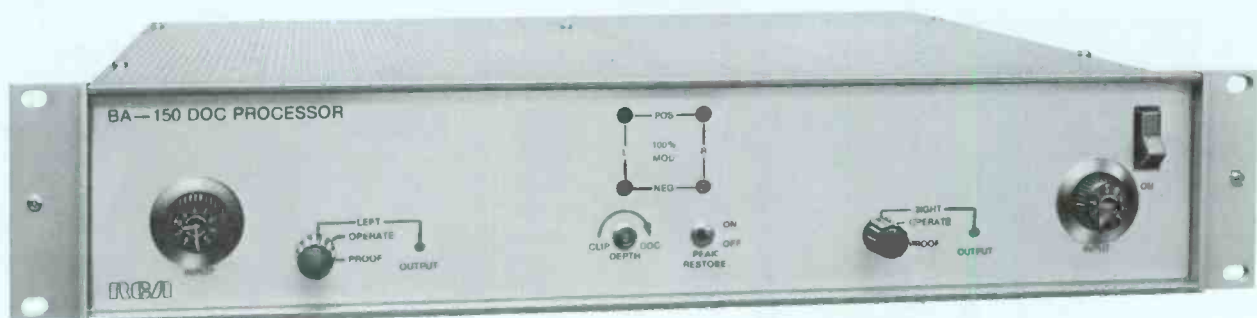


## Digital Overshoot Control Processor, Type BA-150

- 100% modulation without overshoot
- Inaudible action
- Universal. Use with any FM exciter/Stereo generator system

The RCA Type BA-150 Digital Overshoot Control Processor (DOC) is a unique audio processing system which allows the FM broadcaster to achieve the consistently high modulation levels he desires without being plagued by the overshoots which occur even when fast peak limiters are used. Essentially a sophisticated peak clipper, the DOC provides the pleasing sound desired yet the actual processing operation is completely inaudible. It is useable with any FM exciter or stereo generator.



### The Problem

All stereo generators employ low pass filters to prevent interference with the 19 kHz pilot, limit aliasing distortion (caused by high frequencies in the L&R channel leaking into the L-R sidebands), eliminate spurious out-of-band emissions and reduce crosstalk between the stereo and SCA subcarriers. Some of these filters have transition rates of 100 dB/octave or more. The problem of overmodulation of these filters is twofold.

First, these filters often exhibit large, non-linear phase shifts. When clipped audio (which can approach square waves in character) is applied to these filters, the non-linear phase shift can allow amplitudes of various frequencies to add in phase thus causing overshoots—the overshoots which often activate the peak flasher at unexpected times for seemingly no apparent reason.

Secondly, sharp cut-off low pass filters are also subject to ringing when signals approaching square waves, such as clipped audio, are applied because of the loss of harmonic content above 15 kHz necessary to reproduce the waveform (the Gibb's phenomenon). If the clipping occurs at the 100% modulation level, the ringing will exceed 100%. The BA-150 DOC Processor has been designed to solve these problems effectively, efficiently and inexpensively.

It should be recognized that amplitude overshoot does not occur only in the input audio low pass filter circuitry but may occur as an anomaly due to effects distributed throughout the FM exciter system.

The BA-150 was designed to cure the overshoot problem other than in the exciter and stereo generator. The result is that the BA-150 may be used with any exciter and stereo generator.

### The Solution

Figure 1 shows the ringing output of a conventional 15 kHz low pass filter with a clipped audio signal applied. In an FM exciter, this figure is typical of the output of a series of distributed low pass filters within the exciter, each with a different cutoff frequency. To eliminate the ringing overshoots in such a situation, it is necessary to modify the processing circuitry which produces the square top waveforms—the peak clipper—so that it retains the clean audio full frequency response advantages of peak clipping yet does not produce overshoots above 100% modulation. Also, the processor must leave signals with modulation levels of 100% or less completely unaffected. As a further requirement, to be truly cost-effective and useful, the processor must be able to operate downstream of any type of signal processing equipment (AGC, limiters, etc.) and upstream of any type of FM exciter system. The RCA Type BA-150 Digital Overshoot Control Processor meets all these requirements.

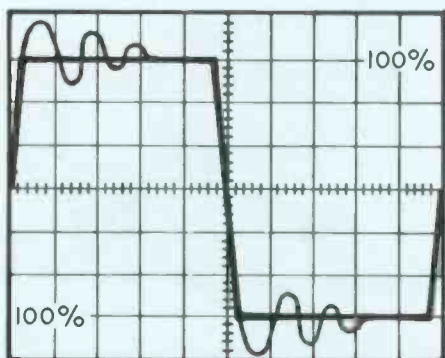
### Operation

The BA-150 is operated between any audio gain controlling stage and the input to the FM Stereo Generator. It employs a form of shaped, bi-level clipping\* to precisely control and maintain the high frequency peaks. As expected, the shaped

peaks will produce a ringing response from the low pass filters. The BA-150 however, will constrain the ringing amplitude to the 100% modulation level or less (as the ring decays during the period of the peak overdrive). This is shown in Figure 2. With a signal that would result in a 5% overmodulation, the BA-150 allows the peak energy to reach 100% modulation at which time a DC voltage is subtracted from the signal during a precisely gated aperture generated by a digital control loop. This condition persists for the period of the peak overload. As the overload amplitude falls to 100% modulation, the BA-150 instantly and imperceptibly disconnects itself from the signal path. As shown in Figure 2, the exciter system response always achieves 100% modulation on the initial wavefront. Thus the percussive attack of the music is preserved while the transient distortion is eliminated.

Installation and set up are simple. Since every FM exciter system will have different low pass filter characteristics and distributed phase delays, the required depth of the gated aperture will vary from system to system. A front panel adjustment is provided to make this adjustment. Front panel LED indicators are used to set the 100% modulation level. Audio drive level is also front panel adjustable for maximum "loudness".

Since the bi-level clipper in the DOC serves only to eliminate overmodulation caused by the so-called Gibb's phenomenon, the second cause of overmodulation—non-linear phase response—must be cor-



**DARK TRACE - SQUAREWAVE INPUT TO LP FILTER  
LIGHT TRACE - LP FILTER RESPONSE**

Fig. 1. LP Filter Response to Squarewave Input.

### Specifications

- Input Impedance ..... 600 Ohms balanced or unbalanced
- Output Load Impedance ..... 600 or 150 Ohms balanced or unbalanced
- Input Level ..... +14 dBm max.
- Output Level ..... +18 dBm (adjustable)
- Signal/Noise Ratio ..... >75 dB, 20 Hz-15 kHz (with 75  $\mu$ s de-emphasis)
- Frequency Response .....  $\pm 1$  dB, 20 Hz-15 kHz<sup>1</sup>
- Attack Time ..... 50  $\mu$ s
- Harmonic Distortion ..... <1%<sup>2</sup>
- System Crosstalk ..... <-46 dB, 20 Hz-15 kHz
- Ambient Operating Temperature ..... 55°C (131°F) max.
- Power Requirements ..... 117/234 VAC, 50/60 Hz 25 W
- Dimensions ..... 19" W x 15" D x 3.5" H (48.3 x 38.1 x 8.8 cm)
- Weight ..... 14 lbs. (6.35 kg)

### Ordering Information

BA-150 Digital Overshoot Control Processor ..... MI-141467

### Accessory

Plug-in 15 kHz Filter (Matched pair) ..... MI-561064<sup>3</sup>

<sup>1</sup>Supplied with 75 $\mu$  pre-emphasis and de-emphasis. 50 $\mu$  seconds and 25 $\mu$  seconds also available.  
<sup>2</sup>THD 20 Hz-15,000 Hz at any level below 100% modulation. Typically less than 0.1%.  
<sup>3</sup>Order one pair for use with stereo system when other than RCA Exciter System is employed  
 \*Patent Pending

rected. The block diagram of the DOC (Fig. 3) shows this audio phase corrector. Phase correction is accomplished in a six-section active delay network that generates the perfect inverse of the phase delay exhibited by the plug-in low pass filter contained in the RCA BTS-101A Stereo Generator. When the DOC is used in conjunction with the BTS-101A, the 17.5 kHz plug-in LPF is deleted from the DOC. When a stereo generator other

than the RCA BTS-101A is used, it is necessary to plug the 17.5 kHz LPF (MI-561064) into the BA-150 DOC Processor and disable the LPF from the stereo generator. This results in perfect phase compensation of the LPF and also allows continued use of existing equipment that may in all other respects give excellent performance.

The Predictive Peak Level Restoration\* (PPLR) circuit rids the last trace of

overmodulation caused by peak level shifts resulting from AC coupling a peak-clipped signal.

The RCA Type BA-150 Digital Overshoot Control Processor is the state-of-the-art solution to the FM overshoot problem. The BA-150 allows the FM broadcaster to achieve the "peak clipping" sound preferred by listeners while avoiding the overmodulation problems which traditional peak clipping has caused.

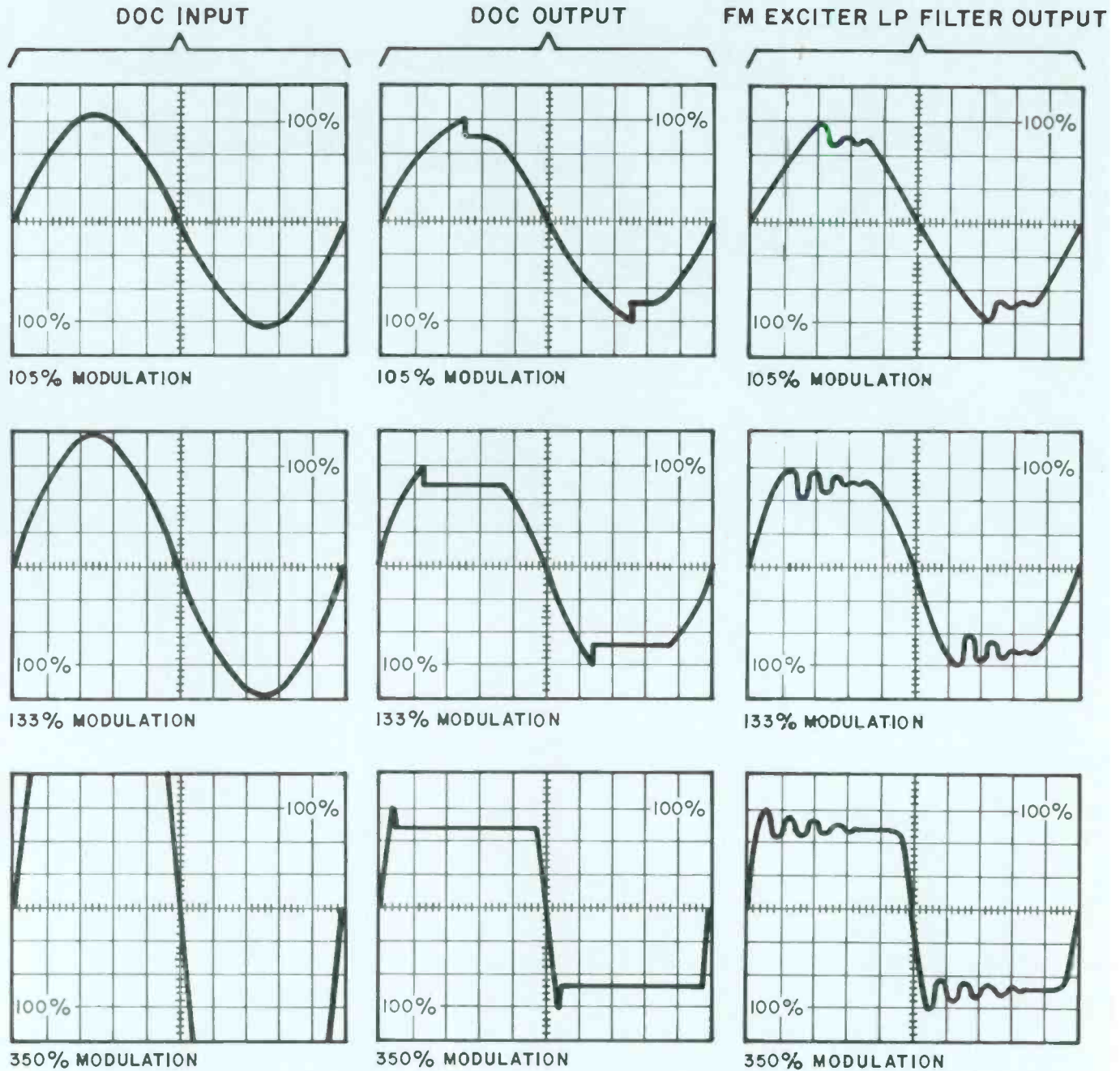


Fig. 2. BA-150 Waveforms.

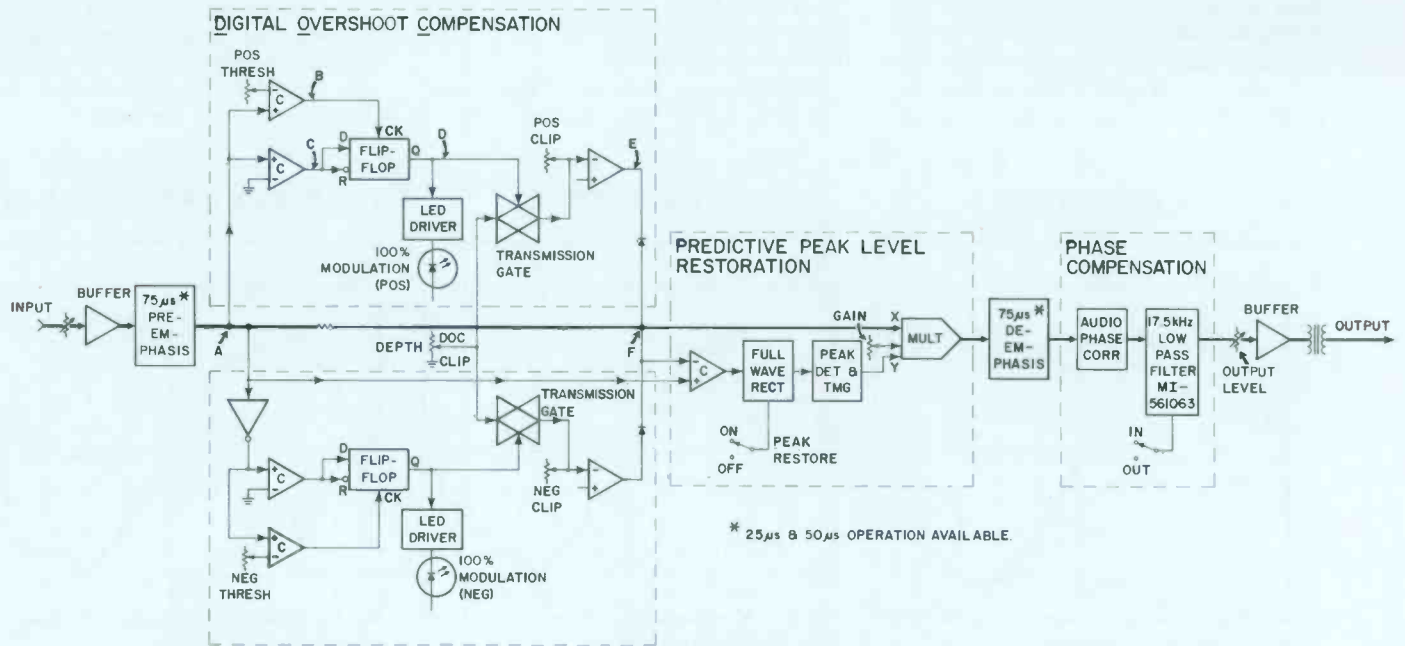


Fig. 3. BA-150 Schematic.