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# PCVISION*plus*®

# Hardware Reference Manual

47-H00010-04

iMAGING Technology

PCVISION*plus*® Hardware Reference Manual

Document Number 47–H00010–04

Revised March 1991

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# PREFACE

The PCVISION*plus*® Frame Grabber from Imaging Technology Incorporated is a single-board, real-time frame grabber. This manual describes the PCVISION*plus*, its operation, and programming.

- Chapter 1, "Introduction" describes some basic image processing principles, and gives the operational specifications of the PCVISION*plus*.
- Chapter 2, "Configuration" describes the factory default configuration, and all configurable hardware options of the PCVISION*plus*.
- Chapter 3, "Installation" gives specific instructions for installing the PCVISION*plus* in a personal computer.
- Chapter 4, "Theory of Operation" describes the PCVISION*plus* operation.
- Chapter 5, "Registers" describes the function of each register and bit.
- Appendix A, "Comparison of PCVISION® and PCVISION*plus*®" details the compatibility between these two models.
- Appendix B, "Glossary" defines some common terms used in image processing.
- Appendix C, "Customer Response Form" describes the return procedure and provides a questionaire.

## DOCUMENTATION CONVENTIONS

The following conventions are used throughout this manual:

| Example | Description |
|---|---|
| WARNING | A warning calls attention to a condition, practice, or procedure that must be observed to avoid personal injury, loss of life, or long-term health hazard. |
| CAUTION | A caution calls attention to a hazard to the equipment or software; a condition, practice, or procedure that must be observed to avoid damage to or destruction of equipment. |
| NOTE | A note calls attention to essential information of special importance, interest, or assistance in operation. |
| X | When used within a table, this notation indicates an irrelevant bit value, also called a "don't care". |
| R/W | The bit or register supports both read and write access. |
| R-O | The bit or register supports read access only. |
| W-O | The bit or register supports write access only. |
| 0x3F0, 03F0H | Hexadecimal numbers are preceded by 0x or followed with an H. |
| 0110B | Binary numbers are followed by a B. |
| PC AT | The IBM Personal Computer AT® and all 100 % compatibles. |

The Return key, which represents a carriage return in this manual, might actually appear as Enter or ↵ on the keyboard. Do not confuse Enter on the keyboard with Enter on the numeric keypad.

This manual documents registers using the same convention as the Intel™ 80286. Intel addresses words at even addresses (for example, 2H). The even byte (address 2H), called the low-byte, is read before the odd byte (address 3H) called the high-byte. The Motorola 68000 uses the opposite convention. The odd byte (address 3H) is read first and called the low-byte, and the even byte (address 2H) is read second and called the high-byte.

## BIBLIOGRAPHY OF RELATED PUBLICATIONS

This manual assumes a rudimentary knowledge of raster graphics concepts, video signal standards, and image processing techniques. A list of information sources is provided for additional reading. These publications might help increase understanding of certain principles of digital image processing.

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# Table of Contents

## Chapter 1. Introduction

1.1 How Digital Image Processing Works ..... 1–1
1.1.1 RS–170/330 Signal ..... 1–2
1.1.2 Resolution ..... 1–4
1.2 Overview of the PCVISION*plus* Frame Grabber ..... 1–4
1.3 Specifications ..... 1–5
1.3.1 Video Input ..... 1–6
1.3.2 Frame Memory ..... 1–6
1.3.3 Video Output ..... 1–7
1.3.4 Timing and Synchronization ..... 1–7
1.3.5 Host Computer Interface ..... 1–8
1.3.6 Physical/Environmental ..... 1–8
1.3.7 Power Requirements ..... 1–8
1.3.8 European Operation ..... 1–8

## Chapter 2. Configuration

2.1 Using the Factory Configuration ..... 2–1
2.2 Compatibility Considerations ..... 2–6
2.3 Memory Base Address ..... 2–7
2.4 Register Base Address ..... 2–8
2.5 Video Source Synchronization ..... 2–9
2.5.1 Accepting Synchronization from the Video Source ... 2–10
2.5.1.1 Stripping Synchronization from Composite Video ..... 2–10
2.5.1.2 Separate Video and Composite Synchronization (non–TTL) ... 2–11
2.5.1.3 Separate Video and Composite Synchronization (TTL) ..... 2–12
2.5.1.4 Separate Video, and Horizontal and Vertical Syncs (TTL) ..... 2–12
2.5.2 Driving the Video Source (TTL) ..... 2–13
2.5.2.1 Driving the Video Source with Composite Synchronization ..... 2–13
2.5.2.2 Driving the Video Source with Horizontal and Vertical Syncs (TTL) ..... 2–14

2.6 Video Output Connections ..... 2-15
2.7 Synchronizing the Display Monitor ..... 2-15
2.7.1 Composite Video ..... 2-15
2.7.2 Separate Composite Synchronization ..... 2-15
2.7.3 Separate Vertical and Horizontal Synchronization ... 2-16
2.8 Master/Slave Operation ..... 2-16
2.9 Factory Configuration for True Color Systems ..... 2-17
2.10 Memory Map Configuration ..... 2-17

## Chapter 3. Installation

3.1 Power Requirements ..... 3-1
3.2 Determining Available Power ..... 3-2
3.3 Installation Procedures ..... 3-3
3.4 How to Connect the Cables ..... 3-4
3.5 Installing a True Color System ..... 3-5
3.5.1 Installing the Ribbon Cable ..... 3-6
3.5.2 Camera and Monitor Cables for a True Color System ..... 3-6
3.6 Initial Checkout Procedure ..... 3-7
3.6.1 Installing the Diagnostic Software ..... 3-7
3.6.2 Running the Diagnostic Software ..... 3-8
3.6.3 Functions of pcplusscd ..... 3-8
3.6.4 How to Stop PCPLUSCD ..... 3-10
3.6.5 Failures ..... 3-10
3.8 The Diagnostic LEDs ..... 3-10

## Chapter 4. Theory Of Operation

4.1 Video Input Interface ..... 4-3
4.1.1 System Timing ..... 4-3
4.1.2 Signal Conditioning ..... 4-3
4.1.3 Programmable Offset and Gain ..... 4-4
4.1.4 Digitization ..... 4-5
4.1.5 Input Look-Up Tables ..... 4-6
4.2 Frame Memory ..... 4-6
4.2.1 Simultaneous Acquire and Display ..... 4-6
4.2.2 Frame Memory Write-Protection ..... 4-6
4.2.3 Pan and Scroll ..... 4-7
4.2.4 Zoom ..... 4-7
4.3 Display Interface ..... 4-8
4.3.1 Output Look-Up Tables ..... 4-8

4.3.2 Digital–to–Analog Conversion ..... 4–10
4.4 Host Interface ..... 4–10
4.4.1 Programming the Look–Up Tables ..... 4–11
4.4.2 LUT Programming Example ..... 4–11
4.4.3 Frame Memory Interface ..... 4–13
4.4.4 The Pixel Buffer ..... 4–15
4.4.5 Emptying the Pixel Buffer ..... 4–15
4.4.6 Frame Memory Access Modes ..... 4–16
4.4.6.1 Z–Mode Memory Access ..... 4–18
4.4.6.2 X–Mode Memory Access ..... 4–18
4.4.7 Memory Read Cycles ..... 4–18
4.4.8 Reading the Pixel Buffer ..... 4–18
4.4.8.1 Reading the Pixel Buffer in Z–Mode ..... 4–19
4.4.8.2 Reading the Pixel Buffer in X–Mode ..... 4–20
4.4.9 Loading the Pixel Buffer ..... 4–21
4.4.9.1 Loading the Pixel Buffer in Z–Mode ..... 4–21
4.4.9.2 Loading the Pixel Buffer in X–Mode ..... 4–21
4.4.10 Memory Write Cycles ..... 4–23
4.4.10.1 Memory Write Cycles in Z–Mode Pixel Buffer Enabled (PBEN=1) ..... 4–24
4.4.10.2 Memory Write Cycles in Z–Mode Pixel Buffer Protected (PBEN=0) ..... 4–24
4.4.10.3 Memory Write Cycles in X–Mode ..... 4–25
4.4.11 Block Moves ..... 4–25
4.4.12 How to Clear Memory ..... 4–26
4.5 True Color Image Processing ..... 4–27

## Chapter 5. Registers

5.1 Control Register ..... 5–3
5.1.1 Zoom Enable (ZOOM) ..... 5–3
5.1.2 Gain Adjust Enable (GAINEN) ..... 5–4
5.1.3 Offset Adjust Enable (OFFEN) ..... 5–4
5.1.4 Adjust Direction Control (DIR) ..... 5–4
5.1.5 Board Select (BDSEL) ..... 5–5
5.1.6 Memory Block Select (BLOCK) ..... 5–5
5.2 LUT Control Register ..... 5–7
5.2.1 Look–Up Table Mode (LUTMOD) ..... 5–7
5.2.2 Input LUT Select (ILUT) ..... 5–8
5.2.3 Output LUT Select (OLUT) ..... 5–8
5.3 LUT Address Register ..... 5–9

5.4 LUT Data Port ..... 5-9
5.5 Gain and Offset Counter ..... 5-10
5.6 Acquire and Status Register ..... 5-12
5.6.1 Video Input Select (VIDSEL) ..... 5-12
5.6.2 Clock Source Select (CLOCK) ..... 5-13
5.6.3 Odd/Even Field Status (OES) ..... 5-13
5.6.4 Last Field Status (LFS) ..... 5-13
5.6.5 Vertical Blank Status (VBS) ..... 5-13
5.6.6 Horizontal Blank Status (HBS) ..... 5-13
5.6.7 Acquire Mode (ACQMD) ..... 5-14
5.7 Pan Register ..... 5-15
5.8 Scroll Register ..... 5-15
5.9 Memory Access Control Register ..... 5-16
5.9.1 Plane Select (PS) ..... 5-16
5.9.2 Transfer Mode (TMODE) ..... 5-17
5.9.3 Pixel Buffer Enable (PBEN) ..... 5-17
5.10 Host Mask Register ..... 5-18
5.11 Video Mask Register ..... 5-18
5.12 Pixel Buffer Register ..... 5-19

**Appendix A. Comparison of PCVISION® and PCVISION*plus*®**

**Appendix B. Glossary**

**Appendix C. Customer Response Form**

**Index**

## List of Tables


| Number | Title | Page |
|---|---|---|
| 1–1. | PCVISION*plus* Frame Grabber Models | 1–5 |
| 2–1. | Factory Default, PFGPLUS–512–3–60/50–AT | 2–2 |
| 2–2. | Factory Default, PFGPLUS–640–3–60–AT | 2–4 |
| 2–3. | Memory Base Address | 2–7 |
| 2–4. | Register Base Address (Factory Configuration) | 2–8 |
| 2–5. | Factory Color System | 2–17 |
| 3–1. | Power Requirements | 3–2 |
| 3–2. | DESKPRO™ 386/16 Power Availability | 3–2 |
| B–1. | Control/Status Low Register | B–3 |
| B–2. | Control/Status High register | B–3 |
| B–3. | Frame Memory Block Select Register | B–4 |
| B–4. | PCVISION*plus* Unique Bit Functions | B–5 |


## List of Figures


| Number | Title | Page |
|---|---|---|
| 1–1. | Components of a Digital Image Processor | 1–2 |
| 1–2. | Video Signal | 1–2 |
| 1–3. | An Interlaced Display | 1–3 |
| 1–4. | Zoom Factor of Two | 1–4 |
| 2–1. | Jumper Positions | 2–2 |
| 2–2. | Jumper Locations, PFGPLUS–512–3–60/50–AT | 2–3 |
| 2–3. | Jumper Locations, PFGPLUS–640–3–60–AT | 2–5 |
| 2–4. | Synchronization Jumpers | 2–9 |
| 2–5. | Dual–Store Memory Configuration | 2–18 |
| 2–6. | Single–Store Memory Configuration | 2–18 |
| 3–1. | Ribbon Cable Installation for True Color Systems | 3–6 |
| 3–2. | Cabling for a True Color System | 3–6 |

4-1. PCVISION*plus* Block Diagram ..... 4-2
4-2. Locking to an External Video Source ..... 4-3
4-3. Video Signal ..... 4-4
4-4. Signal Conditioning ..... 4-5
4-5. Display Interface ..... 4-8
4-6. LUT Programmed for a Ramp ..... 4-9
4-7. LUT Programmed for a Threshold ..... 4-10
4-8. Initializing a Blue LUT to a Ramp ..... 4-12
4-9. Dual-Store Memory Configuration ..... 4-14
4-10. Single-Store Memory Configuration ..... 4-14
4-11. Frame Memory Access Modes ..... 4-17
4-12. Reading the Pixel Buffer in Z-Mode ..... 4-19
4-13. Reading the Pixel Buffer in X-Mode ..... 4-20
4-14. Loading the Pixel Buffer in Z-Mode ..... 4-22
4-15. Loading the Pixel Buffer in X-Mode ..... 4-23

5-1. PCVISION*plus* Control Registers ..... 5-2
5-2. Dual-Store Memory Configuration ..... 5-6
5-3. Single-Store Memory Configuration ..... 5-6
5-4. Signal Conditioning ..... 5-11

B-1. PCVISION® Register Map ..... B-2
B-2. PCVISION*plus* Register Map ..... B-2

# CHAPTER 1
# INTRODUCTION

Imaging Technology's PCVISION*plus* Frame Grabber brings the power of digital image processing to the IBM Personal Computer. The PCVISION*plus* Frame Grabber is a video digitizer and frame memory capable of digitizing standard RS–170/330 (or CCIR) video input and storing the digitized image in a special on–board frame memory. The image can be simultaneously displayed on a video monitor.

Imaging Technology manufactures the PCVISION*plus* for use in the IBM PC XT, AT, and 100% compatibles. The PCVISION*plus* Frame Grabber performs complex digital image processing functions, such as: image averaging; image subtraction; convolutions; and edge–enhancing algorithms.

## 1.1 HOW DIGITAL IMAGE PROCESSING WORKS

A video source, such as a camera or video cassette recorder (VCR), produces an analog video signal containing image data. The image processor converts the analog signal to a digital signal containing the image data in the form of digital "picture elements," or "pixels." The frame memory stores the digital pixel data with each pixel occupying one frame memory location.

The image stored in frame memory is accessed for display, feedback processing, or additional computer processing. (The PCVISION*plus* frame memory is accessible from the host computer). Display circuitry transforms the pixels stored in frame memory back into an analog signal for display on a video monitor. Figure 1–1 illustrates the primary components of an image processor.

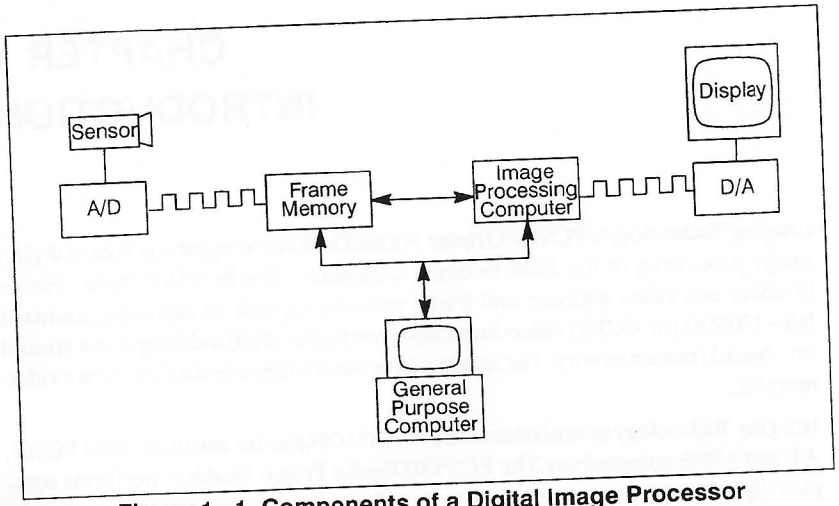



**Figure 1-1. Components of a Digital Image Processor**

## 1.1.1 RS-170/330 Signal

The video most common source for the PCVISION*plus* Frame Grabber is any device that produces an EIA-standard RS-170/330 or CCIR signal, including video cassette recorders. The analog signal, illustrated in Figure 1-2 contains both video and timing information. The timing information is transmitted between each horizontal scan line. The RS-330 and CCIR produce video and timing information similar to Figure 1-2.

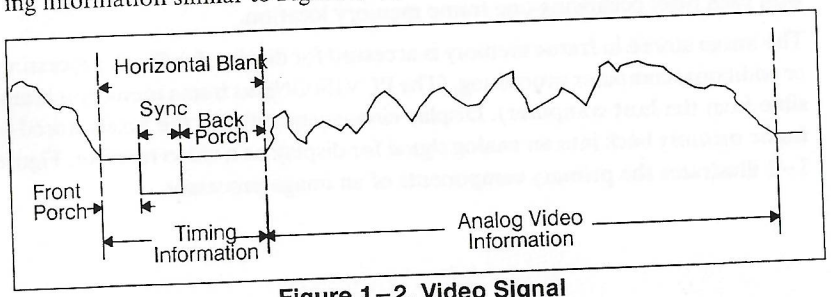



**Figure 1-2. Video Signal**

The RS-170 standard defines an interlaced raster scanning technique that eliminates flicker when the raster image is displayed. The horizontal scan lines that

make up a frame are divided into two fields. The even field consists of all of the even–numbered scan lines in the frame, beginning with line zero (the topmost line). The odd field contains all of the odd–numbered scan lines in a frame, beginning with line one.

Interlaced raster scanning results in the display of one field at a time. First, all the lines of the even field are displayed in succession, followed by all the lines of the odd field. Interlacing takes advantage of the human eye's characteristic of persistence of vision to eliminate flicker. Interlacing the odd and even fields goes unnoticed because the fields appear on the screen at a rate that exceeds the rate the average human eye perceives the flicker. Figure 1–3 illustrates this technique. This sequence repeats continuously producing the raster image.

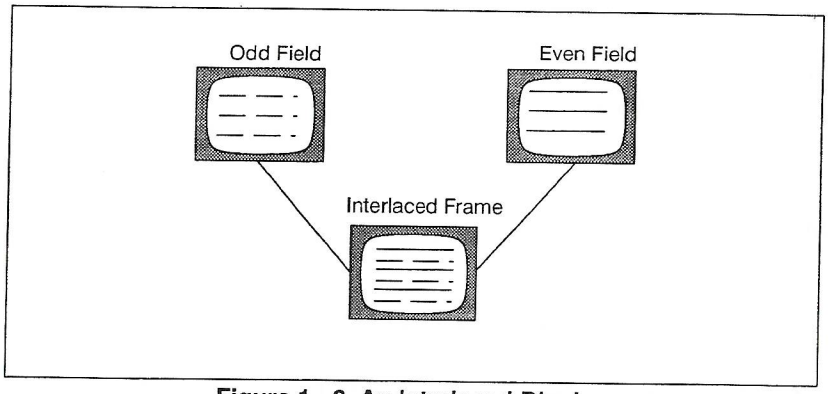



**Figure 1–3. An Interlaced Display**

In interlaced mode and at full–resolution, the Series 100 Image Processor acquires and stores an image with the lines from a pair of successive odd and even fields merged in frame memory. The frame memory stores even field lines (0, 2, 4, ...) at even row (Y) locations and odd field lines (1, 3, 5, ...) at odd Y locations.

## 1.1.2 Resolution

The useful resolution of an image processing system is defined by several factors and controlled by the components that make up the system. The number of pixels displayed on a video monitor defines the display resolution. The number of pixels

transferred to or from frame memory in one frame time defines the display resolution. The size of the frame memory determines the number of pixels stored.

The resolution, or number of pixels displayed by the PCVISION*plus* can be altered through a process called pixel replication, used to create the zoom factor. To expand a 256 x 256 pixel window for a 512 x 512 pixel display, each pixel is repeated (replicated) twice for two lines of display to produce a zoom factor of two, as illustrated in Figure 1-4.

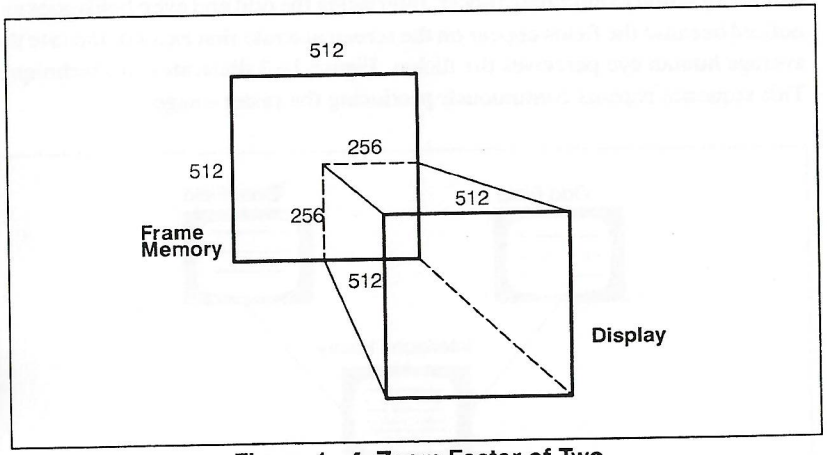



**Figure 1-4. Zoom Factor of Two**

## 1.2 OVERVIEW OF THE PCVISION*plus* FRAME GRABBER

The PCVISION*plus* Frame Grabber is a single board that plugs directly into an expansion slot in the IBM Personal Computer. The PCVISION*plus* digitizes the incoming video signal to eight bits of accuracy at a rate of 30 frames (60 fields, 30 odd and 30 even) per second, and stores the resulting pixels in frame memory. Each pixel in the frame memory is one of 256 possible intensities or gray levels. Two 512 by 512 images or one 640 by 512 image can be stored. Display logic on the PCVISION*plus* Frame Grabber converts the pixels in the frame memory back to an analog RS-170 format for display on a video monitor. Three output channels are provided for pseudocolor display. The input digitization path and each out-

put channel contains eight Look–Up Tables (LUTs). These 32 tables each contain 256 entries. They are provided for performing transformation of the 256 intensity levels. Simple point transformations can be performed without any calculation or processing delay. This is referred to as real–time processing.

## 1.3 SPECIFICATIONS

The Table 1–1 shows the available models of the PCVISION*plus* Frame Grabber, the display resolution, and memory pages.

**Table 1–1. PCVISION*plus* Frame Grabber Models**

| Model | Display | Image Pages |
|---|---|---|
| PFGPLUS-512-3-60 | 512 by 480 | 2 |
| PFGPLUS-512-3-50 | 512 by 512 | 2 |
| PFGPLUS-640-3-60 | 640 by 480 | 1 |

### 1.3.1 Video Input

- RS–170/330 or 50Hz CCIR (European), NTSC luminance only
- Two software–selectable video inputs
- DC restoration corrects input signal drift
- Eight 256 by 8–bit Input Look–Up Tables allow pre–processing
- Monotonic flash A/D Converter digitizes video at 10 MHz for 512 by 480 (512 by 512) image, or 12.5 MHz for 640 by 480 image (square pixels)
- Anti–aliasing filter provides –3dB attenuation at 4.2 MHz and –12dB attenuation at 8 MHz
- Signal–to–noise ratio greater than 40 dB
- Programmable gain .67 to 1.33 in 100 steps (equivalent full-scale voltage range 0.476 to 0.952 Volts). **Allow 10 usec between writes to gain or offset. Refer to Chapter 5.**
- Programmable offset voltage –0.854 to +0.266 Volts in 100 steps. **Allow 10 usec between writes to gain or offset. Refer to Chapter 5.**
- Programmed gain and offset voltage values are stored in a nonvolatile memory

### 1.3.2 Frame Memory

- Frame memory size – 1024 by 512 pixels with 8 bits per pixel allows storage of two 512 by 512 images or one 640 by 480 image
- Memory-mapped access in 64K blocks
- Simultaneous access of up to eight pixels
- Transparent computer access to frame memory – does not disturb display
- Hardware zoom of 2:1
- Hardware pan on eight pixel boundaries
- Hardware scroll on two line boundaries
- Bit-planes protected independently from CPU access and video acquisition

### 1.3.3 Video Output

- RS-170 or CCIR RGB video outputs with sync available on green channel
- Output bandwidth: 10 MHz, minimum
- Output voltage: 1Volt peak-to-peak into 75 ohm load
- Eight 256 x 8-bit Look-Up Tables per output channel
- Three 8-bit Video Frequency Digital-to-Analog Converters

### 1.3.4 Timing and Synchronization

- Software-selectable system clock source: crystal or Phase-Locked Loop (PLL)
- Two stage PLL provides stable horizontal lock to noisy sources, such as VCRs
- Automatically switches to crystal-generated timing if external synchronization is lost
- Composite sync or separate horizontal and vertical sync outputs (TTL) to drive display and inputs
- Pixel jitter typically less than 20 ns
- Special synchronization bus for synchronizing multiple PCVISION*plus* modules for multiple-board configurations
- Host access time: register access inserts no wait states, memory access inserts 0

to 120 ns of wait states for 512 pixel per line image and 0 to 500 ns for 640 pixel per line image

### 1.3.5 Host Computer Interface

- IBM Personal Computer AT, XT, and PC, and all 100% compatibles, Zenith, and COMPAQ
- 8–bit data bus, 24–bit address bus allows mapping into extended address space
- 16 I/O mapped control registers mappable to any 16–byte boundary

### 1.3.6 Physical/Environmental

- Temperature – 10–40 degrees Celsius
- Humidity – 10–90% non–condensing
- Board Size – width 13.3 inches (337.5 mm) height 4.8 inches (120 mm)

### 1.3.7 Power Requirements

- 13 watts nominal

  +5V @ 2.20A

  +12V @ 0.140A

  –12V @ 0.030A

  The combination of the PCVISION*plus* Frame Grabber with other plug–in boards that consume significant power can strain the power supply within personal computers. Be sure to consult the specifications for your personal computer and the boards you are using to determine whether sufficient power and cooling is available. Chapter 3 of this manual discusses power requirements for PCVISION*plus* Frame Grabber configurations.

### 1.3.8 European Operation

The PCVISION*plus* Frame Grabber can be ordered from the factory to operate at the CCIR 50 Hz standard found in most of Europe. In this configuration, 512 lines of video information are digitized and displayed.

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