Upgrade of trigger circuits and DAQ modules for SAMURAI

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Many kinds and a large number of detectors are employed in experiments with SAMURAI. Users often need many complex triggers by using many kinds of detectors to select a certain reaction channel. In addition, the trigger rate is often as high as 2 kHz. To cope with such increased number of triggers and higher trigger rate, the circuits and modules for the data acquisition system (DAQ)[1)] were upgraded, which consisted of two parts, introduction of a trigger selection module and installation of new modules to shorten the dead time of the DAQ system. This paper reports on these two upgrades.

For experiments at SAMURAI, the four trigger inputs of the normal GTO module[2)] is often not enough. Therefore the trigger selector GTO[3)] was newly introduced. Figure 1 shows the diagram of the new trigger circuits for SAMURAI. The trigger selector GTO named as sdgto02 can input 16 triggers and can output downscaled individual triggers and "or" of them. The output from sdgto02 coincides with the "Beam" trigger generated from F13 plastics, and then vetoed by the busy signal and SSM (bit signal to synchronize circuits with DAQ start/stop) from the normal GTO module named as sdgto01. The accepted trigger is distributed to all DAQ branches of the SAMURAI DAQ system. This circuit configuration was used for the SAMURAI21 experiment[4)].

The SAMURAI DAQ system consists of many DAQ branches such as B3F, BDC, FDC1, FDC2-1, FDC2-2, NEBULA, and HODF. The details of the SAMURAI DAQ system can be found in Ref. 1. The B3F branch accumulates information from beam-line plastics and triggers. The BDC branch is used to accumulate data from BDC1, BDC2, and ICB. The FDC1, FDC2-1, and FDC2-2 branches are for drift chambers. The data from FDC2 are processed by using two DAQ branches, FDC2-1 and FDC2-2, to cope with the large number of channel of FDC2. The NEBULA branch is for the neutron detector NEBULA. The HODF branch is used to accumulate data from HODF (+ICF and TED, depending on experiments).

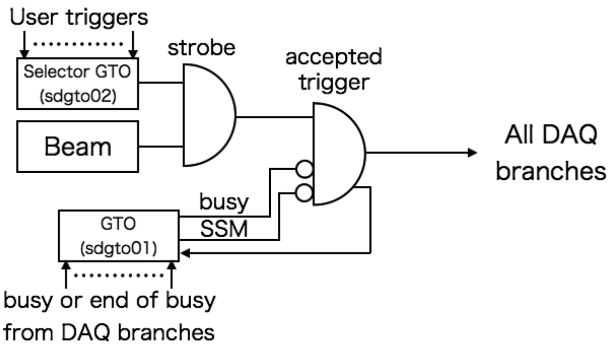

Fig. 1. Diagram of new trigger circuits of SAMURAI.

Table 1. Summary of typical dead time of the DAQ branches in SAMURAI21 and DAY-ONE experiments.

	SAMURAI21 [μs]	DAY-ONE [μs]
B3F	145	360
FDC1	180	170
FDC2-1	210	270
FDC2-2	180	220

To shorten the dead time of the DAQ system[1)], we upgraded the system for the B3F branch and changed the VME controller for the FDC1, FDC2-1, and FDC2-2 branches. The B3F branch is replaced by a VME-based system from a CAMAC-based system. The new VME-based system contains TDC (MTDC32 from Mesytec GmbH), QDC (MQDC32 from Mesytec GmbH), two scalers (SIS3820 from SIS GmbH), and a interrupt register (RPV-130 from Repic Co.). The VME controllers for the FDC1, FDC2-1, and FDC2-2 branches are replaced from SBS-620 (SBS Technologies) to V7768 (Abaco systems).

Table 1 summarizes the typical dead time of DAQ branches in SAMURAI21 experiment and SAMURAI DAY-ONE experiment. For the B3F branch, the dead time was 145 μs, much shorter than that of the previous system (360 μs) in the SAMURAI DAY-ONE experiment[5)]. For FDC2-1 and FDC2-2, the dead time in SAMURAI21 was $\sim$20% shorter than those in the DAY-ONE experiment. The time resolution of the F13 plastics with the new VME system was obtained to be about 46 ps for the SAMURAI21 experiment, showing that the performance of the VME crate is enough for SAMURAI.

With these upgraded DAQ branches, the live time in the SAMURAI21 experiment was 75% for 1.1 kHz triggers. The bottleneck of the dead time is BDC, which had 240 μs dead time in the SAMURAI21 experiment, which can be improved by replacing the VME controller to V7768.

References

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