

<b>Project</b>	CERN-TMS
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## 1. Overview

The full TMS system has been produced and installed at CERN and is under test. Further software and FPGA development is being carried out.

## 2. Work Done

The following work has been performed:

- The third revision PUPE boards have been produced. The complete set of 17 + 1 PUPE boards have been manufactured. These have improved PCB layout to reduce ADC noise, improvements to the ADC PLL clocking system and some other minor changes.
- The Full TMS system has undergone general and performance testing.
- The software API has been modified following discussions with CERN's software engineers.
- The TmsControlGui test application has been improved with abilities to access data from all PUPE channels.
- The TmsTestData program has been created to test data access from the while TMS system.
- A number of software changes have been made to improve features and performance when accessing the multiple PUPE channels in the full TMS system.
- The Full TMS System has been installed at CERN into the main rack.
- The layout of PUPE boards in the rack has been changed after initial system tests. In the new layout no PUPE boards are in the slots next to the power supply and cPCI controller. This reduces the ADC noise picked up the the PUPE boards. The far right PUPE board is now used as the master board for the digital timing signals.
- The Full TMS system has had basic testing performed with the PS machine at CERN. Not all of the digital timing and ADC wires were available at the time, but a few channels where connected and basic data capture and tests performed. The system functioned as expected, tracking particle beam acceleration and capturing the data although detailed data analysis was not done.

## 3. Meetings at CERN during full system installation

During the TMS system installation visit a number of discussions and meetings were had with various CERN staff. This resulted in a list of minor problems, issues and possible improved features for the TMS system. The list of these is given below:

1. The TMS system can have multiple injection events. The current system assumes only one injection event followed by a number of harmonic change events. The FPGA firmware can already handle this situation, but some minor changes to the software are required. We will change the names of the Cycle Periods to be: CyclePeriodEvent\* rather than CyclePeriodHarmonic\* to reflect the fact that

the Cycle Period may not had a harmonic change but an injection event to terminate it.

2. The TmsControlGui application's labelling could be improved to show what units the data fields are in. We will make these changes.
3. It might be better to allow the bunch number to be entered as digits in the TmsControlGui application. We will make this change.
4. There is a problem in the Cycle Parameter editor when a GATE width of 1.0 or greater is used. We will investigate and fix this bug.
5. The Diagnostics function could be improved by having a 32bit post trigger delay counter. This could be done in the future.
6. The Diagnostics function could be improved by having the ability to latch any highs that occur on the trigger data lines when a lower clock frequency that 125MHz is used. This will allow the user to see the trigger events when a whole cycles data is captured. A pre-trigger data capture would also be useful. This could be done in the future.
7. There are occasional data errors when reading the SDRAM data from the PUPE boards. This is being worked upon.
8. It would be useful if the Mean data returned has a time field rather than the number of samples. We will change the software to implement this.
9. For Calibration it is necessary to load a different initial PLL frequency than for injection. We will add the Cycle Parameter entry for this and this value will be loaded at CYCLE\_START.
10. Investigate the reason that Cycle Parameters are not updated sometimes when in simulation mode.
11. Occasionally the diagnostics data was not captured or displayed correctly. We will investigate this.
12. Change the system to use bucket number rather than bunch number when fetching the data.
13. Add the bucket number to bunch number conversion bit-masks to the Cycle Parameter tables.
14. Add an API function to read the bunch number conversion bit-masks and other Cycle Parameters for a given Cycle Type.
15. It would be very useful to be able to read the mean data for any set of bunches at data read time. At the moment the mean for only a single bunch can be read and the parameters need to be set up prior to CYCLE\_START. This makes it awkward for the software API and only one user can request a particular bunches mean data at a time. Although this is not called for in the specification it was clear that this extra feature would be very useful to CERN. We have determined that it is possible to implement this and have decided to carry out the extra work to implement this feature under the contract. The new bunch mean system should allow the 1ms means for all bunches and all pick-ups to be captured and read from the system.

## 4. Work To do

Generally the full TMS system is in a functional state at CERN. There is a small amount of work to be performed to complete the system. As well as the work specified in the above section, there is the following additional work to be performed:

1. CERN need to test the ADC performance with the system in its final rack.

2. The systems documentation needs to be finalised.
3. CERN need to create the client programs to call the setNextCycle() function with appropriate Cycle Type.
4. CERN need to create the appropriate Cycle Parameter tables for the different Cycle types.
5. The spare TMS Server, Module Controller and 3 PUPE boards need to be shipped to CERN.
6. A training presentation needs to be written and presented at CERN.
7. The full software and FPGA source code needs to be shipped to CERN so that they can further develop the system.

## **5. Current Schedule**

The full system was delivered slightly behind the revised schedule. The detailed project schedule is at: <https://portal.beam.ltd.uk/support/cern/schedule.php>.