Signal Generator

2: Broadband amplification

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Abstract

The work presented here was carried out for the purpose of equipping a programmable signal generator with a wide band amplifier with automatic gain control, which was designed and built by the study group on Instrumentation and Electronic Measurement at the National University of Buenos Aires.

Introduction

For any generator used in instrumentation it is necessary to be able to adjust precisely the level of the signal being applied to the circuit being tested. Also the levels of distortion and noise must be kept as low as possible, in order to increase the potential usefulness of the instrument. In every case a signal generator, provided with a synthesizer, is employed, and an output level corresponding to the frequency is maintained; to this is added a calibrated passive attenuator, which allows varying the output level, either in a discrete way or a continuous way, within the range anticipated for the instrument.

In this case the signal generator is synthesized, and is capable of providing an output level on the order of 10 mV RMS over an impedance of 50 Ω in the range of 20 Hz to 1 MHz. This level does not correspond to the frequency, nor is it sufficient for most applications.

What is needed, then, is the ability to provide a level of 10 Volts peak to peak over a load of 50 Ω; this level must correspond to the frequency to be able to take effect on the output attenuator. It is also necessary that the distortion be kept as low as possible so as not to degrade the signal emitted by the synthesizer. As far as the noise level is concerned, this is a critical issue for this kind of amplifier due to the great width of the band.

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It should be emphasized that the initially expected variation of the output level of the synthesizer was much greater than the level finally achieved, and that is why the amplifier was designed with an AGC range sufficiently wide to amply cover these needs.

Finally, the last parameter to take into account in the design was the time required for establishing the automatic gain control. Normally the response time of the loop at low frequency is much greater than at high frequency; this is critical for a programmable instrument, since a wait time is produced until the output level stabilizes, and in this way allows the measuring to proceed.

Special care was taken to implement a design that proved to be broadly reliable and repeatable. It was also equipped with an error detection tree in the final report, so that the job of detecting and repairing errors could be easily accomplished.

Based on the above, the detailed specifications are given as follows:

Specifications

Range of frequency: 20 Hz to 1 MHz
Output level: 10V peak to peak over 50 Ω
Input level: 100 mV RMS +/- 10dB over 50 Ω
Frequency response: +/- 0.1 dB over the entire frequency range
Harmonic distortion: less than 1 % over the entire frequency range
Range of automatic gain control: 30 dB
Noise level – 50 dB
Input impedance: 50 Ω
Output impedance: 50 Ω