Add a P-P feature to voltage reference

Necessity is the mother of invention, according to the popular adage, and the development of the feature to be described certainly falls into this category. It tells how a very simple modification can significantly increase the value of an already useful device.

by PHILIP WATSON

The story started when the author had a need to calibrate the vertical amplifier sensitivity of a CRO; posing the question as to how best to obtain an accurate AC voltage for a reference.

An obvious approach was to take a known AC voltage and use it in conjunction with a suitable voltage divider, designed to deliver the wanted voltage. While better than nothing, this leaves something to be desired in terms of accuracy.

First, it depends on the accuracy of the mains voltage, and there are many factors which can upset this. Second, it depends on the accuracy of the transformer and this is also subject to many variables. In particular, many transformers are designed to deliver their nominal voltage at their rated load and may deliver a lot more than this unloaded. And, third, there is the accuracy of the resistors making up the divider network.

All of which adds up to a rather indeterminate reference at best. The desire for something better turned my mind to the DC Voltage Reference described in our June 1976 issue, which could provide an accuracy of 0.1%. Was there some way in which it could be used as an AC reference?

Without bothering to refer to the original article, I asked the author, Ian Pogson, whether there was some way of using it to provide a clipped AC waveform having the same order of accuracy as the pegged DC.

Ian's reaction was that it probably was impractical, if only for the reason that Murphy's law was unlikely to allow anything as simple as that to work!

In spite of his cynicism, however, he fished out the circuit and we studied it jointly. The idea of feeding AC to the device was ruled out almost as soon as it occurred, since it was obviously designed to operate at one polarity only. But what would happen if we fed it with DC pulses?

My first reaction was to suggest the output from a full-wave rectifier, but Ian countered this by suggesting a half-wave rectifier, pointing out that the period of non-conduction should provide a clearly defined base line while the zener action should clip the positive going pulses and, hopefully, produce something approaching a square wave whose amplitude was just as accurate as the DC reference.

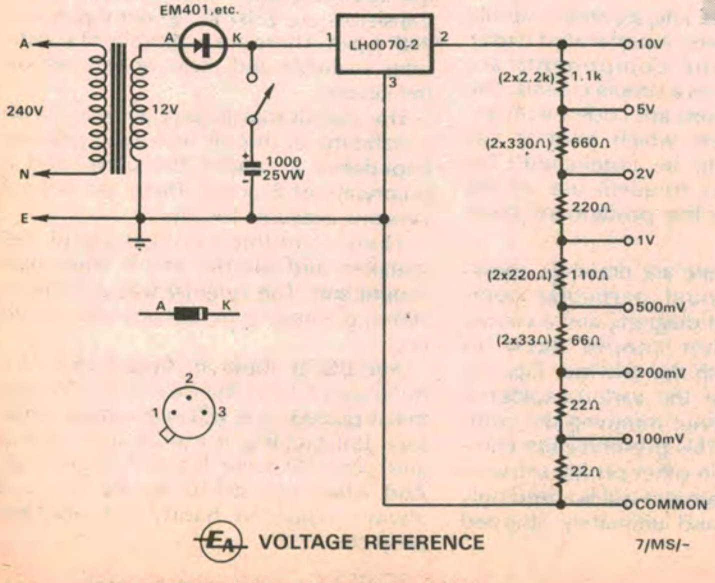
At which point we both looked at the circuit and realised that all that was needed to achieve this was to remove the 1000uF filter capacitor. It seemed too good to be true but, if it worked, Murphy's law would certainly have taken a bashing this time!

Well, to cut the story short, we tried it—and it worked, delivering a waveform exactly as predicted. All we had to do was add a switch to the front panel, and make the appropriate connections.

The wiring changes were simple. We lifted the positive lead of the 1000uF capacitor from its existing tag and moved it to an adjacent blank tag. Then we wired the switch to bridge these two tags.

It must be realised that the signal is useful only for calibrating a CRO. It cannot be used, at least directly, to calibrate an AC meter, since the angular waveform is far removed from the sinewave on which AC meter calibrations are based.

Right: The modified voltage reference showing the added switch. We suggest it be marked "DC" and "P-P" (for peak to peak).



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Below: The modified circuit showing the switch in series with the filter capacitor. A spare lug on the terminal strip simplified the actual wiring changes.