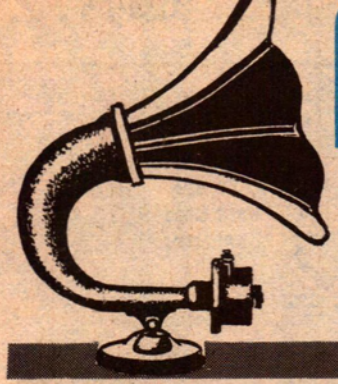

AUDIO TALK

by LEO SIMPSON

Music Power and Dynamic Headroom

Elsewhere in this issue, we have published a design for a toneburst tester entitled "IHF 1kHz Tone Burst Source". The letters IHF stand for the Institute of High Fidelity, an American association which establishes standards for high fidelity equipment sold in the USA. Why have we produced a piece of equipment to perform a test to an American standard?

The answer has more to do with international trade than with the efficacy of IHF standards. In the USA, the major portion of the hifi market is held by Japan and it represents the biggest single market served by Japan outside its own domestic market. Therefore, since Japanese audio companies design their equipment primarily to satisfy the US market, they design to meet the IHF standards. So the IHF standard also tends to serve the world, as far as performance of amplifiers, receivers and tuners is concerned.

There are probably some readers who object to the idea of the performance of equipment sold on the Australian market being determined largely by an American standard. Here we must give the Japanese their full credit. As part of their aggressive marketing approach, no doubt guided by their powerful MITI (Ministry of International Trade and Industry), Japanese companies have shown themselves to be anxious to comply with the standards of every country in which they sell. To give an illustration of this approach, the Technics SA-400 receiver reviewed in the January 1979 issue is manufactured in at least 10 versions to suit different countries and regions. The model for Australia meets our standards for mains power connection and conforms to the intent of Australian Standard AS 3159 (Electronic Sound & Vision Equipment).

Despite this, the fact that the IHF has defined this new "Dynamic Headroom" performance spec does mean that many amplifiers are likely to carry the rating in the future. What does this mean, and is it worth worrying about? A partial answer to the first question can be gained from the article on the toneburst tester elsewhere in this issue. I will elaborate.

"Dynamic Headroom" supersedes the previous IHF rating for "Dynamic Power Output", which in turn superseded "Music Power". So let's start with Music Power. The idea behind this term recognised that most amplifiers can deliver more power on a short term basis, on peaks of program material, than they can when fed with a continuous sinewave tone.

This means that it is possible for two amplifiers to have identical continuous power ratings but for amplifier 1 to be able to deliver substantially more power before the onset of clipping, when fed with actual program signals. The reason for this is that amplifier 1 has a power supply which is not as well regulated as that for amplifier 2.

When each amplifier is delivering full power on continuous tone, the power supply rails may measure +35VDC, for argument's sake. In the "no-signal" condition, the power supply rails of amplifier 1 may rise to +45VDC, whereas the supply rails for amplifier 2 may rise to only +40VDC at no signal. While the difference is only five volts for each supply rail, this can account for a substantial difference in music power output.

On face value, the idea of quoting music power output is a good one as it enables would-be buyers to get a better grasp of the overall performance. If everything else is equal, then the obvious choice is the amplifier with the higher music power output.

The trouble with the music power rating was that it was subject to abuse by the more unscrupulous manufacturers. The recognised method of measurement was to substitute a regulated power supply for the normal amplifier supply rails and measure the power output.

While there is really nothing wrong with the above method of measurement, it led to the production of amplifiers with very poorly regulated power supplies. This meant that the music power rating became wildly optimistic in some cases, when related to actual performance.

In short, the music power rating made it very easy for specifications to be "cooked".

Recognising that the music power rating left much to be desired, in 1966 the IHF defined a new rating. This was "dynamic power", which was measured using a toneburst of 10 milliseconds of sinewave at a low repetition rate. This method at least had the advantage of not using regulated external power supplies.

But the dynamic power rating still could give a substantial advantage to the amplifier with a poorly regulated power supply. And the 10 millisecond toneburst test specified for this measurement bears little relation to the dynamics of normal program signals. In other words, the figures for dynamic power could still be quite unrealistic.

For some time we have been aware of the need for a regular series of articles to provide background to our hifi reviews and audio projects. So this new column will discuss in detail many of the measurements and parameters which characterise audio equipment.

This situation changed rather drastically in 1974, at least in the USA. Up to that time, amplifiers could be advertised with wildly unrealistic ratings and there was no uniform standard of comparison. Then the American Federal Trade Commission stepped in. It has just as many teeth as our own Trade Practices Commission.

The FTC ruled that amplifiers and receivers could only be advertised with a "continuous power rating". Any secondary power rating such as "music power", "peak music power" or "figment of imagination power" had to be printed in the advertising material using type sizes no greater than two-thirds of that used for the continuous power rating.

Consternation reigned. Worse still, the FTC stated that, in testing an amplifier's power rating it had to be "pre-conditioned" by a one-hour soak test running at 33% of its continuous power rating when fed with a 1kHz sinewave. For many manufacturers, particularly those that were not conservative in their ratings, this was an unmitigated disaster.

Some amplifiers could not survive the pre-conditioning without thermal runaway and subsequent breakdown. Others became severely overheated and their thermal overload cut-outs,

where fitted, would trip. Whether it was intentional or not, the FTC had created a very stringent test.

Perhaps the main reason for this is that the maximum power dissipation in a class-B amplifier doesn't occur when the amplifier is delivering full power, but when the amplifier delivers about 40% of its continuous power. This figure is not very far away from the 33% specified by the FTC.

The actual figure for maximum power dissipation in a particular amplifier depends to a large extent on the no-signal voltage of the power supply rails and the effective output resistance of the power supply. What this means is that a poorly regulated power supply is a liability — it results in an amplifier with higher internal power dissipation for a given continuous power rating.

So amplifier manufacturers had to go back to their drawing boards and design a new generation of amplifiers which would pass the pre-conditioning. This meant better regulated power transformers with less internal losses, more rugged rectifiers, and bigger filter capacitors with higher ripple current ratings. And, of course, the power transistors had to be more rugged and their heatsinks more effective.

So the result of the FTC ruling was to make amplifier ratings more conservative. It is now rare for an amplifier or receiver not to meet its continuous power ratings. A further result is that the amplifiers develop less music power than they used to, because their power supplies are better regulated.

Even so, in 1978 the IHF sought to resurrect the music power or dynamic power concept with the new rating "Dynamic Headroom". This is expressed in decibels and represents the ratio between the music power and the continuous power output. Along with the term there was a new toneburst test, more valid than the previous method.

The new toneburst method employs a 1kHz sinewave which increases in amplitude by 20dB over the reference level, for 20 milliseconds at a rate of two bursts per second. This is more realistic than the previous test because the 20dB change in level represents a typical peak-to-average program ratio and the rate of two bursts (peaks) per second is not likely to be exceeded by most program material.

Typical good quality amplifiers will have a dynamic headroom of between 1dB and 2dB. An amplifier with a dynamic headroom of 0dB would have a power supply with perfect regulation. An amplifier with a continuous power output of 30 watts per channel and a dynamic headroom of 1dB would have a music power output of just over 37 watts. The same amplifier with a headroom of 2dB would deliver 47.5 watts music power.

As an interesting paradox, amplifiers with completely separate power supplies for each channel usually have less dynamic headroom than equivalent amplifiers with single power supplies.

In a practical sense, even though Dynamic Headroom has re-established the music power concept, the fact that it is expressed in decibels makes it harder to sell. Thus while a dynamic headroom of 2dB for an amplifier of 30 watts rating means an increase in effective power of 17.5 watts or 58% more, it does not sound impressive. Nor is it impressive, in actual fact. An increase in level of 2dB is barely audible.

There is another problem with Dynamic Headroom and that has to do with accuracy. The toneburst output of the amplifier is displayed on an oscilloscope screen and the signal increased until the amplifier just reaches the onset of clipping. Then the measurement is taken from the oscilloscope display and the calculations made.

Now, under steady-state conditions it is quite difficult to judge the onset of clipping by visual inspection of an oscilloscope waveform. To get around this problem in our tests for continuous power, we judge the onset of clipping by the sudden increase in distortion products. The difference in accuracy of the two methods can easily amount to 0.5dB. This depends to some extent on the visual acuity of the observer, the focussing of the oscilloscope trace and the amount of hum and other noise superimposed on the waveform. But the task of judging the onset of clipping is much more difficult on this toneburst waveform which flicks across the screen at the rate of two per second. So the dynamic headroom cannot be expressed with any great degree of precision.

Some idea of the music power (and dynamic headroom) of amplifiers we have reviewed in the past can be gained by doubling the power delivered by one channel into a 16 ohm load. The resulting figure will give a fair idea of the music power likely with normal 8 ohm loads.

Some sort of conclusion should be drawn from the foregoing. Dynamic headroom is a useful concept, which gives a further parameter for comparison of otherwise similar amplifiers. But because of the American FTC regulations most amplifiers have well regulated power supplies. So the result is that most amplifiers don't have much in the way of dynamic headroom.

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To my mind this is good. Perhaps amplifier manufacturers are now erring on the side of conservatism in their design and maybe a better engineering compromise would produce amplifiers with a dynamic headroom of 3 to 4dB. But because 3 or 4dB is not a large audible difference in loudness, this is largely academic.

What can be stated with certainty, is that almost all of today's amplifiers either meet or exceed their specifications for continuous power output. That is a big improvement over the situation of a few years ago.