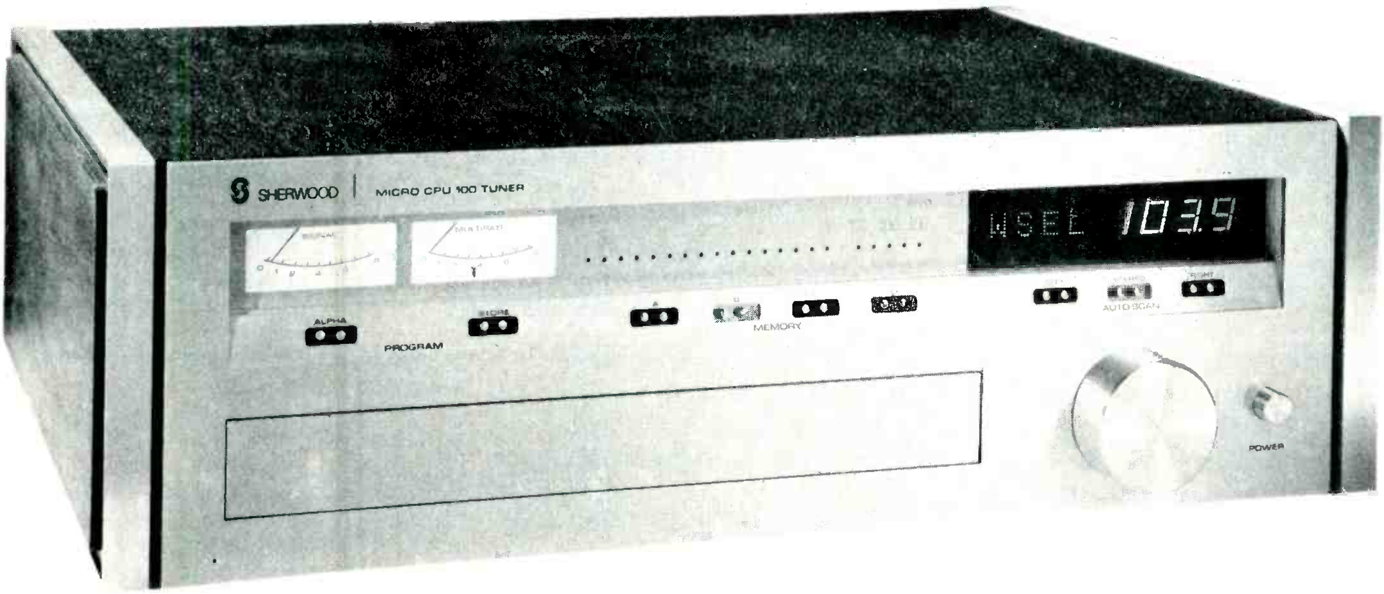


Sherwood Model Micro/CPU 100 Stereo FM Tuner

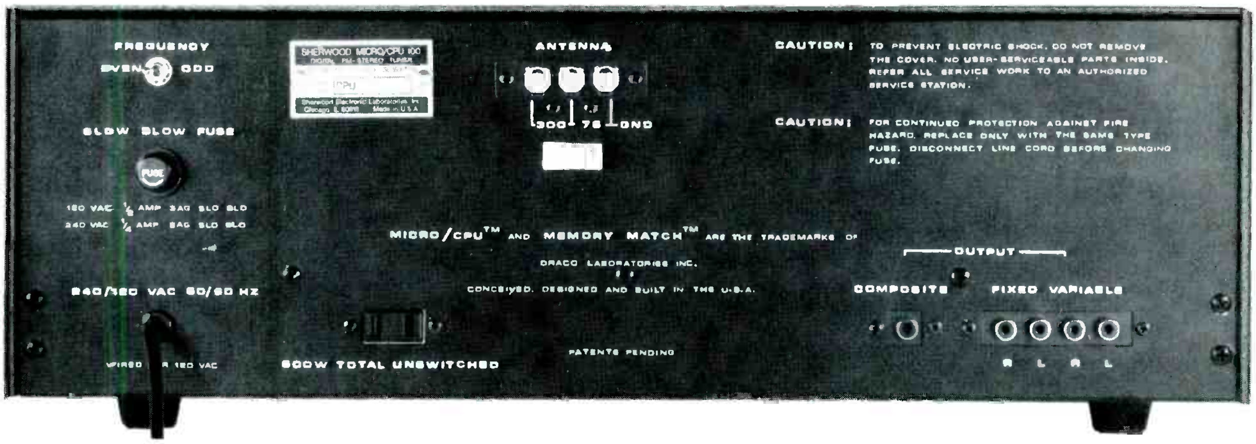
MANUFACTURER'S SPECIFICATIONS
IHF Usable Sensitivity: Normal, 1.7 μV (9.84 dBf); Wide, 1.7 μV (9.84 dBf).
50 dB Quieting: Normal, 2.1 μV (11.7 dBf); Wide, 2.6 μV (13.5 dBf).
50 dB Quieting Stereo: Normal, 25 μV (33.2 dBf); Wide, 30 μV (34.7 dBf).
THD Mono: Normal, 0.1 per cent @ 100 Hz and 1 kHz, 0.15 per cent @ 6 kHz; Wide, 0.07 per cent @ 100 Hz and 1 kHz, 0.1 per cent. @ 6 kHz.
THD Stereo: Normal, 0.2 per cent @ 100 and 1 kHz, 0.25 per cent @ 6 kHz; Wide, 0.15 per cent @ 100 Hz and 1 kHz, 0.15 per cent @ 6 kHz.
S/N Ratio: Mono, 75 dB; Stereo, 72 dB.
Capture Ratio: Normal, 1.0 dB; Wide, 0.5 dB.
Selectivity: Normal, 80 dB; Wide, 18 dB.
Spurious and Image Rejection: 130 dB.
I.F. Rejection: 120 dB.
Muting Threshold: 3.0 μV to 1000 μV.
Stereo Threshold: 4.0 μV (17.3 dBf).
Noise Filter Threshold: 15 μV.
Frequency Response: Mono and Stereo, 20 Hz to 15 kHz, ±0.5 dB.
19 kHz and 38 kHz Rejection: 80 dB.
Stereo Separation: Normal, 40 dB @ 100 Hz, 45 dB @ 1 kHz, and 35 dB @ 15 kHz; Wide, 45 dB@ 100 Hz, 50 dB @ 1 kHz, and 40 dB @ 15 kHz.
Output Voltage: 1.0 V fixed; 0 to 1.5 V variable.

General Specifications:
Power Requirements: 120 V a.c., 50/60 Hz, 30 watts.
Dimensions: 20 in. (50.8 cm) H x 14 15/16 (38 cm) D x 6⅜ in. (16.2 cm) H.
Weight: 34 lbs. (15.4 kg).
Price: $2000.00.

We have just measured what is probably the world's greatest FM tuner! The "probably" qualifier is used simply because we know that many of the measurements we tried to make were limited by the capabilities of our test equipment. Since distortion measurements, for example, were below the stated residuals of our Sound Technology Model 1000A FM Generator, we have no way of knowing whether they are test equipment limited, a combination of product and equipment readings (which may be additive, subtractive, or anything in between) or a true reading of the THD of the product under test. We suspect the latter.

The Sherwood Micro/CPU 100 puts to bed another long-held myth. Until now, it has been generally thought that frequency synthesized tuners cannot exhibit the kind of r.f. performance which is obtainable from conventional, variable capacitor tuned FM tuners. Reasons given have included the higher noise characteristics which were thought to be "inherent" in varactor diodes when they are used as tuning devices, the tendency to skimp on r.f. and i.f. design so as to be able to incorporate all those lovely "memory" buttons, auto-scan tuning, digital read out of frequency, and more. You can forget about that generalization in the case of this "computerized" tuner, too. Not only haven't its designers skimped on basic tuner performance, they have literally outdone themselves!

The front panel of this tuner is completely "uncluttered" in appearance, thanks to the use of a series of electronic "touch" switches and a hinged panel flap behind which are an assortment of secondary controls that we'll get to in a moment. Above what appears to be a conventional tuning knob (it is much more) are three touch switches, one for tuning down in frequency in an automatic scan mode (scanning stops each time a station is received with signal strength determined by the user), another for up-scale tuning, and a third which sees to it that only stereo signals will be intercepted during the scanning mode, if you so desire. Above these three electronic touch switches is a four-digit display of frequency to which the tuner is tuned *plus* a four *letter* alpha display which can be used (among other things) to display the call letters of as many as 48 stations in any given area. How does the set know which call letters belong to which frequencies in your area? Why, you simply tell it! Over at the left are two more touch switches, one identified as "Alpha," the other as "Store." To program in a set of call letters, the user touches the Alpha button and presto, the large tuning knob becomes an alpha selector. As you spin it, the first letter display runs through the complete alphabet, plus all the other symbols on a typewriter keyboard. You simply stop when you get to the first of the station's four call letters (usually W or K in this country). Touch the "store" button and you are ready to "dial up" the next call letter, and so forth, until all four station call letters associated with the frequency to which you are then tuned are displayed. When you press the store button after the fourth letter has been displayed, the tuning knob becomes a tuning knob once more, and you are ready to manually tune to the next frequency of interest. It goes



without saying that you can, if you are in a playful mood, "program in" any four-letter words you choose and assign them to any frequency . . . .

What looks like a conventional "dial scale" at upper center of the panel is, in reality, a series of 20 LED indicator lights, appropriately labelled from 88 MHz to 108 MHz. While somewhat of a redundancy, in view of the direct frequency readout at the right, this "dial" arrangement was included as a psychologically comforting feature for those FM buffs who are too conditioned to a left-to-right dial scale to easily adopt to the newer frequency readout. The meter at the left is a signal-strength meter but, unlike most such meters which often reach peak readings when just a few microvolts of signal are applied to the antenna terminals (rendering them all but useless for accurate antenna orientation), this signal strength meter reads "1" at around 5.0 μV (19. 2 dBf), "2" at 100 μV (45 dBf or so), "3" at 1000 μV (around 65 dBf), "4" at 2 mV, "5" at around 7 mV and "6" at around 30 mV.

Since a crystal controlled frequency synthesized tuner such as this does not require a center-of-channel tuning meter (tuning accuracy is better than 0.0024 per cent), the second meter at the upper right of the panel is a multipath indicating meter. The user then orients the antenna for *least* indication on this meter, which we found to be an extremely sensitive indicator of multipath phenomena.

A gentle push on the hinged flap below opens it to disclose seven more controls and switches. At the left is an output level control (useful in setting tuner output levels to match other program source levels, such as phono and tape), adjacent to which is a wide range muting threshold control. The setting of this control not only determines which stations will be heard during manual tuning, but which will cause the auto-scanning circuits to stop during that tuning mode. A muting switch near the threshold knob defeats muting if you want to do a bit of FM-DX'ing. Next comes one of the more important switches, a selectivity switch. Two completely separate i.f. sections in the tuner provide both a "normal" bandwidth for high selectivity and an extra-wide bandwidth for lowest possible distortion. Choice of bandwidth is determined by local listening conditions and FM station crowding of the dial in your area. An auto-stereo filter switch comes next, and deserves a bit of explanation. Not unlike the "MPX blend" switches we have encountered on other high quality tuners, this one "knows" when to reduce audible noise when weak-signal stereo reception is encountered. In other words, even if the filter switch is "on," if signal strength of a received station exceeds a predetermined level (around 15 μV) such that noise will no longer mar the program, the circuit quietly leaves the scene—automatically.

A mode switch *(Mono/Stereo)* comes next, and finally there is a de-emphasis switch which selects either 75 or 25 microsecond de-emphasis, the latter for Dolby FM broadcast reception using an outboard Dolby decoder. The main power *On/Off* switch is located just to the right of the tuning/alpha selection knob at the lower right, and, before you ask, let us assure you that *all* of the programmable data which can be entered into the memory circuits of the Micro/CPU 100 is non-volatile. That is, all the call letters, the four favorite station assignments (stored by depressing the A,B, C or D touch switches below the "dial" and the "store" button) are retained in the "memories", even if you unplug the line cord from the wall outlet for up to one year. A small battery takes care of that problem inside the tuner. Of course, the usual stereo indicator light has not been forgotten. It appears above those dial-calibration LED's at the upper center of the panel.

In addition to the usual 75- and 300-ohm antenna terminals, the two sets of output jacks (one pair fixed level, the other for variable output level), a composite or detector output jack, a line fuseholder, and an auxiliary a.c. receptacle, the rear panel of the Sherwood Micro /CPU 100 tuner is equipped with a tiny, two position toggle switch. The purpose of this switch is to select "odd" or "even" frequency increments. In the United States, all FM stations broadcast at frequencies ending in an odd decimal fraction of a Megahertz (e.g. 101.1, 101.3, 101.5, etc.) while in some other countries (notably Europe), even decimal increments are used (e.g. 101.2, 101.4 etc). In some instances, we understand that certain cable-FM operators, who supply FM via their already installed Cable-TV service at extra cost, also re-transmit some FM programs using "even" frequency increments, so the Sherwood unit will work in such cases as well.

As you can probably judge from the internal view of the Sherwood Micro/CPU 100, it contains an enormous amount of sophisticated circuitry. An entire circuit board running the full front-to-back dimension of the unit and mounted vertically along the right side of the chassis contains the needed digital electronic circuitry, including the microprocessor which is directly responsible for many of the "computer like" functions of the tuner. The tuner circuits themselves are contained on the horizontally mounted circuit boards visible in the photo of the chassis interior. All circuit boards are constructed of highest quality glass-epoxy military grade material and extensive metal shielding is used for the front end as well as for the i.f. sections.

While we would have liked to discuss some of the actual circuitry of the Micro/CPU 100 in greater detail, such discussion would more than likely double the length of this test report and would center more on the computer-circuit elements of the design than on the tuner circuitry which was, after all, what we were most concerned with. Those interested in the circuit arrangement will have to content themselves with a careful study of the rather detailed block diagram of the tuner presented in Fig. 1.

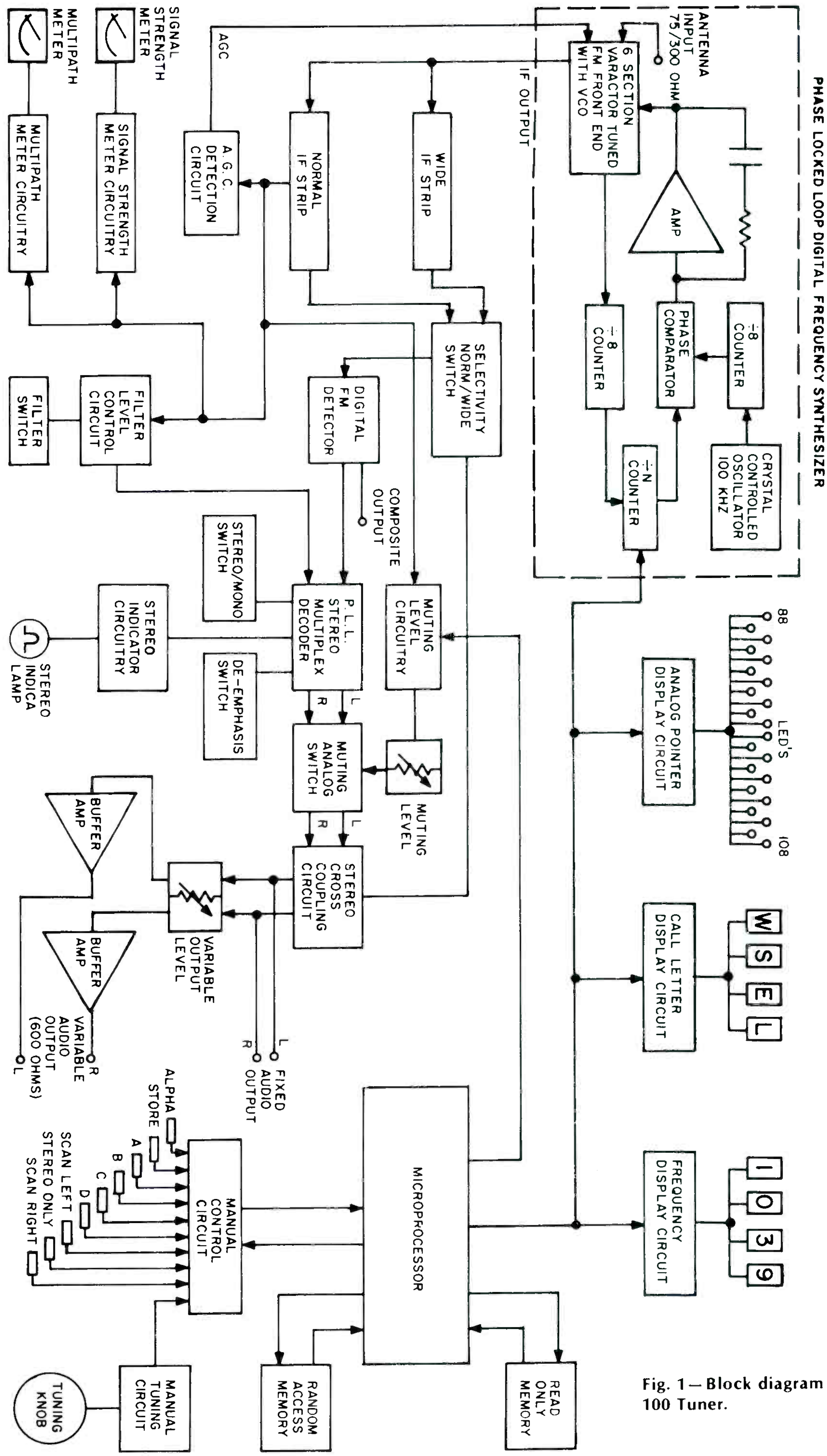


Fig. 1—Block diagram of the Micro/CPU 100 Tuner.

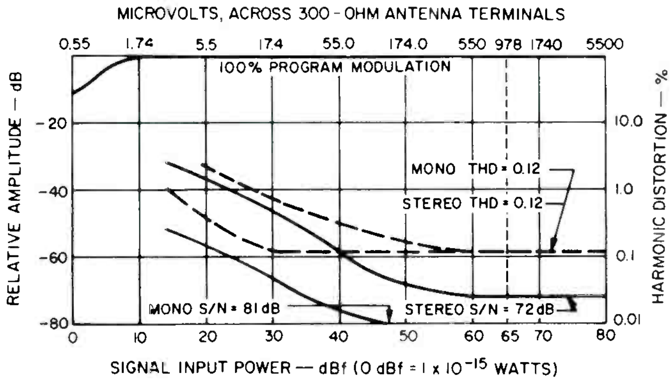


Fig. 2—Mono and stereo quieting and distortion characteristics of the Sherwood Micro/CPU 100 tuner in the Normal i.f. bandwidth.

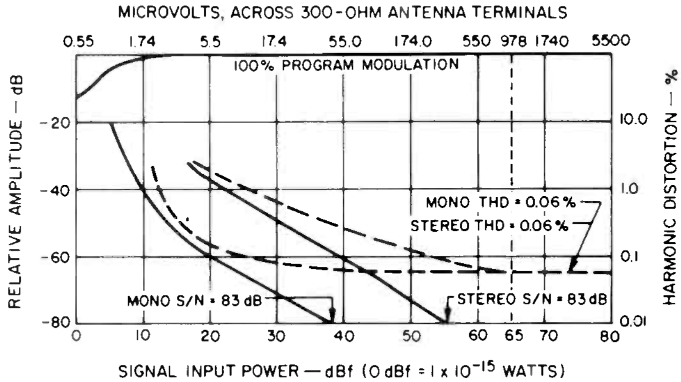


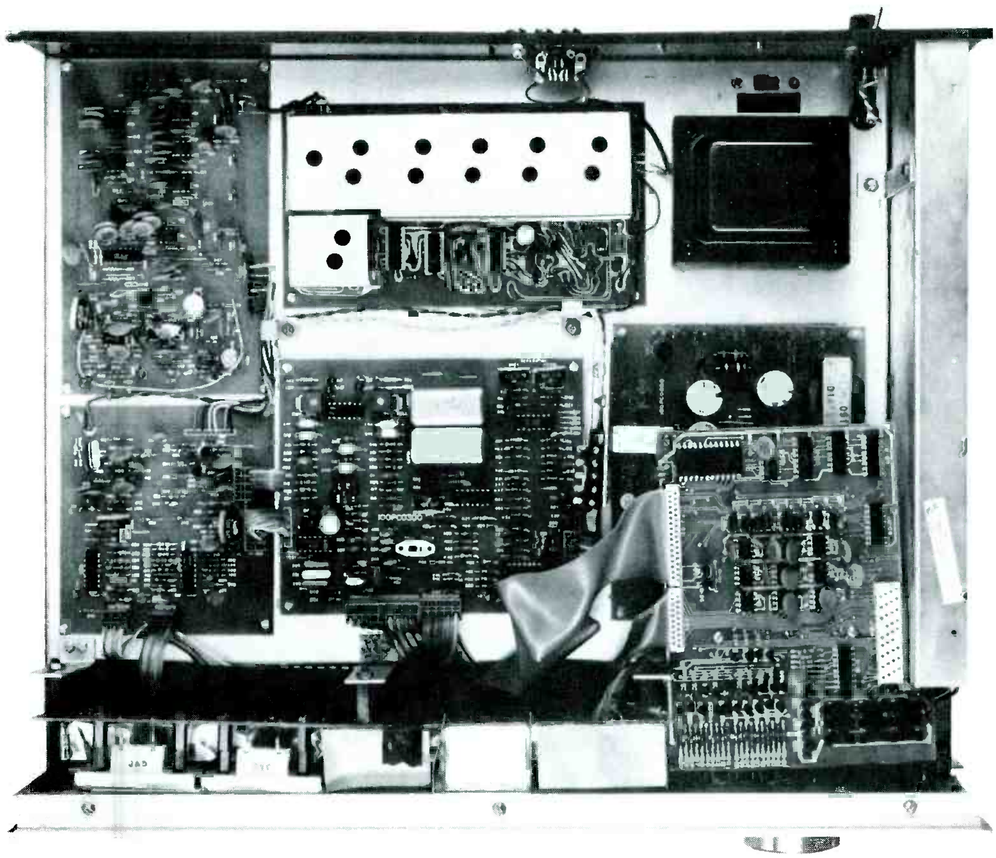
Fig. 3—Mono and stereo quieting and distortion characteristics in the Wide i.f. bandwidth.

Laboratory Measurements

Many of the basic measurements for the Sherwood Micro/CPU 100 tuner had to be made using both the "Normal" and "Wide" bandwidth positions of selectivity, since bandwidth affects such things as S/N, THD, capture ratio, stereo separation and, of course, selectivity itself. Usable sensitivity in mono measured 1.6 μV (9.3 dBf) in the "Wide" i.f. mode; 1.8 μV (10.3 dBf) in the "Normal" mode. Fifty dB quieting for mono occurred with signal inputs of 2.1 μV (11.6 dBf) for "Wide"; 2.5 μV (13.2 dBf) for "Normal". For 50 dB quieting in stereo, we measured signal strengths of 27.0 μV in the "Normal" i.f. mode, and 21.0 μV (31.6 dBf) in the "Wide" i.f. mode (the lowest, by the way, ever measured on any set for this parameter). Best S/N in mono measured 81 dB and 83 dB using the "Normal" i.f. mode and "Wide" modes respectively. In stereo, best S/N measured 72 and 83 dB for the "Normal" and "Wide" i.f. modes. We were somewhat amused to note that after conferring with the Editor of *Audio* Magazine not too long ago and coming up with new "standard" charts for displaying the quieting and THD characteristics of modern tuners (taking into account the new dBf notations, etc.), the "new" charts (see Figs. 2 and 3) were not good enough for this tuner, and the noise curves run off the bottom of the graph!

Mono and Stereo quieting and distortion (with a 1 kHz modulation signal) are plotted in Fig. 2 for the "Normal" i.f. setting and in Fig. 3 for the "Wide" i.f. setting.

Stereo separation and distortion versus frequency are plotted for the "Normal" bandwidth position in Fig. 4 and for the "Wide" i.f. setting in Fig. 5. Stereo separation measured



54 dB at mid-frequencies in the "Wide" mode and was still a very high 38 dB at 15 kHz and 48 dB at 50 Hz. Frequency response in both mono and stereo (using the 75 microsecond de-emphasis setting) was accurate to within ±0.1 dB from 30 Hz to 15 kHz. The unusual accuracy of response at the high end is attributable to the fact that a multi-pole low-pass filter is incorporated in the audio signal chain rather than the more common "notch" filter often employed for sub-carrier product suppression. Using this technique, Sherwood was able to maintain flat response all the way out to 15 kHz and yet suppress unwanted 19 kHz and 38 kHz output by more than 80 dB relative to 100 per cent modulation levels!

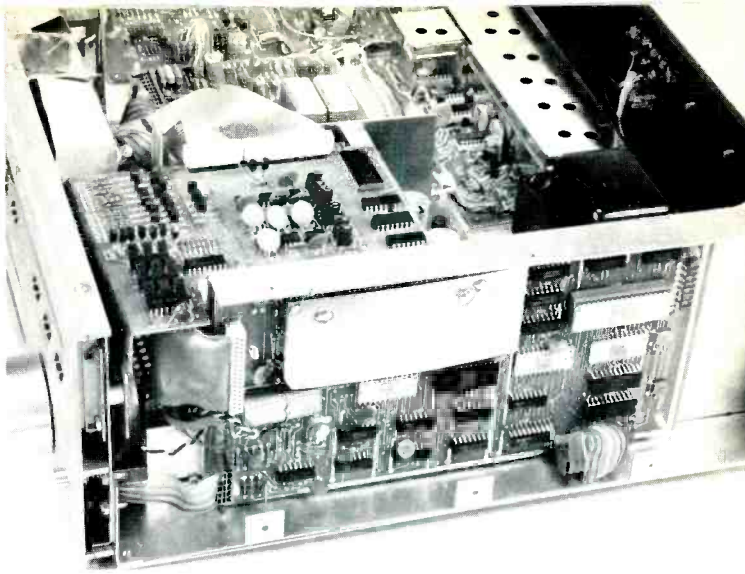
Stereo switching level occurred at 3.0 μV (14.7 dBf) in our sample, while muting threshold was adjustable from a low 4.0 μV (17.3 dBf) all the way up to 10,000 μV (85.2 dBf). We do wonder why such a high muting threshold was provided for, since when we set the muting control to that high level, no stations at all were received either in the scanning mode or in manual tuning. A small point that could probably easily be modified in future production and which would then afford more accurate vernier control at lower muting threshold levels.

Most of the rejection specifications could not be measured accurately, since our test equipment is limited to readings of around 100 dB for i.f., image and spurious rejection and the Sherwood Micro/CPU 100 always did that well (or, most probably better) according to our instrumentation. We were able to confirm a capture ratio of 0.5 dB in the "Wide" i.f. mode and 1.0 dB for the alternate i.f. bandwidth. Selectivity in the "Normal" mode measured 83 dB, a bit better than claimed.

Interesting Sidelights

There is really not much point in discussing the listening quality of the Sherwood Micro/CPU 100. Given a clean signal (and that is the responsibility of the FM broadcaster), the tuner can deliver absolutely flawless audio, with not an audible trace of noise or distortion. To confirm this, we set up a closed circuit transmission facility and used master tape recordings of known high quality to "modulate" our little FM "station" generator. This enabled us to make A-B comparisons between the program reproduced via the tuner and the same program fed directly to the tape inputs of our standard component setup. The two were completely indistinguishable from each other. The fact that we had to resort to this sort of closed-circuit testing is rather a sad commentary on the state of the FM art as it is practiced by most of the stations (with one or two exceptions) in our area!

Living with the Sherwood Micro/CPU 100 for a while, we discovered just how "clever" it really is. As an example, when you wish to "scan" in search of stations, if you start downward in frequency from, say 94.1 MHz, the scanning will



proceed down to 87.5 automatically and then, if you have not settled for a signal in that frequency range, it will hop right up to 94.1 MHz and proceed upwards in frequency, up to 108.5, almost as if it didn't want to waste your time by repeating the scan over previously surveyed frequencies. If you are still not happy, it will simply come to rest back at 94.1, the frequency at which you first commanded it to start scanning!

Some time after we completed our initial bench tests of the Sherwood Micro CPU/100 tuner, its designers were kind enough to send us a "defective" IC component along with a programmed "service" IC which, when plugged into a specific socket on the digital circuitry board actually analyzed the condition of all of the IC's involved in the tuner's computer circuits and quickly displayed the schematic symbol of the "defective" IC which we had deliberately substituted in one of the IC sockets. In other words, the tuner can literally trouble shoot itself! From the looks of it, this program shouldn't have to be run very often. One word of caution: If you have more than 48 listenable stations in your area you will have to content yourself with programming in the call letters of "only" your favorite 48 stations. Should you try to add another set of call letters, the alpha display will quickly flash the word "full." We discovered this feature when, as you might have guessed, we had programmed in that many sets of call letters ourselves and were attempting to enter station number 49! There are probably more things to discover about the Sherwood Micro/CPU 100 that we would have found out about if we had held on to the unit a bit longer, but since we had already been using it longer than we have ever kept any other sample sent to us for evaluation, we reluctantly returned it to Sherwood—along with our heartiest congratulations on a superb design and production accomplishment.

Leonard Feldman

Enter No. 91 on Reader Service Card

Fig. 4—Separation and distortion vs. frequency in the Normal i.f. bandwidth.

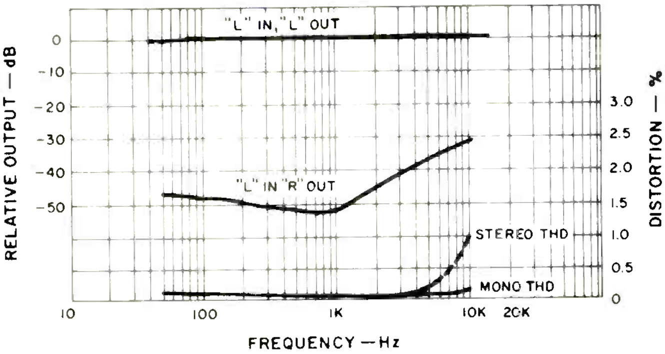


Fig. 5—Separation and distortion vs. frequency in the Wide i.f. bandwidth.