IC Lends Stability To Video Limiter

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Excellent temperature stability and linearity characterize a shunt-controlled voltage limiter employing an IC diff amp.

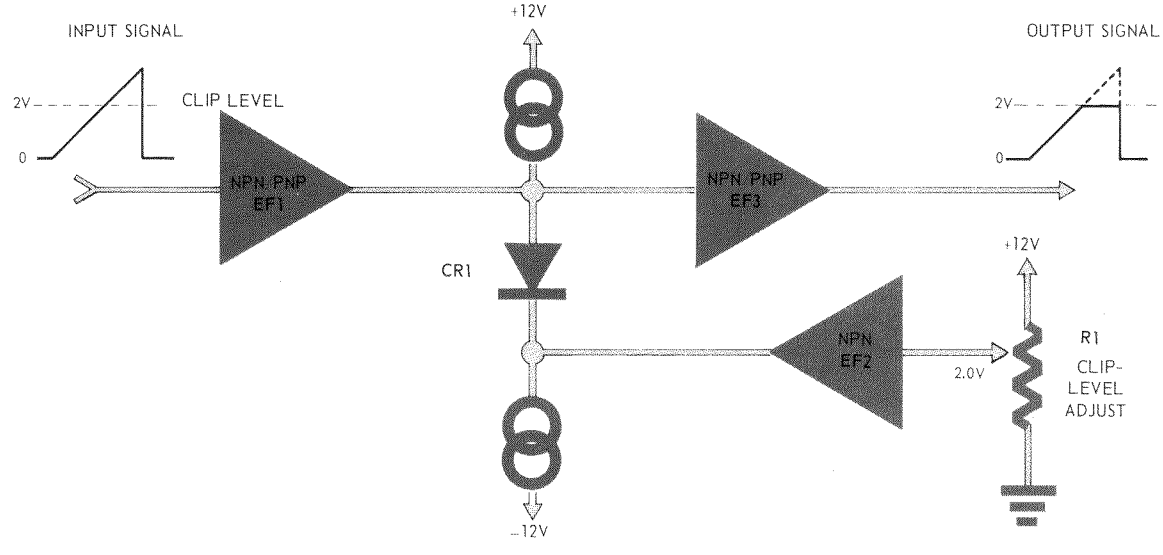
Video systems frequently must define the peak excursions of a video signal predictably with a high degree of linearity, stability and repeatability. The temperature-matching characteristic of a monolithic differential amplifier is suited ideally as a clamping network.

Four discrete transistors connected in complementary Darlington pairs form input and output buffers that pass input signals with inherently wide bandwidth, low distortion and negligible temperature drift.

Design objectives of an ideal video limiter are:

1. Insignificant distortion of input signal prior to limiting, plus unity gain and unrestricted bandwidth.

2. High dc stability. No level shifting of transfer curve or breakpoint of the clipper as a function of tempera-



Simplified block diagram of video limiter illustrates system operation. Limiter clips the input signal at level set by potentiometer. Input signal from dc restorer is black-negative signal (black-negative ground) with a maximum desired excursion of +2V. An npn/pnp emitter follower EF1 buffers this signal and maintains the same dc level as the input. Emitter of pnp output is current-source fed and shunted by biased diode CR1 serving as shunt clipper. Potential applied to npn emitter follower EF2 is the same as that at which CR1 conducts because forward drops cancel. When CR1 begins conducting, pnp emitter follower EF1 becomes current starved and further increasing the input signal turns it completely off. At this point the input signal is completely limited at 2V level. Output npn/pnp emitter follower EF3 buffers signal to low-impedance level and maintains same dc level, as in EF1. Output is a 0 to +2V replica of input with peak excursions above +2V clipped.

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ture. No dc offset.

3. System interfacing impedances should be optimum; i.e. a high input and low output.

4. During clipping, level should be highly predictable and repeatable. No discernible transmission of the input signal should be observable; i.e. complete isolation.

5. DC restored input signal—conventional form is black ground reference, approximately 2V pk.

All five objectives are met by using an IC and the four discrete transistors. A potentiometer permits adjustment of the clipping level.

Matching the characteristics of both discrete and monolithic semiconductors has produced an optimum control function. Additional improvement could be realized by complete integration of the circuit in monolithic form.

A simplified version of the clipper using only two discrete transistors sacrifices some temperature stability of the clipping level. However, in noncritical applications in which hard limiting is still desired, this simplified version could be attractive. □

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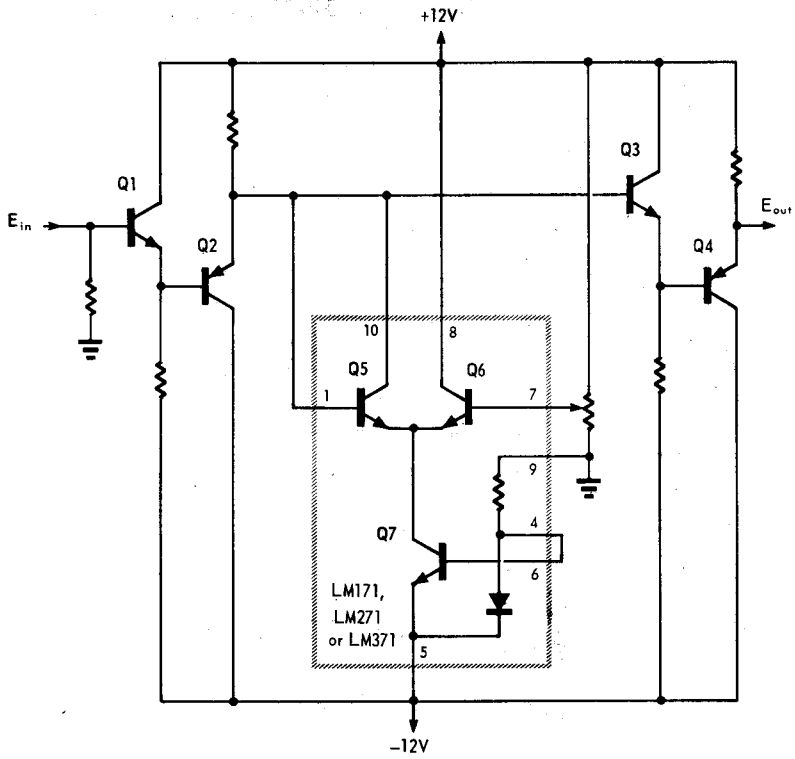

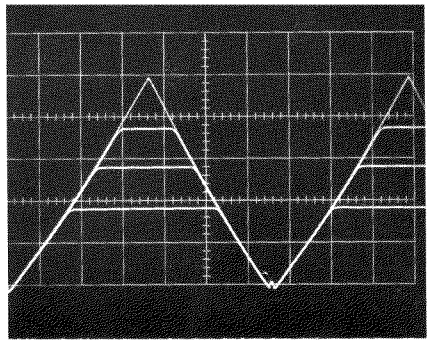

Multiple exposure of output waveforms at three different clipping levels and input triangular waveform. Note flatness of clipping level and linearity where limiter is back biased.

Four discrete transistors in practical circuit comprise level-shifting emitter followers in an IC differential-amplifier clamping network. A check of the circuit properties reveals how the design objectives are met. First, considering the region in which limiter is back biased: Q1, Q2 and Q3, Q4 act as complementary Darlington pairs and pass input signals with inherently wide bandwidth and low distortion. Small shunt capacitance of Q5 is driven by low impedance of Q2. This satisfies objectives 1, 2 and 3. Second, considering the active region of the limiter: Input signal is completely limited when diode-connected Q5 conducts and "robs" Q2 of emitter current. During this period Q2 reverse-biased base-emitter junction isolates input signal so that output remains at clipping level established by voltage on Q6 base. This satisfies objective 4. Characteristics of monolithic IC's insure that no temperature-dependent drift of the clipping level occurs, since both the static value and the temperature-dependent V_{be} drift of Q5 and Q6 cancel. Temperature-dependent V_{be} drift of Q1 and Q2 also cancel. Thus, clipping level does not shift as a function of temperature. This satisfies objective 2.