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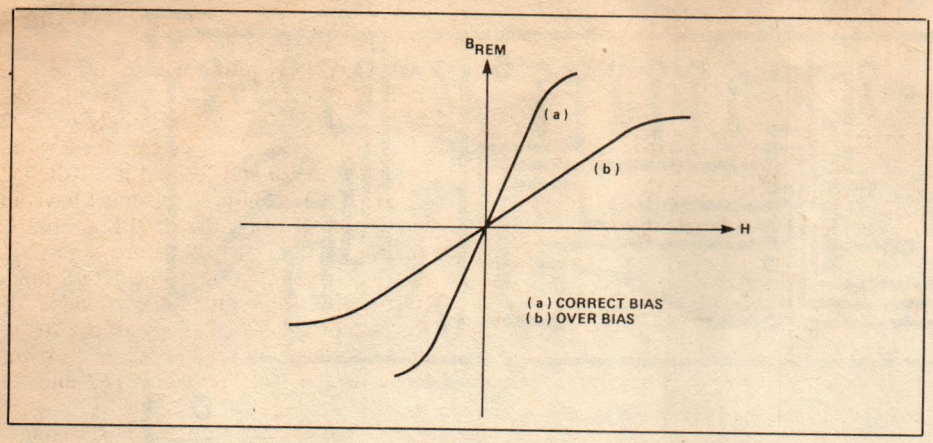


Fig. 10. The effect of HF bias on tape magnetization linearity.

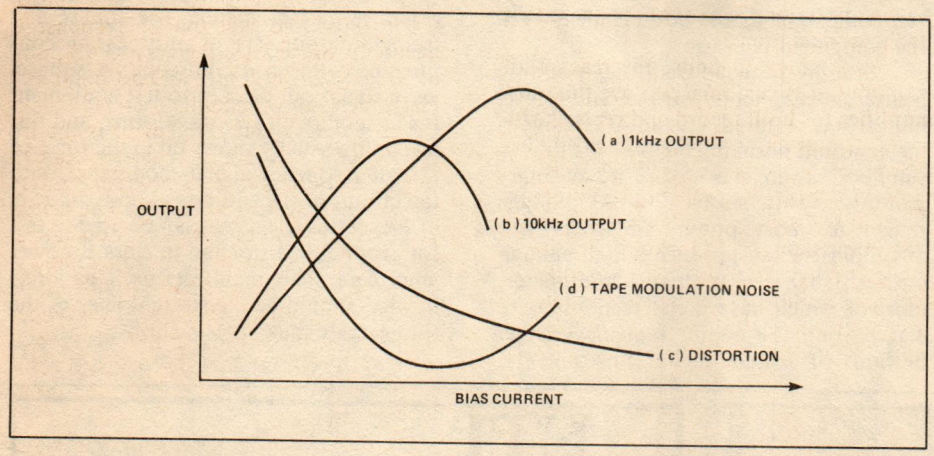


Fig. 11. How recording characteristics vary with bias current; note that only curves a) and b) are to the same scale.

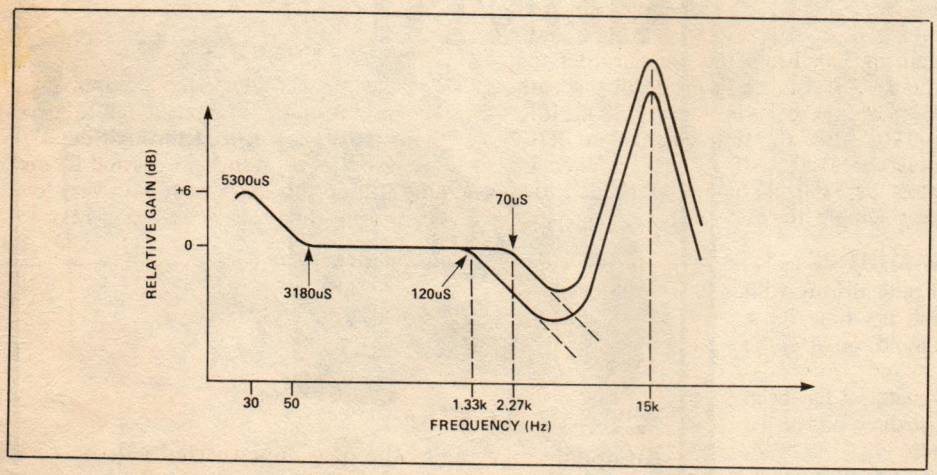


Fig. 12. Record pre-emphasis and de-emphasis for cassettes, showing additional compensation for head losses.

listening to the background noise on a bulk erased tape, as bought, and after it has been 'erased' by one's own recorder following the recorder of a zero signal.

The output from the tape recorder will depend on the tape speed and (although not discussed so far, this is a fairly logical extension of the arguments above) on the tape width at the head. So, the the lower the tape speed and the narrower the tape head width, the worse the signal to noise ratio will be. This becomes a particular problem with cassette recorders, where the tape creeps past the head at 1.875"/sec., and the track width is only 30 thou. or so anyway. The signal output from a cassette recorder replay head will be minute, and will demand a lot of skill in the design of the replay amplifier.

The poor basic S/N ratio of the reproduced signal from a cassette replay head, (though this is now improved by better heads and better tapes) has brought into prominence the various noise reduction schemes, of which the most common is the Dolby B system, used by most cassette recorder manufacturers under license from the Dolby Laboratories. In this, a degree of HF pre-emphasis is applied to the record signal, in which both the amount of HF pre-emphasis and the turn-over point above which this pre-emphasis is applied, is automatically adjusted in response to the measured level of the incoming signal. The reverse compensation is applied on replay to restore a flat frequency response.

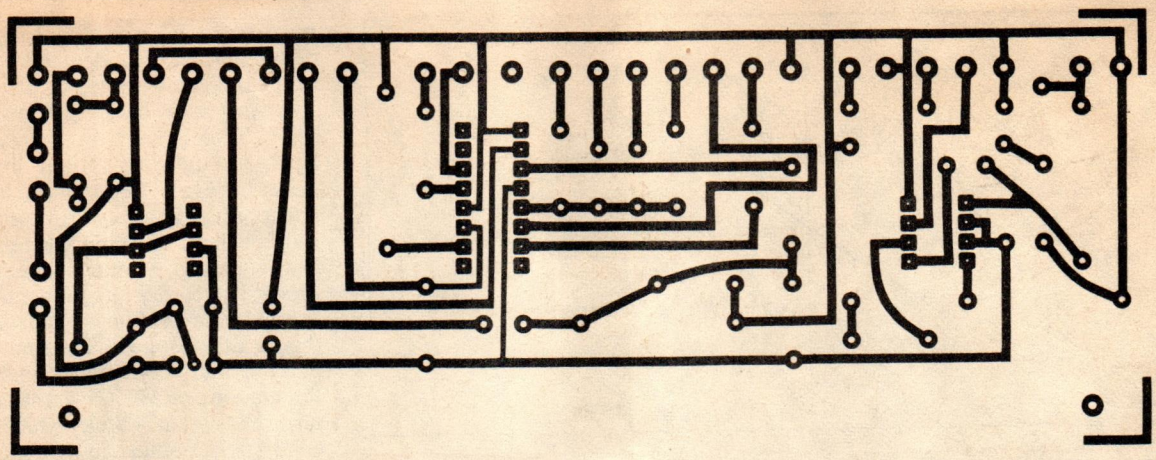
There is a snag of course. This is that unless some means is provided for monitoring the tape output, which is only possible on relatively expensive three-head cassette machines, some assumptions must be made by the cassette recorder manufacturer, in setting up the Dolby B replay operating levels, about the actual signal level which his recorder will give on replay for a given input recording level. This will depend on the actual tape chosen by the user, and on the appropriateness of the bias setting. Nevertheless, in spite of these objections, the Dolby B system does work surprisingly well, even on simple machines, and can give a 6-10 dB improvement in overall S/N ratio.

In many commercial machines, the replay amplifier is muted while the tape is not moving, to avoid drawing the attention of the listener to the background hiss of the replay amplifier.

11. Head losses: We have assumed so far, that the recording and replay heads — which are often the same unit in cassette recorders — behave in a perfect manner. They don't. Mainly because of the finite gap width, their HF performance is poor. This means that some form of HF pre-emphasis has to be applied, during recording, to assist in achieving a satisfactory HF output. This recording pre-emphasis, of 15-25 dB magnitude, will be applied, as shown in Fig. 12, at the point where it is expected that the replay HF response will start to fall. This is not a good thing, since it will tend to cause HF overload, and increased distortion and intermodulation effects, but is feasible because signal amplitudes at HF are generally low.

Practical Circuit Design

We have seen from the above what some of the problems are in tape recording. Since these are exaggerated in cassette recorders because of the narrow low-speed tape tracks, a look at the design of the electronics in a cassette recorder — ex-



and carefully adjusting the control for the same tone as that produced by the musical instrument. Anyone with a reasonably musical ear should not find this too difficult. Only one scale is required for all four ranges, since switching from one range to another simply alters the frequency by a factor of ten, and a scale of one range is easily used on any other range.

There is inevitably a small amount of breakthrough from the generator to the amplifier, and this will be most noticeable when the generator is set for a middle audio frequency. When the amplifier is connected to a single source, this breakthrough will almost invariably disappear completely, and it is not something that should be a problem when the equipment is in use.

In order to make frequency response measurements, some form of audio level indicator is required, and an AC millivoltmeter would normally be used for this. A simple alternative is to use an ordinary multimeter switched to a low AC voltage range, as most power amplifiers and preamplifiers can produce a high enough output signal level to drive a multimeter, most of which have a flat response over and beyond the audio frequency range. Beware of some digital instruments, though.

Use a sinewave signal for frequency response measurements. The square and triangle outputs are of most use in conjunction with an oscilloscope. A square-wave signal can be used to test equipment for instability on fast waveforms, and this instability usually shows up in the form of a high frequency signal modulated onto the output of the equipment under test. A low level triangle signal can be used to test for cross-over distortion in class B power amplifiers. This manifests itself as kinks in what should be the straight lines of the triangular signal.

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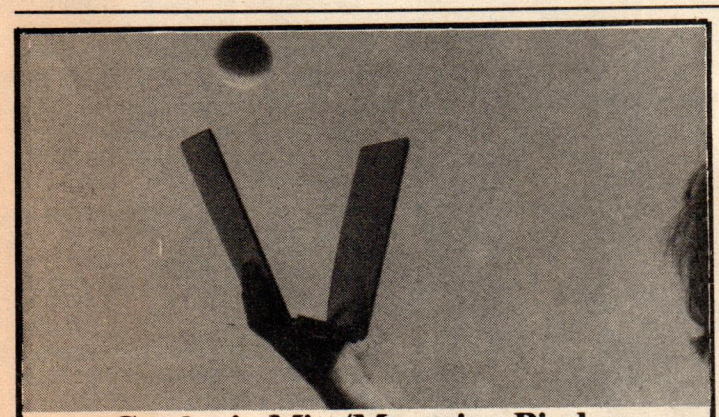

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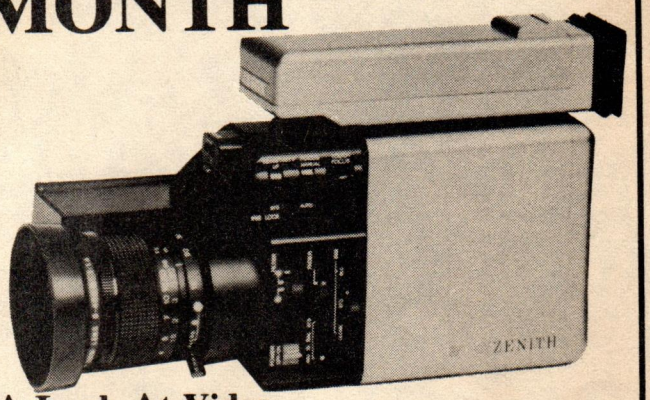

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