



Soundfield 5.1 Surround Recording System

HUGH ROBJOHN'S MIBS describes an elegant and future-proof surround sound microphone system.

The Soundfield Microphone has, in the quarter century since its inception, acquired a reputation as one of the finest and most versatile microphones in the world – although it has always struggled to gain widespread acceptance, despite its remarkable qualities. This may be set to change, however, with the increasing demands of and for surround sound acquisition.

The first Soundfield microphone was developed by the National Research Development Corporation (NRDC) and Calrec Audio, based on the work of mathematician Michael Gerzon. It formed the heart of what became known as Ambisonics – an advanced surround sound system which suffered (unfairly) through association with the much inferior quadraphonic systems of the late 1970s, and is only realising its true potential with the increasing use of DSP-based decoders. In 1993 the rights to the Soundfield microphone technology and patents were bought by Soundfield Research, which has been marketing and developing the microphone and its associated systems ever since.

For those not familiar with the technology, the Soundfield design employs a four-capsule microphone the outputs of which are transformed in the associated control unit to provide signals equivalent to those generated by four first-order virtual microphones (the 'B-format'). These are called W, X, Y, and Z and equate to an omnidirectional microphone and three orthogonal figure-of-eight microphones (all four being coincident with one another) facing front-back, left-right and up-down, respectively. This B-format signal contains all of the directional information of the incident sound wave in three dimensions, and can either be recorded to a four-track machine, or processed directly to produce any number of outputs corresponding to virtual microphones pointing in any direction and with virtually any polar response.

The beauty of the B-format is that a complete surround stage can be recorded on just four tracks

(instead of six or more), it can be transcoded to suit any present or future multichannel surround sound system, and it is fully mono and stereo compatible thanks to its coincident microphone source.

Affordable Surround

The SPS422-B and SP451 combination under review here represents a very elegant, versatile and affordable solution to surround sound acquisition, with the bonus of being track-efficient and both backwards and forwards-compatible. In other words, the B-format output from the SPS422-B can be recorded on any four-track machine, and subsequently used as the source for mono, stereo, LCRS, 5.1, 6.1, 7.1, 10.2 or any other replay format you care to dream up!

The SPS422-B is a 1U rack mounting controller for a Soundfield microphone. Although the same basic microphone element is used in all three Soundfield packages (see box), the mic and controller are matched to one another during manufacture, so you can't 'mix and match'. The microphone connects via a multiway connector, and the balanced line level outputs are presented on six XLRs: a main stereo output plus the four B-format signals.

The front panel is laid out clearly with just five rotary controls, four push buttons, and a large dual bar graph meter. To the left of the meter, two sets of control functions affect the B-format signal. A rotary switch (in 10dB steps from 0 to -30dB) and continuous rotary control (± 10 dB range) adjust gain, while two illuminated push buttons configure the unit for different microphone orientations (inverted or end-fire modes). The controls to the right of the meter adjust the stereo output, and it is worth remembering that the unit actually works internally with MS signals. Thus the two rotary controls to the right of the meter essentially adjust the nominal polar pattern of the mid channel, and the level of the side channel, and labelled pattern and width, respectively.



The stereo outputs can be left as MS signals, or converted to normal left-right stereo, via a push button – the current mode is indicated on the bar graph meter legends. A second button implements an 80Hz high-pass filter. The final rotary control sets the headphone monitor level and is accompanied by a quarter-inch stereo headphone socket. The bar graph meters have a VU ballistic and are scaled from -30 to +21dBu.

The action of the pattern and width controls can be confusing to those not versed in MS theory, but help is at hand in the form of a small but well designed program which can be downloaded from the Soundfield web site. This provides a useful interactive graphical illustration of the effect of these controls, both on the virtual source MS microphones, and on the equivalent left-right microphones.

SP451 Processor

This unit is equipped with four XLRs to accept balanced line level B-format inputs, and eight XLRs providing line level transcoded surround sound outputs. The review unit was set up to provide a 5.1 surround sound, so the last two XLRs were unused. However, with an appropriate decoder card (see below) these may be used to provide outputs for 6.1 or 7.1 systems.

Starting at the left hand side of the front panel, a master input level control adjusts all four B-format signals simultaneously (from full attenuation to +10dB), and the result is shown on four bar graph meters. To the right of the meters three rotary controls adjust various aspects of the transcoding. Essentially, the system uses the B-format input information to create six virtual coincident microphones – all cardioids by default – to feed the 5.1 surround outputs. The first knob is labelled 'front width' and alters the effective mutual angle of the front left and right microphones which feed the left and right front loudspeakers. The range is from zero degrees (mono) through to ± 90 degrees (relative to the centre), with a 'cal' position equating to ± 45 degrees. The second control (rear width) does exactly the same for the rear left and right microphones, with the default position equating to angles of ± 135 degrees. The third control is labelled 'rear focus' and alters the effective polar patterns of the two rear microphones. The default is cardioid, but the range spans omni to figure of eight.

Together these three controls provide a remarkably versatile range of control over the nature of the surround sound stage. The rear focus control is particularly useful as it allows the rearward definition to be 'blurred' by choosing a pattern which captures more spatial or ambient information, for example.

The right hand section of the front panel is concerned with the surround outputs. Six rotary controls, each with an associated bar graph meter, are provided to adjust the output level (from fully off to

+10dB) of each of the first six surround outputs. Alphanumeric displays above each meter identify the corresponding channels of the surround array, as determined by the currently selected transcoding mode.

The transcoding mode is determined by one of up to three plug-in cards called MAPs (microphone array patterns). The standard card supplied with the SP 451 transcodes B-format signals to five coincident cardioids (plus an omni signal below 120Hz for the sub-bass output). However, other formats are available to order, including options to generate 6.1 or 7.1 surround formats. Three illuminated push buttons are provided to select any one of the three possible MAP cards, enabling instant comparison between different transcoding configurations – but since the review model only had the single card, I was unable to try this particular facility.

In Use

I have been using the SPS422 Soundfield Microphone system for a couple of years, so its operation was already familiar to me. It is worth mentioning, though, that for the novice there is a learning curve to get to grips with the width and pattern controls, since these are not entirely intuitive. Although they play no part whatever in the context of the subsequent surround sound transcoding from the B-format outputs, they are vital in configuring the unit's stereo outputs. The only other practical issue to be aware of is the metering. As standard, the meters have a VU-like response which under-reads considerably on fast transients.

The B-format signals have critical phase relationships, but this should not present problems with modern multichannel digital recorders. In addition, if a further two tracks are available (not necessarily on the same machine) then the stereo outputs from the SPS422-B can also be recorded – perhaps providing a stereo track for editing while the B-format track is available for subsequent 5.1 surround post-production. Needless to say, because the stereo (and surround) outputs are derived from a point-source microphone, the signals can be folded down without risk of phase errors: stereo to mono, and surround to LCRS/stereo/mono.

I recorded and replayed B-format signals successfully using SADiE and Genex machines, and I was able to use the SP451 as a surround preamp; the B-format input coming from the recorder with the six outputs directly feeding the Bryston amplifiers of a PMC surround sound system. This arrangement worked well thanks to the full attenuation capability of the input gain control in the processor – although in more normal usage the processor would probably be feeding channels of a post-production console.

With the controls set to their default positions I found the transcoding worked superbly, recreating a very precise and all-enveloping sound stage. However, adjusting the front and rear widths, and the rear pattern control enabled a wide range of different sound stage characters to be created, from accurate and naturalistic to diffuse and ambient. It was also possible to create some dramatic effects – simulating walking through a

long corridor and out onto a stage, for example - by starting with front and rear widths set to zero, and then winding them up to simulate the exit from the corridor. A handy effect for radio drama perhaps.

Final Thoughts

The combination of the SPS422-B and SP451 is a very powerful tool for the capture and reproduction of surround sound, and is ideal for music, radio drama, and the acquisition of atmospheres and sound effects. As well as being easy to use and capable of providing superb audio quality, the complete system also offers the considerable benefits of being able to accommodate all present and future multichannel formats, and requiring only four tracks (instead of six or more) for the archive B-format audio files. From these archive

recordings material can be easily re-tasked for any alternative surround sound format, including those involving a height element.

As with coincident stereo recordings, additional sound elements can be mixed in with the decoded B-format signals to create a fully mono and stereo compatible mix - something which is often not the case when using surround atmospheres captured with spaced microphone arrays.

Although developed a long time ago, the Soundfield technology appears to have a great deal to offer practitioners involved with current (and future) surround sound projects, and I would recommend hands-on experience with this remarkable system.

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Prices

SPS422-B - £2675.00

SP451 - £1975.00

(All prices
exclude VAT)

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Soundfield Systems

There are currently three models in the Soundfield Microphone range. The base unit is the 1U rack mount SPS422-B. Early units provided only a stereo output, but the current version has both stereo and B-format line level outputs. The middle model in the range is a portable unit, the ST250, which is essentially an SPS422 in a smaller box that may be battery powered. This unit can provide a mic-level B-format output via some clever connector wiring. The flagship model is the Soundfield Mark V Processor which includes some sophisticated B-format manipulation tools. These facilities enable the virtual surround microphone array (or a B-format recording) to be 'steered' and 'zoomed'. However, all

Soundfield units allow the effective mutual angle and polar pattern of a virtual stereo pair to be controlled to optimise the stereo output as required.

The company also manufactures a Surround Sound Processor - the SP451 which converts a B-format signal to 5.1 surround (with the capability of handling up to 7.1 channels, if required). There is also a new Direct-X software plug-in for the SADiE System 5 which combines the manipulation tools of the Mark V Processor with the transcoding functions of the SP451.