MPV – Parallel Readout Extension of VME

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We have been developing a data acquisition (DAQ) system at RIBF. The parallel readout VME DAQ system[1)] was successfully operated in 2016. In this system, the data readout of all VME modules were completely parallelized by a mountable controller (MOCO).[2)] The DAQ performance was significantly improved; however, the usability and robustness of the system was rather problematic. To solve these problems, we developed a new MPV system (MOCO with parallelized VME), which is a type of parallel readout extension of the VME. When we set up the MOCO system, several unwanted features were found: 1) MOCO was installed between the VME module and VME backplane; consequently, the VME module protruded from the VME shelf by 7 cm. Some circuit components on the VME module were exposed, which caused a short-circuit. 2) MOCO had USB connectivity. A single PC can handle multiple MOCOs. However, owing to the congestion in the USB, the data transfer speed fatally degrades. To obtain a good performance, same number of PCs and MOCOs should be installed. 3) To synchronize events between MOCOs and other DAQ devices, trigger and busy signals have to be exchanged. For this purpose, four additional pairs of differential cables were connected to the MOCO located inside the VME shelf, which creates a mess of cables.

In this study, we developed circuit boards known as the MPV controller (Fig. 1) and MPV backplane (Fig. 2). All DAQ communications (*e.g.* trigger and data) for MOCO are done through this controller. Avnet PicoZed 7010[3)] (red board in Fig. 1), which contains Xilinx Zynq-7000 All Programmable System-on-Chip, is adopted as the main circuit of the controller. Logic circuits to handle the MOCO are implemented on PicoZed.

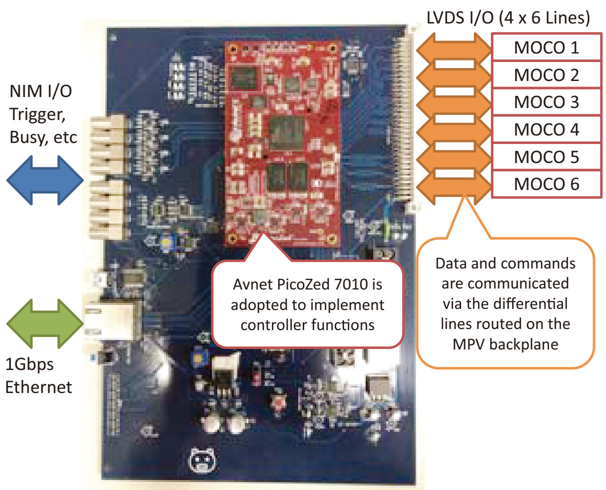

Fig. 1. Image of MPV controller. This controller can simultaneously handle up to 6 modules of MOCO.

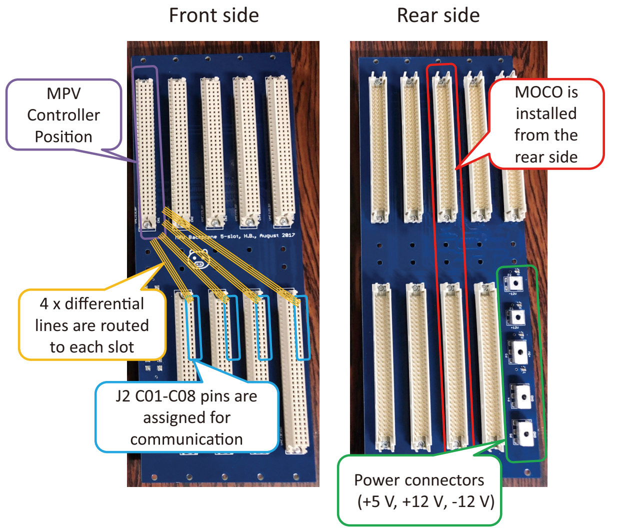

Fig. 2. Image of the MPV backplane (5-slot). 7-slot type is also available. Dimension and mounting holes are compatible with Schroff/NVENT Monolithic Backplane (23001-065 for 5 slot, 23001-067 for 7 slot).

The MPV controller accesses the MOCO through the differential lines on the backplane. Four pairs of differential lines (LVDS) are routed to each slot from the controller position, *i.e.*, there are 24 pairs of differential lines on the MPV backplane. In the previous MOCO-based system, additional cables and PCs were required. However, this MPV system does not require any extra cables and devices. As shown in Fig. 2, the MPV controller is installed at the left-most slot of the backplane. VME modules are installed at the front, similar to the standard VME system. Simultaneously, MOCOs are inserted from the rear side of the backplane. A MOCO can access the VME module through the DIN41612 connectors. In the standard VME backplane, all slots shared the VME bus lines. In contrast, the MPV backplane has an isolated architecture except for power lines. Data are independently acquired by FPGA on the controller, which can be read-out from the 1 Gbps ethernet port. The maximum possible data rate for the six MOCOs is 960 Mbps, which is within the range of theoretical throughput of 1 Gbps ethernet with a jumbo frame. These features enable the complete parallel read-out of the VME-based DAQ system.

In conclusion, the hardware of the MPV has been successfully produced. The firmware for the MPV controller is under development. This system will be ready in 2019.

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References

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3) `http://zedboard.org/product/picozed`