Robert A. Hirschfeld
National Semiconductor

JANUARY 1969

A UNIQUE MONOLITHIC AGC/SQUELCH AMPLIFIER

INTRODUCTION

As complexity and usage of communication systems increases, there is a growing use of a special class of circuitry, designed to make the system more convenient to the user, as well as allowing it to adapt to changes in the transmission channel. The most common function is voltage-variable gain, used in volume compression and expansion, and a specialized case, squelch, in which gain remains either in its maximum or minimum state.

The main problem in such circuitry is finding a suitable nonlinear element to do the job. Conventional elements, appearing in Table 1, share common problems of distortion, cost, limited signal handling capability, sometimes limited gain reduction range, and usually insert unwanted transients onto the signal during periods of rapid gain changing. Two mechanisms may be defined for these elements; either effective resistance or effective transconductance is varied by the DC control voltage. Because the variation is accomplished by changing quiescent operating points, DC decoupling is required at the output, and only AC signals may be handled. DC decoupling, however, still allows rapid changes in DC operating point to be transmitted as switching transients. While linearity is claimed for FET and the lamp-photocell schemes, such linearity is still only part of a large-signal nonlinear characteristic. With any of the elements, quasi-linearity is obtained by traversing a small segment of the overall element range; hence, variable gain elements must precede any system voltage gain.

TABLE I

CONVENTIONAL GAIN CONTROL ELEMENTS

Element	Mechanism	Control Range	Control/ Output Isolation	Large Signal Handling	Comments
P-N Junction	Forward Resistance	Good	Poor	Poor	Simple, predictable
Bipolar Transistor	Saturation Resistance	Fair	Poor	Fair	Beta Dependent
FET	Channel Resistance	Good	Poor	Fair	Unpredictable gate control voltage requirements; for driving fairly high impedance loads
Photocell-Lamp	Photocell Resistance	Good	Good	Good	Requires power to drive lamp; cell must be shielded from ambient light
FET	Transconductance	Fair	Poor	Poor	Unpredictable gate control voltage requirements; for driving fairly high impedance loads
Bipolar Transistor	Transconductance	Fair	Poor	Poor	Commonly used in AM-IF applications
Tetrode Vacuum Tube	Transconductance	Fair	Poor	Good	Filament Power