Transient Testing of A.C. Amplifiers

METHOD OF COVERING THE FULL DYNAMIC RANGE

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TESTING the transient response of an amplifier is well known as being simple and informative. The usual weakness of the test is that only a small signal can be used in order to avoid the higher harmonics overloading the amplifier, which means that the transient response can only be obtained at a low power level. The need for testing the transient response of an amplifier up to maximum power output is perhaps greater with amplifiers using transistors than it is with valve amplifiers. This is because the parameters of transistors vary a lot with both operating current and voltage, making it possible for an amplifier to have a good transient response at low power levels, whereas this response may be quite unacceptable near maximum power output. This is particularly true of amplifiers using negative feedback where changes in the transistor parameters can easily reduce the stability margins.

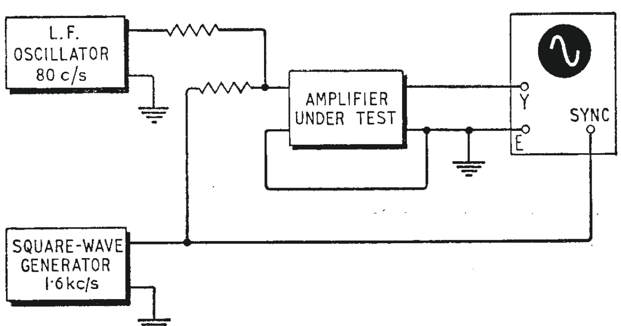

Fig. 1 Test set-up for an audio amplifier.

Method of Testing.—The transient response of a d.c. amplifier can be taken over its full range of output levels by having a d.c. input signal in addition to the transient test signal, the d.c. signal being used to swing the output to overload point in each direction. A d.c. signal cannot be used for an a.c. amplifier, but it can be replaced by a low-frequency a.c. signal. Fig. 1 shows the block diagram of a typical test set-up for an audio amplifier. The low-frequency sine wave and the square-wave transient test signal are added together by fitting a series resistor in each signal lead. A photograph of the combination of the two signals is shown in Fig. 2. It is important to keep the amplitude of the square wave signal small so that there is no danger of the higher harmonics in the waveform overloading the amplifier. The low-frequency signal amplitude is set so that the amplifier is just overloaded on the peaks of the sine wave. The output of the amplifier due to the combined input signals is not the easiest of waveforms to inspect in detail, but if the scope is triggered by the square wave and the frequency of the oscillator adjusted carefully, a sufficiently steady display for looking at can be obtained. Ideally, of course, the two frequencies should be locked together and this was done to obtain the photograph of the output of a ten-watt audio amplifier which is shown in Fig. 3. If the edges of the square wave are examined carefully it can be seen that the transient response is very good in the centre (i.e., low power level) but deteriorates at the top and bottom of the waveform which is when the amplifier is just overloading. It can also be seen that the transient response is worse at the bottom of the waveform than at the top.

Although this article has concentrated on using this method of transient testing for audio amplifiers, it is equally applicable to other a.c. amplifiers, particularly amplifiers designed to deliver appreciable power output. It may of course be necessary to use different input frequencies.

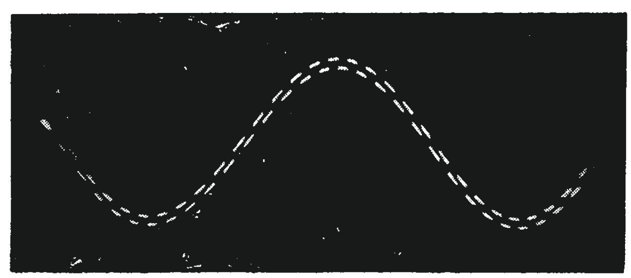

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Fig. 2 Input waveform.

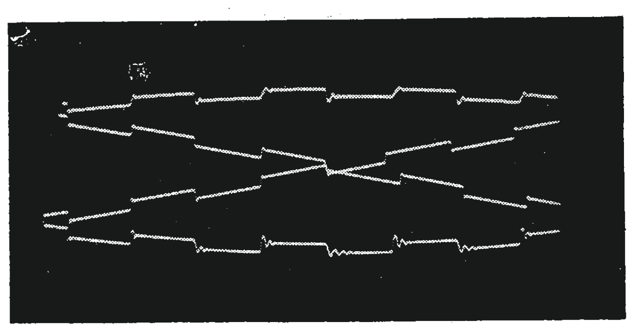

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Fig. 3. Output of 10-W audio amplifier.