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NAD 4155 TUNER

Manufacturer's Specifications

FM Tuner Section

Usable Sensitivity: Mono, 9.8 dBf (1.7 µV, 300 ohms).

50-dB Quieting Sensitivity: Mono, 13.2 dBf (2.5 µV, 300 ohms); stereo, 32 dBf (22 µV, 300 ohms).

S/N: Mono, 82 dB; stereo, 75 dB (80 dB at 75 dBf).

THD: Mono, 0.09% at 1 kHz (0.2%, 100 Hz to 6 kHz); stereo, 0.09% at 1 kHz (0.3%, 100 Hz to 6 kHz).

Frequency Response: 30 Hz to 15 kHz, ±0.5 dB.

Alternate Channel Selectivity: 70 dB.

Capture Ratio: Less than 1.5 dB.

Image Rejection: 85 dB.

I.f. Rejection: 90 dB.

AM Rejection: Greater than 65 dB.

Stereo Separation: 50 dB at 1 kHz, 40 dB from 30 Hz to 10 kHz (Dynamic Separation off).

SCA Rejection: 70 dB.

Subcarrier Suppression: 60 dB.

AM Tuner Section

Usable Sensitivity: 300 µV/meter.

Selectivity: 35 dB.

Image Rejection: 50 dB.

I.f. Rejection: 50 dB.

General Specifications

Power Consumption: 12 watts.

Dimensions: 16½ in. (41.9 cm) W × 3 in. (7.6 cm) H × 11 in. (27.9 cm) D.

Weight: 8⅝ lbs. (3.9 kg).

Price: $348.00.

Company Address: 675 Canton St., Norwood, Mass. 02062.

For literature, circle No. 93

The name Larry Schotz has been associated with FM tuner products produced and sold by NAD ever since that company delivered its outstanding 4150 tuner some two years ago. The new NAD 4155 incorporates a new concept developed by Mr. Schotz, which NAD calls Dynamic Separation. Basically, this circuit reduces noise normally heard during weak-signal stereo FM reception by blending the highs during quiet moments or pauses in the music (when background noise would be most obvious and obtrusive) and restoring wider separation when there is more significant stereo information in the signal, or when the signal is stronger. In all other respects, the 4155 follows the traditional, no-nonsense design approach characteristic of NAD products: There are no superfluous controls or gimmicks. Front-panel layout is simple and clean. The basic black finish of both the panel and the metal enclosure retains the NAD look, free of gaudiness and meaningless gloss, of bells and whistles.

Unlike other auto-blend circuits, NAD's Dynamic Separation stops blending when the treble content is enough to mask the noise.

The Dynamic Separation Circuit

While the overall performance of the NAD 4155 was excellent, what particularly interested me was the Dynamic Separation circuit. In conventional, manual high-blend circuits (Fig. 1), high frequencies are crossfed between channels, cancelling the out-of-phase components of the high-frequency noise that occurs when signals are weak. With this blend, however, a moderate amount of midrange separation (about 10 dB at 1 kHz) is retained.

Although this lowers noise for weak-signal stereo reception, the result does not sound as open nor is stereo imaging as precise as it would be if full stereo separation were retained. For this reason, many tuners have automatic high-blend circuits, which blend only under weak-signal conditions. Dynamic Separation varies the blend effect not only according to r.f. signal strength but also according to the audio signal's high-frequency content, on the premise that high blend is desirable during quiet pauses in the music but increased separation is wanted whenever the musical signal is loud enough and rich enough in high frequencies to "mask" the background hiss and noise. Figure 2 shows how the Dynamic Separation circuit controls the crossfeed from the right channel into the left; a similar circuit (not shown) controls the crossfeed from the left channel to the right. As long as the FET remains turned off (offering a high-impedance path to ground), the full crossfeed signal reaches the opposite channel and maximum high blend occurs. When a positive gate voltage turns the FET on, its low resistance short-circuits the crossfeed to ground and full, wide stereo separation is thus restored. Such positive gate voltages reach the FET gate from three sources:

(1) From the "Dyn Sep" switch on the front panel;

(2) From the a.g.c. line from the i.f. stage (which is, of course, proportional to signal strength and is calibrated so that the high-blend turns off for signal strengths greater than about 150 µV, at which time stereo signal-to-noise is greater than 60 dB), and

(3) From the Dynamic Separation controller, which consists of a high-pass filter and a rectifier. When there is little or no modulation, full high blend occurs. With significant modulation levels at mid- or high frequencies, the filter and rectifier produce a control voltage at the FET gate, progressively shorting out the high blend again and restoring wider separation. Figure 3 shows how separation at 1 kHz varies from around 10 dB at low modulation levels to around 45 dB at full modulation.

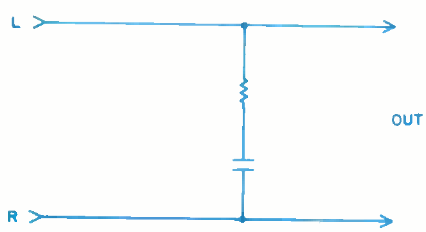


Fig. 1—Basic high-blend circuit.

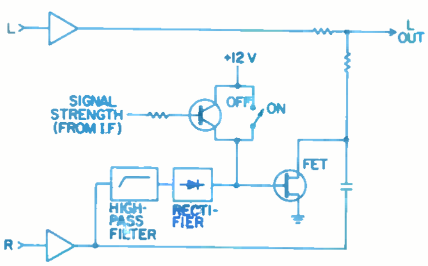


Fig. 2—Dynamic Separation circuit used in NAD 4155 tuner (see text).

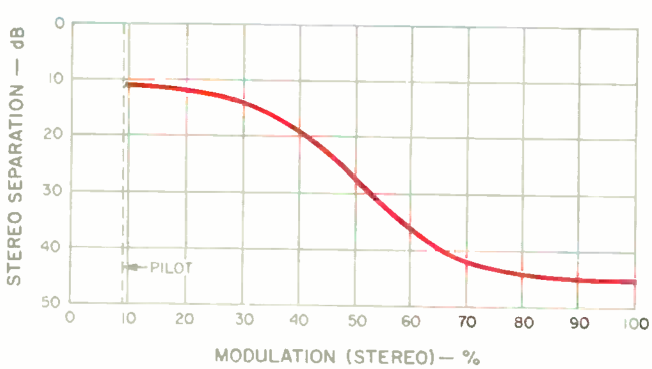


Fig. 3—Dynamic Separation circuit varies interchannel separation (shown here at 1 kHz) according to modulation level of mid/high-frequency program content.

Control Layout

A "Power" switch is located at the lower left of the front panel of this tuner. Nearby are three more pushbuttons for mono/stereo selection, engaging "FM Mute," and turning Dynamic Separation on or off. A display window just to the left of the panel's center shows station frequencies, AM or FM mode, and relative signal strength (a row of LEDs light progressively with increasing signal strength). Tuning is in 10-kHz increments for AM and 100-kHz increments for FM. A separate stereo indicator light is just to the right of the display window.

Seven pushbuttons, arranged horizontally, are located along the right section of the panel. The first five are numbered and are used as preset buttons for memorizing five favorite AM station frequencies plus five FM station frequencies. The sixth button, colored tan to stand out from the others, is used for entering the selected frequencies into memory, while the seventh button in this cluster selects AM or FM reception.

A rocker switch at the upper right corner tunes up or down the frequency scale. A pushbutton, below the rocker, switches tuning from normal frequency-incrementing mode to the "Search" mode. When in search, touching the rocker causes the tuner to go up or down in frequency until the next usable signal is found.

On the rear panel are a pivoting AM loopstick antenna and AM and FM antenna terminals. These are similar to many speaker terminals: You simply insert the stripped wire end of your antenna cable into a small hole and flip down a locking lever to keep the wire firmly in place and in contact

I am constantly amazed at how NAD comes up with reasonably priced products that often outperform more expensive competitors.

with the input circuits. Two of these terminals are used for 300-ohm transmission lines; the other two for external AM antenna and ground connections. A 75-ohm coaxial connector is also provided for those using coaxial shielded transmission lines from outdoor antenna to tuner input. Signal levels at the left and right output jacks are controlled by an output-level control also located on the rear panel.

Measurements

Usable sensitivity in mono measured 10.8 dBf (1.9 μV, 300 ohms), while usable sensitivity in stereo was governed by the point at which the tuner switches over from mono to stereo. This occurs at an input signal level of 23 dBf (7.8 μV, 300 ohms). Fifty-dB quieting in mono was obtained with signal strengths of 14 dBf (2.8 μV); for stereo, with the Dynamic Separation circuit defeated, 34 dBf of signal was required. Turning on the Dynamic Separation circuit improved the 50-dB quieting figure to 32 dBf. Best signal-to-noise ratio in mono (with strong-signal inputs) measured 84 dB and a remarkably high 81 dB in stereo. Total harmonic distortion for a 1-kHz mono signal at full modulation was 0.055%; in stereo, THD for a modulating signal at the same frequency was even lower, at 0.05%. Quieting and mid-frequency distortion as a function of input-signal strength are plotted in Fig. 4. Note that with the Dynamic Separation circuit activated, an improvement in stereo quieting (for any given signal strength) of around 3 dB is evident. This may seem like a minimal improvement, but remember that these curves are derived from 100%-modulated signals and that the major action of the Dynamic Separation circuit occurs at lower modulation levels.

Figure 5 shows harmonic distortion versus frequency for mono and stereo operation. In mono, THD figures were 0.08% at 100 Hz and 0.14% at 6 kHz. In stereo, THD measured 0.06% at 100 Hz and only 0.19% at 6 kHz. This last result is quite remarkable: Distortion in stereo usually tends to *rise* at higher frequencies because of pilot-carrier related "beats" and other spurious signals generated in the multiplex decoder section. No such problems were noted with the 4155.

Figure 6 is a 'scope photo of a logarithmic frequency sweep made with my spectrum analyzer, from 20 Hz to 20 kHz, without activation of the Dynamic Separation circuit. The upper trace represents frequency response at the output of the fully modulated left channel, while the lower trace shows crosstalk, or separation, as measured at the output of the opposite channel. Separation under these test conditions measured nearly 60 dB at 100 Hz, 52 dB at 1 kHz, and 47 dB at 10 kHz.

Figures 7A and 7B illustrate the action of the Dynamic Separation circuitry. For Fig. 7A, I used a medium-strength signal and, with pre-emphasis in the signal generator turned on, swept from 20 Hz to 20 kHz. Full separation (bottom trace) is again obtained with the Dynamic Separation circuit off. The unusual crosstalk curve (middle trace) that occurs when the sweep is repeated and the Dynamic Separation circuitry is activated results from the fact that at low frequencies, modulation levels were low (owing to the way my generator works when pre-emphasis is turned on). As higher frequencies are reached, however, modulation levels approach 100%, and less high blend (greater separation) results. Figure 7B shows what happens when signal strengths are so weak that signal strength becomes the dominating factor in the operation of the Dynamic Separation circuits. Now, even at full modulation levels (in the high-frequency region of the sweep), high blend remains fully in force, and noise is substantially reduced at the expense of good high-frequency separation.

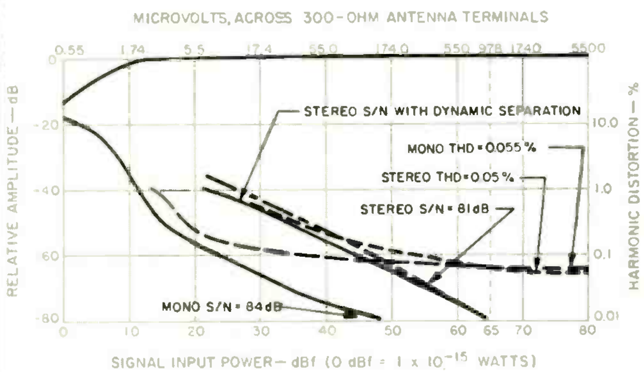


Fig. 4—Mono and stereo FM quieting and distortion characteristics.

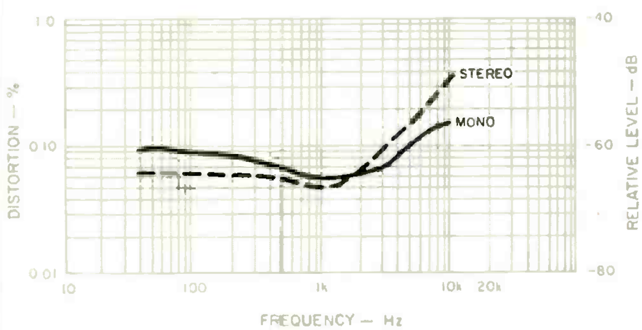


Fig. 5—THD vs. modulating frequency.

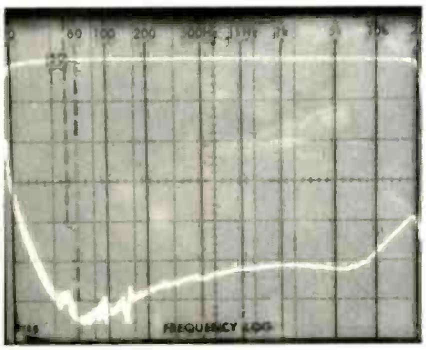
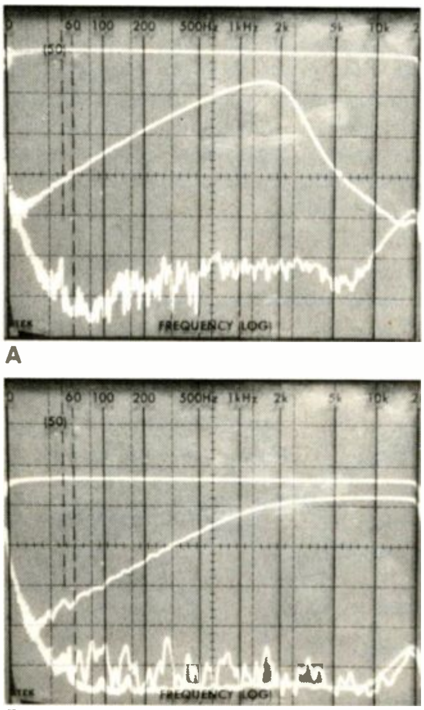


Fig. 6—Frequency response (upper trace) and separation vs. frequency, with Dynamic Separation off.

There is no doubt that the Dynamic Separation does what it claims to. This circuit simply wiped away 15 to 20 dB of high-frequency noise.



A

B

Fig. 7— Action of Dynamic Separation circuits. With medium-strength signal, blend (middle trace) is regulated by frequency content of pre-emphasized signal (A). With weak signals, blend increases with frequency, regardless of program content (B).

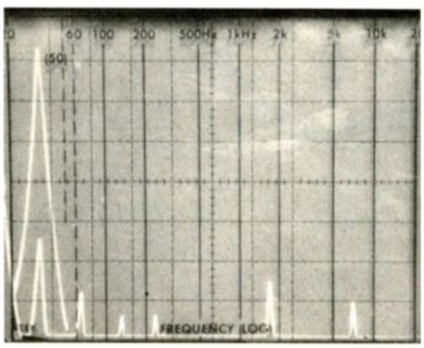


Fig. 8— Crosstalk, subcarrier and distortion products at unmodulated channel's output, with opposite channel modulated 100% by 5-kHz signal. Sweep is linear from 0 Hz to 50 kHz.

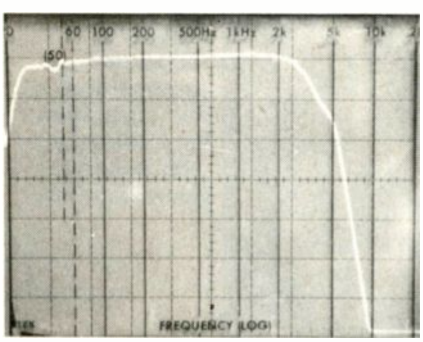


Fig. 9— Frequency response, AM tuner section.

Figure 8 shows what happened when I applied a 5-kHz modulating signal to one channel of the FM generator at full modulation levels. The tall spike at left represents the desired output. Sweep is linear this time, extending from 0 Hz to 50 kHz. A second sweep was made while observing the unmodulated channel. The lower spike contained within the tall one therefore represents true separation at 5 kHz, while other components appearing in the unmodulated channel (such as harmonic distortion and the 19- and 38-kHz subcarrier components) are visible further to the right.

Capture ratio for the 4155 measured exactly 1.5 dB, as claimed. Selectivity was somewhat better than claimed, measuring 72 dB. Image rejection was 85 dB and i.f. rejection 92 dB. Spurious rejection, not quoted in NAD's specification sheet, measured a very comfortable 93 dB.

Figure 9 shows frequency response for the AM tuner section. The sweep is logarithmic this time, extending from 20 Hz to 20 kHz. Note the care with which NAD's designers have managed to extend AM frequency response at least to 4 or 5 kHz, while at the same time insuring that there is almost infinite attenuation at 10 kHz to prevent audible whistles and "birdies."

Use and Listening Tests

After satisfying myself that the tuner, without Dynamic Separation circuitry, was up to the standards I have come to expect from NAD (it was), I spent most of my listening time playing with the special "Dyn Sep" switch on the front panel. There is no doubt in my mind that this innovative circuit does what is claimed for it. When I tuned to weaker FM stereo signals, pressing that switch simply wiped away a good 15 to 20 dB of high-frequency hiss and noise. For most types of programs to which I listen, the loss of separation, as such, was hardly noticeable. In one or two instances, however, I did sense a slight wavering in the stereo imaging as music alternated between soft and loud, but to notice this effect I had to concentrate on the music intently and to remain centered exactly between my loudspeakers. During more casual listening there was no evidence of wavering stereo image—only reduced noise when the circuit was activated.

As for my more basic impressions of this moderately priced tuner, they are pretty much the same as those I had when testing its predecessor, the 4150, some time ago. I am constantly amazed by NAD's ability to come up with components at reasonable cost that perform as well as (and often outperform) competing products costing much, much more. As NAD says in one of their technical papers, "With ICs and a few other off-the-shelf building blocks, designing an FM tuner has become almost a routine exercise. Since these parts are manufactured in large quantities at only a few dollars each, a mid-priced tuner can now be audibly indistinguishable from a costly super-tuner under typical listening conditions." Still, we all know that there *are* differences between tuners—in every price class. Obviously, this company has done more than just assemble some off-the-shelf integrated circuits and other parts to create such a fine tuner. As in earlier products, NAD seems to be able to put things together in a way that provides excellent performance at a price that never ceases to amaze me—and those who buy their products. *Leonard Feldman*