

G-2 tracker DAQ

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G-2 DAQ workshop
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The g-2 DAQ software uses MIDAS

Event builder, combines the events from the different frontends

Master GM2 stores the trigger information (begin of fill)

Straws frontend collects the straws data into a MIDAS bank

Slow Controls frontend records monitoring data (currents, temperatures etc.)

High Voltage frontend Monitors the high voltage supply and issues an alarm if the HV trips

The screenshot shows the MIDAS Tracker DAQ interface with the following sections:

- Run Status:** Run 28 Running, Start: Tue Apr 11 10:36:13 2017, Running time: 1h33m16s, Data dir: /data/midas, Alarms: On, Restart: Yes, Experiment Name: gm2.
- Equipment Table:**

Equipment	Status	Events	Events[/s]	Data[MB/s]
EB	EB@g2tracker0.fnal.gov	10903	9.9	0.009
MasterGM2	MasterGM2@g2tracker0.fnal.gov	0	0.0	0.000
StrawTrackerDAQ	StrawTrackerDAQ@g2tracker0.fnal.gov	10901	5.0	0.004
StrawTrackerLVandSC03	StrawTrackerLVandSC03@g2tracker1.fnal.gov	0	0.0	0.000
StrawTrackerHV03	StrawTrackerHV03@g2tracker1.fnal.gov	0	0.0	0.000
- Logging Channels Table:**

Channel	Events	MiB written	Compr.	Disk level
#0: run00028.mid.gz	10895	1.531	N/A	34.2%
- Clients Table:**

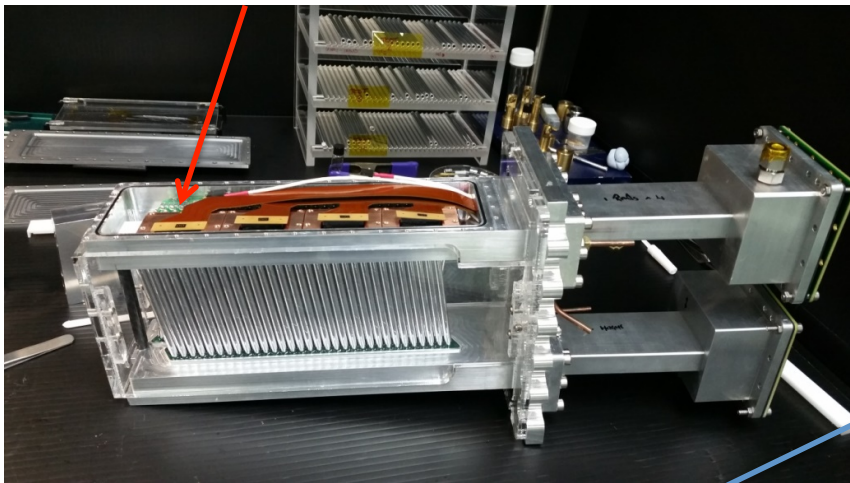
mserver [g2tracker0.fnal.gov]	mhttpd [g2tracker0.fnal.gov]	Ebuilder [g2tracker0.fnal.gov]
Logger [g2tracker0.fnal.gov]	MasterGM2 [g2tracker0.fnal.gov]	StrawTrackerLVandSC03 [g2tracker1.fnal.gov]
StrawTrackerDAQ [g2tracker0.fnal.gov]	StrawTrackerHV03 [g2tracker1.fnal.gov]	

Straw Tracker Readout Chain

The straw tracker DAQ has a hierarchical structure through the various layers of electronics

The straws are readout by **ASDQs** :

- 1 ASDQ board for 16 straws
- 8 ASDQ boards per tracker module



The data is passed to the **TDCs** :

- 2 TDCs per TDC board
- 1 TDC per ASDQ

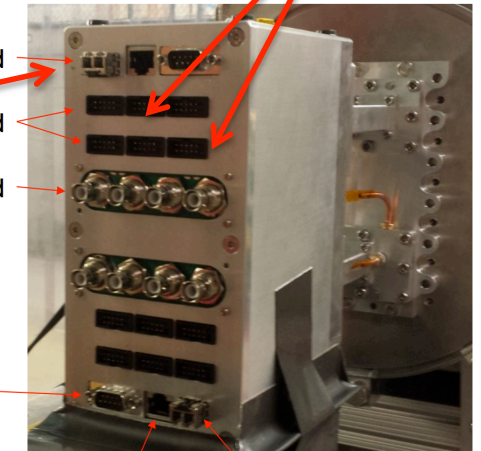
The **logic board** collates the data from 4 TDCs (2 LBs per tracker module)

Logic Board

TDC Board

HV Board

Power

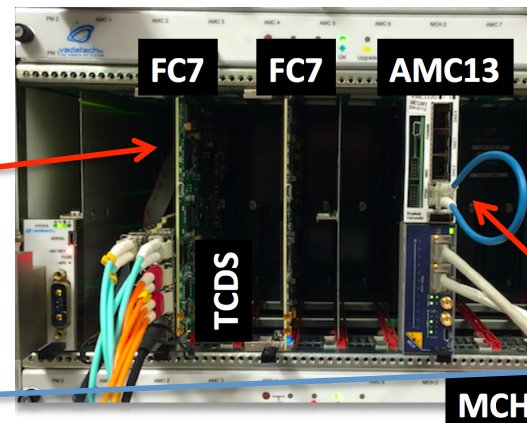


Slow Control

CLK/Data

The data from the logic board is passed to the **FC7** :

- Reads data from 16 logic boards
- 1 FC7 per tracker station



The data from all FC7s is passed to the **AMC13** and read into the **PC**

MC-1 setup

We have 8 trackers installed, cabled and taking data



Each tracker has HV cables, fibres, slow control lines and low voltage power cables

The rack contains the uTCA crate, HV and LV supplies

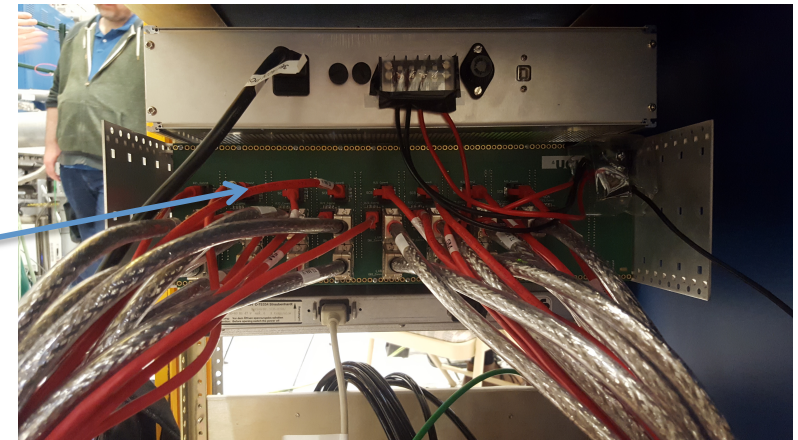


MC-1 setup

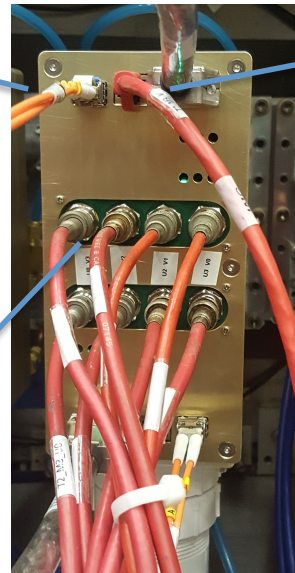
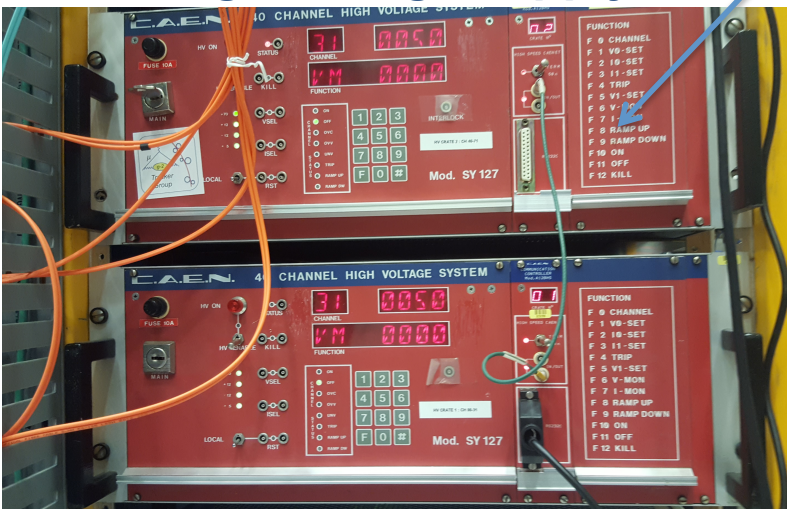


uTCA crate (FC7, AMC13)

Low voltage supply



High voltage supply



Straw Tracker DAQ Frontend



The Straws frontend reads the data from the AMC13 and sends it to the event builder where it is written out in MIDAS banks

- Configures all the electronics boards according to the settings in the ODB
- Polls for events from the AMC13 either via fibre or I2C
- The settings page allows for easy configuration of common parameters

Tracker-2 Settings

FC7-2 Settings

ID	Enabled	Present	Number Of LBs
4	y	y	16

[change TDC thresholds](#)

LB-0 Settings

ID	0
Present	y
Enabled	y
Number of TDCs	4
LV channel	2
LV output	0

LB-1 Settings

ID	1
Present	y
Enabled	y
Number of TDCs	4
LV channel	2
LV output	1

LB-2 Settings

ID	2
Present	y
Enabled	y
Number of TDCs	4
LV channel	3
LV output	0

LB-3 Settings

ID	3
Present	y
Enabled	y
Number of TDCs	4
LV channel	3
LV output	1

TDC-0

ID	0
Present	y
Enabled	y
DTHR threshold	200
Channel mask	65535

TDC-1

ID	1
Present	y
Enabled	y
DTHR threshold	200
Channel mask	65535

TDC-2

ID	2
Present	y
Enabled	y
DTHR threshold	200
Channel mask	65535

TDC-3

ID	3
Present	y
Enabled	y
DTHR threshold	200
Channel mask	65535

Straw Tracker DQM

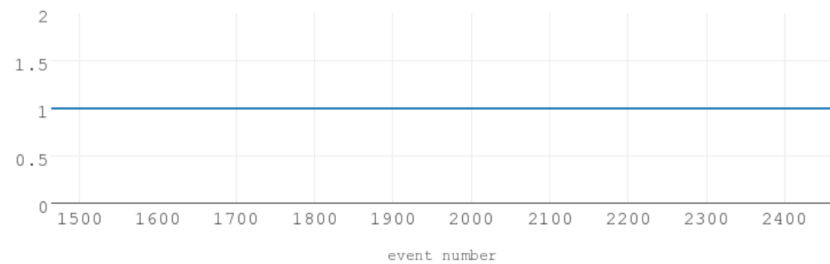


The Straw Tracker DQM run online using the art framework to display useful information : g2tracker0.fnal.gov:3344

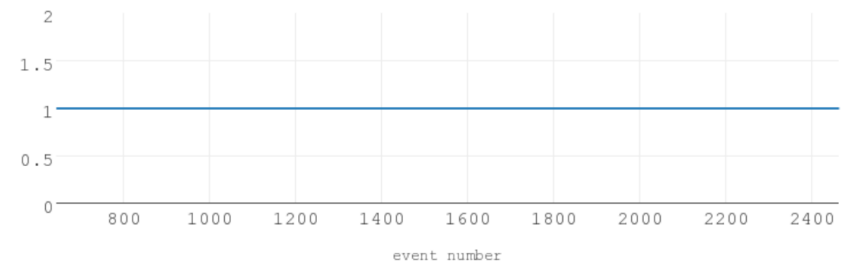
Overview

Page with overview plots on

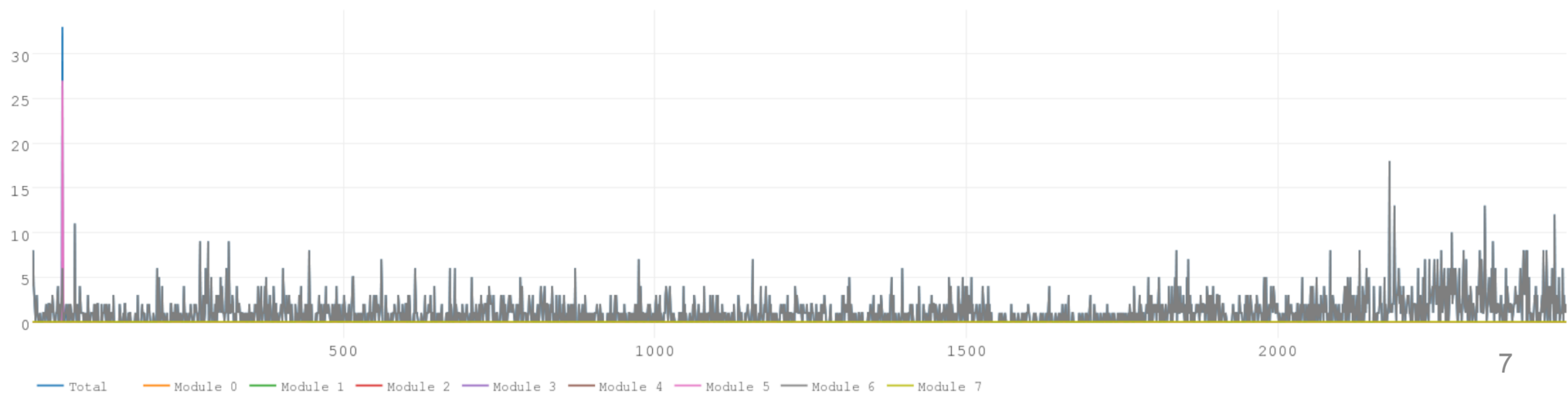
Tracker Data In Event



Completed Unpacking per Event



Number of Hits Per Event



Straw Tracker DQM

There is a page for each tracker station displaying the number of hits on each straw

Buttons to turn the display of different modules on/off



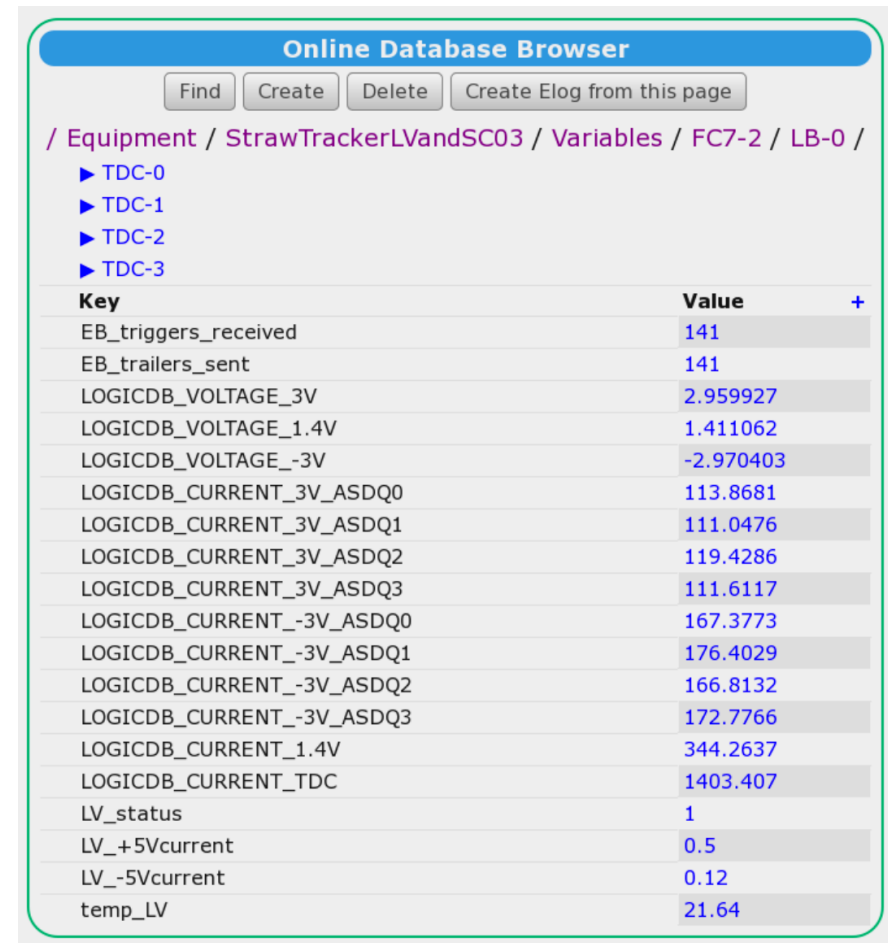
The data here is from 3 modules we had running in lab 3

The orange shows layer 0 and the blue layer 1

Straw Tracker LV and SC

The Low Voltage and Slow Controls frontend controls the USB connection to the tracker and records monitoring information – temperatures, voltages...

- **The monitoring variables** are read about once a minute (adjustable from the ODB)
 - Temperatures
 - Currents
 - Voltages
 - DAQ errors
- The values are recorded in both the **ODB** and in the **postgres database**
- The frontend is independent of the event builder
- There is a Slow Control Monitoring page to observe the variables
- Alarms in MIDAS are thrown based on these variables



Online Database Browser

Find Create Delete Create Elog from this page

/ Equipment / StrawTrackerLVandSC03 / Variables / FC7-2 / LB-0 /

- ▶ TDC-0
- ▶ TDC-1
- ▶ TDC-2
- ▶ TDC-3

Key	Value	+
EB_triggers_received	141	
EBtrailers_sent	141	
LOGICDB_VOLTAGE_3V	2.959927	
LOGICDB_VOLTAGE_1.4V	1.411062	
LOGICDB_VOLTAGE_-3V	-2.970403	
LOGICDB_CURRENT_3V_ASDQ0	113.8681	
LOGICDB_CURRENT_3V_ASDQ1	111.0476	
LOGICDB_CURRENT_3V_ASDQ2	119.4286	
LOGICDB_CURRENT_3V_ASDQ3	111.6117	
LOGICDB_CURRENT_-3V_ASDQ0	167.3773	
LOGICDB_CURRENT_-3V_ASDQ1	176.4029	
LOGICDB_CURRENT_-3V_ASDQ2	166.8132	
LOGICDB_CURRENT_-3V_ASDQ3	172.7766	
LOGICDB_CURRENT_1.4V	344.2637	
LOGICDB_CURRENT_TDC	1403.407	
LV_status	1	
LV_+5Vcurrent	0.5	
LV_-5Vcurrent	0.12	
temp_LV	21.64	

Straw Tracker Power Page



There is a straws power page to show the LV status with buttons to power the Low and High voltage (on or) off

Low Voltage Status

Tracker	Logic Board	On	+5V current	-5V current	Temperature		
2	0	1	0.49	0.11	21.44	on	off
2	1	1	0.46	0.1	21.34	on	off
2	2	1	0.51	0.12	24.14	on	off
2	3	1	0.45	0.12	24.24	on	off
2	4	1	0.55	0.11	NAN	on	off
2	5	1	0.47	0.11	NAN	on	off
2	6	1	0.5	0.11	22.83	on	off
2	7	1	0.47	0.11	22.93	on	off

All tracker power

Tracker uTCA On Tracker uTCA Off
All HV On All HV Off

Tracker Power On

Tracker 2 LV On Tracker 2 HV On

Tracker Power Off

Tracker 2 LV Off Tracker 2 HV Off

Recent Relevant Messages

```
1492182229 10:03:49.338 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 started
1492182127 10:02:07.597 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 stopped
1492182118 10:01:58.868 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 started
1492181877 09:57:57.918 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 stopped
1492181868 09:57:48.185 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 started
1492181627 09:53:47.658 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 stopped
1492181626 09:53:46.564 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 started
1492181602 09:53:22.613 2017/04/14 [LVpower,INFO] Program LVpower on host g2tracker1 started
```

The boards that are enabled are displayed (to make it more readable)

The messages at the bottom will show any errors when the power scripts are run

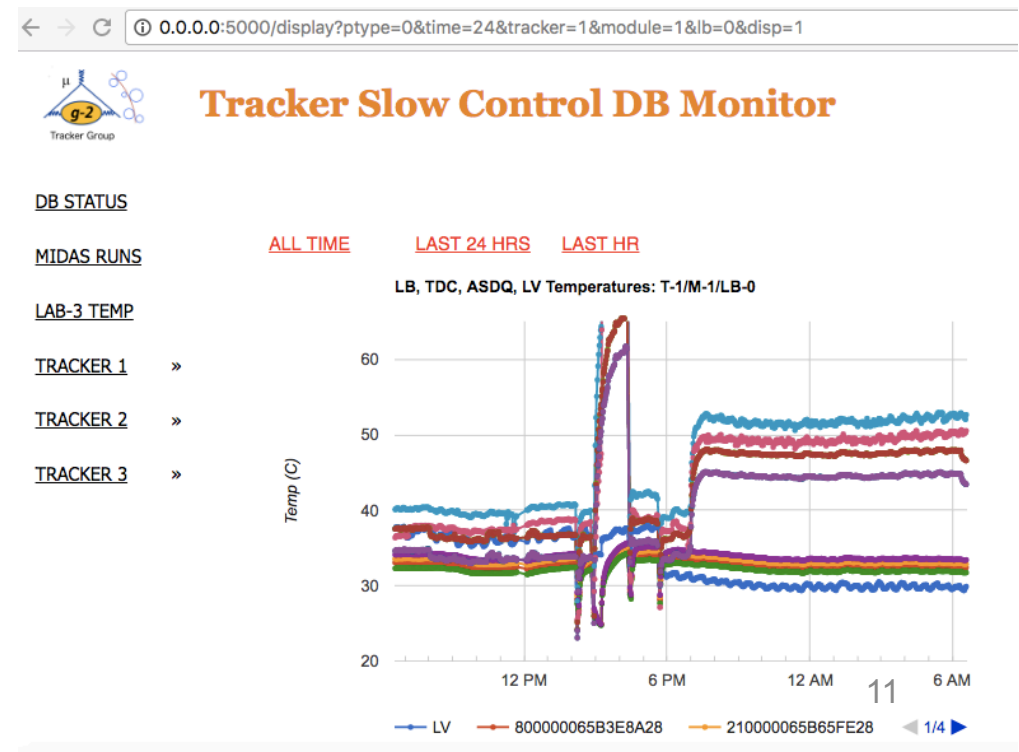
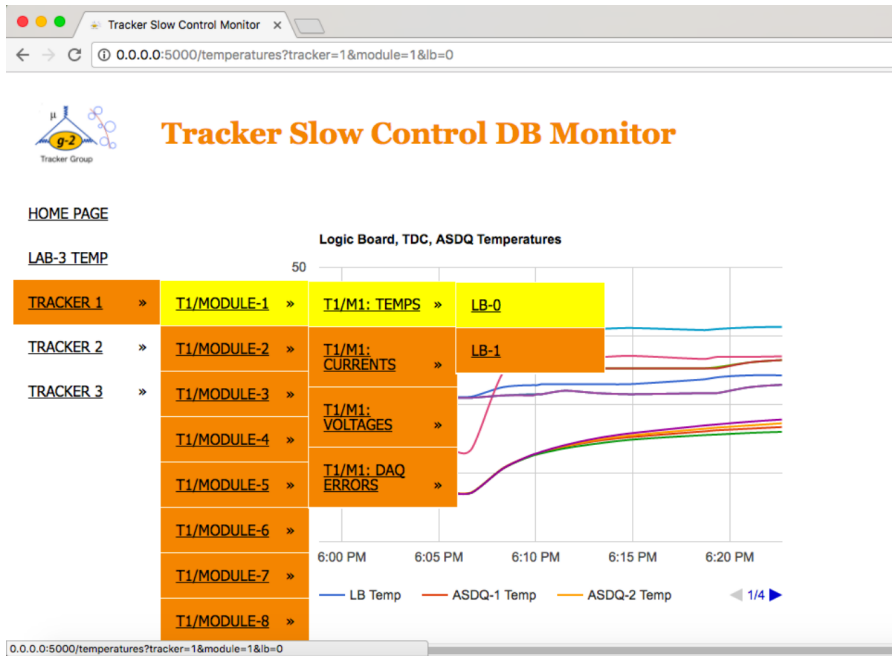
Slow Controls Monitoring Page



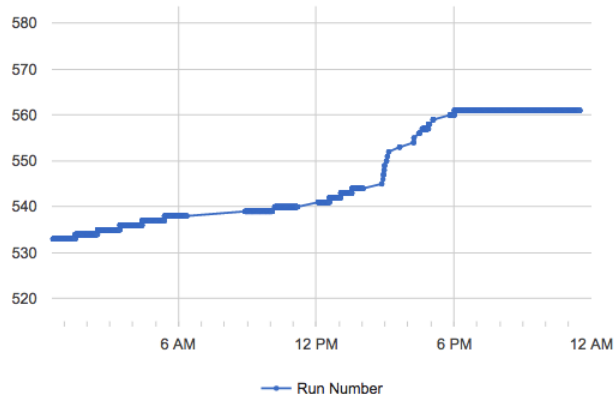
Plots of the slow control variables read from the postgres database are displayed on a webpage : g2tracker0.fnal.gov:5000

The navigation bar on the left allows you to look at the different tracker modules

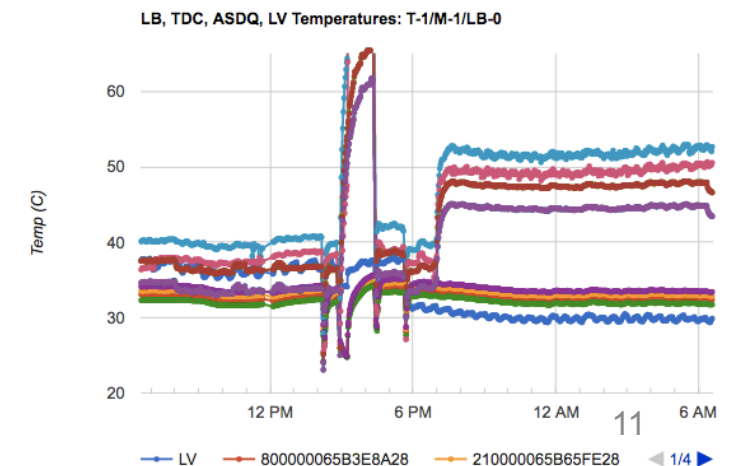
There are displays for temperatures, currents, voltages and DAQ errors



ALL TIME LAST 24 HRS LAST HR

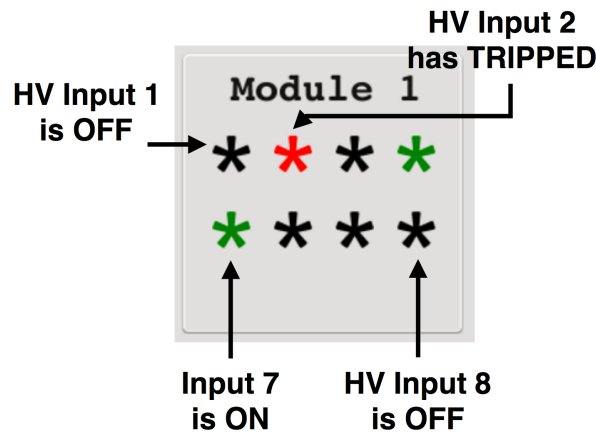


ALL TIME LAST 24 HRS LAST HR



Straw Tracker High Voltage

The HV GUI monitors and displays the high voltage supply to the tracker modules. The HV frontend reads the data written by the GUI and throws an alarm in case of trips



CAEN SY127 High Voltage System GUI showing status for 8 modules. Legend: Black = OFF, Green = ON, Red = TRIP, Blue = RAMP DOWN, Yellow = RAMP UP, Orange = CH is ON but HV_ENABLE is OFF.

The status of the HV is also displayed in the slow controls monitoring page

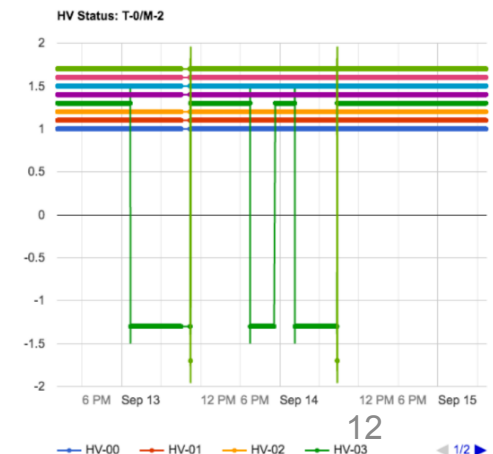
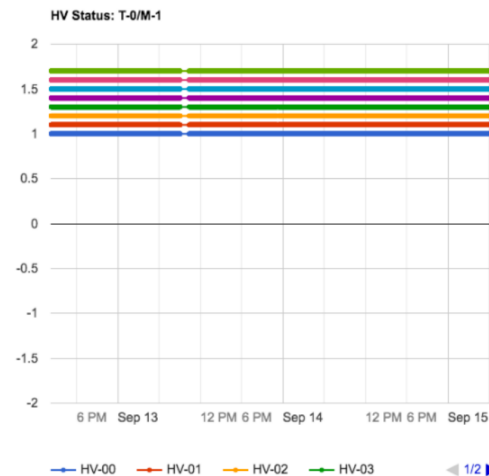
Run Status: Start: Wed Sep 14 03:43:13 2016, Stop: Wed Sep 14 04:41:38 2016. Experiment Name: gm2. Alarms: On. Run 719 Stopped. Start button.

Equipment Table:

Equipment	Status	Events	Events[/s]	Data[MB/s]
EB	Ebuilder@gm2straw6.fnal.gov	200079	0.0	0.000
MasterGM2	MasterGM2@gm2straw6.fnal.gov	0	0.0	0.000
StrawTrackerDAQ	StrawTrackerDAQ@gm2straw6.fnal.gov	200079	0.0	0.000
LVandSC01	LVandSC01@gm2straw6.fnal.gov	0	0.0	0.000
StrawTrackerHV	StrawTrackerHV@gm2straw6.fnal.gov	0	0.0	0.000

Logging Channels Table:

Channel	Events	MIB written	Compr.	Disk level
run00719_mid.gz	200081	55.264	N/A	47.7 %



MIDAS integration



The tracker DAQ has been integrated into the main MIDAS experiment for g-2

The image shows a computer monitor displaying two web-based monitoring interfaces. The top interface is a Grafana dashboard titled 'g2be2-DAQ-Monitor' showing various performance metrics for the g2be2 system. The bottom interface is the 'Straw Tracker DQM' overview page, which includes a table of equipment status and a plot of calo 23 traces.

Equipment Status Table:

Equipment	Status	Events	Event(f/s)	Data(MB/s)
MapleGR2	Frontend stopped	34392	29.9	0.032
EB	Frontend stopped	34398	29.9	101.044
AMC1303	Frontend stopped	7250	0.0	0.000
AMC1304	Frontend stopped	914	0.0	0.000
AMC1305	Frontend stopped	10396	0.0	0.000
AMC1311	Frontend stopped	2498	0.0	0.000
AMC1312	Frontend stopped	12031	0.0	0.000
AMC1314	Frontend stopped	0	0.0	0.000
AMC1300	Frontend stopped	34400	30.6	0.034
AMC1307	Frontend stopped	12078	0.0	0.000
AMC1308	Frontend stopped	3586	0.0	0.000
AMC1310	Frontend stopped	4718	0.0	0.000
AMC1316	Frontend stopped	4892	0.0	0.000
AMC1313	Frontend stopped	3138	0.0	0.000
AMC1317	Frontend stopped	1931	0.0	0.000
AMC1320	Frontend stopped	0	0.0	0.000
AMC1322	Frontend stopped	521	0.0	0.000
AMC1326	Frontend stopped	34398	21.3	2.830
AMC1318	Frontend stopped	0	0.0	0.000
AMC1321	Frontend stopped	258	0.0	0.000
AMC1329	Frontend stopped	34398	29.9	9.974
AMC1325	Frontend stopped	34394	21.8	22.094
IBM DataBot	Frontend stopped	0	0.0	0.000
AMC1324	Frontend stopped	24384	24.0	9.099
AMC1309	Frontend stopped	4546	0.0	0.000
StrawTrackerDAQ	Frontend stopped	34398	21.3	0.000
StrawTrackerDAQ	Frontend stopped	0	0.0	0.000
StrawTrackerDAQ	Frontend stopped	0	0.0	0.000
AMC1318	Frontend stopped	0	0.0	0.000
msb119	Frontend stopped	27	0.3	0.000
msb110	Frontend stopped	26	0.0	0.000
msb174	Frontend stopped	26	0.0	0.000
msb303	Frontend stopped	27	0.3	0.000
msb134	Frontend stopped	27	0.0	0.000
AMC1315	Frontend stopped	3026	0.0	0.000

Calo 23 Traces: The plot shows ADC counts versus sample number for 23 channels. The first trace (xtal 0) shows a sharp peak at sample 10. The remaining traces show a series of smaller peaks, with the 13th trace (sample 13) highlighted in red.

- The g-2 DAQ system uses MIDAS with uTCA hardware
- The tracker DAQ has been reading data out of the 8 modules in the ring
- There are a variety of tools for data quality monitoring
 - Data DQM web pages
 - Slow controls monitoring pages
 - High Voltage monitoring GUI
- Testing, improvement and bug fixing is ongoing in MC1