ABSTRACT

A NEW CHARGE-COUPLED AREA IMAGING DEVICE

by

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A two-phase, buried-channel 100 x 100 element charge-coupled area imaging device is described; early results on performance are reported. This new design is unique in that it incorporates 100 vertical opaque CCD registers interdigitated and distinct from 100 columns of light sensing elements. This feature permits the device to be operated at a uniform readout rate without requiring additional device area for a separate storage register and without image smearing.

The CCD gate system for this design incorporates two levels of polysilicon gate structure with undoped polysilicon between the gates of the upper layer. These gates are transparent in the visible and near-infrared spectral regions except for higher absorption in the blue region; this makes it possible for the device to give high performance with topside illumination. A single layer of aluminum forms the electrical connections and shields the transport register.

Included in the device is a differential, gated charge detector-preamplifier. The differential feature minimizes transients from the reset clock in the video output signal.

A number of high performance units have been fabricated to date. These have exhibited both wide dynamic range and low defect density. Dynamic ranges of > 1000: 1 have been measured at an output frequency of 500 KHz. Devices

have been operated successfully at 4 MHz; the design should be capable of 9 MHz operation, which is required if a scaled-up device is to operate at the standard television rate. A resolution of 75 lines per picture has been demonstrated in both the vertical and the horizontal directions.

Random noise sets the limit of detection at approximately 400 signal electrons. This limit is set by the preamplifier and should be substantially reduced when improved preamplifier designs are incorporated.

The dominant type of fixed-pattern noise in the output signal is caused by local regions of higher-than-average dark current. Some of the characteristics of these dark current signals will be described, as well as approaches which are being taken to eliminate them.

In summary, a novel charge-coupled area imaging device design has been conceived which has a number of major advantages over existing designs. A 100 x 100 element version of this has been fabricated; good performance has been achieved.