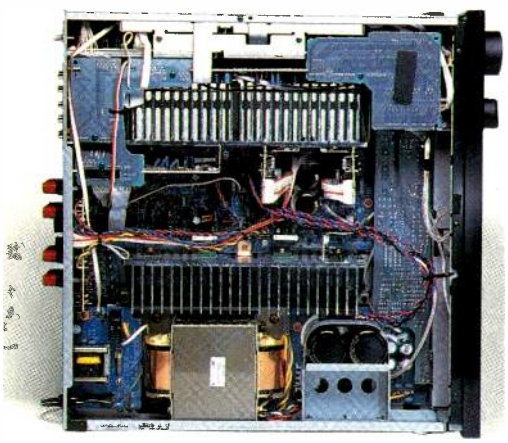
EQUIPMENT PROFILE

YAMAHA DSP-A2070 DIGITAL SOUND-FIELD PROCESSING AMPLIFIER



It's been well over two years since I tested Yamaha's DSP-A1000 Digital Sound-Field Processing integrated amplifier (June 1991 *Audio*). Since then, I have not come across a more versatile or effective single component that could provide as many home-theater and surround sound functions with such stunning sonic impact. Until now! And not surprisingly, it is Yamaha that has outdone their earlier effort.

Physically, the new DSP-A2070 is almost indistinguishable from the earlier model (which, by the way, is still available). One big difference is the price, which is some $500 higher than that of the DSP-A1000. What, I wondered, had Yamaha done to justify this rather steep increase in price? After a hands-on comparison between the older unit and the new DSP-A2070, it didn't take long to conclude that the increase was fully justified. The DSP-A2070 provides three times the sound-field processing capabilities and nine times more early-reflection and reverberant sound-field data, and it calculates 64 times faster than the DSP-A1000. The result, to my ears and to others who heard the old and new products compared, was increased dialog intelligibility, greater separation between music, effects and dialog, and a larger, broader soundstage. After I outline the amplifier's basic features, I'll give a brief comparision between the features of the DSP-A2070 and the older model.

Like the earlier DSP-A1000, the DSP-A2070 is a seven-channel surround sound amplifier that provides digital sound-field processing and digital Dolby Pro Logic decoding with digital enhancements. It provides at least 80 watts each for the main (left, right, and center) channels, while the four effects channels (two front and two rear) get at least 25 watts apiece. A built-in test-tone generator provides a sequential sweep through the channels for use in establishing proper balance.

Control Layout

The upper half of the DSP-A2070's all-black front panel houses the power switch, a "Tape 2 Monitor" switch, a rotary "Input Selector" and the "Volume" control, which is calibrated in dB from 0 dB (maximum) to −80 dB and then full off. A centrally positioned LCD display shows selected program names and parameters and information about a wide variety of settings and adjustments, with adjacent LED's showing activation of the Pro Logic and "Sound-Field Processor" circuits.

FOR THE BEST POSSIBLE BASS, YAMAHA PROVIDES TEST TONES AND SPLIT SUBWOOFER OUTPUTS.

Lowering a swing-down hinged panel reveals additional controls. These include an "Input Trim" rocker that adjusts input levels of each program source and also adjusts items selected by a "Set Menu" button. That button brings up seven different items for adjustment: Center mode, center graphic equalization, a low-frequency test, parameter initialization, memory lock, VCR3 video out (record out or monitor) and input level trim. A "program" rocker sequentially selects the digital sound-field processing programs, while an "Effect" switch turns the center and effects speaker channels on and off.

Along the lower section of the panel, and also hidden by the hinged swing-down flap,

are a stereo headphone jack, a "Bass Extension" switch, bass, treble, and balance controls, a record output selector switch and a set of "Auxiliary" audio and video input jacks including an S-video connector.

In addition to duplicating the control functions found on the front panel, the supplied remote control offers buttons that adjust rear and center levels relative to main channel levels, on-screen display adjustments, and keys for operating other compatible Yamaha components. Yamaha supplies a couple of blank templates with which to cover the existing remote control labels. All the keys on this remote can be "taught" commands other than those preset at the factory. Each key, in fact, can "learn" two different functions.

The rear panel of the DSP-A2070 is crammed full of jacks and speaker terminals. There are seven pairs of jacks for audio-only program sources (including

"Tape 1" and "Tape 2" record-out jacks), eight sets of audio/video program jacks (including output jacks for three VCRs) plus a video-monitor output jack, with S-video jacks for all video inputs and outputs. The eight sets of speaker terminals include two main, four "Effects," and two center-channel terminals; line-level "Mono" and "Split" subwoofer jacks allow use of powered subwoofers or separate amplifiers powering passive subwoofers. There are also "Effects Out" jacks (for those who prefer to use separate amplifiers for surround channels), jacks for interconnection of preamp and main amp sections, and in/out jacks for the center channel. A small "Main Level" rotary control adjusts the main-channel line output level at the "Main Out" jacks. A "Front Mix" on/off switch, a center-speaker impedance switch, three a.c. convenience outlets (two switched, one unswitched) and a ground terminal complete the rear panel's layout.

IN AUDIO-ONLY MODES, ONLY THE EFFECTS CHANNELS ARE DIGITAL, BUT IN CINEMA MODES, THEY ALL ARE.

Despite strong similarities between that description and my description of the DSP-A1000 back in 1991, there are substantial changes and improvements in the new DSP-A2070. In place of the separate DSP and Dolby Pro Logic chips used in the older model, the DSP-A2070 uses a new LSI that incorporates both functions, plus two additional DSP chips; this setup replaces a huge signal-processing p.c. board used in the DSP-A1000. The D/A and A/D converters are new, interpolative designs that provide the equivalent of 19-bit processing.

Eight different sound-field parameters are now adjustable including, for the first time, effect trim and independent front effect (presence) and rear effect (surround) delay times, reverberation percentage, and reverberation level. Parameters can be reset to their factory levels at the touch of a button, and a "Memory Guard" feature prevents unwanted changes to parameter settings.

Both mono and "Split" line-level (2-V) subwoofer outputs are provided. The use of dual subwoofers can, in many installations, improve bass response and directionality as well as provide a greater feeling of presence. To help the user optimize subwoofer output and placement, the unit can provide

SPECS

Audio Section

Power Output (20 Hz to 20 kHz): Main and center channels, 80 watts/channel into 8 ohms, 100 watts/channel into 6 ohms; front and rear effects channels, 25 watts/channel into 8 ohms, 30 watts/channel into 6 ohms.

THD: Main and center channels, 0.015%; effects channels, 0.05%.

Damping Factor, Main and Center Channels: 120.

Input Sensitivity: High-level inputs, 150 mV; phono, 2.5 mV; main and center amp inputs, 1 V.

Maximum Input Signal (1 kHz, 0.05% THD): High-level inputs, 2.3 V; phono, 130 mV.

Maximum Preamp Output: 3 V.

Headphone Output Level: 0.19 V at 1 kHz, for 8-ohm load.

Frequency Response: 20 Hz to 20 kHz, ±1.0 dB, via high-level and main amp inputs.

RIAA Equalization Deviation: ±0.5 dB.

S/N: High-level inputs, greater than 96 dB; phono, greater than 86 dB.

Residual Noise: 150 μV.

Tone Control Range: Bass, ±10 dB at 50 Hz (350 Hz turnover frequency); treble, ±10 dB at 20 kHz (3.5 kHz turnover frequency).

Bass Extension: +7 dB at 70 Hz.

Audio Muting: –20 dB.

Video Section

Video Input Levels (peak to peak): Composite and S-video luminance, 1 V; S-video chrominance, 0.286 V; maximum, greater than 1.5 V.

Video Input Impedance: 75 ohms, all inputs.

Video S/N: 50 dB.

Video Frequency Response: 5 Hz to 10 MHz, +0, –3.0 dB.

General Specifications

Power Requirements: 120 V a.c., 60 Hz, 400 W.

Dimensions: 17⅛ in. W × 6¾ in. H. × 18⅞ in. D (43.5 cm × 17.05 cm × 46.85 cm).

Weight: 46.3 lbs. (21.0 kg).

Price: $1,999.

Company Address: P.O. Box 6660, Buena Park, Calif. 90622-6660.

For literature, circle No. 90

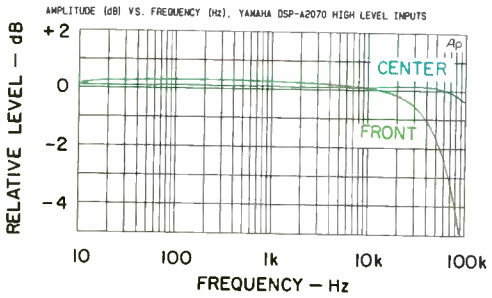


Fig. 1—Frequency response, front main and center channels, at 1-watt out.

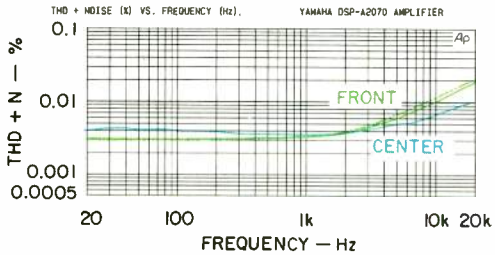
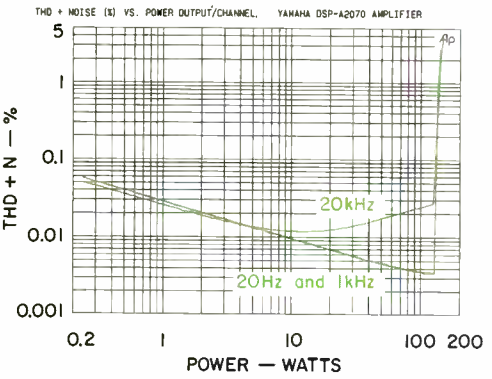


Fig. 2—THD + N vs. frequency at rated output; see text.



A

B

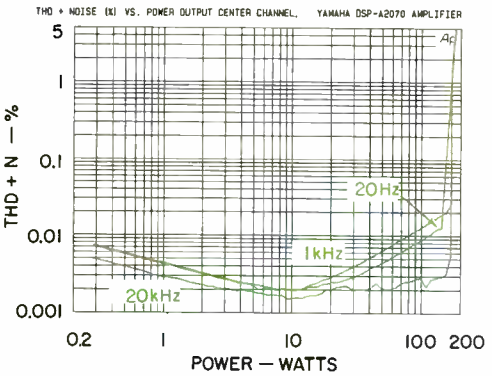


Fig. 3—THD + N vs. power for front main channels (A) and center channel (B).

separate low-frequency test signals from 35 to 250 Hz.

While only the four effects channels are digital in the 12 audio DSP settings (the left and right main channels are unaltered analog), all seven channels are digital in the audio/video modes. Four new such modes have been added: 70 mm Spectacle and 70 mm Musical, Recital, and Pavilion.

Connections are now provided for a third VCR, and the "VCR 3" output can be switched for use as a second video monitor.

In an audio/video system, adjustment and readjustment are simplified by on-screen displays that show the differences between the user's current settings and the factory settings. New cursor indicators also mark which adjustment is being set. The front-panel LCD display has been enhanced, too, to provide better contrast.

Lab Measurements

For all its complexity, the main purpose of the DSP-A2070 is to amplify and process audio signals, so my first objective was to measure the basic performance of its amplification channels. Figure 1 shows the frequency response of the main (front) amplifiers. Response in the left and right front channels is down less than 0.5 dB at 20 kHz, and the –3 dB cutoff point extends to 65 kHz. The frequency response of the center-channel amplifier, when fed directly from the "Center In" jack on the rear panel, actually extends even further than this (there is about 0.5-dB attenuation at 100 kHz) because this jack bypasses all the preamp functions.

Since response of the effects channels is largely dependent on the DSP mode chosen, I decided not to attempt to measure the frequency response of these channels objectively. I did, however, measure their power output capability by "getting inside" the unit and tapping into those amplifier inputs at points beyond the DSP processing circuitry. Both the "front effects" and "surround effects" channels were able to deliver their rated power output of 25 watts per channel with no more than 0.03% total harmonic distortion, as against 0.05% specified by Yamaha.

Returning to the front channels, I next measured harmonic distortion plus noise as a function of frequency at rated output (80 watts per channel) using 8-ohm loads (Fig. 2). At 1 kHz, THD plus noise in the front left and right channels measures just under 0.004%, increasing to just over 0.01% at 10 kHz. Results for the center channel are fairly similar. For both tests shown in Fig. 2, input levels were regulated to maintain constant 80-watt outputs into 8-ohm loads.

YAMAHA HAS EXTENDED DSP TECHNOLOGY WELL BEYOND ANYTHING ELSE I'VE HEARD TO DATE.

Figure 3A shows how THD plus noise varies as a function of output power level at the front channels, for 1 kHz, 20 Hz, and 20 kHz. Figure 3B represents results of the same test, conducted for the center-channel amp.

Figure 2 suggests that at high frequencies (above 10 kHz) the sample exceeded the rated distortion figure quoted by Yamaha. In fact, that is not the case, since Figs. 2 and 3 both represent readings of THD *plus* noise. To obtain a true THD reading for the front channels, at their rated output, I used my Audio Precision test equipment to run a spectrum analysis of the actual harmonic content of a 1-kHz test signal (Fig. 4). The most significant harmonic (at 2 kHz) is 100 dB below reference level. This corresponds to a true THD reading of only 0.001% as against the 0.003% reading observed in Fig. 2. The difference can be attributed to random noise rather than actual harmonic distortion, and it is safe to presume that at the higher audible frequencies, a similar difference would be observed, rendering the true THD at 20 kHz far lower than the 0.015% quoted by Yamaha.

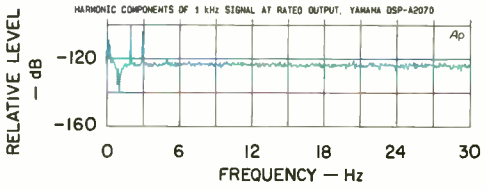


Fig. 4—Spectrum analysis of 1-kHz signal at rated output.

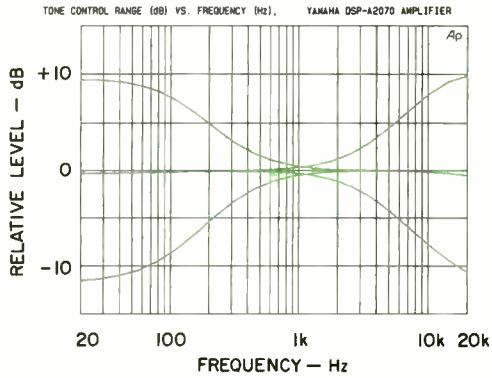


Fig. 5—Bass and treble control range.

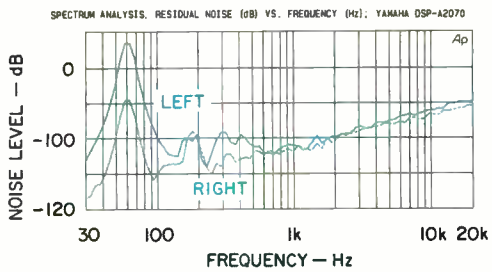


Fig. 6—Spectrum analysis of residual noise.

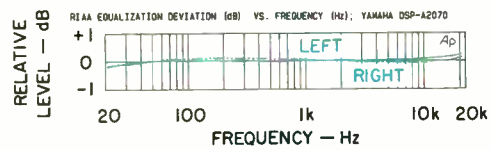


Fig. 7—Deviation from RIAA equalization.

The maximum boost and cut ranges of the bass and treble tone controls (shown in Fig. 5) were pretty much as specified by the manufacturer. The "Bass Extension" feature peaks the response at 70 Hz and then attenuates bass response steeply to avoid amplifier overload (not shown).

The A-weighted signal-to-noise ratio for the high level inputs of the amplifier measured 83.4 dB for the left channel and 84.6 for the right channel. It should be noted that I measure S/N below a referenced output of 1 watt, obtained by lowering the master volume control to that level while feeding an input signal of 500 mV. Yamaha obviously obtained their higher published S/N readings by referencing rated output, rather than the 1 watt called for by the long-established IHF/EIA Amplifier Measurement Standards. Had we added the difference, in dB, between 1 watt and 80 watts, we would have come up with S/N readings well in excess of Yamaha's claims. The same holds true for the MM Phono S/N, where we measured an A-weighted reading of 80.6 dB for the left channel and 81.4 dB for the right channel. Again, our reference is a constant 1-watt output, this time referred to an input of 5 mV at the phono inputs.

Figure 6 is a spectrum analysis of the residual noise at the outputs of the front amp channels, using the same reference output and input levels as reported for the overall A-weighted single-readings of S/N. Of course, in this plot no weighting curve is used, and it is clear that the major "noise" peak is a hum component at the power-line frequency of 60 Hz. This plot is referenced to 1-watt output. Referred to rated output, even the "hum" peak would be better than 90 dB below rated output.

Input sensitivity for the high-level inputs was 34 mV for 1-watt out, while in the phono mode, 0.3 mV was required to produce the same 1-watt output at a test frequency of 1 kHz. Figure 7 shows the deviation from standard RIAA equalization of the phono preamplifier section. There is less than 0.2 dB of deviation from the standard playback curve, and even that minimal amount showed up only at the frequency extremes.

Viewing and Listening Tests

As was true when I tested the earlier Yamaha DSP-A1000 more than two years ago, three members of the Yamaha staff set up the DSP-A2070 in my relatively small "home theater" viewing and listening room. What's more, in addition to arriving with a full complement of eight speaker systems (a pair of front-main units, pairs of front and rear effects speakers, a center-channel speaker, and a powered subwoofer), a LaserVision player, mounds of interconnects and speaker cables, and some test CD and LaserVision discs, the Yamaha team insisted on hooking in a sample DSP-A1000 and a switch box so that we would be able to judge the difference between the older (less expensive) amplifier and the newer DSP-A2070. The only element of my own "home theater" that was incorporated into this installation was my reference 32-inch direct-view TV set, whose internal speakers were turned off for our listening tests. A single center speaker was used, though the Yamaha provides for a pair.

THE FRONT EFFECTS CHANNELS CONTRIBUTE SO MUCH THAT I'M SURPRISED FEW OTHER COMPANIES OFFER THEM.

Let me first report that the differences between the older and newer Yamahas are anything but subtle. Much as I had admired the DSP-A1000, switching virtually any program source material from it to the newer unit revealed an obvious improvement in dialog intelligibility, more authentic sound-field simulations when playing either CDs or videodiscs, and, depending on the parameters chosen and the sound fields selected, a feeling that the Yamaha engineers had extended the technology of