

Design Brief

SPA23 Integrated AV Amplifier

7 pages



Introduction

The SPA23 is a 5x120W integrated A/V amplifier and digital controller and is the natural successor to the SPA22, which was recognised around the world for its ease of use and 'hi-fi' sound quality. As the first of a new generation of Primare home entertainment products however, the SPA23 represents a considerable evolutionary advance in terms of design, performance, user flexibility and versatility.

Modular Design

The SPA23's comprehensively shielded heavy-duty steel chassis houses a newly developed modular design that allows for DSP, video and connections to be upgraded easily with proprietary Primare boards, incorporating thoroughly evaluated and optimised versions of the latest technologies and connectors.

In every instance we have taken special care to keep signal paths short and layouts uncomplicated. Together with high performance FFC-wiring, these techniques give the unit an extremely high performance and the highest possible signal-to-noise ratio. The finest audio grade semiconductors and capacitors have been used whenever possible. All parts that are known to interfere with each other are isolated by shielding, dedicated signal paths and power supplies.

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Ultra Fast Power Device (UFPD) Class D Amplification

Switch mode power electronics is an important technology for reducing energy consumption and also to meet the demands for more channels in smaller enclosures. Unfortunately Class D amplifiers and switch mode power supplies have a deserved reputation for poor audio quality. The reason is that it is very difficult to apply enough feedback to control high frequency distortion while retaining stability in the Class D circuit. The culprit is the demodulation filter on the output, which shifts the phase 180 degrees. At low frequencies where the phase margin is large the application of enormous amounts of feedback creates fantastic THD figures, but at higher frequencies THD rises quickly. While the sound quality of such an amplifier is usually very dynamic and vivid, it can sound tiring and uncontrolled in the long run, especially when driving complex loads such as multi-way speakers. The worst examples have 0.001% THD at 1kHz and 0.1% THD at 7kHz : 100 times more THD at 7kHz. Female voices can sound harsh and metallic, percussion like breaking glass.

Primare is now introducing a Class D technology called UFPD (Ultra Fast Power Device) which for the first time provides for the possibilities of an 'audiophile' Class D design. It is a Class D technology which has 30dB constant loop gain in the entire audio range and beyond the filter resonance frequency. It treats all signals equally regardless of frequency or slew rate and has the ability to suppress the filter resonance entirely.

Consequently THD is kept very low at all frequencies. Irrespective of load, the frequency response is the same therefore UFPD is able to drive any speaker while maintaining control and vividness.

Although switch mode power supplies have gained a reputation for noise and unreliability, the theoretical advantages of the design are well known. The rails can be regulated with precision and current demand from the mains is lower as the result of high efficiency and the absence of current spikes: energy is taken from the mains over a larger period of the sine wave.

In conjunction with UFPD, Primare uses an isolated PFC (Power Factor Control) technology in the power supply, which controls the current from the mains voltage so that it is a pure sine wave with the same frequency and phase as the mains voltage. This means that even if 1000W is taken from the mains, other equipment in the room will not be affected. Its presence becomes virtually invisible to the mains voltage! The isolating stage of the converter works in a ZVS mode and as a result, the switch flanks contain a lower quantity of harmonics, providing lower EMI and a clean environment for the amplifiers to work in.

Operational Versatility

Almost every parameter in the configuration of the SPA23 can be user defined. Any input can be assigned a name and associated with any audio and video source. Surround format, trigger activation and input sensitivity can be specified for the input. Individual levels, speaker types, crossover frequencies and delay configurations including bass management can be selected for each of the major surround formats. A 250mS global delay system, with dedicated DSP, is incorporated in order to achieve the best possible picture to sound synchronisation. For the highest possible installation flexibility, all the SPA23's functions can be controlled in three ways: from the front panel, IR or RS232.

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Inputs/Outputs

The SP33 has five HDMI v1.4 inputs and two HDMI v1.4 outputs for audio and video, incorporating a user-selectable audio processing and bypass function (see Technical Information).

HDMI v1.4 capability is significant because it carries uncompressed multi-channel PCM audio from a Blu-ray player to the SPA23's DACs and beyond to the amplifiers and loudspeakers. **HDMI 1.4 deployed by the SPA23 supports 3D pass-through but not ARC or 4K UHD.**

Eight pairs of unbalanced analogue audio inputs are provided together with six digital audio inputs. Via the 'input settings' menu, any audio input can be assigned to any of the HDMI video inputs, for simultaneous output to the HDMI video outputs. 7.1 channel analogue audio inputs are also provided for the connection to DVD-A / SACD players. Unbalanced pre-amplified audio outputs (FL, FR, C, SUB, SR, SL, SBL, SBR) are provided for connection to any type of power amplifier. Front channels are re-routable in 7.1 Mode. Three 12V high current DC-triggers are provided, as well as IR and RS232 inputs.

HD audio and video upgrade features for SPA23

Audio Upgrade (included on all new SPA23s)

The audio board uses a Sharc DSP from Analog Devices (ADSP 21367) capable of decoding the HD formats such as DolbyTrue HD and DTS-master HD.

New features with the HD audio board:

Improved and more extended trigger options.
Individual HD format settings including Multi-PCM.
Easy lip-sync access using 'balance' button.
Upgraded design of the on-screen menu and display of the SPA22 or SP32.

Formats decoded

Dolby Prologic IIx
Dolby DigitalEX, Plus, TrueHD
DTS, DTS-ES, DTS-NEO:6, DTS 96/24, DTS-HD Master Audio, DTS-HD High Resolution Audio, 2ch-PCM, Multi-PCM, LPCM

Dolby TrueHD: lossless encoding of up to 8 channels of audio, built on MLP technology. It offers a maximum bit rate of 18.64Mbps, up to 8 channels of 24bit/96kHz audio and up to six channels of 24bit/192kHz audio. Under the Blu-ray standard, support is optional.

DTS-HD Master Audio: lossless encoding of up to 8 channels of audio. It offers a maximum bit rate of 24.5Mbps, up to 8 channels of 24bit/96kHz audio and two channels of 24bit/192kHz audio. Under the Blu-ray standard, support is optional.

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Video Upgrade (included on all new SPA23s)

HDMI up-scaling to 1080P, 1080P/24 over 24/50/60Hz, with user selectable bypass for deep colour signals.

Five HDMI inputs, two HDMI outputs (not simultaneous): the user selects which output to use (1 or 2).

HDMI Audio support, user selectable feature to have the audio processed by the SP33 or forwarded to the TV.

Setup menu available on either HDMI output (not at the same time)

Blu-Ray Disc and HD Audio

Blu-ray players can be configured to output uncompressed multi-channel PCM from any Blu-ray Disc. The SPA23 will perform accurate D/A conversion on the multi-channel LPCM bit-stream.

Blu-ray Disc is the only source of 5.1 or 7.1 channel HD audio currently available
Most film soundtracks are mastered in 5.1-channel, 24-bit/48kHz PCM
LPCM has the highest bit rate of all three lossless codecs*

Currently 26% of Blu-ray discs carry a native multichannel PCM soundtrack+
Most Blu-ray players can be set to decompress (unpack) Dolby and DTS HD audio formats and output them as uncompressed multichannel PCM audio. Even if the Blu-ray Disc doesn't carry the PCM soundtrack, it's still available from the player.

Blu-ray lossless audio formats*

Three are available currently: multichannel LPCM, Dolby TrueHD and DTS-HD Master Audio.

Multichannel LPCM – Linear Pulse Code Modulation: LPCM (often referred to as PCM) is used for the lossless encoding of audio data in the compact disc Red Book standard; has been defined as a part of the DVD and Blu-ray standards and is used by HDMI. On Blu-ray it offers a maximum bit rate of 27.648Mbps, up to 8 channels of 24bit/96kHz audio and up to six channels of 24bit/192kHz audio. Under the standard, players must have the capability to support LPCM.

Dolby TrueHD: lossless encoding of up to 8 channels of audio, built on MLP technology. It offers a maximum bit rate of 18.64Mbps, up to 8 channels of 24bit/96kHz audio and up to six channels of 24bit/192kHz audio. Under the Blu-ray standard, support is optional.

DTS-HD Master Audio: lossless encoding of up to 8 channels of audio. It offers a maximum bit rate of 24.5Mbps, up to 8 channels of 24bit/96kHz audio and up to six channels of 24bit/192kHz audio. Under the Blu-ray standard, support is optional.
Blu-ray and LPCM+

Currently 87% of all Blu-ray Discs offer lossless multichannel audio, split this way: 8% LPCM, 64% DTS- HD:MA, 15% TrueHD

<http://www.blu-raystats.com/Stats/Stats.php>

Irrespective of the studios' choice, the only lossless audio format that Blu-ray players must support (because it's mandatory in the standard) is LPCM. Even so most Blu-ray players are able to decode (decompress) DTS-HD:MA and Dolby TrueHD and to output multichannel PCM.

SPA23 Technical information

HDMI

The SPA23 incorporates a five input HDMI repeater based around the Silicon Image SIL9135, which incorporates digital audio extraction over SPDIF or I2S format. It supports both multichannel PCM audio from Blu-ray, SACD or DVD-players and the more commonly used Dolby D and DTS formats, which are fed over high quality FFC cable to the DSP processor. A user selectable bypass function for HDMI audio is also available, telling the SPA23 either to process or forward HDMI audio to a display device. A user-configured default function addresses any other audio input source, if there is no signal on the defined HDMI input.

DSP

The SPA23's DSP is performed by a Freescale DSPC56371 24bit processor, which is able to fast lock and decode all the commonly used multichannel formats (with up to 192kHz sampling frequency). A slave Freescale DSPB56367 24bit processor handles all delay functions, including the global 250mS delay used for perfect synchronising of picture and sound. Analogue signals for Dolby Pro Logic IIX or DTS NEO processing are first converted to digital by a Burr Brown PCM4202, which incorporates an automatic level sensing circuit eliminating the need for manual ADC adjustments.

DACs and analogue circuits

The audio DACs are 24bit, 192kps WM8740s from Wolfson, used in conjunction with Burr Brown OPA2134 and Texas Instruments NE5532 operational amplifiers for the analogue, semi-balanced, DC-servo controlled, buffering and filtration circuits. These feed the purified audio signal into an eight-channel low distortion, half passive volume control CS3318 from Cirrus. For the SPA23 we have located all the gain stages and DC-servo circuits before the volume control in order to achieve a much better signal to noise ratio. An eight and 2-channel analogue bypass mode bypasses the DSP completely for the analogue fans.

SPA23 Features

Versatile DC- triggers that incorporate time delay and can be assigned to separate inputs, as well as to Zone 2.

A Zone 2 output which incorporates volume control, any analogue input can be routed to Zone 2 without obstructing the main source.

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A versatile audio delay system. A maximum 140mS of global delay is included for perfect synchronisation of picture and sound. This system uses its own DSP engine, in order to not obstruct the main decoding engine.

5 input HDMI repeater with user selectable digital audio bypass

Default to other input source if the HDMI input lacks input signal.

Smooth-acting master volume control: volume changes are read into a buffer, and thereafter the volume setting is changed at a constant speed.

Versatile bass management with extended crossover frequencies as well as level adjustments.

Transformer-coupled SP-DIF inputs for increased protection against loss of digital lock, due to impurities.

Multichannel PCM decoding with up to 192kHz sampling frequency from Blu-Ray, DVD-A and SACD players over HDMI input, as well as down-mix capable DVD-players.

Improved user interface with clearer presentation of user inputs by the use of large characters in the display, as well as user selectable extended OSD "popup" screens.

User interface buffer: all input configurations from the user interface are read to a buffer memory and performed when SPA23 has finished its present task. User inputs are never discarded.

Improved RS232 interface, including general status feedbacks and extensive direct accessible low-level functions.

Automatic saving of the last user settings upon exit - no need for manual saving.

Improved S/N ratio through UFPD modules and improved analogue design.

Double Bass option, to enable the subwoofer on all DSP modes

- Modular Architecture.
- Fully Balanced Analogue AV Preamp & Digital Controller
- Dolby® True HD, DTS Master Audio, Dolby® Digital, Prologic IIX, EX 7.1, dts®, dts-ES 6.1, Neo6
- 1080p HDMI Switching (5in/2out)
- DVD-A & SACD 5.1 input,
- Multi-Channel PCM Compatible
- Fully Configurable & Format independent Bass Management
- Two Balanced Source Inputs,
- 7.1 Balanced Outputs
- Discrete IR & Full RS232 Operation,
- Programmable Triggers
- Upgradeable Architecture.
- Available in Black or Titanium
- Dimensions W x D x H mm: 430 x 385 x 180
- Weight: 15 kg

SPA23 Specifications

<u>General</u>		<u>Analog Preamp Data</u>	
Output power	5 X 120W 8Ω	THD	<0.005%, 20 Hz-20kHz
Analogue Inputs	8 RCA, incl. 7.1 inputs	Signal-to-Noise	-110 dB
Digital Inputs	3 RCA, 3 TOS-Link	Frequency Response	10 Hz-100 kHz, 1dB
Video Inputs	5 HDMI	Input Impedance	47 KΩ, unbalanced
Analogue Outputs	Front (left and right) Center, Sub, Surr (left and right) Surr back (left and right)	Output Impedance	47 R unbalanced
Analogue Record Output	1 RCA (left and right)	<u>Power Amp Data</u>	
Zone2 Output	1 RCA (left and right)	Output power 1Khz, one channel driven.	8R 150W THD+N <1% 4R 300W THD+N <1% AP AUX0025 Filter
Digital Output	1 RCA, 1TOS-Link	Output power 1Khz, all channels driven	120W 4/8R THD+N <0.1% AP AUX0025 Filter
Video Output	2 HDM	THD	<0.01% 20-20Khz 1W 8R AP AES17 Filter
Zone 2	1 RCA (left and right)	Signal-to-noise	80dB _r , AP AES17 filter, ref 2.828V _{rms} .
Upscaling	1080p/24		
Modes	Stereo Bypass Party Dolby Prologic IIx Music Dolby Prologic IIx Moive DTS NEO:6 MUSIC DTS NEO:6 CINEMA	Frequency Response	20 Hz-20 kHz -0.2dB 1W 8R
Decoding Formats	Dolby Digital Dolby Digital EX Dolby Prologic II Dolby Prologic IIx Dolby EX Dolby Plus Dolby TrueHD DTS DTS ES DTS Neo:6 DTS 96/24 DTS HDMaster Audio DTS HD High Res audio MULTI/2 CH PCM/LPCM	<u>Digital Data</u> Frequency Response THD+Noise Dimensions (WxDxH) Weight	20 Hz-20 kHz± 0.2dB 0,005% @1 kHz(AES17 filter) 430 x 385 x 180 mm 15Kg
Sampling rates	32KHz,44.1KHz,48KHz, 88.2KHz,96KHz,192KHz		
Video	HDMI with HDvideo pass-thru with 3Dpass and HDMI OSD		
Other out-/inputs	1 IR Input 3 12v outputs (triggers) 1 RS232		
Fully stabilized SMPS			
Power Consumption operate:	800W at 1K, 8R ,120W all channels driven		

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