

Indiana University – Purdue University Fort Wayne
Opus: Research & Creativity at IPFW

Computer and Electrical Engineering Technology &
Information Systems and Technology Senior Design
Projects

School of Engineering, Technology and Computer
Science Design Projects

4-21-1989

Advanced Solid-State Optical Imaging System

Douglas A. Worden

Indiana University - Purdue University Fort Wayne

Follow this and additional works at: http://opus.ipfw.edu/etcs_seniorproj



Part of the [Computer Sciences Commons](#), and the [Engineering Commons](#)

Opus Citation

Douglas A. Worden (1989). Advanced Solid-State Optical Imaging System.
http://opus.ipfw.edu/etcs_seniorproj/208

This Senior Design Project is brought to you for free and open access by the School of Engineering, Technology and Computer Science Design Projects at Opus: Research & Creativity at IPFW. It has been accepted for inclusion in Computer and Electrical Engineering Technology & Information Systems and Technology Senior Design Projects by an authorized administrator of Opus: Research & Creativity at IPFW. For more information, please contact admin@lib.ipfw.edu.

FINAL REPORT

ADVANCED SOLID-STATE OPTICAL IMAGING SYSTEM

PHASE I DEVELOPMENT

Submitted to:

Electrical Engineering Technology Department
Indiana University - Purdue University
at Fort Wayne
2101 Coliseum Boulevard East
Fort Wayne, Indiana 46805

Submitted by:

Douglas A. Worden

April 21, 1989

TABLE OF CONTENTS

	<u>PAGE</u>
LIST OF ILLUSTRATIONS	v
ABSTRACT	vii
INTRODUCTION	1
HISTORY OF SOLID-STATE IMAGE SENSORS	3
TODAY'S PILOTS ARE HANDICAPPED	10
PROPOSED SOLUTION	11
SPECIFICATIONS	12
TECHNICAL DISCUSSION	14
I. CCD IMAGE SENSOR	15
Functional Description	16
Image-sensing	18
Image area gate and serial register gate .	20
II. CCD STEERING LOGIC TIMING.....	22
Circuit Design	24
Software Flow And System Sequencing	32
III. CCD STEERING LOGIC DRIVE	43
Diode Clamp Circuit	44
Charge Voltage Control	46
IV. CCD THRESHOLD PROCESSOR	52
CCD Output Signal Discussion	52
Method of Signal Processing	53

TABLE OF CONTENTS (Continued)

	<u>PAGE</u>
V. POWER CONVERTER ANALYSIS	56
+5 VDC Voltage Converter	56
+5 VDC Converter Calculations	58
-5 VDC Voltage Converter	63
+12 VDC Power Converter	66
METHOD OF TESTING	69
Procedure	70
Data Sheet	73
Test Conclusion	75
COST DATA	81
SUMMARY	82
REFERENCES	84
APPENDIX A	85
APPENDIX B	90
APPENDIX C	99
APPENDIX D	107

LIST OF ILLUSTRATIONS

<u>FIGURE</u>		<u>PAGE</u>
1	CCD CONTROL AND DATA PROCESSING	14
2	TC211 PACKAGE CONFIGURATION	16
3	FUNCTIONAL BLOCK DIAGRAM OF THE TC211	17
4	CHARGE ACCUMULATION AND TRANSFER PROCESS	19
5	TC211 TIMING DIAGRAM	21
6	CCD STEERING LOGIC TIMING DIAGRAM	23
7	87C51 OSCILLATOR CIRCUIT	25
8	FREQUENCY DIVIDING CIRCUIT	26
9	ADDRESS DECODER	28
10	POWER ON RESET CIRCUIT	30
11	MAIN PROGRAM FLOWCHART	32
12	INITIALIZATION OF SYSTEM FLOWCHART	33
13	CLEAR IMAGE AREA	36
14	INTEGRATION FLOWCHART	37
15	TRANSFER ROW TO SERIAL REGISTER	39
16	READ SERIAL REGISTER	41
17	RECOMMENDED OPERATION CONDITIONS OF CCD SENSOR	43
18	DIODE CLAMP CIRCUIT	44
19	IMAGE AREA GATE CLOCK LEVEL CONVERTER	47
20	LEVEL-SHIFT AND BLACK-LEVEL CLAMP	54
21	+5 VDC REGULATOR SECTION	59
22	BLOCK DIAGRAM OF -5 VDC CONVERTER	64

LIST OF ILLUSTRATIONS (Continued)

<u>FIGURE</u>		<u>PAGE</u>
23	-5 VDC CONVERTER CONNECTIONS	64
24	+12 VDC POWER CONVERTER	66
25	ACTUAL IAG CLOCK PULSE	76
26	ACTUAL SRG CLOCK PULSE	77
27	ACTUAL ABG CLOCK PULSE, HIGH AND LOW LEVELS ...	78
28	ACTUAL ABG CLOCK PULSE, INTERMEDIATE LEVELS ...	79
29	ACTUAL IAG AND SRG CLOCK PULSES RELATIONSHIP ..	80

ABSTRACT

Worden, Douglas Alan, Indiana University - Purdue University, Fort Wayne, Indiana, April 1989. Advanced Solid-State Optical Imaging System. Major Professor: R. D. Hack.

Today's aircraft pilots are faced with a severe handicap. With increasing aircraft air speed, technology must provide the pilot with the capability of long range vision.

To solve this problem, I will develop an Advanced Solid-State Optical Imaging System. The development has been separated into two phases. This paper will deal with the Phase I development of the system.

I have completed the Phase I development of this project. A prototype consisting of the electronics required to scan and read an Image Sensor, and convert the data levels to digital information was developed. The Image Sensor chosen is a full-frame charge-coupled sensor, that was designed specifically for applications where ruggedness and small size are required.

The system will have an operating temperature range of 0 to +50 degrees C, and a storage temperature range of -20 to +60 degrees C. It will operate from a single external supplied voltage of +15 VDC and require a maximum of 30 watts.