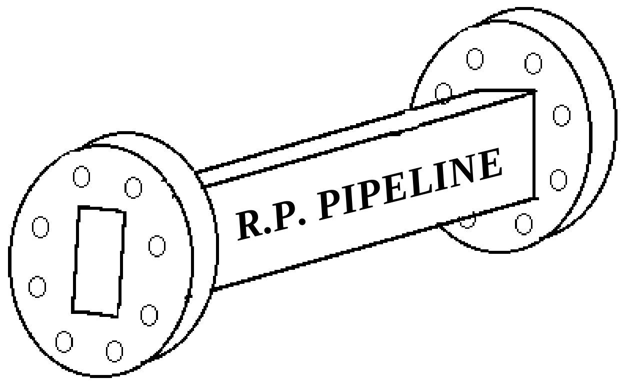
Communications & Power Industries
beverly microwave division



STC

Introduction

In this issue of the *Pipeline*, we discuss the issue of STC. “STC” stands for Sensitivity Time Control. This is really a radar system term. Most modern radar systems have a need to attenuate, in a controlled way, the amplitude of large target returns that may occur close to the trailing edge of the transmitted pulse. This is accomplished through the use of a variable attenuator which is located somewhere in the receive channel behind the receiver protector. In a typical application, the attenuator is set to maximum attenuation during the period of the transmitter pulse. At the end of the pulse, the amount of attenuation is reduced, in a controlled way according to system requirements, until it reaches 0 dB. In this way, large close-in target returns are controlled and the effective dynamic range of the receiver is increased.

So, STC is really a programmed attenuation function. This function may be located in different parts of the system. For instance, in some systems, the STC is done after the receiver downconverter at IF frequencies. In other systems, it may be done at RF frequencies by means of a separate attenuator placed behind the Receiver Protector. It is becoming increasingly more common, however, to incorporate this function INTO the receiver protector, thus making the RP a multi-function component. And so -- begins our tale.

Why the RP?

The first question one might ask is what are the benefits of incorporating the STC function into the RP. The answer is that, in many applications, doing so gives superior performance for the least cost. Virtually all modern RP’s contain, in part, a diode limiter. In most cases, the same diodes used for the limiter function can do “double duty” and serve a second role as a variable attenuator. The main technical benefit is that the STC function is realized with no increase in insertion loss. Cost benefits are realized in that the system contains one less component. Often, the additional cost to add the STC to the RP would be less than the cost of a separate attenuator. Also, there are the logistical and reliability/ maintainability benefits associated with having one less component in the system's layout.

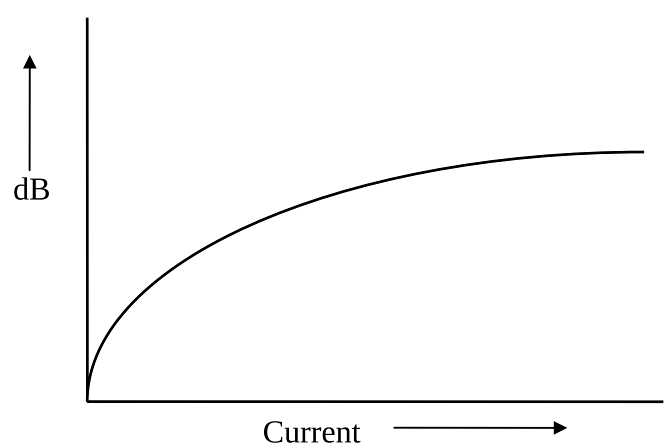
Of course, there are times when the STC spec is such that additional diode stages must be added to the RP. However, even this does not normally change the benefit equation. If the STC can be performed as part of the RP, it is usually better to do it that way.

How is STC incorporated into the RP?

We said above that the STC function is accomplish by making the limiter diodes do double duty. What did we mean by that? A receiver protector is a two-state device. During the transmitter pulse, the RP is in its high power state in which it is acting to protect the receiver. In between pulses, the RP enters its low power state (commonly called the "insertion loss" state) in which the RP is supposed to sit quiescently in the system and let the target return signal ("echo" signal) pass through unattenuated to the receiver. In a diode limiter, this is accomplished by designing the device in such a way that the diodes are in a low impedance state when protecting and a high impedance state when not protecting.

However, diodes are not two state, digital devices. Rather, a diode's impedance is a continuously variable function of the amount of current applied to it. In a diode limiter, the amount of attenuation is a function of the diodes' impedance. Therefore, a diode limiter has the inherent capability to become a current controlled, continuously variable attenuator. The amount of attenuation actually achievable for any device is very much dependent on other performance factors, especially bandwidth. However, a rough rule of thumb is that a single diode stage will yield a maximum of 15 - 20 dB of attenuation. The control current required is very small -- on the order of tens to hundreds of microamps per diode.

The graph below shows the typical attenuation characteristic of a diode attenuator.



Its salient characteristics are that it is monotonic and quite non-linear, reaching its maximum value with the application of only a few hundred microamps of current. Very often, the system designer will desire a different attenuation versus control transfer function or, perhaps, a different type of control input. A linear attenuation versus voltage function is quite common. Often the customer wants to use a digital word to set various attenuation levels. Virtually any type of control versus attenuation function is achievable by using a driver to interface between the customer's control signal and the RF attenuator. The driver will be designed to have a transfer function which converts the customer's control signal input to the current characteristic needed to operate the RF attenuator. C.P.I. has a complete driver design capability.

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