CAR STEREO STANDARDS

Until now, makers of car stereo equipment have not had a set of standards and specifications that were meaningful to the consumer. Recently twenty-two manufacturers agreed on these new standards. Others are expected to follow.

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IF YOU ARE A HIGH-FIDELITY ENTHUSIAST who has considered duplicating the good sound you enjoy at home in your car, truck, or van, you already know that until now there has been virtual chaos in the car stereo marketplace. Twenty watts of power in a car stereo amplifier or complete receiver is, in most instances, not even remotely related to 20 watts of audio power in a home hi-fi system. And a tuner sensitivity of 2.0-μV in a car radio (if quoted at all by the manufacturer) has usually meant sensitivity that is only one fourth as good as that of a home tuner boasting the same 2.0-μV sensitivity. As for tape-playing equipment in automobiles, frequency response, if quoted at all, has provided the prospective purchaser with little or no information as to the fidelity of the product being considered for installation in his or her vehicle.

We can now hope that the situation is about to change. As of this writing, 22 leading car stereo equipment manufacturers have agreed to publish specifications and measurements about their products that will be meaningful and helpful to consumers who want good sound on the road. What follows is some of the background that led to the creation of those new standards and a summary of the standard measurements themselves. Particular thanks are due to Marshall Mack Brown of Craig Corporation, who was in charge of the standards meetings that led to the creation of the new standards, along with Jim Twerdahl of Jensen Sound Laboratories and Don Coleman of Clarion Corporation.

It took more than 30 years for the home audio component industry to reach its present level. But in less than five years annual sales of car stereo equipment have actually equalled or surpassed those of home audio equipment. Unfortunately, the rapid growth of car stereo has resulted in many practices that are contrary to high-fidelity philosophy and concepts. Perhaps the most flagrant abuse has been the artificially inflated "power ratings" of car stereo products. (We all remember that battle in home equipment.)

Back in 1974 the Federal Trade Commission formulated a rule that requires all manufacturers of home audio equipment to state the power output of audio amplifiers on the basis of continuous power, with extremes of frequencies at which the rated power can be delivered for a given level of harmonic distortion and into a specified load impedance. Note, however, that the FTC rule applies *only* to "home" audio equipment. In 1974, car-stereo equipment sales were not significant, and the FTC did not include that category in its rule. Given that loophole, many car-stereo manufacturers began to exaggerate power ratings, omit references to distortion levels, and so forth and so forth. Serious and conscientious audio-equipment makers were caught up in the specification race as well, and were often forced to publish unrealistic figures for their own products, if only to survive in a highly competitive marketplace.

Discouraged, but by no means defeated, those manufacturers (including many in the U.S., and several importers of equipment from abroad) did not give up. More than a year ago, they formed an Ad Hoc Committee of Car Stereo Manufacturers and set about to write and publish their own measurement standards. Seventeen well-known manufacturers and importers participated in the deliberations. Their work has now been completed and, in a letter to all car-stereo manufacturers, they have invited all to endorse and use the specifications as presented. By endorsing the new standards, participating companies agree that by June 1, 1980, all of their printed catalogs, specifications sheets, advertisements, and other literature will present product specifications in accordance with the new standards.

Amplifier measurements standards

The new car-stereo standards are divided into three sections. Section I deals with audio power amplifiers (whether supplied as separate components or as part of a car radio) and parallels many of the standards developed for home audio amplifiers by the IHF (Institute of High Fidelity). Six specifications must be presented by a manufacturer in standard format. The format for specifying power output must read: "*Power Output: ___ watts per channel minimum continuous average power into ___ ohms, both channels driven, from ___ Hz to ___ Hz with no more than ___% total harmonic distortion.*" While that method of presentation corresponds almost exactly to that required for home-audio equipment, the committee had to address itself to one important additional matter. The nominal 12-volt supply in most cars may vary from 11 to 16 volts under driving conditions. Figure 1 shows what happens to the power output of a nominally-rated 10-watt-per-channel amplifier over those

SHMEGG ELECTRONICS MODEL 60A

extremes of supply voltage. With only 11 volts of supply voltage, clipping distortion is reached with only 8 watts delivered, while with 16 volts of battery supply, power output increases to more than 12 watts per channel. The new standards call for a standard DC voltage of 14.4 volts to be used when measuring power output of a car amplifier.

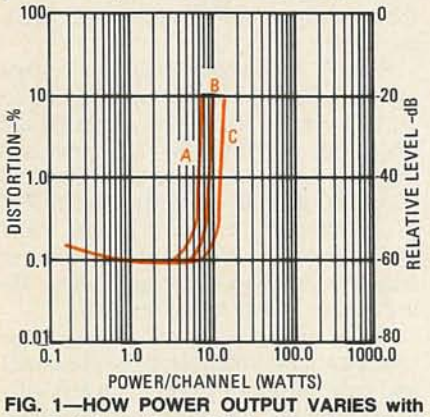

FIG. 1—HOW POWER OUTPUT VARIES with supply voltage. Curve A is for 11-volt supply, B is for 14.4 volts and C for 16.0 volts.

Frequency response for a car amplifier must be stated as follows: *Frequency Response: ____ Hz, to ____ Hz, ± ____ dB*. Measurements must be made at a 1-watt output level with the amplifier terminated in its rated load impedance. For complete car radios (where the amplifier is inaccessible as a separate entity) the "input" maybe considered to be at the input of the volume control of the receiver.

For signal-to-noise measurements, an "A"-weighting network is to be used (that weighting is also called for in the IHF Amplifier Measurement Standards) and the S/N ratio must be quoted with respect to 1-watt output, with an input voltage of 0.5 volts.

Input Sensitivity must be referenced to 1-watt of power output and should be expressed in volts. Here, an option is provided, wherein an additional sensitivity specification may be given for the input voltage required to produce rated output.

A minimum input-impedance specification is called for in the new standards, but that spec is applicable to separate component amplifiers only and is intended to establish compatibility of interfacing between models and brands. It would be stated, simply, in ohms.

The last required amplifier specification is Tone Control Action and the format will be: *Tone (Equalizer) Action: ± ____ dB at ____ Hz and ____ Hz*. In the case of bass and treble controls, the recommended test frequencies are 100 Hz and 10,000 Hz. For multiband equalizers, the appropriate center frequencies should be used in making the measurements. Curves, such as those shown in Fig. 2, may also be presented as an option, but those will most likely be used only for multiband equalizers.

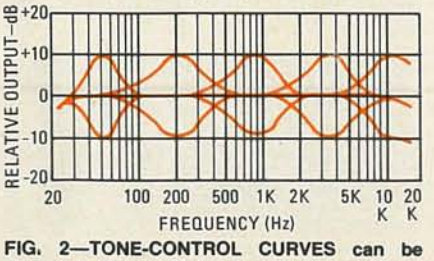

FIG. 2—TONE-CONTROL CURVES can be shown in specs. These curves are typical of those for a five-section equalizer.

Standards for FM tuners

The second section of the new standards is concerned with FM-tuner specifications, or the tuner section of a complete radio receiver. Nine separate disclosures are called for. The first of those is Monophonic Usable Sensitivity. It is to be stated in dBf. There has been wide variation in practice in measuring and stating the sensitivity of an FM receiver or tuner. Although it has been common practice to state sensitivity either in dB re: 1 μV, or directly in volts (or microvolts), the modern practice of stating the sensitivity in terms of relative power level (expressed in dBf) eliminates ambiguity and enables the consumer to make direct comparisons between products. The ambiguities have been particularly prevalent when it comes to car stereo FM receivers, largely because their antenna input impedance is usually 75-ohms as opposed to the more common 300-ohm input impedance found on home FM equipment.

Figure 3 shows how 2 μV, applied to a 75-ohm antenna input impedance, is

actually four times as much *power* delivered to the first stage of the receiver as the same 2 μV would be if connected to a 300-ohm impedance. Looking at it another way, a tuner that boasts a 2-μV

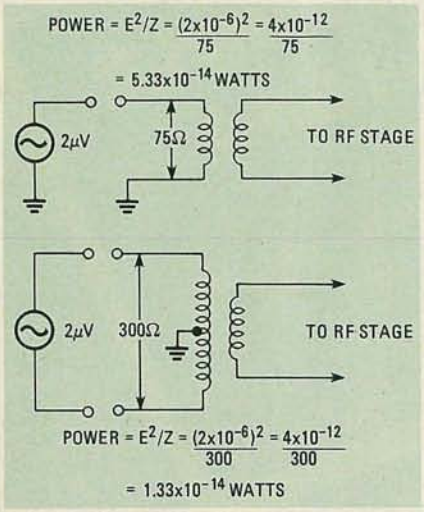

FIG. 2—RECEIVER SENSITIVITY depends on the input impedance of the first RF stage. Equations show relationships.

sensitivity (and fails to mention the fact that this figure applies to 75-ohm inputs) is really only one fourth as sensitive as one which has a 2-μV sensitivity but has a 300-ohm input.

Another indicator of tuner sensitivity that must be stated by manufacturers adhering to the new Car Stereo Standard is 50-dB Quieting Sensitivity, in mono. A signal-to-noise capability of 50 dB is generally considered to be the least amount of noise (with respect to signal peaks) that can be tolerated in high-fidelity equipment, whereas the 30-dB S/N figure, often used by car-stereo equipment manufacturers, really amounts to "barely usable" performance. The signal strength required for producing 50 dB of S/N is also to be quoted in terms of power, or dBf.

Frequency response of the tuner section is to be quoted over the range from 30 Hz to 15,000 Hz (the frequency limits of FM broadcasting) with a "plus and minus" dB tolerance required in the reporting format.

Such less familiar tuner characteristics as Capture Ratio (the ability of a tuner to zero in on the stronger of two stations broadcasting at the same frequency), Alternate Channel Selectivity (the ability of the tuner to reject signals that are removed in frequency from the desired station frequency by 400 kHz), Image Response Ratio (the ability of the tuner to reject incoming signals that are above 10.7 MHz the local oscillator frequency), and IF Response Ratio (ability of the tuner to reject incoming radio signals that are broadcast at the tuner's 10.7-MHz IF) are all called for in the new standard and are generally to be measured and reported in a manner consistent with the universally used IHF/IEEE Tuner Measurement Standard which has been formalized since 1975 (IHF-T-200, 1975).

One additional tuner measurement standard called for in the new Car Stereo standards is actually borrowed from the IHF Amplifier Standard, and is called Maximum Output Voltage. It is to be reported in *Volts, from ___ Hz to ___ Hz, with ___ ohms load.* That specification is applicable to tuners, decks, and integrated units provided with line output terminals and is intended to establish compatibility of interfacing between models and brands. The minimum recommended load impedance must also be stated.

The third and final section of the new Car Stereo Standards deals with tape players. Since IHF standards for tape decks have not as yet been established, here the committee had to develop its own interim standards. Six required measurements and specifications are called for.

The first of those is playback frequency response. Tape playback frequency response has probably been one of the most flagrantly exaggerated specifications relating to car stereo tape equipment. As illustrated in Fig. 4, the frequency response shown in curve "A" for one typical tape deck and that shown in curve "B" for an inferior product could both be reported as extending from "30 Hz to 15,000 Hz"—providing that no tolerance in dB accompanies the published statement.

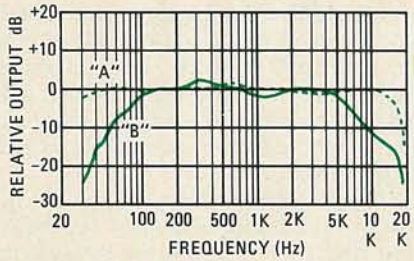

FIG. 4—PLAYBACK FREQUENCY RESPONSE curves for two tape recorders. The one producing curve A is clearly superior.

Clearly, the tape deck represented by the response curve of "B" *is* able to deliver some output at 30 Hz and some output at 15,000 Hz. That output, however, is some 15 dB *lower* than the reference level measured at 1 kHz and is therefore all but useless. For that reason, the format for stating tape playback frequency response must be: *Frequency Response: ___ Hz to ___ Hz, ± dB.* The specification must be referred to 1000 Hz as zero reference level and a ±3-dB tolerance is recommended (but not required) in the standard. Units having selectable equalization (e.g. for ferric oxide and chrome or chrome-equivalent tapes) should have frequency response stated for all conditions.

IN-DASH AM/FM/MPX CAR RADIO that includes an 8-track tape player. This model is the RCA AutoSound 12R711.

Wow-and-flutter performance of the tape equipment is to be measured using an rms-responding meter with weighted response. The meter is read for random 10-second periods at the beginning, middle, and end of the tape cassette or cartridge, noting the average of the peak readings, but excluding random peaks which do not occur more than twice in any 30-second period. Wow and flutter is reported as a percentage, followed by the notation "wrms" (weighted rms).

To measure stereo separation of car tape equipment, a reference level of 250 nWb/meter tone at 1 kHz is used, recorded on one channel. The opposite channel is played back through a narrow-band filter that includes 1 kHz, and the residual signal is measured. The purpose of the filter is to minimize the masking effect of tape noise, since interchannel leakage (crosstalk) may actually be lower in level than the noise and still be more objectionable.

"A"-weighted signal-to-noise ratio is also to be specified for tape playback devices intended for car use and is to be measured with respect to a 1-kHz recorded signal at a level of 250 nWb/meter, using a 20 Hz to 20,000-Hz bandpass filter.

Finally, the maximum output voltage of the tape deck is to be specified in volts, over the relevant frequency band and with a minimum recommended load also stated. Again, that specification is intended to establish compatibility of interfacing between models and brands, particularly where separate car stereo components (as opposed to all-in-one car stereo units) are used.

While there are certainly many more specifications which might be measured and published for mobile audio products in those three categories of amplifiers, tuner/receivers, and tape players (or combinations of them), it is significant that a group of audio-equipment manufacturers were able to get together, without any government prompting or pressure, to produce meaningful measurement standards. The result of their efforts can only benefit the audio consumer who wishes to have good high-fidelity sound while traveling in a vehicle.

The proposed standards have been printed, and readers wanting to learn more about them may write to Marshall Mack Brown, Chairman of the Ad Hoc Standards Committee of Car Stereo Manufacturers, at Craig Corporation, 921 West Artesia Blvd., Compton, California 90220. **R-E**