# DL LCU—ROE Connectivity Tests

Richard J Mathar, MPIA

September 20, 2002

**Abstract**

The robustness of the communication between the Acromag9481 Digital I/O board (that represents the MIDI Internal Delay Lines) and the MPIA Read-out Electronics has been tested on a statistical basis on Sep. 13, looking for missing trigger edges from the ROE.

## 1 Implementation

The test program `lmiSync(1)`—documented by the corresponding online man page on the MIDI Instrument Workstation (IWS) `wmidi`— has been run by S. Ligori multiple times on Sep. 11. It mimics well the standard sychronization between the MIDI Internal Delay lines (represented by the `Piez` device in the `miidev` CMM module) and the Read-out Electronics in the way described before [1].

Accurate time measurements are made by looking at the watch implemented by ESO's TIM board right after a level change has been detected, and subtracting pairs of consecutive reads of this high resolution clock.

The statistics is given by a median value and $1\sigma$ and $2\sigma$ error intervals that encompass 68% and 95% of all values. The results are accumulated in files of the pattern `lmiSync` on the IWS.

## 2 Run lmiSync2002-09-11T13-11-23

This run consisted of 50 repetitions, each of which let the LCU trigger the ROE once, then collect the statistics of the two measured time intervals, one representing the duration of the high level of the digital line then driven by the ROE, the other one representing the duration of the low level. (The software would interpret the low level as the time of detector integration, the high level as time spent on other tasks like analog-to-digital conversion, data transfers etc.)

Figs. 1–3 show an overview of the first of these repetitions to demonstrate how conclusions are drawn through statistical analysis. In this case, there are two narrow peaks in the time intervals with no isolated events outside these peaks, which means there were no delayed frames or spurious spliced intervals that could indicate spikes on the line connections. To be precise, all time intervals measured fall either in a bin between 0.185 ms and 0.229 ms, or in the other bin between 6.381 ms and 6.415 ms.

Figs. 4–6 show an overview of the second of these repetitions (following immediately after the first and initiated by the second trigger from the LCU to the ROE) to be compared with the results of the first trigger. In this case, all time intervals belong either to the interval from 0.189 ms to 0.230 ms or to the interval 6.382 ms to 6.418 ms.

Figs. 7–9 is an overlay of all 50 trigger attempts in the style of the figures before. There is one measured interval of 7.409 ms after one of these triggers, one interval of 6.641 ms after another one of the triggers, and another one of 6.514 ms after the next trigger, which ought be considered errors, all the other 39,997 frames were recorded within the uncertainty interval of about 30 $\mu$s that follows from software latencies on the LCU. Since the second of these three "failed" triggers was measured with the sum of the two "regular" time intervals, one may assume that in this case the ROE was delaying one toggle of the trigger by one cycle, because the LCU recorded the full 8,000 frames in all 50 cases, including these three.

For each of the 50 triggers of the LCU, the response time of the ROE (time between the outgoing signal and the first edge of the ROE response) was in the interval 1.102–1.109 seconds.

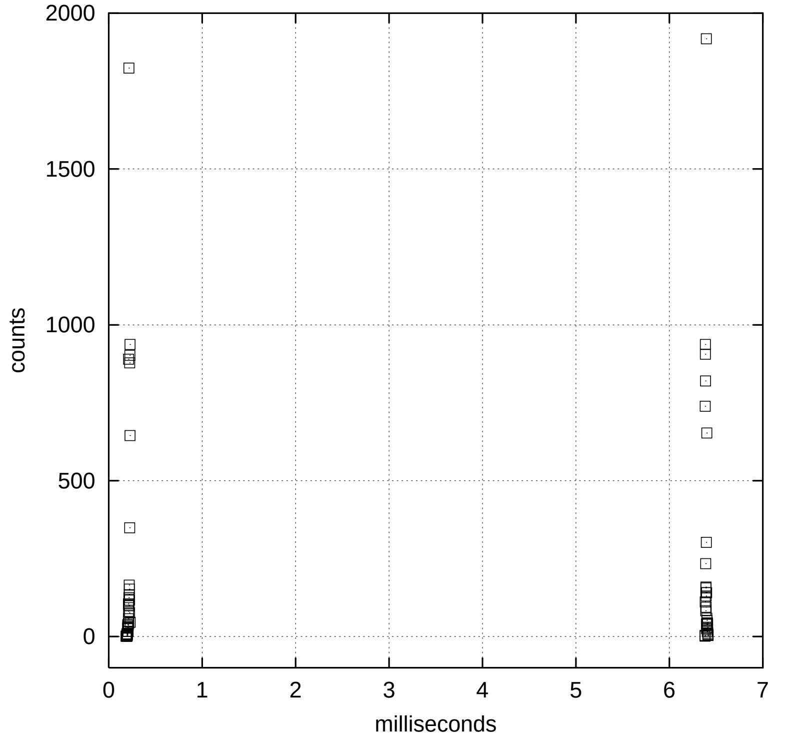


Figure 1: The durations of 8000 frames are 0.221 ms + 0.006 ms - 0.009 ms ($1\sigma$) for one level and 6.391 ms + 0.005 ms - 0.006 ms ($1\sigma$) for the other.

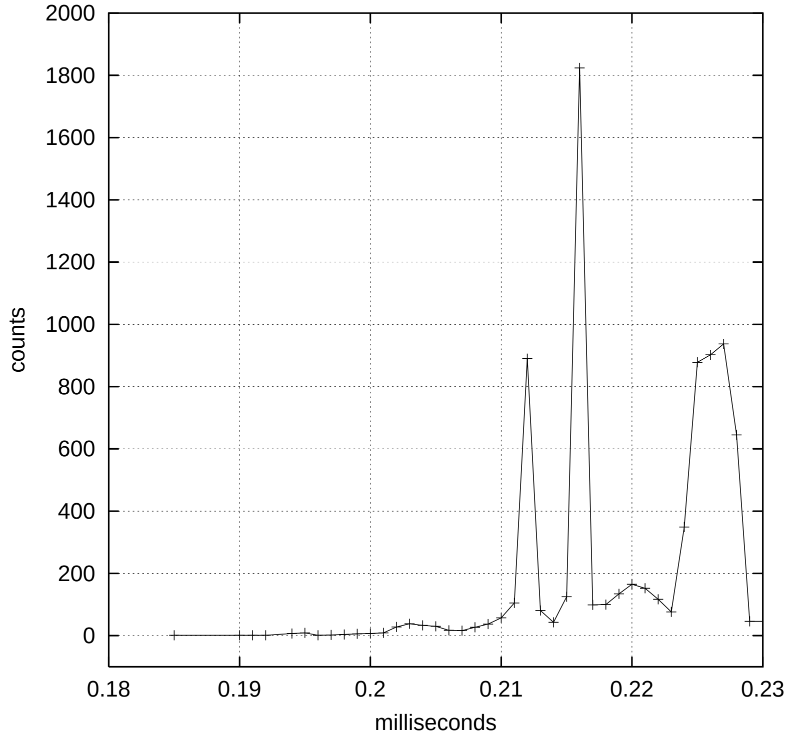


Figure 2: An enlargement of the left part of Fig. 1. The durations of 8000 frames are 0.221 ms + 0.006 ms - 0.009 ms ($1\sigma$) and 0.221 s + 0.007 ms - 0.015 ms ($2\sigma$)

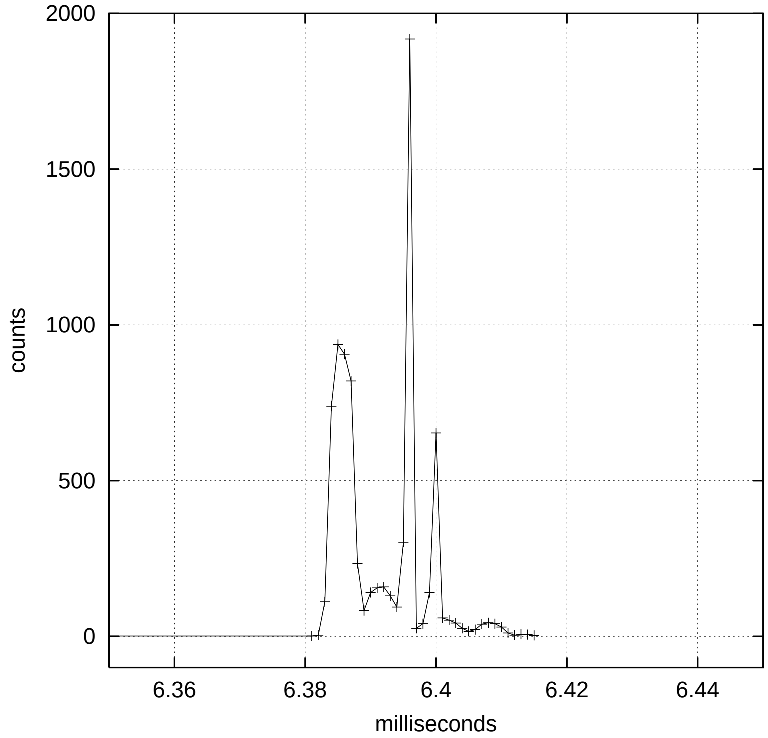


Figure 3: An enlargement of the right part of Fig. 1. The durations of 8000 frames are 6.391 ms + 0.005 ms - 0.006 ms ($1\sigma$) and 6.391 ms + 0.016 ms - 0.007 ms ($2\sigma$)

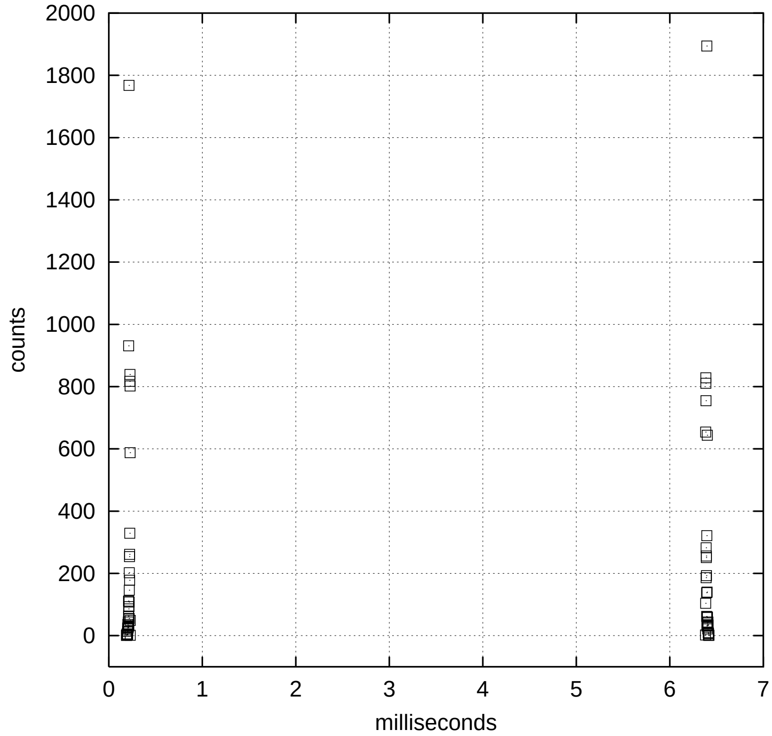


Figure 4: The durations of 8000 frames are 0.221 ms + 0.006 ms - 0.009 ms ($1\sigma$) for one level and 6.391 ms + 0.005 ms - 0.006 ms ($1\sigma$) for the other.

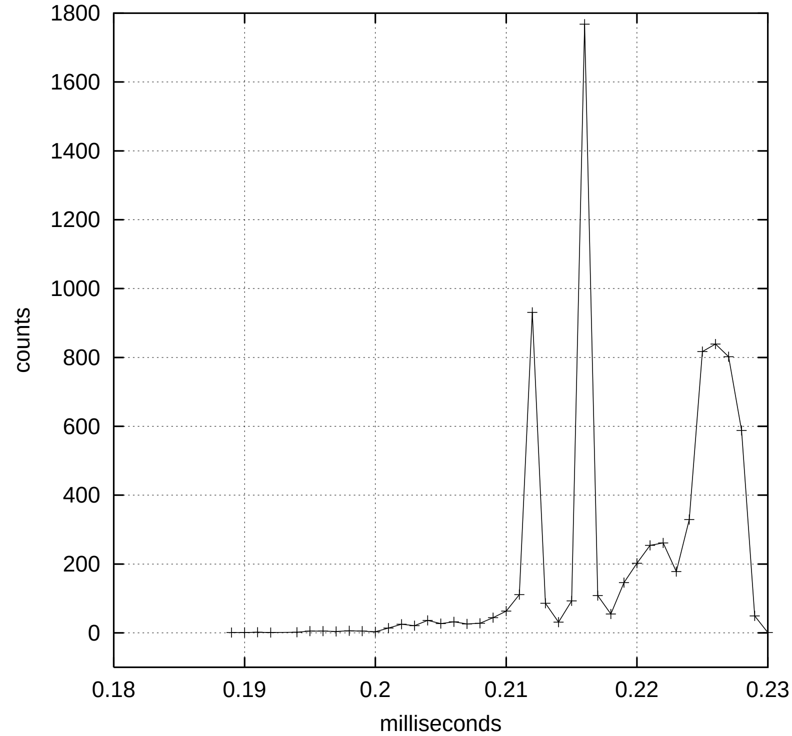


Figure 5: An enlargement of the left part of Fig. 4. The durations of 8000 frames are 0.221 ms + 0.006 ms - 0.009 ms ($1\sigma$) and 0.221 s + 0.007 ms - 0.015 ms ($2\sigma$)

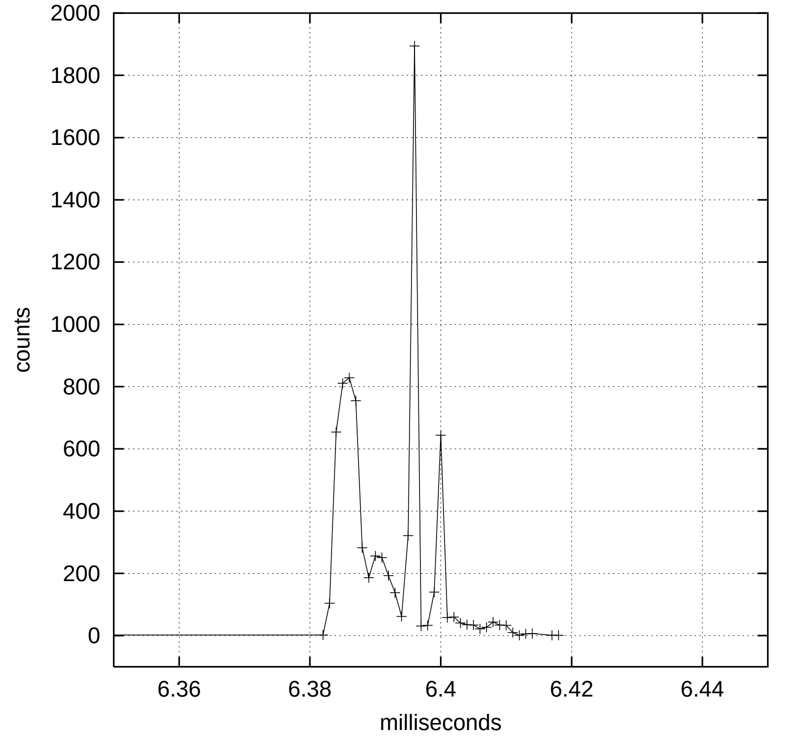


Figure 6: An enlargement of the right part of Fig. 4. The durations of 8000 frames are 6.391 ms + 0.005 ms - 0.006 ms ($1\sigma$) and 6.391 ms + 0.015 ms - 0.007 ms ($2\sigma$)

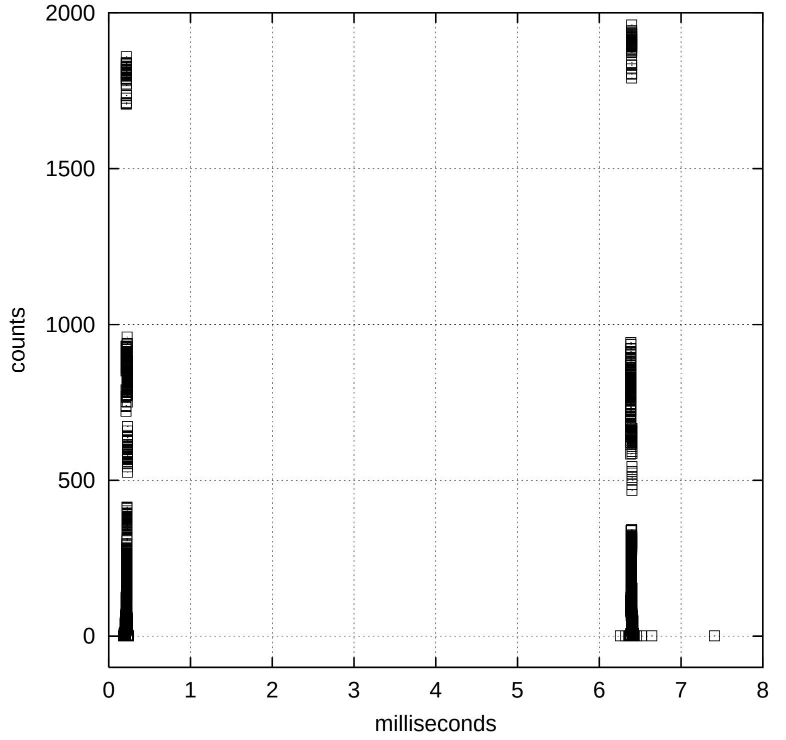


Figure 7: Overview of the durations of 400,000 frames of the first batch. All the short intervals are in the range 0.181–0.242 ms and, with the exception of the three cases mentioned in the text, all the long intervals in the range 6.258–6.455 ms.

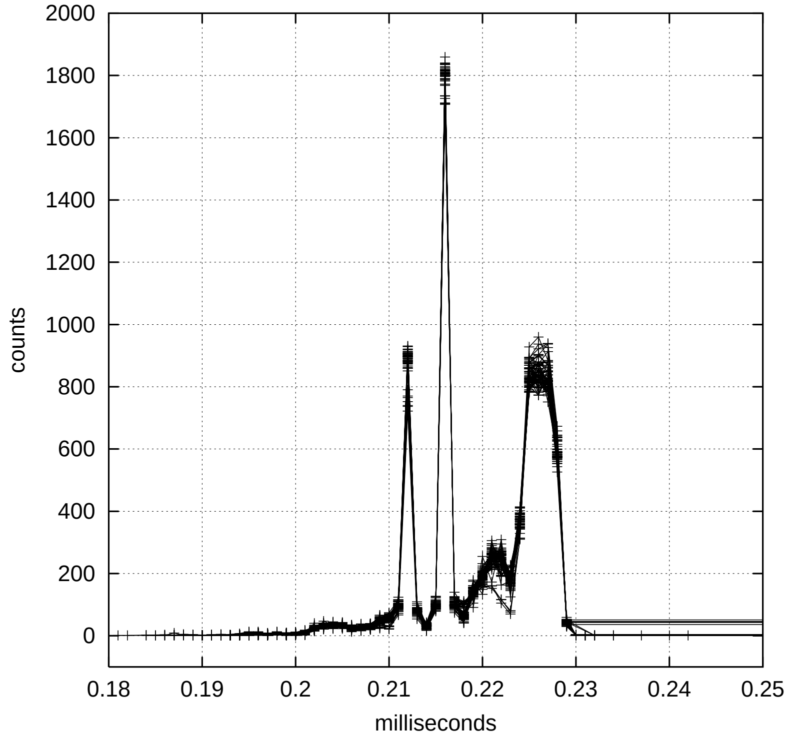


Figure 8: An enlargement of the left part of Fig. 7.

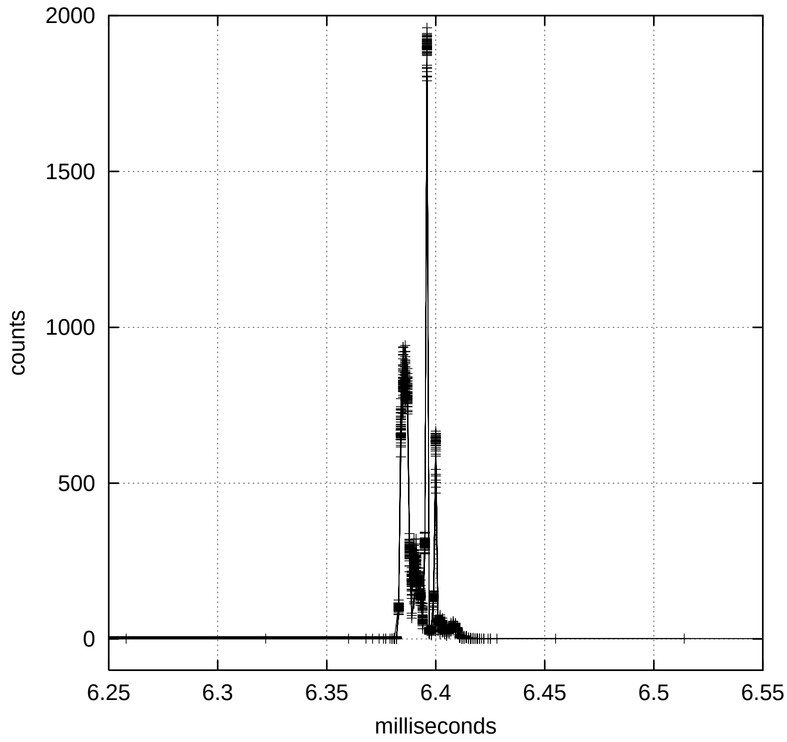


Figure 9: An enlargement of the right part of Fig. 7.

# 3 Run lmiSync2002-09-11T14-05-11

The second batch run also consisted of 50 runs of 8000 frames each, now with a different time interval spent on the high and low voltage level of the ROE response line (0.216 and 1.592 ms). Only the overall result is shown (Figs. 10–12). The delay between the LCU trigger and the first response of the ROE was in the interval from 1.102 to 1.120 seconds in all of these 50 cases.

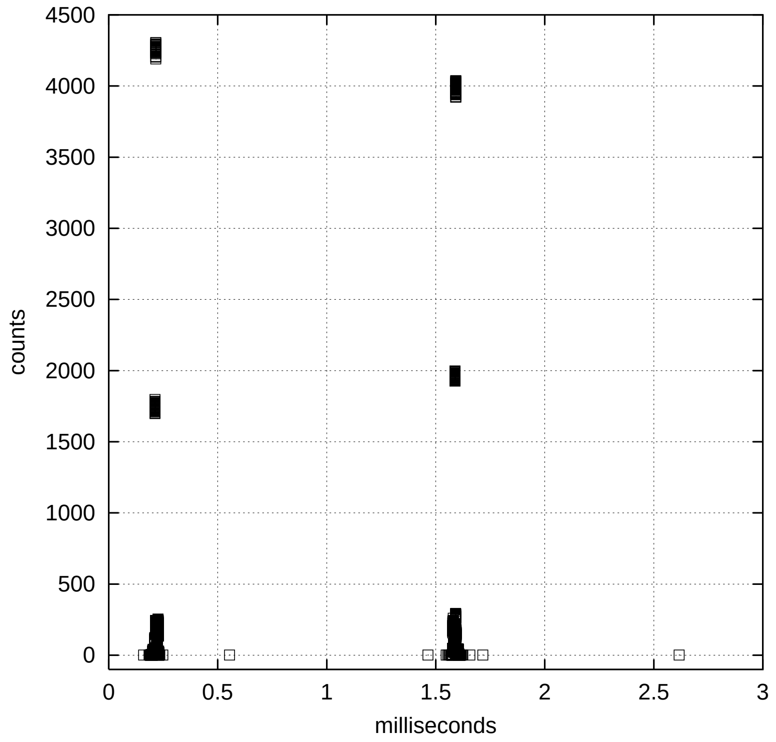


Figure 10: Overview of the durations of 400,000 frames of the second batch. All the short intervals are in the range 0.160–0.248 ms with the exception of one at 0.554 ms. All the long intervals in the range 1.464–1.656 ms with the exception of one at 1.716 and one at 2.616.

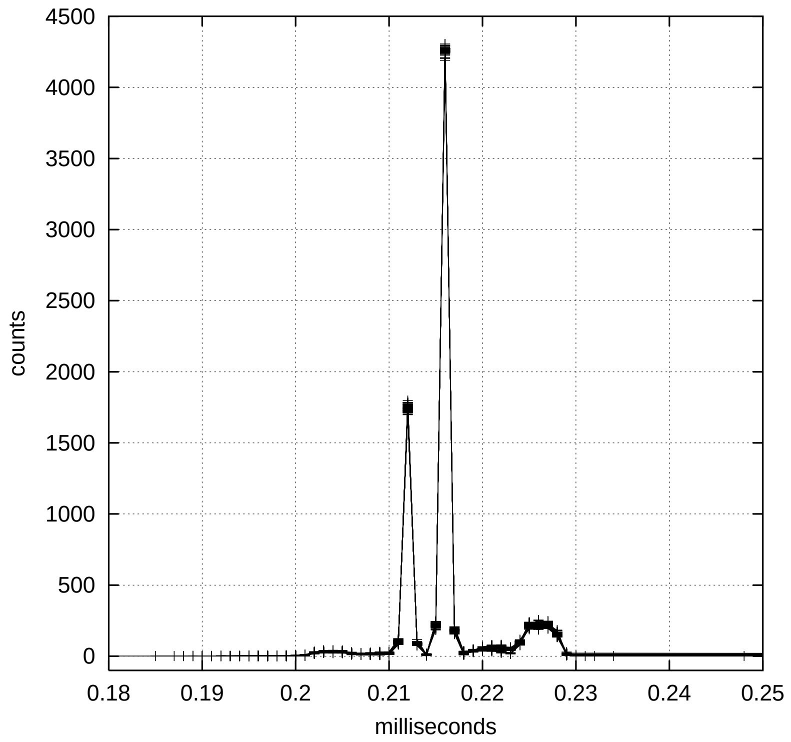


Figure 11: An enlargement of the left part of Fig. 10.

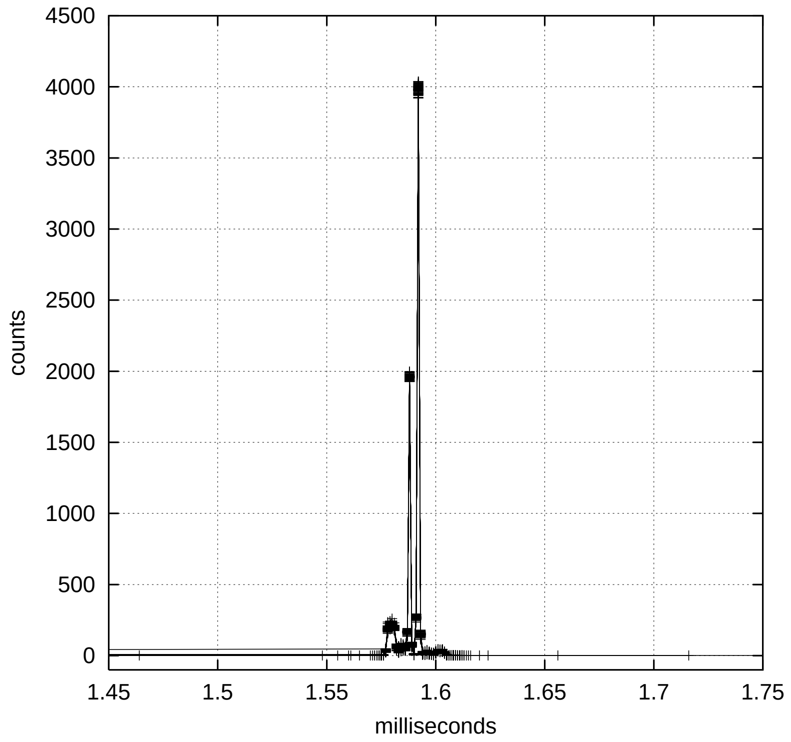


Figure 12: An enlargement of the right part of Fig. 10.

## 4 Summary

In all 100 runs of 8000 frames each, representing a total of eight hundred thousand MIDI integrations, all frames were actually counted by the LCU interrupt routine associated with the Acromag9481 board. The the first batch of 50 runs, on frame with a suspicious time interval were seen, in the first batch two frames. Since the deviation of this time interval from expected one is close to the standard response time of 1.1 ms after a new LCU trigger, one could speculate whether in two or three of these spurious events the cause was that either the LCU did actually re-trigger the ROE or the ROE reset itself.

## References

[1] R. J. Mathar, *Acromag Real-Time Tests*, report Feb. 15, 2001.