216 analog outputs or for connecting 6 analog (return) surround signals from a sound card to which the DDX3216 is connected (see above figures).

One possible way to wire your equipment:

DDX ADAT® Out to the ADAT® In of a sound card > mixing/recording on a computer > 6 Analog Outs of the sound card to the 6-channel input of a surround amplifier.

Alternatively, you can of course connect high-quality 5+1 speakers such as the BEHRINGER TRUTH B2031 directly to the analog sound card outputs. This way you avoid having to use a surround Hi-Fi amplifier in the studio, thus achieving much better sound quality.

➤ **SURROUND VIA HEADPHONES**

Please note that you *cannot* control a surround mix by using headphones. Firstly, all channels fed to the headphone output would have to be mixed, which is not an option that is available on conventional headphones. Secondly, no standardized surround headphones that could produce a correct surround playback are available on the market!

The so-called “surround” headphones create only a virtual surround sound space generated from a single stereo source (!) and can not reproduce a true surround signal!

Some systems such as AKG® “HEARO” do indeed offer additional DOLBY® Prologic and DOLBY® Digital decoders, but they too convert the incoming surround signal into a binaural (“two-ear”) audio signal to be played on conventional headphones.

Even the YAMAHA® “Silent Cinema” technology found in their home cinema receivers/amplifiers merely uses the internal DSP chip to generate *virtual* surround effects for conventional headphones.

➤ **“GAPS” WHICH MAY OCCUR DURING SURROUND PANNING**

When you modify a sound source in a circle, “acoustic gaps” may occur, or you may perceive acoustic jumps from one speaker to another. This is by no means a defect of the surround option of the DDX3216, it is a normal phenomenon that occurs on *all* 5.1 surround systems.

The reason is the fact that 5 (+1) loudspeakers can not perfectly cover any one area. Theoretically, a more ideal solution with far greater uniformity of coverage would be an 8 (+1) system. The current standard (supported by the DDX3216) is a 5.1 surround system; you should be aware of the limitations of “rotating”.

➤ **SURROUND MUSIC**

Surround sound in pure musical productions is still a relative novelty, aside from the failed attempts at achieving quadraphonic sound. There are no universally accepted guidelines for surround music productions. DVD audio is

also in its infancy, and only time will tell which features delving into sound esthetics will have a lasting impact. Having a pioneering spirit is nowadays just as important as it was when stereophonic sound was first launched. The only rule that really goes nowadays is the following: less is often more! Nobody wants to listen for music for 75 minutes if instruments continuously circle throughout the room or if primary musical elements such as lead vocals sometimes come from the back.

➤ **DTS® & DOLBY® DIGITAL**

DTS® is an abbreviation for Digital Theater System and is second in popularity only to **DOLBY® Digital**. Even though **DTS®** is technically more advanced (since there is a much higher data rate), it is seldom used on DVDs. The first reason is because corresponding decoders are not often found in surround amplifiers. The second reason is that the higher data rate of the audio signals requires more disk space than similar AC-3 encoded signals. The latter would lead to storage issues with extra-long films or DVDs that contain many special features. **DTS®** was developed in 1990 by Terry Beard, and 3 years later Universal Studios and other investors came out with the first-ever film with **DTS®** sound: Steven Spielberg's *Jurassic Park*.

DOLBY® DIGITAL or AC-3 was introduced in 1992, and is the next logical step in the development of the first digital surround format AC-1, introduced in 1984 by the **DOLBY®** Laboratories. AC-3 is the most popular current surround format. Six separate sound channels are encoded in a linear PCM bit data stream (just like **DTS®**). The signal is then highly compressed (similar to **DTS®**) in order to reduce data size. Sound quality reduction is within reasonable limits, and is comparable to the difference in quality between the sound of an audio CD track and a high sampling rate MP3 file derived from it.

Separating sound into 6 channels has its roots in film production, or, more exactly, in sound implementation in cinema theatres. Usually, the front left and right speakers reproduce music and sound effects visible on-screen. The center speaker is usually used for dialog, and the subwoofer or the "LFE"

channel (Low-Frequency Enhanced) is used for special effects such as earthquake grumble, bomb explosions and so on. The rear surround speakers are used to merely reproduce background noises and may contain delayed segments of the front speaker section. For example, the rear speakers are used to help reenact the sensation of being in the middle of a church, being at a bar, or to give the viewers the sensation that a fighter jet just flew by and similar special effects.

At a typical cinema, the 3 front speakers and the subwoofer are located behind the screen, while the surround speakers are hung in the rear half of the cinema on the side walls.

➤ **SURROUND FORMAT VARIATIONS**

DOLBY® Stereo was first introduced in 1975, and shortly thereafter the first popular home cinema version, **DOLBY® Surround**, also turned up on the market. In both of those, a front stereo signal + 1 center speaker signal + 1 rearward mono surround channel with a trimmed frequency were matrix-encoded and encrypted into 2 audio tracks. In doing so, it was possible to encode these 4 audio channels onto 2 tracks and transmit them along with the stereo TV signal and also record it on a stereo VCR.

DOLBY® Surround ProLogic is almost identical to the above two, but allows for better channel separation. **DOLBY® ProLogic II** even makes reproduction on 5.1 speaker sets possible. **DOLBY® Digital or AC-3** is today's most popular digital 5.1 surround format with 3 front speakers (Front Left, Front Right, Center), a subwoofer (or LFE channel) as well as 2 completely separate surround speakers (Surround Left & Right) with a full frequency response. **DOLBY® Digital Surround EX** adds a third surround channel coming from behind the rear wall (Rear Surround, contrasted to Left/Right Surround on side walls). This way, this format achieves a full 6.1 channels. Furthermore, there are various other types of **DOLBY® "Virtual Surround"** formats for headphones and TV sets. They are sold under the names **DOLBY® Headphone**, **DOLBY® ProLogic II Virtual Speaker**, **DOLBY® Digital Virtual Speaker**, **Virtual DOLBY® Surround** and **Virtual DOLBY® Digital**.

DTS[®] (5.1 channels, just like **DOLBY**[®] Digital, but with a higher data rate, 768 to 1536 kBit/s, compared to AC-3 with up to 448 kBit/s) struck back in 1999 with **DTS-ES** (Extended Surround). It also uses a rear center speaker, thereby making 6.1 surround possible. In 2001 it was further enhanced with **DTS96/24**.

The **THX**[®] acronym seen the world over is no surround format of its own; rather, it is a *certificate* awarded by the US company Lucas Film Ltd. (of *Star Wars* fame). It is awarded to high-end home cinema surround components as well as cinemas featuring strictly prescribed room acoustics. There is **THX**[®] **Select** for those products fulfilling the norm, and there is **THX**[®] **Ultra** for those components that feature surround components of particularly high quality.

THX[®] **Surround EX** is the highest current surround standard. It is the result of cooperation between **LUCASFILM**[®] Ltd. and **DOLBY**[®] Laboratories. It supports 7.1 channels in home DVD applications: front left/right/center, subwoofer, surround left/right as well as two (!) rear center speakers (Surround Back). For more information, visit www.thx.com.

SONY[®]'s answer to having a surround system with 8 separate channels is called **SDDS (SONY**[®] **Dynamic Digital Sound)** (see www.sdds.com), but it is exclusively used in cinemas. Therefore, there are no encoders/decoders you can buy for home cinema applications, and no Hi-Fi receiver/amplifier or a DVD player supports this format.

➤ **DVD-V vs. DVD-A vs. SACD**

After **DVD-V (Video)** established itself as a standard (colloquially referred to only as "DVD"), since 2002 the industry has also been trying to push the **DVD-A (Audio)** against its staunchest opponent, **SACD (Super Audio Compact Disc)** developed by **SONY**[®] and **PHILIPS**[®].

DVD-V does indeed offer surround sound, but only on a limited scale, since the largest data blocks are eaten up by the video material itself. Nevertheless, it is today's most significant multi-channel medium.

DVD-A audio quality is much better than the audio quality of tracks found on DVD-V recordings, since DVD-A recordings feature much higher sampling rates, ranging from 44.1 kHz all the way up to 192 kHz. When working with the sampling frequency of 96 kHz, a maximum of 6 channels in 24-bit quality can be fit on a DVD-A. The number of channels drops to only 2 if you're working with higher sampling rates (176.4 and 192 kHz). Storing audio tracks is done according to the LPCM protocol (Linear Pulse Code Modulation), DOLBY® Digital, MPEG-2 or optionally in the DTS® format. Playback times range from 65 minutes (LPCM, 192 kHz, 24 Bit, 2 channels) up to 1,550 minutes (DOLBY® Digital, 48 kHz, 24 Bit, 6 channels).

It is worth noting that DTS® can encode up to 8 audio channels at 24 bit/96 kHz, and with noticeably lower data compression rate than DOLBY® Digital or MPEG-2.

SACD (Super Audio CD) is based on "DVD-9" (one of the many Digital Versatile Disc media types available) and offers "Dual Layering", that is, there are two separately scanable layers. The first layer corresponds to the Red Book Standard and offers full compatibility with conventional CDs, and SACDs can be played on all CD players.

Conversely, conventional CDs can be played on SACD players as well. However, there are incompatibility issues with DVD ROM drives that can also be found in stand-alone "DVD multi-players".

The second layer carries a 6-channel surround mix, a stereo mix as well as additional data types such as texts, graphics, pictures etc., but contains no videos.

The SACD specs are impressive: a sampling rate of 2,822.4 MHz (the equivalent of 64x sampling rate of 44.1 kHz found in traditional CDs!) makes a frequency range between 0 to 100 kHz with a dynamic range of 120 dB! 74 minutes of multi-channel music in 24-bit quality fit on one SACD, but there

is 50% data compression using the DSD (Direct Stream Digital) protocol developed by PHILIPS®.

DVD-A and SACD both offer advantages as well as disadvantages. SACD discs can not be played on any DVD player, but that can even happen to some DVD-As! While DVD-A expands on the success of DVD-Vs, SACD (being a high-end, technically superior product) is facing a tough challenge, even though it is completely reversely compatible with CDs and CD players. Get more information under www.surroundassociates.com.

➤ **FORMATS & MEDIA THAT MAKE SENSE**

On what format a musical surround production will later be pressed makes pretty much no difference, regardless of whether it is DVD-V, DVD-A, CD or SACD. What is of much higher importance is the actual surround format. Basically, there are currently 3 plausibilities:

1. If you want to listen to a surround mix at home or at the studio, you can use multi-track hardware or software that was also used to create the mix.
Advantage: Mix available for manipulation at all times.
Disadvantage: Not compatible to popular surround formats; complete set of equipment has to be powered up (on average, at least a computer plus an audio sequencer software plus surround/amplifier speakers).
2. Convert the completed mix into DOLBY® Digital or DTS® format.
Advantage: Compatible worldwide, almost all DVD players/surround amplifiers can play it.
Disadvantage: Expensive encoder/software required.
3. Convert the completed mix using the WINDOWS® Media Encoder.
Advantage: Easily exchangeable via the internet, can be played on almost any WINDOWS® XP PC, the encoder is free
Disadvantage: Not really widespread, high data compression, can not be played on traditional DVD multi-players right now.

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