EQUIPMENT PROFILE

DENON TU-680NAB "SUPERRADIO"

For some years now, I have bemoaned the fact that the AM circuitry in most "high-fidelity" tuners and receivers does not take advantage of the signal quality that AM stations are capable of transmitting. As readers of *Audio*'s tuner reports know, AM frequency response typically rolls off at around 2.5 kHz or, in exceptional cases, at 4 or 5 kHz. Yet AM broadcasters can transmit signals whose response extends far beyond this limit.

To show how good AM could be, the National Association of Broadcasters (NAB) commissioned a "SuperRadio" tuner from Denon, originally made for NAB members but now available to audio enthusiasts. The project resulted from the improved AM broadcasting and reception standards developed by the National Radio Standards Committee (a joint effort of the Electronic Industries Association and the NAB). The NAB has also set up a certification standard, called AMAX (AM at its maximum) for high-fidelity tuners. To get AMAX certification, a tuner must have frequency response from at least 50 Hz to 7.5 kHz, with correct NRSC de-emphasis; it must also have automatic noise blanking to reduce impulse noise, manually or automatically selectable audio bandwidth, connections for an external AM antenna, and the capacity to pick up all stations on the newly expanded AM band (now 540 to 1,700 kHz). If stereo is included, an AMAX tuner must be able to decode the Motorola-developed C-QUAM system. According to Denon, the TU-680NAB is the first tuner to incorporate all of the AMAX requirements, and the NAB is offering it directly to its member stations.

THE DENON TU-680NAB IS BOTH A BYPRODUCT AND A JUSTIFICATION OF TODAY'S IMPROVED AM BROADCAST STANDARDS.

Both the FM and AM sections of the TU-680NAB have selectable bandwidth but not in quite the same way. The FM section has selectable wide or narrow *i.f.* bandwidth, with the narrow setting used for increased selectivity in areas where stations are closely spaced on the dial. The AM section has selectable *audio* bandwidth; the "Wide" setting has a rated bandwidth of 7.5 kHz, while the "Narrow" setting varies automatically with signal strength, narrowing as far as 3 kHz when conditions call for it. The AM section also incorporates a noise-blanking circuit that significantly reduces interference from such sources as fluorescent lights and electric motors. According to Denon, this circuit detects and suppresses impulse spikes, filling in with a portion

of the preceding signal. The button that actuates noise blanking in AM mode also switches in the multiplex filter for FM. Confusingly, Denon has labelled this button "NR/NB," implying that the multiplex filter is some sort of noise reducer; actually, the only connection to "NR" is that the filter enables a tape deck's Dolby noise-reduction circuits to work properly when taping a signal from this tuner.

Up to 30 channels of either AM or FM can be stored in memory for instant recall. A remote control, capable of handling virtually all the tuner's functions, is supplied. The remote control also has a "Preset Scan" button that is not found on the tuner's front panel. Supplied accessories include the usual stereo interconnect cable, FM ribbon antenna, and snap-on AM loop antenna. Separate connections are provided for an external AM antenna, so the loop need not be disconnected when an outdoor antenna is used. (According to Denon, disconnecting the loop antenna from this or most other AM tuners will change the resonance of some front-end circuits, preventing proper operation even when an external antenna is substituted for the loop.) The tuner's AM frequency band extends from 520 to 1,710 kHz, covering the expansion of the AM band recently authorized by the FCC.

A NOISE-BLANKING CIRCUIT SIGNIFICANTLY REDUCES AM ELECTRICAL INTERFERENCE.

SPECS

FM Section
Usable Sensitivity: 11.3 dBf.
50-dB Quieting Sensitivity: Mono, 15.3 dBf; stereo, 37.2 dBf.
Frequency Response: 20 Hz to 15 kHz, +0.5, –1 dB.
S/N: Mono, 88 dB; stereo, 82 dB.
THD at 1 kHz: Mono, 0.06%; stereo, 0.1%.
Capture Ratio: 1.3 dB.
Image Rejection: 80 dB.
I.f. Rejection: 100 dB.
Alternate-Channel Selectivity: Wide, 50 dB; narrow, 75 dB.
Separation: 50 dB at 1 kHz.
AM Suppression: 60 dB.

AM Section
Frequency Response: 50 Hz to 7.5 kHz, +1.5, –3 dB.
Channel Separation: 32 dB at 1 kHz, 50% modulation.
THD for 50% Modulation at 1 kHz: Mono, 0.3%; stereo 0.5%.
S/N: Mono, 53 dB.

General Specifications
Power Requirements: 120 V, 60 Hz a.c., 12 watts.
Dimensions: 17 1/16 in. W × 2 15/16 in. H × 11 5/16 in. D (43.4 cm × 7.4 cm × 28.7 cm).
Weight: 6.8 lbs. (3.1 kg).
Price: $650.
Company Address: 222 New Rd., Parsippany, N.J. 07054.
For literature, circle No. 92

Control Layout

The "Power" switch and remote-control sensor are at the far left of the panel. Just to their right is a display that shows the current tuning frequency, preset number, radio band, tuning mode ("Auto" or "Manual"), reception mode ("Mono" or "Stereo"), and which of the mixed AM/FM preset banks is in use. The display also shows the presence of a signal, even if it's too weak to be indicated by the signal-strength section of the small secondary display further to the right. This secondary display also indicates the current bandwidth and if the noise blanker and multiplex filter are on.

The right half of the panel is dedicated to pushbuttons, including "Memory" for storing station frequencies and others for auto/manual tuning, "Bandwidth," "NR/NB," AM/FM "Band" selection, and "Tuning (Down/Up)." Below this row are 10 numbered buttons and an "Enter" button, used in entering and recalling preset stations.

The rear panel of the TU-680NAB is equipped with a bracket for the AM loop antenna. Terminals are provided for this AM antenna and for an external or outdoor antenna, as is an F-connector for a 75-ohm coaxial FM antenna lead and the usual left and right phono jacks for audio output.

Although Denon and the NAB emphasize the AM performance of this component, I was equally interested in finding out just how good its FM circuitry is. After all, to be dubbed a "SuperRadio" implies that its performance is super in all respects. Accordingly, I tested FM performance before tackling the AM section.

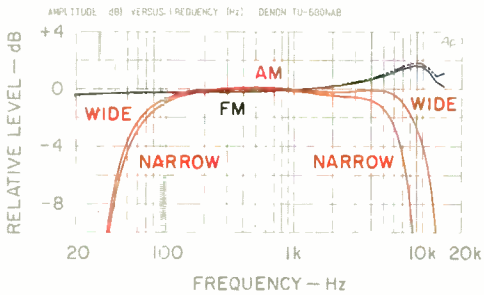

Fig. 1—Frequency response.

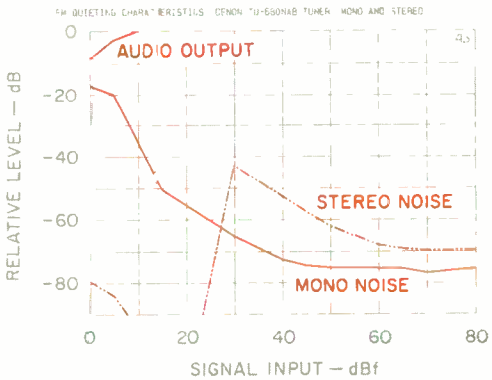

Fig. 2—FM quieting characteristics; see text.

FM Measurements

Figure 1 shows frequency response. Despite a rise of almost 2 dB at 10 kHz, overall

FM response extends out to 15 kHz. We'll get to AM performance later, but note how well the AM section's frequency response, superimposed for comparison, stands up to that of the FM section.

Figure 2 shows FM quieting characteristics for both mono and stereo, as a function of incoming signal strength. In mono, 50-dB quieting is achieved with input signals of only 15.3 dBf, exactly as claimed by Denon. To measure this, I had to press the "Auto Mute/Manu" button, which controls muting, automatic or manual tuning, and mono switching. Stereo reception is only possible when this button is set to "Auto Mute." Stereo muting occurs somewhere below 30 dBf, by which time S/N is already well above 40 dB. This is typical of sets that combine the muting and mono/stereo switching functions in a single control; such sets can only receive stereo signals whose signal strength exceeds the muting threshold. In the TU-680NAB, this threshold has been set at just about the right level.

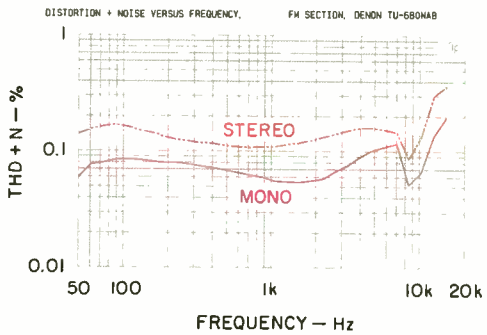

Fig. 3—THD + N vs. FM modulating frequency.

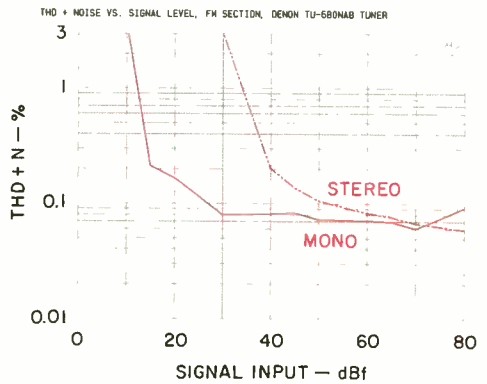

Fig. 4—THD + N vs. FM signal strength.

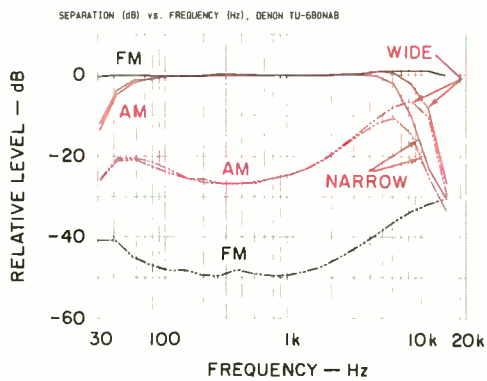

Fig. 5—Frequency response and channel separation.

Figure 3 is a plot of THD + N versus modulating frequency. In mono, THD + N at 1 kHz is a very low 0.057%, increasing to 0.085% at 100 Hz and a bit over 0.1% at 6 kHz. For stereo reception, THD + N measures just over 0.1% at mid-frequencies, increasing to 0.17% at 100 Hz and to 0.16% at 6 kHz. Figure 4 shows how distortion of a 1-kHz modulating signal varies with signal strength. For a 65-dBf signal, THD + N is 0.07% in mono and 0.08% in stereo.

Figure 5 shows frequency response and channel separation for FM, with the AM section's response and separation overlaid for comparison. In the FM mode, separation is excellent, reaching nearly 50 dB at 1 kHz and maintaining that level at 100 Hz. At 10 kHz, the separation remains greater than 30 dB.

A further test of stereo FM performance involved a spectrum analysis of the modulated (left-channel) and unmodulated (right-channel) outputs of the tuner for a 5 kHz left-only signal modulating my FM signal generator (Fig. 6). The top curve shows the reference output level of the 5-kHz signal (peaking at 0 dB) as well as harmonic components at 10 and 15 kHz and at 5-kHz intervals out to the end of the sweep. Even the greatest of these harmonic components (that at 10 kHz) is down about 70 dB below reference level, equivalent to a second-harmonic distortion level of only 0.03%. Note, too, that the 19-kHz pilot carrier has been suppressed by 80 dB, while the sidebands of the suppressed 38-kHz subcarrier, at 33 and 43 kHz, are attenuated by almost 60 and 65 dB, respectively. As for the output of the unmodulated channel, 5-kHz crosstalk is down some 40 dB relative to the reference level. Other harmonic components and subcarrier components are also adequately attenuated.

EVEN IN NARROW-BAND MODE, THE AM SECTION'S FIDELITY WAS BETTER THAN I'VE HEARD FROM AM IN MANY YEARS.

Alternate-channel selectivity measured 60 dB in the wideband mode, increasing to 77 dB when the narrow mode was selected. Image rejection exceeded the published spec; it was 85 dB, as against 80 dB claimed. AM suppression was exactly 60 dB, as claimed, while capture ratio measured 1.2 dB. I.f. rejection was in excess of the 100 dB claimed.

AM Measurements

What a pleasure it was to finally come across a tuner whose frequency response in AM extends well beyond 5 kHz. In fact, as was shown in Fig. 1, response in the wideband AM mode extends way out to 9.2 kHz before the attenuation reaches 3 dB! (In other tuner reports, I usually use a more permissive 6-dB criterion for AM frequency response.) Even when I used the narrow mode, frequency response of this remarkable AM section extended beyond 6 kHz for a 10-mV signal. At the bass end of the spectrum, the –3 dB point was reached at approximately 50 Hz.

Figure 7 shows how THD + N varies with frequency for the AM section, with modulation levels of 90%. At 1 kHz, the THD + N measures 1.2% in the wide mode and increases slightly, to 1.4%, in the narrow mode. Note that the published specs for AM distortion were given for 50% modulation. At that modulation level, the claimed THD figures of 0.3% in mono and 0.5% in stereo were met or surpassed.

Harmonic distortion itself, without the noise component, was just under 1%, as measured by spectum analysis of a 1-kHz signal at 90% modulation. Ultimate S/N, with strong signals applied, was 55 dB for monaural operations, as against 53 dB claimed.

TO MY EARS AND OTHERS', THE AM ACTUALLY SOUNDED BETTER THAN AN FM SIMULCAST!

As shown in Fig. 5, channel separation in AM is just over 24 dB at 1 kHz, regardless of the audio bandwidth setting, and it is more than adequate. At 100 Hz, separation is approximately 23 dB for either bandwidth setting. At 6 kHz, it decreases to just over 8 dB for either mode at the 10-mV r.f. signal level I use.

Use and Listening Tests

I hooked up an ordinary indoor dipole antenna to the FM antenna terminal and oriented the dipole towards the west, in the direction of most of the transmitter antennas in my metropolitan area. Under these conditions, I was able to receive no fewer than 53 acceptable signals in mono, nearly a half dozen more than I've usually gotten with typical "hi-fi" tuners and receivers I have tested in the last several years. Switching to the automatic tuning mode (thereby activating stereo circuitry), I logged some 43 acceptably noise-free stereo signals on the FM band.

Orienting the supplied AM loopstick for best reception, I then switched to the AM band and logged 26 acceptable signals. There was little difference in the signal count when I switched from automatic to manual tuning mode. A few of the stations exhibited less interference when I switched to the narrow-band mode, but even then, audio fidelity was better than I have heard from an AM tuner in many years. (Back in the 1940s and 1950s, AM receivers—then in the majority—sounded a lot better than most AM tuner sections do today. The Denon TU-680NAB is a happy exception to this unhappy trend.) Perhaps the most startling revelation occurred when I tuned to a classical music station on the FM band that also simulcasts on AM. This enabled me to switch back and forth between them while listening to the same program. I know you may find this hard to believe, but to my ears (and to those of several visitors in my lab when these tests were going on), the audio quality of the AM transmission actually seemed better than that of the FM band!

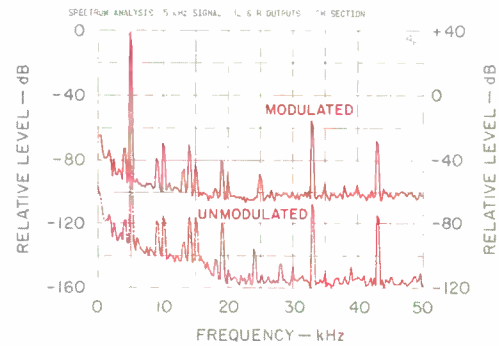

Fig. 6—Spectrum analysis, showing FM stereo crosstalk and distortion products. Use right-hand scale for bottom curve.

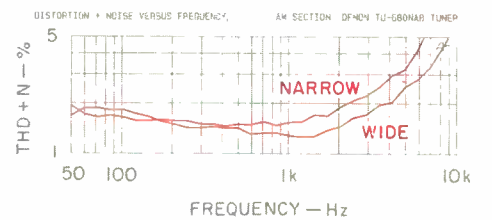

Fig. 7—THD + N vs. AM modulating frequency, with monophonic input signals.

Denon deserves to be congratulated for its effort. The TU-680NAB "SuperRadio" may very well inspire other equipment manufacturers to follow a similar course in designing tuners and receivers.

Leonard Feldman