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DAQ hardware and software for RPC Test Station

User's help
(Only for internal use)

Limited Warranty

USERS MUST WORK VERY CAREFULY WITH ALL PARTS OF THE SYSTEM. THE DAMEGE OF ANY PART OF SYSTEM WILL BE PUNISHED BY REPEARING WITH GUILTY.
DUE TO THIS DECLAMATION BEFOR USE (EVEN SWITCH ON POWER) MAKE SURE YOU WANT (AND REALY NEED) TO USE THE SYSTEM OR SOME PART OF IT FOR YOUR (PROBABLY PRIVATE) BUSINESS. IF YOU ARE AGREE WITH ALL POINTS ABOVE, GO AHEAD.

Trademarks

“DAQ hardware and software for RPC test station” in NOT a trademark of Gruppo 1.

Introduction

Present User's Help describes in some details hardware and software features of the RPC Test Station.

Main steps

- Prepare all devices which you need to use at present time (scintillators, drift chambers, RPCs, MicroMegas, etc.)
- Switch on Gas System, high and low voltage power supplies, VME, CAMAC and NIM crates.
- Initialize PCI-MXI bus and TDCs.
- Run programs, which you need for this time.
- Store data files on PC.
- Analyze data.

Initializing of PCI-MXI and VME-MXI

First of all, after rebooting of PC and power up of VME and CAMAC crates (first should be powered up VME create and then the CAMAC, only in this sequence) PCI-MXI and VXI/VME-MXI buses **must be initialized.** This procedure could be done in a following way:

- From **National Instruments** toolbar run **Resource manager,** the location of the program is: **Start -> All Programs -> National Instruments -> LabVIEW -> Resman**

After successful initialization the system is ready for work. If necessary, the configuration of system could be changed. For this procedure run **Start >> Programs >> National Instruments >> T&M Explorer** and select item which you want to change (to add new devices, remove old one etc.).

The present configurations for main items are the following:

- **VME-MXI-2** controllers are configured with LA=1 and LA=2 logical address in A32/D32 mode address base 0x20000000 and 0x22000000.
- **CBD 8210** CAMAC branch driver is configured with Pseudo-LA=270 logical address in A24 mode at address base 0x800000.
- **TDCs** are located in Pseudo-LA field 301 - 307

Hardware

The RPC test station hardware contains several VME and CAMAC control and measurement modules:

VME

- **32CH TDC** - The system contains 4 (3+1) 32 channel Time-To-Digital converters. These are single width 6U VME modules working in A32/D32 mode (as well in A24/D32 mode after some simple modification). First tree TDCs (96 channels) are working with drift chambers. Fourth one is used for reading of MicroMegas, or other detectors data.
  As default settings, the TDCs have with the following settings:
  - Working mode – Common Stop
  - Time window before Stop – 2 μSec
  - Rising front detect
  - All channels ON
- **CBD 8210** - CAMAC branch driver. This module is located in VME frame but uses in different mode. User can not access module in standard mode. CBD 8210 is defined for PCI-VXI bus as Non-VXI device which works in A24/D16 (A24/D32) modes and transfers standard CAMAC commands directly to CAMAC branch (in our case to A2 crate controller). All CAMAC commands could be send using D23-D00 VME address bus. Under CBD 8210 is defined VME address field different from VME-MXI-2.

CAMAC

- **CCA2 2110 Crate Controller –** A2 CAMAC crate controller.
- **Trigger Module –** This is single-width CAMAC module which recognizes a trigger, sets **LAM**, sets **BUSY** output to **"0"** and **disables** next trigger until **LAM** is set to **1**. Module uses the following CAMAC functions:
  NA(0)F(8) - Test LAM. Q=1 when LAM=1
  NA(0)F(10) - Reset LAM. This function as 1 μS wide NIM-level pulses goes out for use as external **CLR** for TDCs or any other devices.
  NA(0)F(24) – Enable LAM
  NA(0)F(26) - Disable LAM.

- **C.A.E.N. 8 CH TDC** (Mod. C414) **–** 8-channel 12-bit Time-To-Digital converter with 25 (50, 125, 250, 500 or 1250) pSec resolution (see manual for details). This TDC is used to measure timing of scintillator counters and creating of scintillator pattern.

Software

Any useful program will have to be changed.
Murphy's Law for programmers

For data storage is used LabVIEW 7.1 software. There're several programs for control and measurement. The main parts are located at **C:\Atlas RPC Group** folder. It contains the following virtual interfaces (VIs) and libraries:

C:\Atlas RPC Group
- **InitializeTDCs.vi –** initializes TDCs in different modes. From front panel it is possible to change any accessible parameters, like common start/stop mode, time window, number of recorded hits, etc.

C:\Atlas RPC Group\VME Drivers
- **TDCin32.vi** and **TDCout32.vi –** make single read and write operations with TDC in A32/D32 mode.
- **QDCin.vi** and **QDCout.vi –** make single read and write operations with QDC in A32/D32 mode
- **TDC_IO.vi -** makes single read or write operations with TDC in A32/D32 and A24/D32 modes.

C:\Atlas RPC Group\CBD Drivers
- **GenerateC.vi –** generates global **C** on CAMAC branch.
- **GenerateZ.vi –** generates global **Z** and **I** on CAMAC branch.
- **RemoveI.vi –** removes global **I** from CAMAC branch.
- **CSRegister.vi –** reads/writes Control and Status Register bits. Useful for **Q** and **X** control.

C:\Atlas RPC Group\CAMAC Drivers
- **CNAF Read24.vi** and **CNAF Write24.vi –** make single read and write operations with any CAMAC units through **CBD 8210** CAMAC branch driver. During the write operation subroutine reads also the status register for Q-response.
- **WaitLAM.vi –** waiting LAM from CAMAC module.

C:\Atlas RPC Group\Utility
- **Slow control.vi –** reads temperature and pressure sensors via Field Point.
- **Write I32 To Spreadsheet File.vi –** writes I32 data in ASCII format in file.
- **CAMAC zs.vi –** reads data from CAMAC TDC (C.A.E.N. 8 CH TDC) and makes zero suppression. The output are: TDC data 0<data<overflow and number of hits.
- **RPC Data Converter.vi –** converts VME TDC data in following string: TDC raw data, TDC channel number, TDC time.
- **Data Range 0-31.vi –** on output of this VI is information in logical values (True/False) when we have one and only one hit in DC channel ranges 0-11, 12-23 and 24-31.
- **Data Range 32-63.vi –** on output of this VI is information in logical values (True/False) when we have one and only one hit in DC channel ranges 32-35, 36-47, 48-59 and 60-63.
- **Data Range 64-95.vi –** on output of this VI is information in logical values (True/False) when we have one and only one hit in DC channel ranges 64-71, 72-83 and 84-95.

Programs for data storage and event monitoring

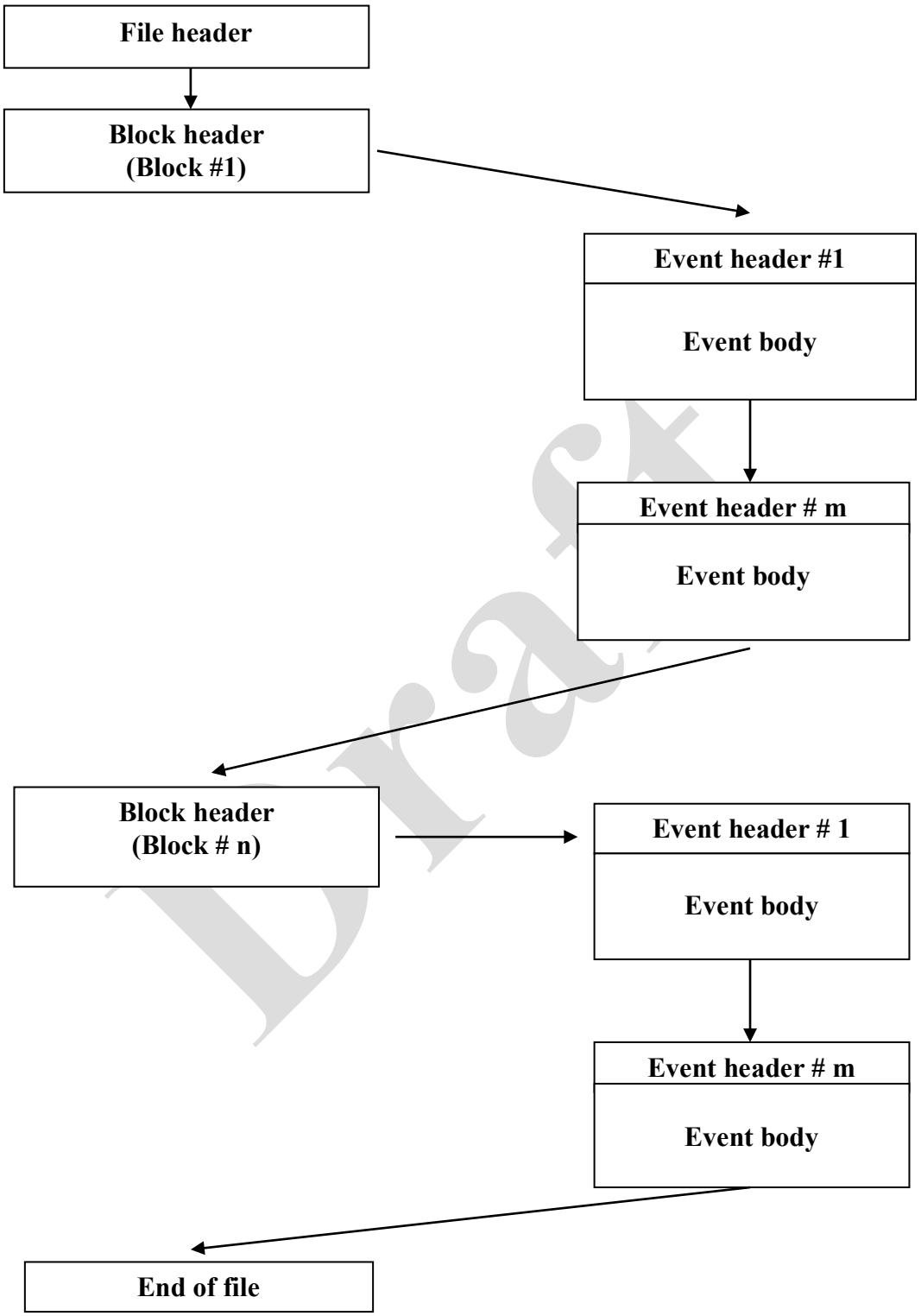
The main programs for data storage and event monitoring are located at **C:\Atlas RPC Group** subdirectory.

- **C:\Atlas RPC Group\System monitor.vi** – This program allows to monitor the scintillators and drift chambers condition without storing the data on the hard disk. It's recommended to run this program always after start-up the system.
- **C:\Atlas RPC Group\Tracking system.vi** – This program stores high statistic data for fixed position of the drift chambers. The total number of the events of the tracking system is calculated as derivation of **(Number of blocks) x (Block length) x (Number of steps)**. The location of the stored files and their names could be seen from the front panel of the program.

Important NOTE
The drift chamber Channel numbers are corresponding in following order:

- **Ch#0 ÷ Ch#11 – X1-layer of bottom chamber.**
- **Ch#12 ÷ Ch#23 – X2-layer of bottom chamber.**
- **Ch#24 ÷ Ch#35 – Y1-layer of bottom chamber.**
- **Ch#36 ÷ Ch#47 – Y2-layer of bottom chamber.**
- **Ch#48 ÷ Ch#59 – X1-layer of top chamber.**
- **Ch#60 ÷ Ch#71 – X2-layer of top chamber.**
- **Ch#72 ÷ Ch#83 – Y1-layer of top chamber.**
- **Ch#84 ÷ Ch#95 – Y2-layer of top chamber.**

Data file structure



Data format (Tracking system)

File header

Date and time (ex. **Friday, May 17, 2002 17:17**)
Program name

Block header

Date and time (ex. **20020517 1717**)

Event header

1	**0**	**0**	**0**	Block # (12 bits)		Event # (16 bits)	
1	**0**	**0**	**0**	N SCINT (4 bits)	N Fili (8 bits)	Empty (8 bits)	Pattern (8 bits)

Event body

					Bit 24	Bit 23 Bit 17	Bit 16 Bit 1
0	**0**	**0**	**0**		0	DC channel (7 bits)	DC time (16 bits) res. 1.04 nSec

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					Bit 20	Bit 19 Bit 17	Bit 16 Bit 1
0	**1**	**1**	**1**		0	Scint channel (3 bits)	Scint time (16 bits) res. 1.04 nSec

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End of file

1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	Total number of events