Shift Manual for Forward Tracker Upgrade Tests

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Contents

1 Introduction

This instruction manual is intended to serve as an informative document for people starting Forward Tracker (FT) test data taking shifts at Daresbury.

As well as instructions on what is actually required of the shift person, a brief overview of the test rig is given.

The "In Case of Trouble" section contains a directory of contact phone numbers should a major problem occur.

2 Hardware

This section describes the planar drift chambers that are to be tested and the high voltage system they use. Also described here are the hodoscopes, which provide a cosmic radiation trigger.

2.1 The Planar Drift Chambers

The upgraded FT planar chambers are similar in design to the existing ones. The vital difference is that the new planes are eight sense wires deep rather than four (see figure 1). Detailed information can be found elsewhere [1].

Each planar can be regarded as two asymmetric halfs, each containing 14 drift cells. Figure 1 shows a cell cross section. The cells are constructed with conducting strips on the walls/sides which are held at set potentials in order to set up a constant drift field within the cell. Sense wires at the central plane of the cell are used to collect the drift charge as shown in figure 2. The wires either side of the sense wires are called guard wires and are used to improve the drift field characteristics.

When a charged particle passes through the cell it may ionise gas atoms. The electrons from these atoms then drift to the sense wires where they are collected. The current on the sense wires is then amplified by pre-amps which are located on circuit boards external to the drift chamber itself. The signal from the pre-amps is then sent to the DAQ.

Ionisation and subsequent drift of electrons in the cell is critically dependent upon the composition of the gas. For the test set-up a gas mixture of 90% CO_2 and 10% Ar is used. Oxygen is known to soak up electrons and quash drift signals. The chamber is therefore enclosed in a sealed tank and must be flushed with CO_2:Ar for days before testing begins.

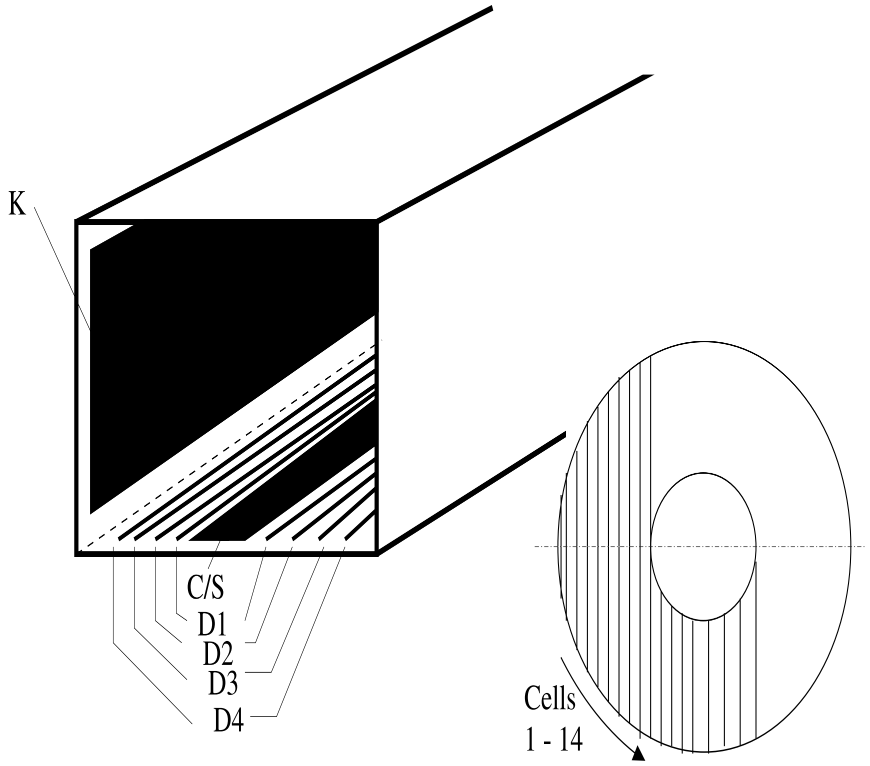

Figure 1: At the bottom right is a cartoon showing arrangement of cells on a plane (first half only). Also shown is a close up of one cell showing the arrangement of strips on a cell. The strips will be referred to as cathode (K), centre strip (C/S) and drift strips one to four (D1, D2, D3, D4.).

2.2 The High Voltage (HV) System

The default voltages for each of the strips are given in the table 1 and should be adhered to.

A CAEN HV supply is used to generate and monitor all drift chamber potentials; including the sense wires. For detailed operating instructions see the CAEN manual. A brief operational summary is now given.

The CAEN crate is used to set and monitor HV on multiple channels. There are three modules (each with four channels) slotted into the back of

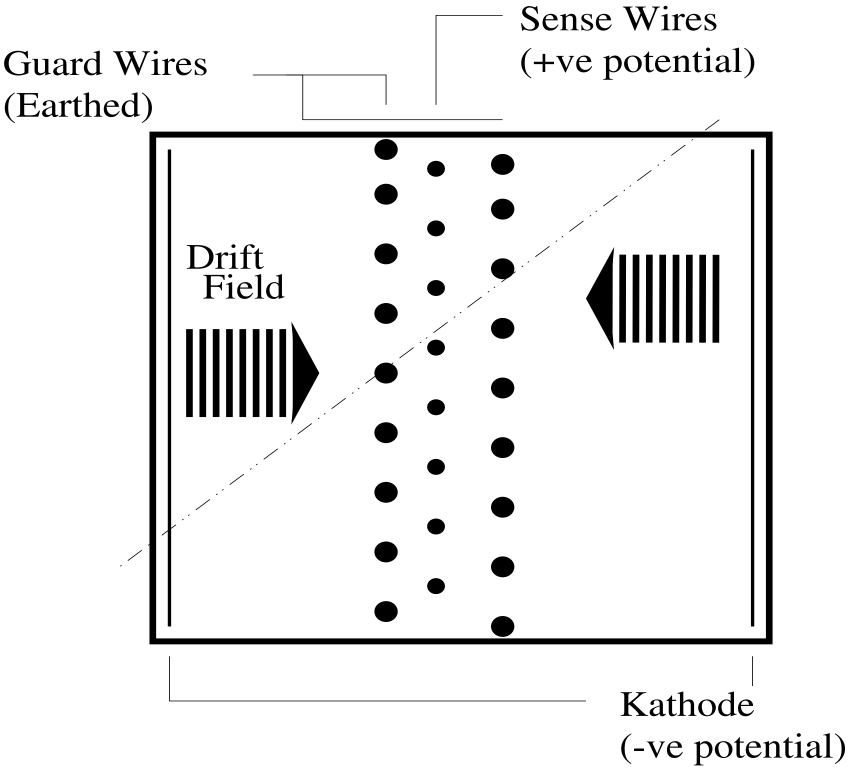

Figure 2: Schematic diagram showing the cross section of a cell. The potential difference between the cathode and sense wires caused a drift field. Charged tracks passing through the cell cause ionization. The free electrons drift toward the sense wires where they are collected.

the crate. The first module is set to supply positive potentials. Modules two and three supply negative potentials. The channels are numbered such that channel 00 is the first channel on the first module and channel 11 is the last channel on the last module.

It is possible to define groups of channels which may be turned on independently. This allows the sense wire volts to be applied once the drift field has been established.

Beware!!! Do not change the mapping of the channels, some channels are

Component	Code	CAEN Channel	Voltage (V)	I_{Max}
Sense wire	S	CH00	+1850	200 nA
Centre strip	C/S	CH03	+800	1 μA
First drift strip	D1	CH04	-150	1 μA
Second drift strip	D2	CH06	-800	1 μA
Third drift strip	D3	CH07	-1500	1 μA
Fourth drift strip	D4	CH08	-2100	1 μA
Cathode	K	CH09	-2500	1 μA

Table 1: Potentials for various HV components of the drift chamber. The I_{Max} values are the maximum current that should be drawn while ramping up the potential. Once ramping has finished **all** currents should be below 30 nA.

not working! See the table for current map.

An xterm is used to communicate with the crate. For each channel the following parameters must be set:

- V0: The HV set point.
- I0: The maximum current allowed before trip.
- RUP: The rate (Vs^{-1}) to ramp up.
- RDW: The rate (Vs^{-1}) to ramp down.
- TRIP: The time that the current must exceed I0 before trip.

The current monitor on CAEN crate is only approximate. To read the current the external ammeter units should be used.

- To look at the status: press 1 for main menu, A for status, O to update.
- To enable voltages flick switch on top left of CAEN box .
- To start ramping up a channel: press 1 for main menu, B for modify parameters, chose A for single channel, press Q repeatedly until required channel is reached, press N to toggle ON/OFF status.

- To start ramping up a group: press 1 for main menu, B for modify parameters, C to select group mode, press Q until required channel is reached, N to toggle ON/OFF status. You can then toggle the ON/OFF status for each channel in a group.
- To ramp down. Reverse the order of instructions above.
- To disable voltages: Only once the volts have reached zero (and the charge on the wires has dissipated) set the voltage disable switch.

2.3 The Hodoscopes

A coincidence of signals in two hodoscope paddles is used to trigger the DAQ read out on cosmic signals. The trigger system is fairly stable once the HV supply to the hodoscope's PM tubes is set.

Please do not adjust the HV setting for the PM tubes unless you really know what you are doing :-)

With the paddles completely overlapping a rate of about 2.5 Hz should be observed. Occasionally a tear might develop in the paddles covering wrapper. If this happens the coincidence rate will be at least 500 Hz. With somebody watching the rate locate and cover the tear with black gaffer tape.

3 The Data Acquisition System (DAQ)

The DAQ system transforms the continuous raw signals from the pre-amps into event triggered time slices that may be recored on disk. The layout of the hardware situated in the control room outside the clean room is shown in figure 3.

3.1 DAQ Hardware

The main hardware components of concern to people on shift are:

- The output of four cells may be monitored simultaneously. The sense wires from each cell are wired up to a *feed-through* block on the side of the gas tank. The cards upon which the pre-amps are mounted are attacked to the feed-through blocks. For each (of the four) monitored cells, a cable connects the pre-amp card to the DAQ hardware - situated in the office outside the clean room.

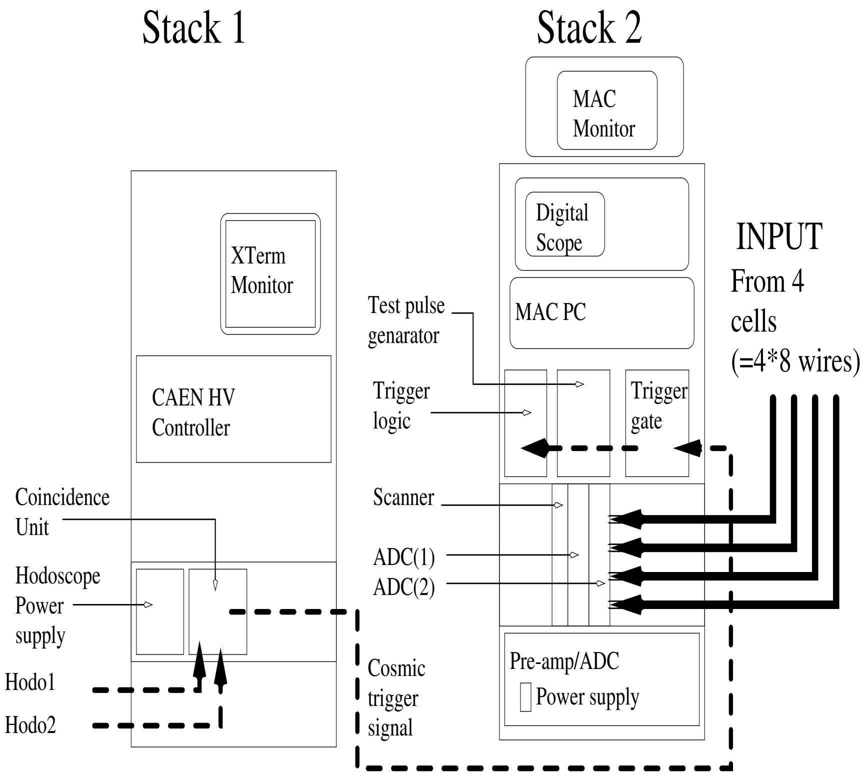

Figure 3: Layout of hardware in the control room.

- Analogue to Digital Converter (ADC) cards. Each ADC card has two input cables (16 sense wire channels) plugged into the back. Therefore two cards are required to monitor four cells.
- Scanner card. The scanner is controlled by the DAQ software and reads the selected contents of the ADCs.
- There is also a unit for generating test pulses if required. Test pulses are fed into the "test pulse" socket on the front of the scanner.
- The MAC PC is used to run the DAQ software and write data to a local disk. The MAC will crash if the pre-amp/ADC power supply is turned on/off, so always turn the PC on/off last/first to avoid this.

3.2 DAQ Software

The DAQ software can be started by double clicking on the "testdaq_dq" icon on the MAC desktop. The menu options to worry about are given below:

- OUTPUT: Select none unless data is to be permanently recorded. Select local file and give filename, *e.g.* /DATA/NEW/test¡date¿-¡chamber#¿-¡cell#¿, to record data to disk. You can also manually increment the run number if required (normally this happens when last run stops).
- START RUN: Hit this and a new run will start.
- PEEK: Graphical display of the last event to be read. This is useful when you want to see events, but can confuse the scanner - don't peek while recording data!!! The display shows time (ADC channels) in x versus pre-amp voltage in y. The colour coded output of four wires are shown at a time. The wires numbering is hexidecmal and initially wires 0 to 3 are displayed, which are the first 4 wires on the cable labelled 00. Hitting the "WIRE UP" button displays wires 4 to 7 - the next four wires on cable 00. Press "WIRE UP" again and wires 8 to B are displayed - the first four wires on cable 08. And so on for all 36 channels. Hit "NEW EVENT" to read the next event stored on the ADC. If there is no new event in memory try again. Occasionally the DAQ software will ask you to reset the ADCs. This can be done by pressing the small green button mounted on the left side of rack 2 near the scanner.
- PARAMETERS: Unless asked by an expert, leave all these settings alone.
- STOP RUN, PAUSE RUN, EXIT DAQ: self explanatory.

4 What to do on Shift

The aim of the FT test data shifts is to record a reasonable amount of data on each cell (usually about 1000K triggers per cell, but check what the current requirement is before you start!) of each chamber so that the construction and basic behaviour can be checked. Only half a chamber (14 cells) can be wired up in the tank at a time and it takes 5 days for the oxygen to be purged from the tank. Therefore, to test a chamber every two weeks requires that between Monday and Tuesday each week a complete half chamber is tested. This section will give you some tips for achieving this goal.

4.1 Preparing to Take Data

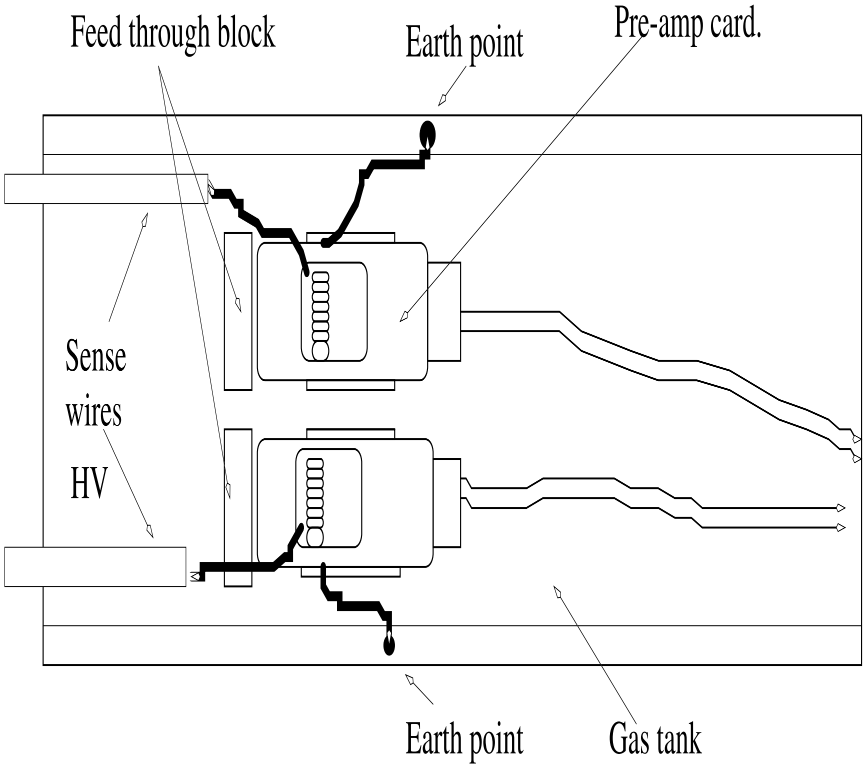

Figure 4: Diagram showing how pre-amp cards are connected to the feed throughs. Only the outer cards are shown (i.e. there is a second layer of cards below). Once the cards are plugged into the feed throughs, electrical connections for the sense wire HV and pre-amp ground must be made as described in the text.

Before turning anything on it is necessary to connect the pre-amps to the sense wires on the cells to be tested.

ALWAYS MAKE SURE EVERYTHING IS TURNED OFF (I.E. PRE-AMP POWER SUPPLY AND HV) BEFORE WORKING ON APPARATUS IN THE CLEAN ROOM; TO ENSURE SAFETY OF YOURSELF AND THE APPARATUS!!!

The black cables to the DAQ should already be connected to the pre-amp cards.

Up to four cells can be monitored simultaneously. To attach the pre-amp cards to the cell to be monitored:

- 1. Attach the card to the feed through connector (chips always facing outwards from the tank) as shown in figure 4. You will need to make sure the cables are supported other wise the cards can be wrenched from the plug - bending the connector pins.
- 2. Wire up the sense wire cables to the cards. The HV for the sense wires needs to be connected at the point shown in figure 4.
- 3. Wire the earth connectors to the cards at the point shown in figure 4. The other end should be screwed onto the tank at the point shown in the figure.
- 4. Connect the sense wire HV cables and the HV cables for the drift strips (should be clearly labelled!).
- 5. Double check everything!
- Ready to turn on ?

4.2 Turning On

Once you are sure you have correctly connected the pre-amps to the cells (see above) you are ready to turn on. Follow the procedure below, figure 3 should help.

- Make sure the plugs are turned on at the wall.
- Turn on the CAEN crate (turn the key).
- Turn on the rack containing the hodoscope power supply (stack 1). Then the power supply itself. If the hodoscopes are overlapping pressing "start" on the counter should now start the trigger counter.

- Turn on the power to the rack containing the trigger logic etc (stack 2).
- Turn on the pre-amp ADC power supply (bottom of stack 2)
- Once all other systems are on the MAC can be booted. To do this press the key on the top right of the keyboard.
- Ramp up the drift cage voltages on the CAEN, watch the currents.
- Once the drift voltages are ramped and the currents have stabilised, ramp up the sense wire HV.
- NB: If there is a major problem with the chamber it will likely become evident while ramping the HV up. Keep watching the currents while ramping!
- Place the hodoscope paddles above and below the cell to be tested.

4.3 Taking data

The pre-amp cards are connected, the HV on the drift cage and sense wires have been ramped and the cosmic trigger is setup. It's time to take some data!

Start the DAQ software and set the file output to none. Start a run and after a few events select peek to look at the data. If you can't see large signals there is a problem. Check the setup again! If everything looks reasonable record some data on the cell (see section 3.2).

After the run has finished move the hodoscopes to the next cell and repeat until all four cells are done. You will then need to ramp the HV down, turn off and reconnect the pre-amp cards to the next set of feed-throughs. Repeat until all 14 cells have been tested.

4.4 Turning Off

Reverse the "Turn on" Procedure. To shutdown the MAC select *Special* then *Shutdown*.

4.5 Before you leave

Please write down everything you do in the log-book. Take note of the currents and voltages, what data you record on which cells, which cables were connected at the time etc, etc, etc. This information is vital when people look at the data at a later date!!!

If there is a major problem please tell Gary Markey and/or Graham Haoughton and notify others via email.

Make sure the pre-amp/ADC power supply is off. If you need to leave the HV on, put the warning signs on the tank.

5 In Case of Trouble...

DON'T PANIC.
Ask somebody from Daresbury first (Gary or Graham) - they are very helpful. For software try Dave Sankey or John Morris.
For DAQ try Scott Kolya.
For really big problems try Tim Greenshaw.

5.1 Forward Tracker Upgrade Group

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References

[1] http://www-h1.desy.de/h1/www/h1det/tracker/fdet/poster.html

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/ud53/mike/doc/reports/FTmanuel/.*