Equipment Profiles

Lafayette LR-4000 4-Channel SQ Receiver

MANUFACTURER'S SPECIFICATIONS:

FM Tuner Section:

IHF Sensitivity: 1.65 uV. S/N Ratio: 70 dB. THD (Mono): 0.1%.

Capture Ratio: 1.5 dB. Image rejection: 75 dB. **Selectivity:** 60 dB. **Cross-Modulation Index:** 90 dB. **Stereo Separation** (400 Hz): 40 dB.

AM Tuner Section:

Sensitivity: 15 uV/meter. S/N Ratio: 45 dB. **Image Rejection:** 68 dB. **Selectivity:** 50 dB. **Frequency Response:** To 4500 Hz ± 6 dB.

Amplifier Section:

Continuous Power Output: 164 watts (41 watts/channel) at 8 ohms; 228 watts (57 watts/channel) at 4 ohms. THD: .07% at 1 watt; 1.0% at rated output. **Power Bandwidth:** 15 to 70,000 Hz. **Frequency Response:** 20-20000Hz. **Input Sensitivities:** Aux 1, 2: 225 mV; MAG: 4 mV; CER: 140 mV; **TAPE PLAY** (2 and 4 Ch.) 500 mV; Mic: 6 mV. Maximum Inputs: Aux 1 & 2: 5V; MAG: 90 mV; CER: 3 V; TAPE PLAY: 10 V; MIC: 150 mV. Hum and Noise: AUX 1 & 2: -75 dB. MAG: -65 dB; TAPE PLAY: -83 dB; CER: -60 dB; MIC: -70 dB. **Tape Out Level:** 450 mV (for rated input).

Matrix Decoder Section:

SQ Phase Shift Characteristics: 90° ± 10° from 50 Hz to 20,000 Hz. Decoder Channel Separation (with Logic, SQ position): LF to RF: 22 dB; LF to LB: 20 dB; RF to RB: 20 dB; LF to RB: 20 dB; RF to LB: 20 dB; CF to CB: 14 dB; LB to RB: 16 dB.

General Specifications:

Dimensions: 21" w x 5¼" h x 15¾" d. **Net Weight:** 30 lbs. **Retail Price:** $499.95 (including walnut enclosure).

The Lafayette LR-4000 Receiver is the first four-channel all-in-one receiver to include so-called "full logic" in its built-in SQ decoder circuitry. The exact nature of "full logic" in a matrix decoder will be discussed later, but its presence in a receiver suggests that the initial success of CBS's SQ matrix system will be further consolidated as more and more equipment manufacturers develop better and better circuitry to show up this particular matrix system to best advantage.

Considered strictly as a four channel receiver, this top-of-the line entry from Lafayette has much to commend it. The front panel dimensions suggest that there is a lot of receiver behind all those controls, switches and lights, and there is. The upper portion of the panel contains blacked-out plastic which becomes illuminated when power is applied. Five push-buttons to the left of the dial area select signal sources. The central, tuner button simply selects tuner section and it is necessary to use a second, TUNER MODE control, located below the meters, to choose AM, FM or an MPX FILTER position when noisy stereo FM transmissions are encountered. Illuminated words corresponding to the button depressed appear under the dial scale, but we wish that the buttons themselves were either illuminated or more legibly marked. Set against the "blacked out" plastic it is virtually impossible to read the designations in normal living room ambient lighting. Below the push-button selectors are a signal strength and center-of-channel tuning meter while to the right of the dial scale is a good sized tuning knob (flywheel coupled) as well as main and remote speaker push buttons and the main power on-off button. Additional indicators in the dial area denote the presence of stereo FM transmission as well as the fact that a tape monitor or speaker button has been depressed. These latter two lights are a great idea and no doubt will save Lafayette from many a consumer complaint when users forget that they are in the "monitor" position (or have failed to press *either* of the two speaker buttons) and therefore think the set is inoperative!

The lower portion of the panel contains a stereo microphone jack and a stereo tape-out jack for easy access by a "visiting" tape recorder. The TUNER MODE Switch, already described, comes next, followed by a function switch with positions for two-channel operation, a pair of "regular" matrix positions called "composer A" and "composer B", the SQ decode position, a discrete four-channel position and a "reverse" position which flips front channels to the rear and vice versa. The master volume control consists of a pair of concentrically mounted knobs, one for rear volume adjustment, the other for front channels. Balance controls for front and rear channels are similarly arranged on a single shaft. Three sets of tone controls (bass, mid-range and treble) also provide separate tonal adjustment of front and rear channels, but these three are friction-held, so that both sections operate together when turned, unless one is deliberately restrained from rotating. Six more push buttons appear at the lower right of the panel. These are of the push-to-make, push-to-break type and operate such features as a pair of tape monitoring systems (one is two-channel, the other will accommodate four-channel tape machines both "in and out"), stereo mono switching, loudness compensation, high frequency filtering and the interstation muting circuit for FM. At the extreme right of the panel are front and rear headphone

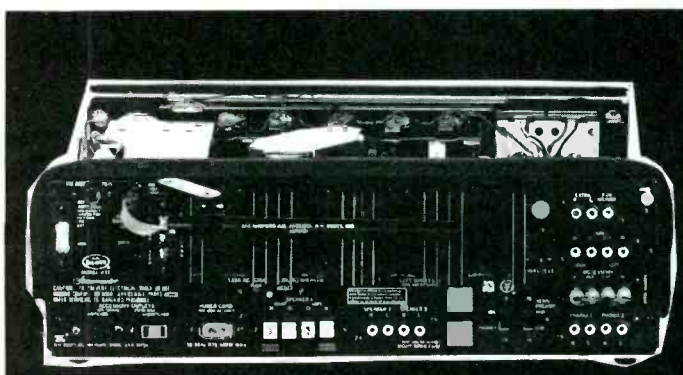

Fig. 1—Rear panel view

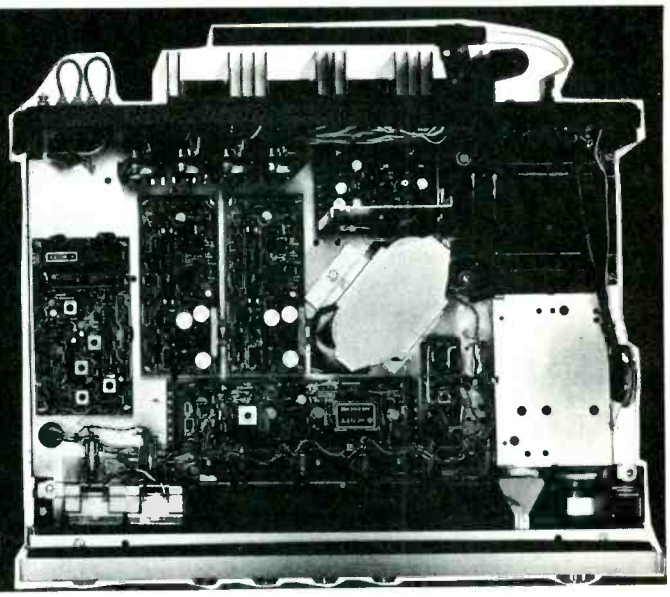

Fig. 2—Inside view

jacks which can be used singly for conventional stereo headphones or together for the new quadraphonic phones equipped with two plugs.

A diagram of the rear panel is shown in Fig. 1. Protective output fuses are provided for each of the amplifier outputs, and there is a power line fuse as well. Screw-terminal barrier strips are used for "main" speaker system connections, while remote speakers, if desired, are connected by means of phono-tip plugs. There are, therefore, enough connections for two full four-channel systems in two locations. An antenna terminal strip permits connection of both FM and AM external antennas, and for FM antenna connection, a shorting link must be opened to disconnect the receiver's own internal antenna (which consists of a small capacitor connected to one side of the power line—which we promptly disconnected!). There are enough input jacks for discrete sources of four-channel programming, either at the AUX inputs or at the tape-monitor playback inputs. Phono inputs are limited to a stereo pair as are the other tape monitor in and out jack pairs. A slide switch alters phono input sensitivity and equalization to accommodate magnetic or ceramic cartridges. An FM detector output jack is also provided for possible future use if a system of discrete four channel FM broadcasting is approved. The usual ferrite bar antenna and a pair of AC convenience outlets (one switched, one unswitched) complete the rear panel layout.

For all the circuitry contained in the LR-4000, examination of the inside of the chassis discloses a very orderly arrangement of circuit boards and neatly harnessed interconnection wiring. Eight printed circuit modules are used, with identical boards used for each stereo amplifier pair of output channels, as can be seen in the top view of Fig. 2. Interestingly, the schematic diagram supplied with the receiver fully discloses all circuitry *except* that contained in the two circuit boards relating to the SQ decoder and its associated logic circuitry. Evidently, the information obtained by Lafayette from its licensor, CBS, is still of a proprietary nature and the manufacturer has no desire to share it with competition that may not have taken a license with CBS. As for the other portions of the circuitry, in reading the general description as supplied in the instruction manual we were dismayed by two statements—neither of which belongs in a receiver of this fine quality. First, Lafayette still insists upon quoting power on a ± 1 dB basis (bringing the power rating up to 250 watts at 8 ohms or 360 watts when driving four ohm loads). The rest of the industry has long since abandoned this childish practice which doesn't fool a single knowledgeable audiophile (and it is to be presumed that anyone investing $500 in a four-channel receiver is not a babe-in-the-woods). Then, in describing the tuner section, reference is made to a new "phase-lock" circuit which is said to ensure good stereo FM separation and low distortion. Now, it so happens that a new, popular circuit known as a "phase lock *loop*" is being used in ultra sophisticated tuner products these days. What it does is ensure crystal-tuned tuning accuracy. The equipment being reviewed here does NOT contain a phase lock loop circuit. What the authors of the manual must mean is that an attempt has been made to maintain good, linear phase response throughout the IF and detector systems of the FM circuitry which does, indeed, insure good stereo FM separation and lowered distortion. The fact is, that this receiver DOES have unusually good stereo separation and very low FM distortion, as is evident from our measurements which will be discussed shortly. To create a phrase such as "phase lock" circuitry which, at first glance sounds so much like "phase lock loop" circuitry (which is quite another thing) is *just not cricket* and the copywriters ought to be ashamed!

Output circuits use capacitor coupled complementary symmetry and the coupling capacitors are 2200 mfd units. Voltage at the high side of each pair is 64 volts. All other, lower supply voltages are well regulated electronically, with a zener diode used as a reference for the stable and critical tuner voltages. A dual-gate MOS-FET is used as an RF amplifier for FM, while a single IC takes care of the entire AM circuitry. IC's are also used as amplifiers and limiters in the FM-IF section. Tone control circuitry is of the preferred feedback type and low-level preamplifiers use discrete transistors selected for their low-noise characteristics. To give you an idea of just how much circuitry is needed for a four-channel receiver of this class, the unit contains 1 dual gate MOSFET, 10 FET's, 8 IC's and 89 transistors!

Electrical Measurements

Figure 3 represents the monophonic quieting and distortion characteristic of the LR-4000. IHF sensitivity was measured as 1.8 uV and, more importantly, the steepness of the quieting characteristic is as good as we have ever seen, reaching 50 dB of S/N with an input signal of only 2.5 uV. Ultimate S/N reached an incredible 75 dB—this sets a new record for ultimate quieting in FM since we've been using our new FM Generator. Distortion, too, is quite impressive at just

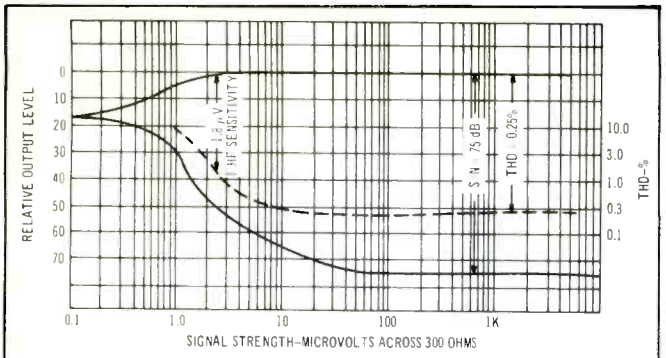

Fig. 3—Mono FM characteristics

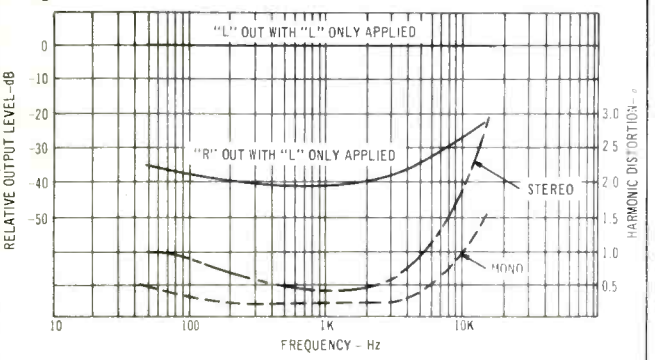

Fig. 4—Stereo separation and THD vs frequency

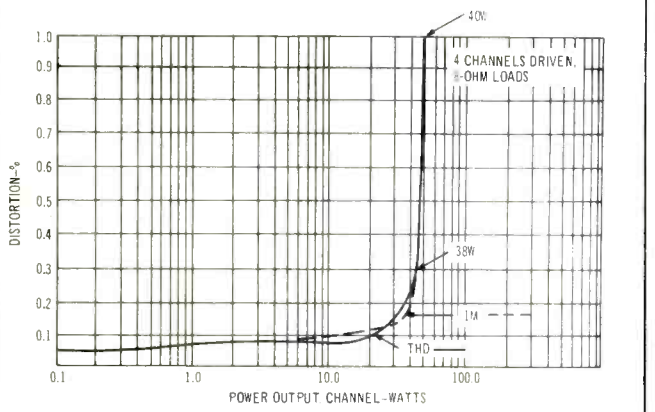

Fig. 5—THD and IM characteristics

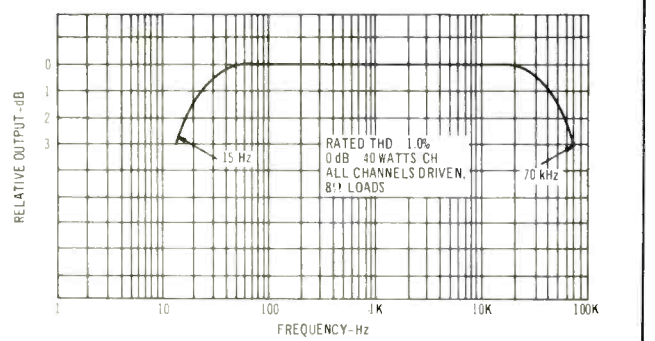

Fig. 6—Power bandwidth

under 0.25%, though it falls somewhat short of the 0.1% claimed in the published specs.

Figure 4 confirms Lafayette's claims of 40 dB stereo FM separation at mid-frequencies and also displays separation at other frequencies. At the low end, separation is maintained above 35 dB and even at 10 kHz, separation is still a bit above 27 dB. Monophonic THD remains well under 0.5% at

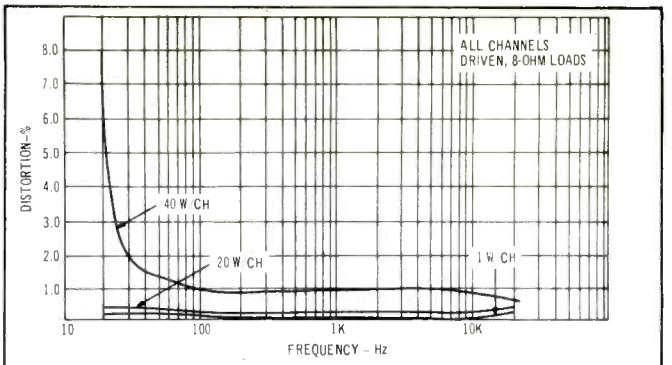

Fig. 7—Distortion vs frequency

all frequencies from 50 Hz to 6 kHz and is acceptably low all the way to 15 kHz. Mid-frequency stereo distortion stays below the 0.5% mark and crests at 1.0% at the low end. As usual, high frequency distortion in stereo appears to be high (maximum 3.0%) but it should be recalled that some of the components read are really "beats" and not actual harmonic distortion.

The power amplifiers produced 40 watts per channel at rated THD (1.0%) with all four channels driven. That's as close to the 41 watts claimed as anyone can measure accurately and we wonder why Lafayette insisted upon pushing the claim for that extra watt. 160 total continuous watts for four channels would seem to be quite enough for *anyone* in a home environment. THD levels at all power levels under 20 watts per channel are well below the 0.1% figure—and that applies all the way down to low, low listening levels of 0.1 watts. Interestingly, the IM characteristic follows the THD characteristic almost point for point, reaching the 1% limit at exactly 40 watts per channel. These results are plotted graphically in Fig. 5, while Fig. 6 confirms the power bandwidth claims from 15 Hz to 70 kHz.

While the four amplifiers, operating simultaneously, are not quite capable of producing full output at 20 Hz with less than 1.0% distortion, at 30 Hz THD has decreased to just under 2% per channel, again with all channels being driven fully. As can be seen in Fig. 7, operation at 20 watts per channel (half power) and 1 watt per channel results in THD readings which are essentially 0.2% and 0.1% across virtually the entire audio spectrum from 20 Hz to 20 kHz.

Figure 8 illustrates the tone control range, filter and loudness compensation characteristics of the LR-4000 and all published specifications concerning these features are confirmed.

Additional measurements made but not shown graphically include a confirmation of the 1.5 dB capture ratio (we actually measured a bit better—1.3 dB) and an alternate channel selectivity of 60 dB. Image rejection was measured as 80 dB, better than the 75 dB claimed, while spurious response rejection measured a bit better than 90 dB.

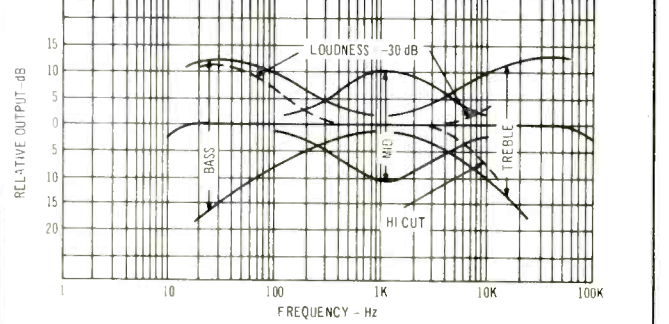

Fig. 8—Tone control, loudness and filter characteristics

Four Channel Decoder Characteristics

As yet, no reliable test record has been produced with which to measure the separation characteristics of SQ decoders (with or without logic built in). Because of the complexity of the composite signals which constitute the matrixed L-total and R-total inputs from an SQ record, it would be rather difficult to simulate such composite signals using ordinary signal generators. At very least, a professional SQ encoder would be required, and these are only available to recording studios and broadcast stations at the present time. How about a good test record, CBS, to make a reviewer's life a little easier—now that SQ equipment abounds? In the meantime, our tests had to be confined to musical listening—using a variety of SQ records that we had previously auditioned on both "simple" matrix SQ decoders and front-back logic SQ decoders. There's no doubt about it, the "double" logic does a much better job. A good deal of the ambiguity of instrument placement is gone and, in the case of this particular logic circuit, gain-shifting or "breathing" is rarely perceived. We are familiar with the basic approaches to SQ logic circuitry, but certainly wish Lafayette had seen fit to fill in those blank spaces in the schematic diagram. Suffice it to say that while we cannot confirm the various channel-to-channel separation figures quoted in the published specs, we certainly found separation and localization of sounds to be better than in any previous auditioning of the SQ matrix system. It is so good, in fact, that one tends to question again the need for two competing four-channel disc systems—matrix and "discrete."

We used the LR-4000 with our newly acquired open-reel four-channel recorder and found some of the control features to be most useful. In particular, we liked the dual master-volume and dual-balance arrangement and found ourselves able to manipulate these controls properly after just a few moments of practice. We were able to do such things as decoding SQ FM stereo broadcasts and recording the four resultant channels on discrete tape for subsequent playback in "discrete" fashion.

As noted in the instruction manual, the additional "matrix decode" formats identified as "Composer A" and "Composer B" are useful for non-SQ matrixed four channel records as well as for simulating four-channel sound from conventional stereo records. We found that the Composer "B" position works best with classical stereo records, while the Composer "A" position seems more effective with pop recordings, surrounding the listener with music from all directions.

Considering the LR-4000's performance in areas unrelated to quadraphonic sound, we found that FM reception was excellent. We logged 54 usable signals, using an outdoor moderately priced Yagi antenna (5-element array), of which some 24 were in stereo. To obtain these results, however, we had to defeat the interstation mute control, which cuts out signals below 6 or 7 microvolts. A receiver as sensitive as this one (and having such excellent quieting characteristics) should have had its mute threshold adjusted somewhat lower—to about 3 microvolts or so. Otherwise, a customer adjustment of mute threshold should have been provided.

The 4-millivolt sensitivity established for magnetic cartridges seemed a bit on the low side, in that we had to push the volume control up a bit higher than usual, but there was still enough reserve left to make this comment relatively unimportant. Sound from both phono and radio was clean and tight. What's more, low level listening was actually noticeably superior than on some other receivers we've checked recently—a direct consequence of the lack of cross-over distortion in the output circuits evidenced by the extremely low distortion readings obtained at low power output levels.

About the only thing the LR-4000 *can't* do (that some other quadraphonic receivers *can*) is parallel or "boot-strap" pairs of output channels for higher-powered operation in stereo. In other words, in the case of the LR-4000 when the selector is switched to "two channel", the rear speakers simply duplicate the material heard from the front speakers. We suspect, however, that anyone interested in the LR-4000 will be buying it for immediate four-channel use and, under those circumstances, even if he should occasionally want to turn down the rear speakers and listen to ordinary stereo programming, the eighty continuous watts still available for two 8-ohm channels seems like enough for just about any situation that might arise.