Update of MOCO for the MPV system

H. Baba,*1 T. Ichihara,*1 T. Isobe,*1 T. Ohnishi,*1 K. Yoshida,*1 Y. Watanabe,*1 S. Ota,*2 H. Shimizu,*2 S. Shimoura,*2 S. Takeuchi,*2 D. Nishimura,*3,*2,*1 J. Zenihiro,*4,*1 A. O. Tokiyasu,*5 and R. Yokoyama*6

We have been developing a data acquisition (DAQ) system. VME-bus-based DAQ systems are widely utilized in RIBF. To speed up the VME DAQ system, a mountable controller (MOCO)[1] was developed and introduced in some experiments[2] in 2016. We could achieve very good DAQ performance; at the same time, problems on the usability and robustness were found. To establish a robust and easy-to-use system, we developed a new MOCO with parallelized VME (MPV), which is a type of parallel readout extension of VME.[3] The system architecture is described in Ref. 3). In this contribution, we report the update of MOCO to adopt the MPV system.

The original MOCO and new versions (prototype and production) of MOCO-MPV boards are shown in Fig. 1. In the original MOCO, trigger and data communications are performed using the LVDS I/O and USB interface. On the other hand, these communications between the MPV controller and MOCO-MPV are realized through four differential lines (LVDS I/O) that are patterned on the MOCO-MPV board. These differential lines are assigned as follows: 1) 100-MHz clock, 2) command packet, 3) data packet A, and 4) data packet B. The 100-MHz clock and the command packets are distributed from the controller. All commutations are synchronized with this 100-MHz clock. MOCO-MPV sends 200-Mbps data at maximum by using two data packet lines to the controller. This 200-Mbps data throughput is sufficient because the maximum data rate of a typical 32-bit VME module is 160 Mbps (in experiments at RIBF, this data rate is usually much less than 20 Mbps per VME module). An eight-port debug interface is additionally implemented on the MOCO-MPV board to monitor the bus signals between MOCO and a VME module. Figure 2 shows the signals of MOCO-MPV reading out data from CAEN V792 QDC. MOCO-MPV waits for the interrupt signal of V792, and the block transfer is started when the interrupt signal is issued. After 34×32-bit data read out, the BERR signal is generated from V792, following which this block transfer is terminated. Including the conversion time of V792, the duration of the one event busy is only 15 μs. In the original MOCO case, DC power is supplied via the DIN41612 female connector (right-side connector) because the board is designed to place the front side of the VME backplane. In contrast, since the MOCO-MPV board is installed at the rear side, both DC power and VME bus signals pass through the DIN41612 male connectors (two left-side connectors).

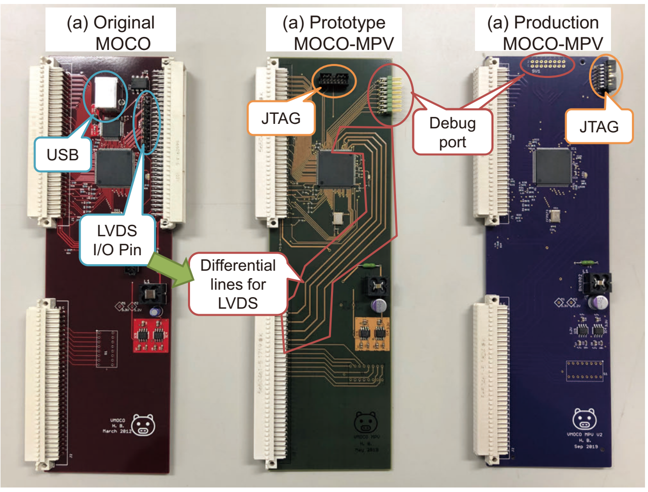

Fig. 1. Photograph of different versions of MOCO. The functionalities of the prototype and production MOCO-MPV boards are the same. However, the positions of the JTAG and debug port connectors are different.

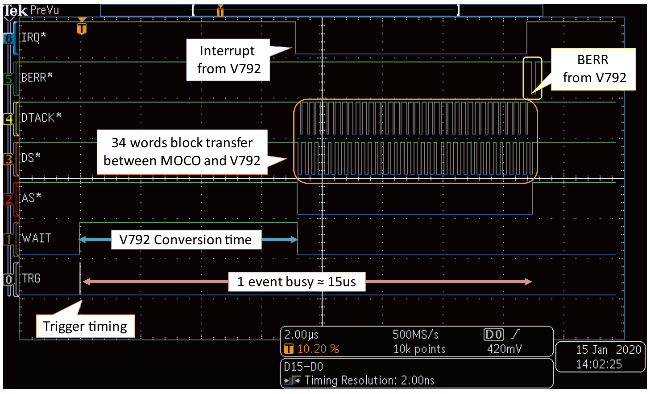

Fig. 2. Monitor signals between MOCO and CAEN V792 QDC captured by Tektronix MDO3034 through the debug port of the prototype MOCO-MPV board.

The MPV system with the prototype MOCO-MPV board was successfully introduced in the NP1512-RIBF79R1-02 experiment[4] in November 2019 for the first time. Legacy VME DAQ systems in RIBF will be gradually replaced by the MPV system together with the production MOCO-MPV board.

*1 RIKEN Nishina Center
*2 Center for Nuclear Study, University of Tokyo
*3 Department of Natural Sciences, Tokyo City University
*4 Department of Physics, Kyoto University
*5 ELPH, Tohoku University
*6 Department of Physics and Astronomy, University of Tennessee

References
1) H. Baba *et al.*, RIKEN Accel. Prog. Rep. **45**, 9 (2012).
2) H. Baba *et al.*, RIKEN Accel. Prog. Rep. **50**, 224 (2017).
3) H. Baba *et al.*, RIKEN Accel. Prog. Rep. **52**, 146 (2019).
4) J. Zenihiro *et al.*, in this report.