Overview of the Tritium DAQ and Trigger: General Setup and Installation Work and Tests

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1 Preface

This document gives an overview of the trigger and DAQ system for the Tritium experimental run in fall 2017 and spring 2018 at Jefferson Lab's Hall A. It shows not only the final setup of the electronics but also its development including the results of several tests done before the experimental run. In this way, the document summarizes the work of all the people involved in the installation of the DAQ and trigger system for the Tritium experiments. It can be treated as a guide line for further experiments in Hall A which wanted to use the LHRS and RHRS spectrometers in a parallel setup of coincidence and single arm DAQ. Furthermore, the document is a documentation and reference of the work of several PhD students involved in the different Tritium experiments.

2 Overview

Information of the content of the next chapters should be described here as well as the general idea for the tritium DAQ and its prerequisites and constraints. Decisions by the spokespersons.

3 Trigger Setup and Testing

Information about the trigger and DAQ system

3.1 Trigger Overview

3.2 S2 Trigger Study

Here information should be added by Florian and Jonathan.

4 Cable Setup and Testing

Information about the final cable maps for the racks in both spectrometers and the testing of the individual cables. Furthermore, information about the added cables and details about timing measurements. Some parts should be already mentioned in the previous chapters about the trigger 3.

4.1 Cable Setup

4.2 Update on connection of detector channels to HV, ADCs and TDC

07/02/17: Tyler updated the information on the RHRS?

4.3 Results of Cable Tests

The first cable tests which were done in the end of June 2017 are the following:

1. Testing of existing interconnection cables between spectrometers and labeling
    - Flatband cable between TS and ROCs
    - 6 fast coax cable (panel next to right rack), also measuring time delay
    - 3 slower coax cable (grey), connect them on detector level with the nearby cables and find the corresponding ending on hut level, then test interconnection to other side and time delay
2. Testing and labeling of existing Twinnax cables on each spectrometer
3. Checking of spare flatband connections from hut to TDCs, not both ends are clear
4. Labeling of Flatband cables going to scalers

Results of tests of interconnection cables: Information and Pictures from Rey (coax) and Florian (flatband cable)

Results of existing Twinnax cables on each spectrometer LHRS done by Florian and Tyler. All good.

RHRS done. All good.

Checking of spare flatband connections to TDCs: Spare 1 and 2 flatband cables to the TDCs are checked and working on both arms. All good.

Fastbus Busy Cable tests RHRS

	Label	Front/Back	Color
	01	Back	Grey
	02	Back	Grey
	03	Back	Grey
	04	Front	Grey
	05	Front	Grey
	06	Front	Grey
LHRS	07	Front	Grey
	08	Front	Grey
	09	Front	Grey
	TOP FB BUSY	Back	Grey
	MID FB BUSY	Back	Grey
	BOT FB BUSY	Back	Grey
	SPARE 1		Flatband
	SPARE 2		Flatband
	B		Flatband

4.4 BCM, BPM and Raster cables

4.5 Fast Cables between RHRS and LHRS

They are black! Also, The total length of these cables was measured by sending a pulser signal between spectrometers and then back, under the assumption that these three cables are the exact same length. Working on these conditions, we found that the length of each cable is: 222 ns (each cable). See figure 1

4.6 Slow Cables between RHRS and LHRS

Besides the fast (black) cables connecting the two spectrometers, there are three slow (white) cables as well. These can be found on the left- (right-) hand side of the lower level of the hut in the LHRS (RHRS). They were extended to get to the upper level of the hut with similar cables. These cables on one HRS were matched to the corresponding cables on the other HRS using a pulser, and labeled accordingly. The total length of these cables was measured by sending a pulser signal between spectrometers and then back, under the assumption that these three cables are the exact same length.

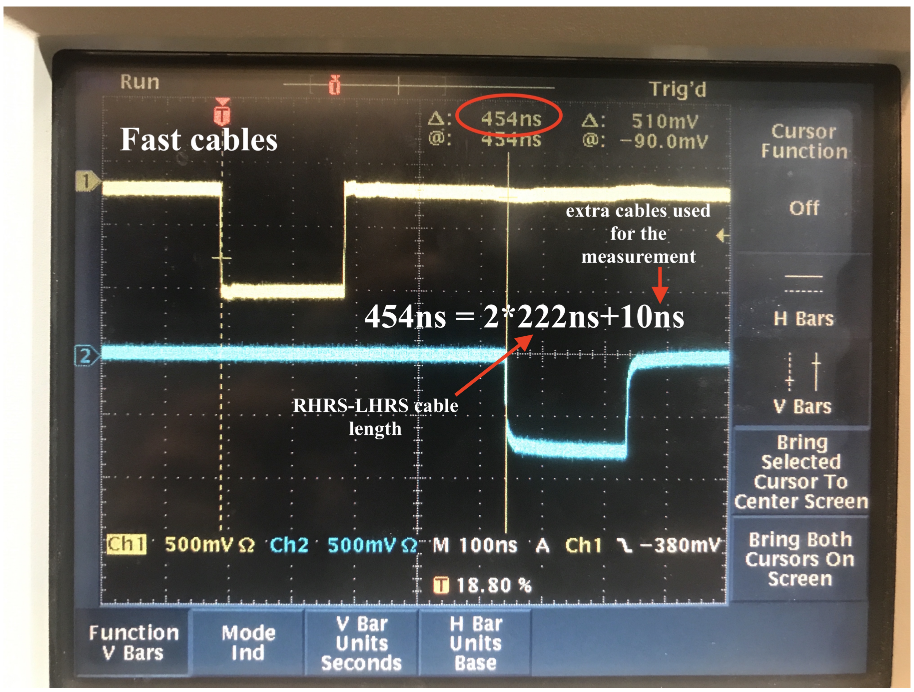

Figure 1: Fast Cable Length

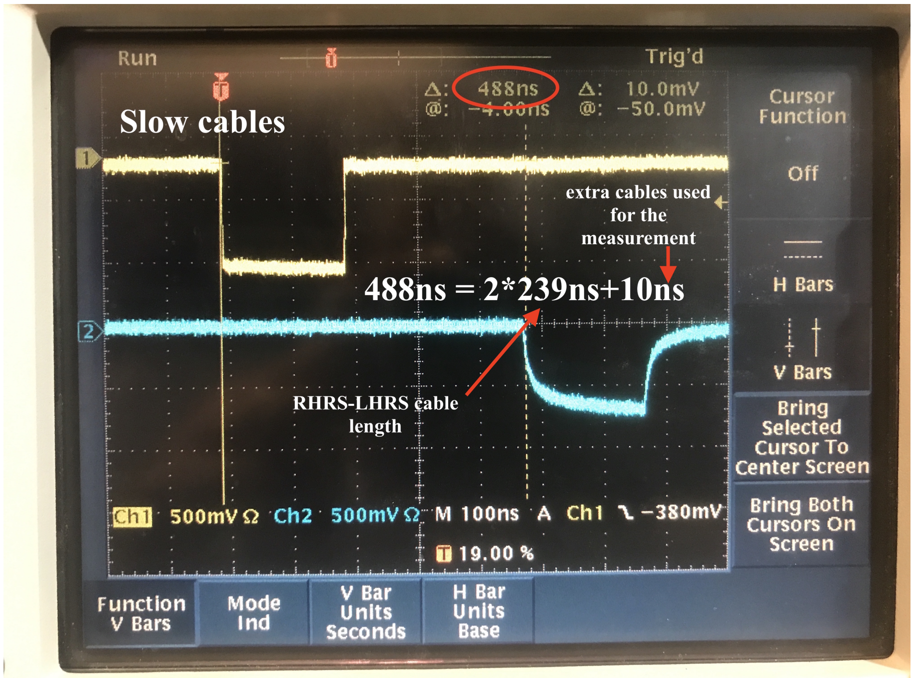

Figure 2: Slow Cable Length

Working on these conditions, we found that the length of each cable is: 239 ns (each cable). See figure 2

5 S2 Timing Test

To test the timing of S0 and S2 with cosmics, we connected 8ns cables from the S0 coincidence and S2 coincidence outputs to their respective FIFO inputs. We then brought the outputs of the FIFO to a logic unit to create the (S0&&S2) trigger.

We connected the S0 coincidence output and S2 coincidence output to channels 1 and 2, respectively, of the oscilloscope. We used the (S0&&S2) trigger as an external trigger.

As shown in the figure, there is almost no overlap. S2 comes 30ns before S0. As documented in the trigger setup, we would like S2 to come 20ns after S0. The S2 signal is coming 50ns earlier than desired.

Since this test was done with cosmics, we have to account for the particles

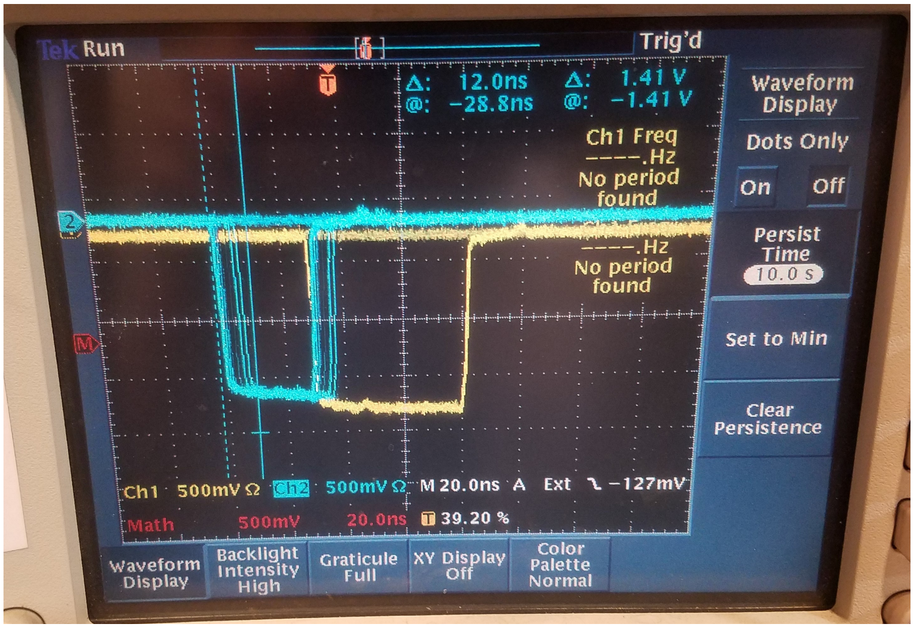

Figure 3: S2 timing

traveling backwards through the detectors. When ignoring electronic delays in a cosmics setup the S2 signal will come earlier than the S0 signal by the time of flight (TOF) between S0 and S2. In an experiment setup this will be reversed, S2 will come later by the TOF.

So, we need to delay S2 by (50-(2*TOF))ns.

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6 Flash ADC Setup and Tests

Information about the FADCs , the readout scripts and the test done to achieve a working system.

Information should be added from Mike, Rey and Vardan?

7 Other DAQ parts

Maybe extra chapter for MLU?

Information about Remote Control for all Racks?