CCD IMAGERS WITH ENHANCED UV SENSITIVITY FOR INDUSTRIAL AND SCIENTIFIC APPLICATIONS

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ABSTRACT: A family of virtual phase (VP) CCD array image sensors for various industrial and scientific applications has been designed, fabricated and tested. All share the common concept of a "2.5-phase" photosensitive cell, combining the advantages of known "1.5-phase" VP devices (increased quantum efficiency, especially in the UV, and radiation hardness) with the simpler fabrication process and extended functionality of three-phase devices.

1. PHOTOSENSITIVE "2.5-PHASE" CELL

The cell structure is similar to a three-phase CCD where a third level of polysilicon is replaced by a structure formed by N-type implant ("virtual well") followed by a shallow P-type implant forming a "virtual gate". Comparing the manufacturing process of this structure with that of the "1.5-phase" VP CCD, two important moments should be noted: it takes only two additional implants to form the "2.5-phase" device, compared to four necessary for "1.5-phase"; and both implants are self-aligned, with polysilicon electrodes acting as a mask.

2. VP CCD SENSORS FOR SLOW-SCAN TV SYSTEMS

These devices are intended for applications where a wide spectral range, uniform photoelectric response, high resolution, and low noise performance are essential. They have been designed primarily for operation at low readout frequencies and low temperatures (-40° C and lower), however, they can readily operate at room temperature and readout frequencies up to 10 MHz. All these devices have a peripheral drain surrounding photosensitive area to protect it from stray charge generated at the chip periphery, and a built-in active load of the first stage of two-stage on-chip preamplifiers that can be switched off to prevent light emitting effects during integration. The basic design features of the family are presented in tables on the next page.

3. CCD COOLING SYSTEMS

The laboratory develops and manufactures various kinds of CCD cooling systems for both ground and space applications. The CCDs can be supplied with coolers providing the required thermal conditions for the devices installed into equipment, meeting the ultimate requirements to weight, size and the power consumption of the cooler (heat tubes, heat accumulators and so on). We are experienced in the design of the CCD imagers with Peltier coolers, cryostats, open space heat radiators.

A. G. Davis Philip et al. (eds.), New Developments in Array Technology and Applications, 323–324.

TABLE 1

Design Parameters

CCD Type	ISD 017A	ISD 015A	ISD 011A	ISD 034A	ISD 048A	ISD 049A
# of Vertical	1040	520	512	258	290	576
pixels Hor.	1160	579	512	256	386	576
Format	FT		FF		FT	
Pixel Vert.	16	18	16		22	
size Hor.	16	24	16		22	
# Registers	2		1			
Numb. clocked phases						
Image Sect	2		2		2	
Storage Sect	2		-		3	
Register	2		2		3	
Number readout ampl. in every register	2				1	

TABLE 2

Typical Performance Characteristics

Parameter	Units	Value
Saturation signal	mV	500
Full well	ke	130 (ISD011A,17A,34A) 220 (ISD015A,48A,49A)
Optical response non-uniformity	%	3
Sampled optical response non-uniformity	%	1.2
Dark signal @ -40° C	e^-/pix/s	10
Charge transfer inefficiency in any direction (by Fe55 source)		$1x10^{-5}$
Readout noise @20 kHz		
HS output	e^- rms	10
LN output	e^- rms	7

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