SPACEBORNE VIDEO INTERFACE MODULE (VIM)

Mark Eason
MSTI Electronics Engineer
Wyle Laboratories, Edwards AFB, CA. 93524

KEY WORDS

Video Telemetry, Video Instrumentation, VME

ABSTRACT

The use of video imaging in VME based data acquisitions systems is increasing. Some systems require the video data to be telemetered. In telemetry systems that require video data to be sent, a dedicated video data channel is common. It is the purpose of this paper to present the combination of a video interface and a video PCM channel into one module. The name of this project is "Video Interface Module" (VIM).

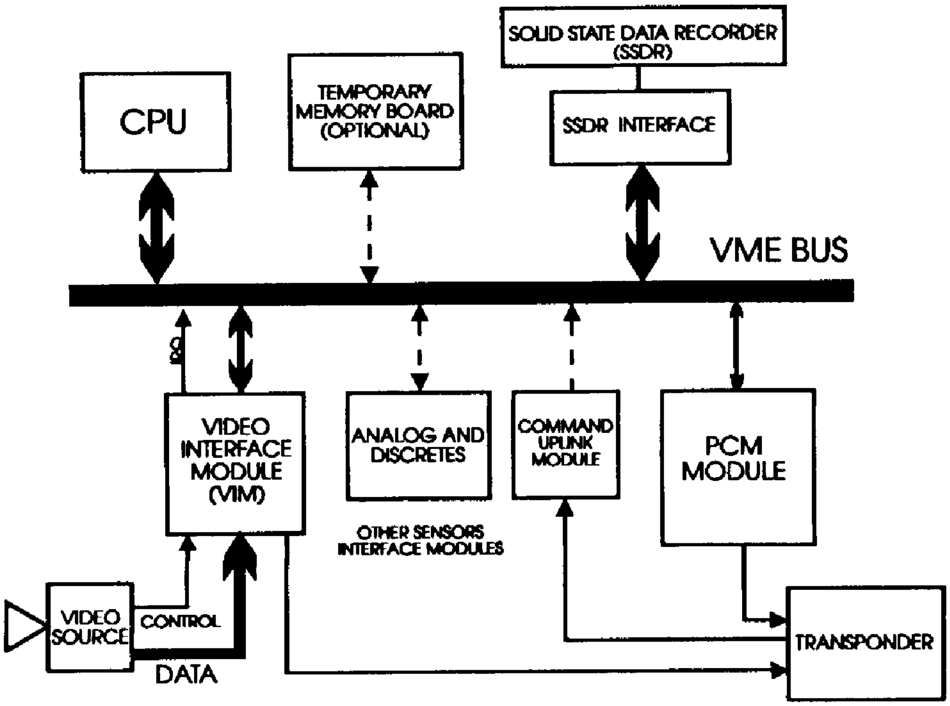
INTRODUCTION

The Video Interface Module was designed for the MSTI satellite program. The series of MSTI satellites are designed to test different video sensors. The spacecraft's Flight Control Computer (FCC) is based on the VME bus. Figure 1 shows the block diagram of a typical VME acquisition system. In order to make a versatile test platform, a flexible video interface board was conceived. To save power, weight, and board space the PCM channel was added to the video interface module. The VIM has a variety of user configurable parameters making it useful for accepting different video camera formats and different transponder requirements.

VIDEO INTERFACE MODULE

This design is a versatile video data instrumentations interface for VME based systems. The design includes 1) video data gathering, 2) realtime video PCM, 3) temporary storage and 4) a path for playback (data retrieval). This video module is the front end of the instrumentation unit. it directly connects to the video source.

FIGURE 1. VME Aquisition System



SENSOR INTERFACE

One of the operational requirements is to receive high speed video data with different data formats. This presents two problems to solve; 1) different pixel sizes (word size) and 2) different frame sizes i.e. 256 x 256 pixels, 512 x 512 pixels, plus a host of other formats.

The design solution to the pixel size problem is to use a software setable control circuit for incoming video data word size. The software sets up the pixel size format during power up. This board accepts up to 16 bits of pixel video data. The video data formatter will receive the data (in the specified format) and convert it onto a width of 32 bits. It then stores it in a video memory buffer (refer to figure 2 for the block diagram). When a complete video frame of data has arrived, the circuit switches the incoming data to a second video memory buffer and signals the CPU to read (move to storage) the full frame of data. This technique is known as a "double buffering scheme". The conversion to a data width of 32 bits is for efficient transfers on the VME bus, resulting in high speed.

The signals from the video source include "pixel clock", "vertical sync", and parallel pixel "data bits". To accommodate a variety of video frame sizes, the vertical sync is used to signal "end of frame". Thus, the end of frame signal provides an automatic frame sizing. The maximum size of a video frame is 512k bytes.

For data acquisition systems that don't require all available video data a "frame selection" parameter is provided. This feature also is good for a system that can't store all data. The "frame selection" discards frames as specified by software, i.e. discard 2 of 3 frames, discard 3 of 4, or 255 of 256, etc.

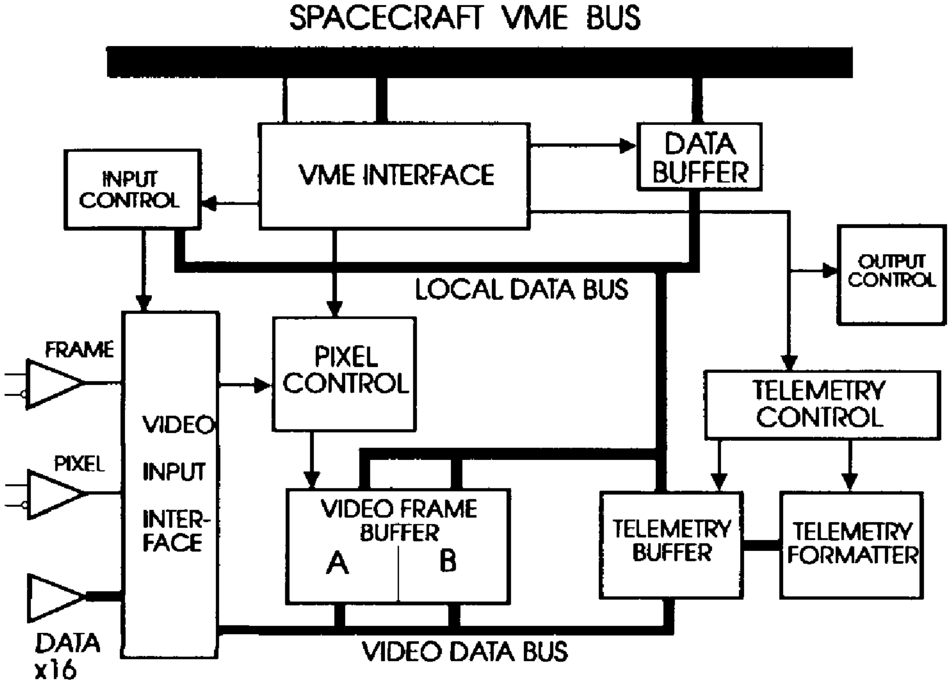


FIGURE 2. Video Interface Board.

REALTIME VIDEO PCM

This feature provides the realtime "quick look" of video data. The PCM output may have a different frame size and bit rate than the video input. The PCM frame sync, bit rate, word size, and frame size are set by software. The output of PCM is user selectable for one of the following; NRZ, NRZI, NRZL, and BIPHASE formats. The PCM encoder detects the VIDEO end of frame signal and fills a PCM buffer with one (1) full video frame of data. It then converts the data into a serial format. At the appropriate times (PCM minor frame) the circuit adds a PCM frame sync to the serial stream. When half of the video data has been sent, a second PCM buffer is filled with the next video data frame. The incoming data is switched (ping ponged) to the second PCM buffer when the last word of the previous buffer is shifted to the serial stream.

The video "quick look" rate is dependant on the telemetry rate. This results in some latency in the data. However, it still provides a uniform video rate to the downlink. The Video Interface Module supports PCM bit rate up to 4 megabits per second.

PLAYBACK MODE

The playback function provides for the video data from VME bus to the telemetry stream. The design incorporates two provisions for this function; interrupt driven, or VME bus master. The interrupt approach is to flag the CPU to full a telemetry buffer. The bus master approach is to request for mastership of the VME bus. Once given mastership, the VIM will perform a memory block transfer to move the stored data to the PCM buffer. Note: during the playback mode the video input is shut off.

This board can be used as a backup PCM encoder board but the software is required to set up the data in the proper order. This method is not recommended due to the overhead needed by the CPU.

CONCLUSION

This design fills the need for any VME data acquisition system that includes a video data source. The incorporation of a PCM channel provides for realtime "quick look" video data. Consideration for future and existing ground systems was accomplished by configurable PCM configurations.

The versatility of this module makes it useable for existing and future camera applications. As this is designed for space applications (MSTI satellites) it can be used for any environment that uses a VME bus.