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VSI Interfaces for Legacy Systems

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Abstract

The upgrade of a Mark 5A Data Transport System (DTS) to Mark 5B requires more than simply upgrading the Mark 5A system to Mark 5B. Since the Mark 5A system was designed as a plug-in replacement for a Mark IV or VLBA tape recorder, the station or correlator interfaces to the tape recorder DTS must be converted to the VSI, the VLBI Standard Interface. To that end, a set of interface boards has been designed to interface Mark IV or VLBA samplers to the VSI input of a Mark 5B Data Input Module, and to interface the Mark 5B Data Output Module to to a Mark IV correlator. This paper describes the details of these interface devices.

1. Introduction

Recent legacy VLBI recording and playback systems are based on modified versions of the Honeywell Model 96 Tape Drive. These legacy systems, and the new modules that will replace them include

- VLBA Data Acquisition System:
  - VLBA Formatter replaced with
  - VSIC Universal Converter
- VLBA Correlator:
  - VLBA Station Unit
  - To be determined in the future
- Mark IV Data Acquisition System:
  - Mark IV Formatter replaced with
  - Mark 5B Sampler Module
- Mark IV Correlator:
  - Mark IV Station Unit replaced with
  - Mark 5B Correlator Interface Module

The purpose of all of these interface modules is to convert the ECL input and output levels of the legacy systems to the LVDS levels of the Mark 5B VSI interfaces. Most of the functions of the formatters and station units have been incorporated into the Mark 5B Data Input Module (DIM) and the Data Output Module (DOM). For more information on the Mark 5B DIM and DOM, see The Mark 5B VLBI Data System by Alan Whitney [3].

1.1. VLBA Data Acquisition Systems

For VLBA data acquisition systems, the formatter will be replaced by a VSIC universal converter board described elsewhere [1]. The VSIC board converts the balanced ECL output of the

VLBA sampler modules to VSI for input to the Mark 5B DIM. Since the total output data rate of the two VLBA sampler modules in a VLBA data acquisition rack is 1024 Mb/s, connecting the VLBA samplers to a Mark 5B system doubles the maximum data rate of a VLBA system from 512 Mb/s to 1024 Mb/s.

1.2. VLBA Correlator

For the near future, the VLBA correlator is planning to use Mark 5A+ systems to play back Mark 5 B recordings, as described elsewhere in this volume by A. Whitney [3]. This arrangement requires playback through the VLBA station units, which limits the data rate to 512 Mb/s.

1.3. Mark IV Data Acquisition System

To convert a Mark IV data acquisition system to Mark 5B, the formatter is converted to a Mark 5B sampler module by replacing some of the circuit boards with a new VSI board. For a variety of reasons, the VSIC converter board described above for use with VLBA systems can not be used for this purpose.

1. The outputs of the Mark IV samplers are single-ended.
2. The total power integrators in the Mark IV video converters require a 1 Hz tick from the formatter.
3. An RS232 MAT interface is required to allow Field System control of the recording mode (geodetic, VLBA, or test vector) as described in reference [2]

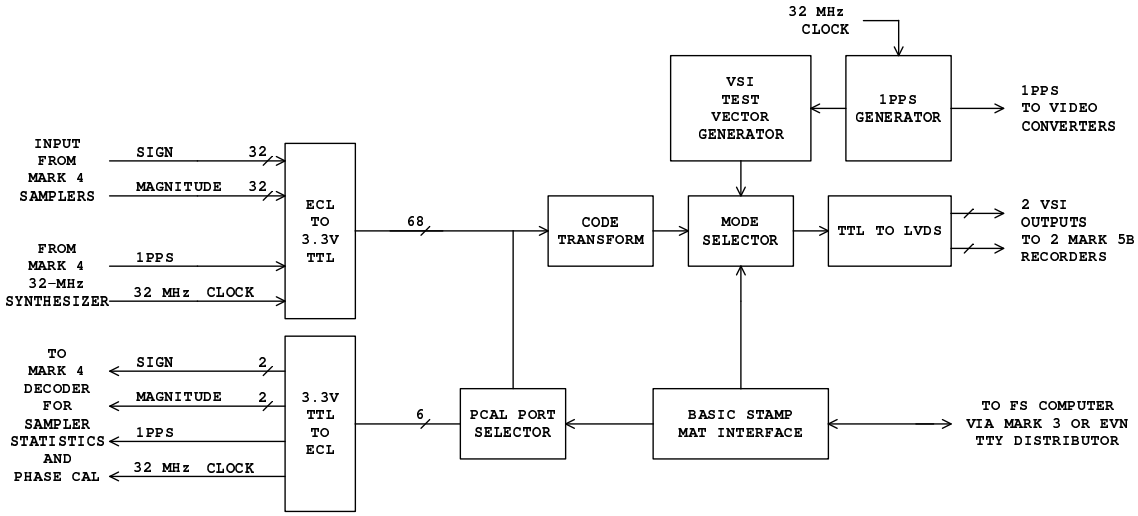

Figure 1. Block Diagram of the VSI Interface Board for the Mark 5B Sampler Module

A block diagram of the VSI interface board is shown in Figure 1. In addition to the three functions listed above, this board also encodes the sign and magnitude bit streams to make them compatible with the bit streams produced by the VLBA samplers. As an extra feature, sign and magnitude bit streams from any two video converters can be directed to the "X" and "Y" inputs

of a Mark IV Decoder to monitor sampler statistics and phase calibration tones. This feature has been used to verify proper operation of the prototype sampler module. Figure 2 is a photograph of the circuit board, and Figure 3 is a photograph of a Mark IV formatter that has been converted to a Mark 5B sampler module.

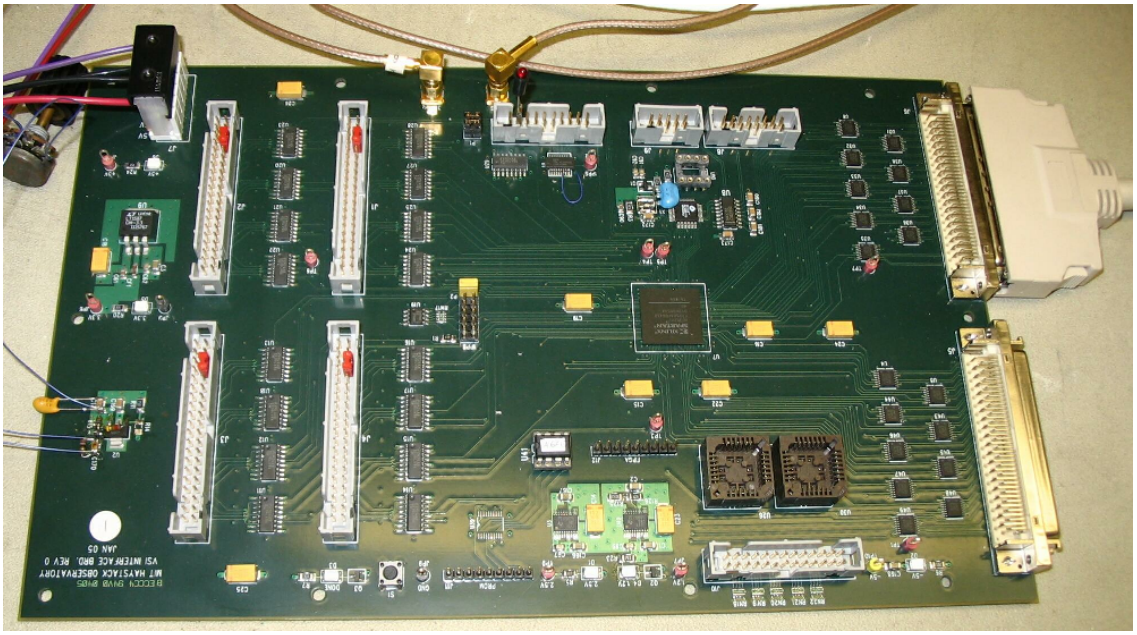

Figure 2. Photograph of the VSI Interface Board for the Mark 5B Sampler Module

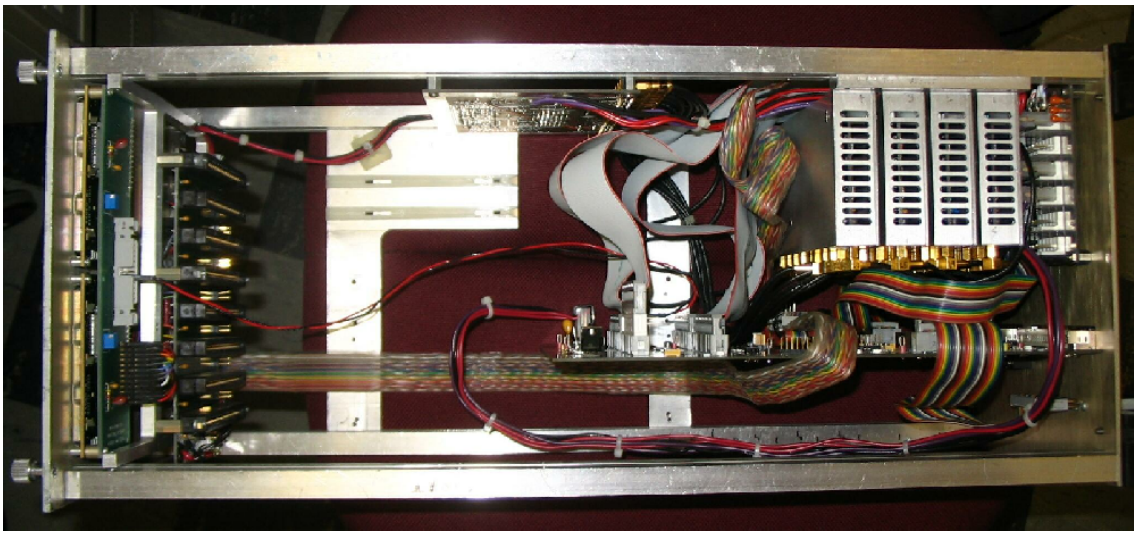

Figure 3. Photograph of a Mark IV Formatter converted to a Mark 5B Sampler Module

1.4. Mark IV Correlator

A block diagram of the correlator interface board (CIB) is shown in Figure 4. It converts the LVDS levels from the VSI output of the Mark 5B DOM to the coaxial serial link outputs required for the input boards on the Mark IV correlator. It also performs some logical functions to convert the 32 sign and magnitude VSI bit streams from the DOM to the 48 encoded sign, encoded magnitude, and validity bits streams required by the Mark IV correlator. The correlator interface board also provides the DOM with the VSI clock and 1 Hz tick from the clock module on the Mark IV correlator (via the "TSPU"). A photograph of the CIB is shown in Figure 5; and a photograph of a correlator interface module, with power supplies and a CIB is shown in Figure 6.

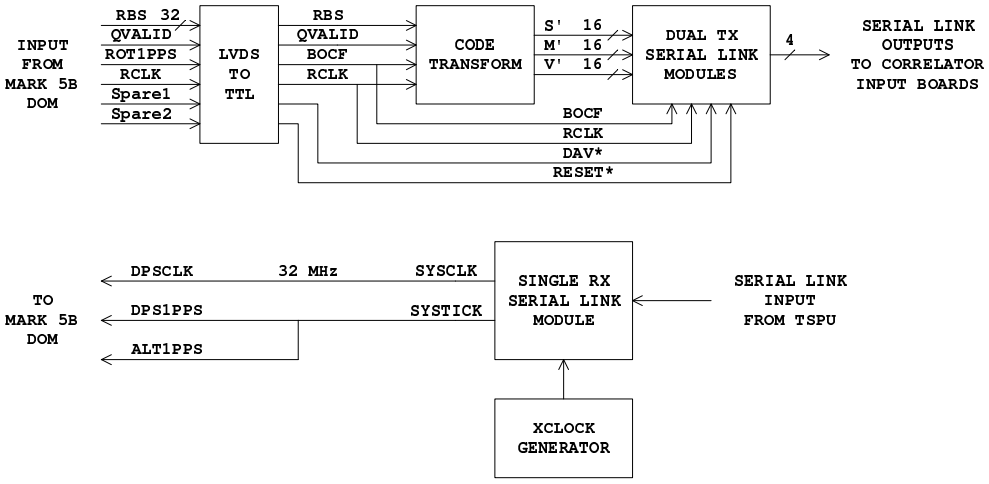

Figure 4. Block Diagram of the Correlator Interface Board

2. Summary

After upgrading to Mark 5B, all tape recorder ECL (RS422) interfaces are replaced with VSI LVDS interfaces. The functionality of the VLBA and Mark IV formatters is included in the Mark 5B DIM, and the functionality of the Mark IV station unit is included in the Mark 5B DOM. The recording data rate is doubled to 1024 Mb/s with VLBA samplers and to 2048 Mb/s with Mark IV samplers. Sixteen Video Converters or Base-band Converters (or a digital back end) and 2 Mark 5B recorders are required to achieve the full 2048 Mb/s data rate.

3. Acknowledgements

This work could not have been done without the help of Pete Bolis, Dave Fields, and Ken Wilson, who skillfully converted my designs into real hardware.

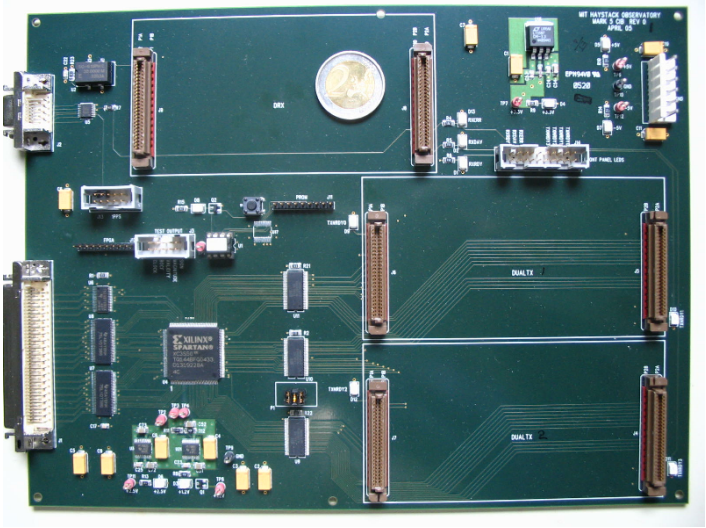

Figure 5. Photograph of a Correlator Interface Board

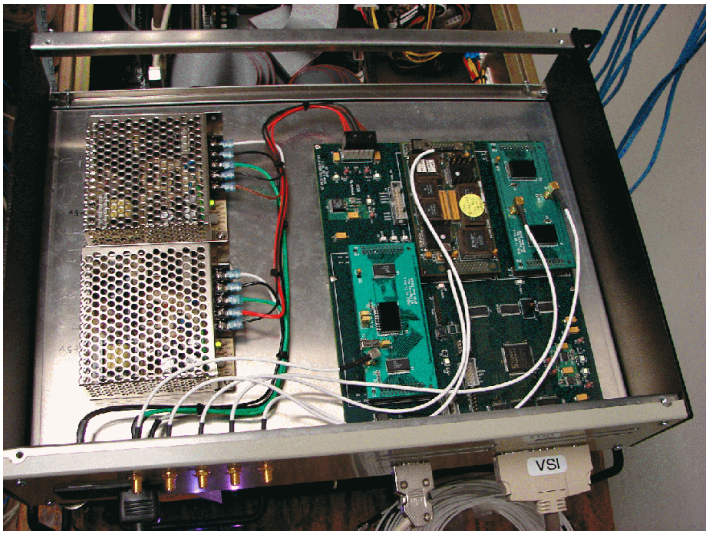

Figure 6. Photograph of a Correlator Interface Module

References

[1] Ritakari, J., A. Mujunen, Gbit/s VLBI and eVLBI with Off-The-Shelf Components, In: IVS 2004 General Meeting Proceedings, NASA/CP–2004-210002, N. R. Vandenberg and K. D. Baver (eds.), 182–185, 2004.

[2] Smythe, D., VSI Interface Board for the Mark IV Formatter, Mark 5 Memo #16, ftp://web.haystack.mit.edu/pub/mark5/016.pdf, 7 January, 2004.

[3] Whitney, A., The Mark 5B VLBI Data System, this volume, 2006.