Improved linearity is needed by high power amplifiers (HPAs) used in communications systems. It has been demonstrated, at microwave frequencies, that a linearizer can improve HPA linearity by more than 10 dB. Linearization allows an HPA, for a given level of distortion, to operate at a higher power level and with greater efficiency. As frequencies increase, the use of a linearizer has an even greater payback, since available HPA power level is more limited and cost is greater than at lower frequencies.

A linearizer system is even more valuable for multi-carrier traffic and high information rate, bandwidth efficient modulated (BEM), digital signals. When linearized, existing HPAs can be used with the new BEM digital signals, thereby gaining considerable cost savings over replacement with a new amplifier. A smaller linearized HPA can provide equivalent transmission performance to a much larger un-linearized amplifier. Both new and existing transmitters will require less source power and operate at greater efficiency when linearized.

A linearizer can be employed to substantially correct for non-linear HPA's characteristics and thus allow the power level to be substantially increased. Or, conversely, allow operation with a substantially smaller, less costly HPA.

Several different approaches can be used to provide linearization; feed-forward, feedback and predistortion. Predistortion (PD) linearizers, which provide relatively wide-band characteristics and the ability to function as stand-alone units, have been preferred for microwave systems.

A PD linearizer works by creating signal distortion (amplitude and phase) that is the complement of the signal distortion inherent in the HPA. The signal to be amplified is first passed through the linearizer, distorting the signal, with no loss in gain. The distorted signal is then fed to the HPA to be amplified. The distortion inherent in the HPA negates the distortion introduced by the linearizer producing a near linear transfer characteristic.

To design such a linearizer, one must find devices and operating modes that have characteristics that are generally considered unwanted. Then one must find a way to separate and enhance the needed characteristics from the unwanted characteristics. As frequency is increased the task becomes more difficult.

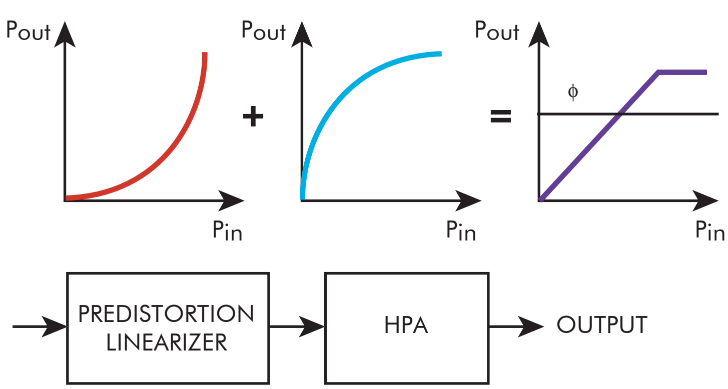



FIGURE 1 : PREDISTORTION CONCEPT

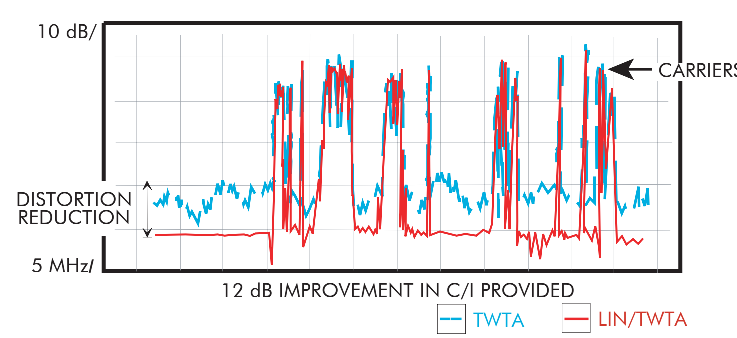
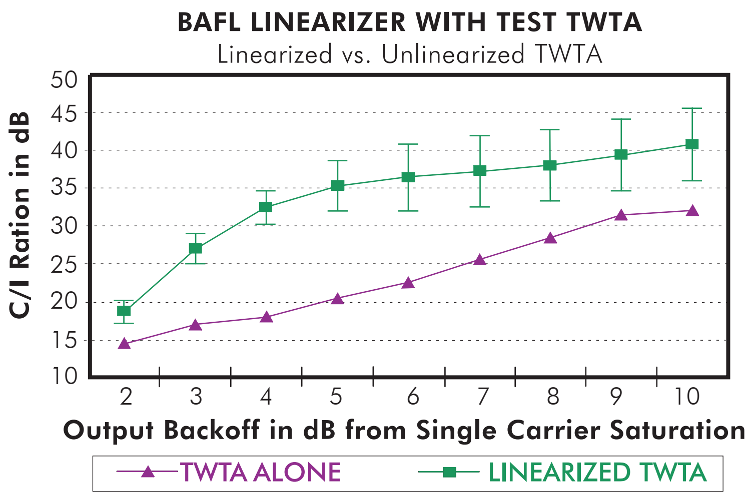


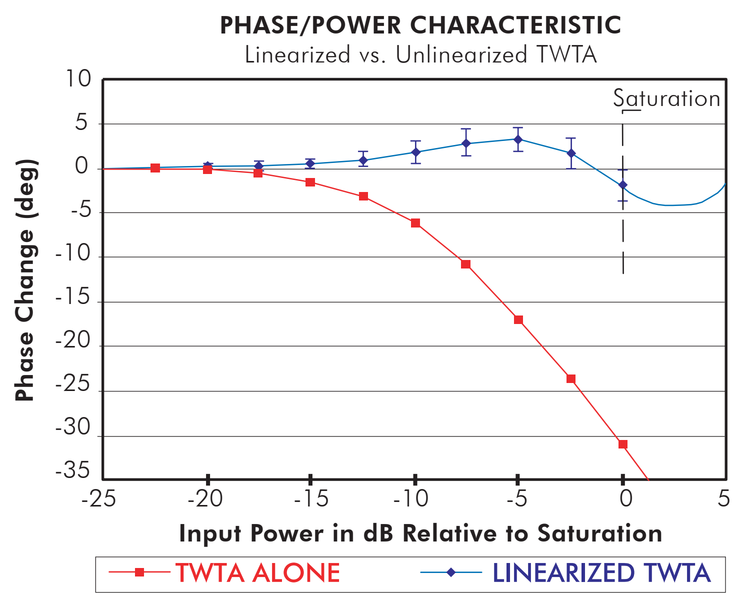

FIGURE 2 : MULTICARRIER PERFORMANCE

In this method a non-linear transfer function is created which is complimentary to the amplitude and phase non-linearities of the amplifier. This is used to predistort the incoming signal such that after it passes through both non-linear elements, it is restored to its original waveform, as shown in Figure 1. Notice that the gain of the linearizer increases by the same amount as the amplifier gain decreases. Likewise, the phase shift introduced by the linearizer is equal and opposite to that of the amplifier and results in the phase improvement shown in Figure 3b.

Typical performance of the linearized amplifier should appear as in the Spectrum Analyzer display shown in Figure 2 for multi-carrier operation. A plot of the C/I vs. Output Power Backoff (OPBO) is shown in Figure 3.

LTI has pioneered advances in predistortion linearizer design for the L/S-(2 GHz), C- (6 GHz), X- (8 GHz), Ku- (14 GHz), K- (18 GHz), and Ka- (28 GHz) bands. The LTI linearizers, using unique proprietary designs and construction techniques, provide the equalization necessary to greatly enhance SSPA, TWTA and Klystron HPA performance over more than a 20 percent bandwidth. The full satellite bandwidths are covered for up-link space applications. LTI linearizer designs employ an exclusive tuning system with a minimum of interaction making alignment simpler and more accurate. LTI linearizers deliver up to a four-fold increase in HPA power capacity, and more than double HPA efficiency. Thus the use of a linearizer provides significantly more useful output power and hence, allows the use of a smaller TWTA, thereby reducing the cost of the transmitter.




**FIGURES 3A & B :** The Combination of a BAFL or WAFL type linearizer provides improved C/I and Near Constant Phase Transfer Characteristics. (Standard deviations shown represent a statistical sample of 38 units at center band and at band edges.)


Linearizer Technology, Inc.™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