Booster Loss Monitor Data Logging

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Architecture

Open Access Client, BLMLOG

BLMLOG is a Java Open Access Client front-end running on the Data Acquisition Engine DUE06. Its function is to acquire and log reset, charge, and beam loss data for the Booster. It also logs Chipmunk data.

BLMLOG utilizes the data logger's client logging functions to push data into a data logger as opposed to normal data logger scheduled data acquisition and logging. This is because the collected raw data is composed of double precision floating point, an unsupported raw data format, and each collection collects nearly 40,000 doubles and much of it is unchanging data.

BLMLOG logs double precision IEEE floating point values with millisecond time stamp resolution of data sufficient to reconstruct the Booster loss monitor data at two minute intervals.

BLMLOG logs Chipmunk background and normalized beam data as sufficient integrations accumulate; an hour of no beam and beam respectively are the minimum integration times.

Data Collection Devices

Loss monitor, charge, and reset information is gathered from the loss monitor front ends. The collected loss monitors number 75 and are named: B:LMS021-026, BLMS121-126, B:LMS401-408, B:LMSDF1-2, B:LMSL01-24, B:LMSRB0, B:LMSRB2, B:LMSRB5-6, B:LMSRD3, B:LMSS01-24. The loss monitor data is composed of 12 groups of 40 double values, where 12 spans the number of unique Booster reset events supported and 40 represents losses in the first 39 milliseconds since reset and the last value represents the sum of the loss of the former. Each double value is an incrementing sum since the front-end cleared its sums.

Charge data is collected from device B:LMSCHG. Charge data is composed similarly to loss data, 12 groups of 40 double values representing incrementing sums.

Reset data is collected from device B:LMSCE. Reset data is composed of double values representing the sum of resets for 12 reset types. The reset order within the data is 0x11, 0x12, 0x13, 0x14, 0x15, 0x16, 0x17, 0x19, 0x1c, 0x1d, 0x10 (representing the sum of other resets) and the last one is undefined.

Chipmunk data spans devices G:RD0192 through G:RD0203, G:RD0208 through G:RD0219, and G:RD0224 through G:RD0251.

Data Collection Retrieval

A data acquisition job is started requesting the Chipmunk, loss monitor, charge, and reset data on repetitive event of a software state transition of device V:BLMLOG. BLMLOG periodically raises the state transition begin collection event (value of 1). On OnRepetitive pools on receipt of the state transition transfer the request to one-shot front-end pools. The deepest one-shot front-end pool contains 12 devices that must be collected serially due to their data return length, yet the average collection time is under 500 milliseconds. V:BLMLOG is also set to values 2 and 3 for Chipmunk integration and background completion respectively.

Raw Data Collection Processing

The entire loss monitor raw data of 75 * 12 * 40 (devices, resets, samples) double values are logged at BLMLOG startup. The previous collection of raw data is saved in memory to detect changes in resets and charges. When the reset device, B:LMSCE, indicates a reset and the charge device, B:LMSCHG, indicates a charge, the 75 * 40 (devices, samples) are logged for that reset as well as the charge and reset data. The data is logged to an array element of the loss, charge, and reset devices where indices 0 – 11 are mapped to the reset order within the data as specified above, e.g. reset 0x11 is in array element 0, reset 0x1d is in array element 9, and the total across all resets is in array element 10. The timestamps of the logged raw data are identical and equal to the time of the software state transition detection time.

Difference Data Collection Processing

When the reset device, B:LMSCE, indicates a reset and the charge device, B:LMSCHG, indicates a charge the difference of 75 * 40 (devices, samples) are logged for that reset as well as the charge and reset data. The data is logged to an array element of the loss, charge, and reset devices using an array element equal to the decimal equivalent of the reset event, e.g. reset 0x11 is in array element 17, reset 0x1d is in array element 29, and the totals reset (0x10) is in array element 16. The timestamps of the logged raw data differ by a millisecond (1-40) and begin at the time of the software state transition detection time

Totals Data Collection Processing

Since each data collection can encompass several and multiple resets, the device B:LMRSUM is logged with a double value of the number of resets (when non-zero) detected by the last two collections. The devices B:LMCSUM and B:LMLSUM are logged with 40 double values representing the summed charge and loss data of the last two collections. The device B:LMEVNT is logged with each reset event that was detected within the last two collections. The totals' reset (0x10) does not contribute to the summed data.

Availability

The device Z:BLMLOG is logged on each successful collection with a value of 1.0 and is logged with a value of 0.0 when the collection experienced a data acquisition error. The device indicates the availability of BLMLOG.

Chipmunk Data Processing

The Chipmunk data is collected to determine background rates and to calculate normalized dose rates. A background collection is started when 5 consecutive samples (at least 10 minutes) indicate no beam. A normal background is completed and logged after an additional one hour of no beam. The background devices are of the form B:BKnnnn where nnnn ranges from 0192 to 0251 and have values equal to the average background reading.

The Chipmunk data is collected to determine normalized rates. An integration for normalization is started after 5 samples of beam have been detected and continues while the number of no beam samples remains less than the number of beam samples and the number of consecutive no beam samples remains less than 10 (5 minutes) and will complete after an hour (30 beam samples if continuous beam).

The beam intensity must meet certain criteria for integration to continue. A lower limit of charge per reset is defined by device B:NRCHGL. Its setting may be set on a parameter page. The reading property reflects the last integration's sample of charge per reset.

The beam intensity variation for continuing integration is controlled by device B:NRCHGR. A parameter page may be used to set the percentage variation allowed between the current intensity reading and the average of the accumulated intensities. The reading property reflects the last integration sample's variance from the accumulated average intensity.

The average beam intensity updated throughout the integration is found in the device B:NRCHGA and is logged when an integration completes.

The highest normalized reading is reflected in device B:NRMAXR. The Chipmunk number of the device with the highest normalized reading is reflected in device B:NRMAXI. When B:NRMAXI's value is 240, the Chipmunk with the highest normalized reading is G:RD0240. These devices are updated throughout the integration and logged when an integration completes

The normalized data devices are of the form B:NRnnnn where nnnn ranges from 0192 to 0251 and have values equal to the ratio of calculated dose due to beam at a normalized charge to the limit of calculated dose for each Chipmunk.

The dose limit devices are of the form B:CLnnnn where nnnn ranges from 0192 to 0251 and range in value from 0.4 to 50.0 mRem/hour. These limits may be set on a parameter page and are logged on each normalized data set completion.

The normalized charge device is B:CLCHG (presently 1.2E16) and may be set on a parameter page and is logged on each normalized data set completion.

The raw total charge device for the collection period is B:NRCHG and is logged on each normalized data set completion. The raw total charge is calculated from the integrated charges for each reset type at the beginning and end of collection and the index determining the time within the cycle for this calculation is controlled by device B:NRINDX (presently 10) which may be set on a parameter page and is logged on each normalized data set completion.

All of the normalization logged times will be at the time of the last collection.

When a Chipmunk background and a Chipmunk integration is logged, the state transition

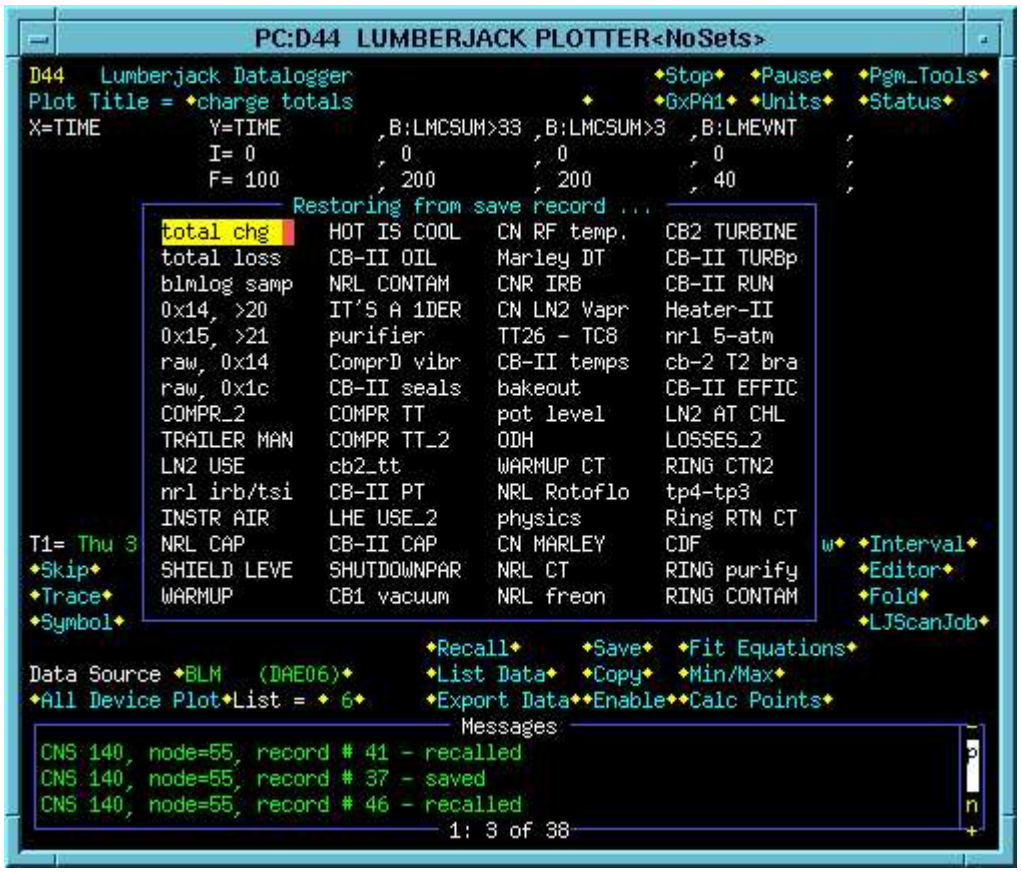
Data Logger

BLM

The data logger BLM is the repository of this data. The data logger BLM2 is associated with this facility.

Data Logger Plotter Save/Recall Examples

ACNET Page D44, Lumberjack Plotter, supports plot setup save and recall. The visual examples of beam loss plotting are taken from the first few save/recall slots. On page D44, select BLM for DataSource, select Recall and the following image appears:

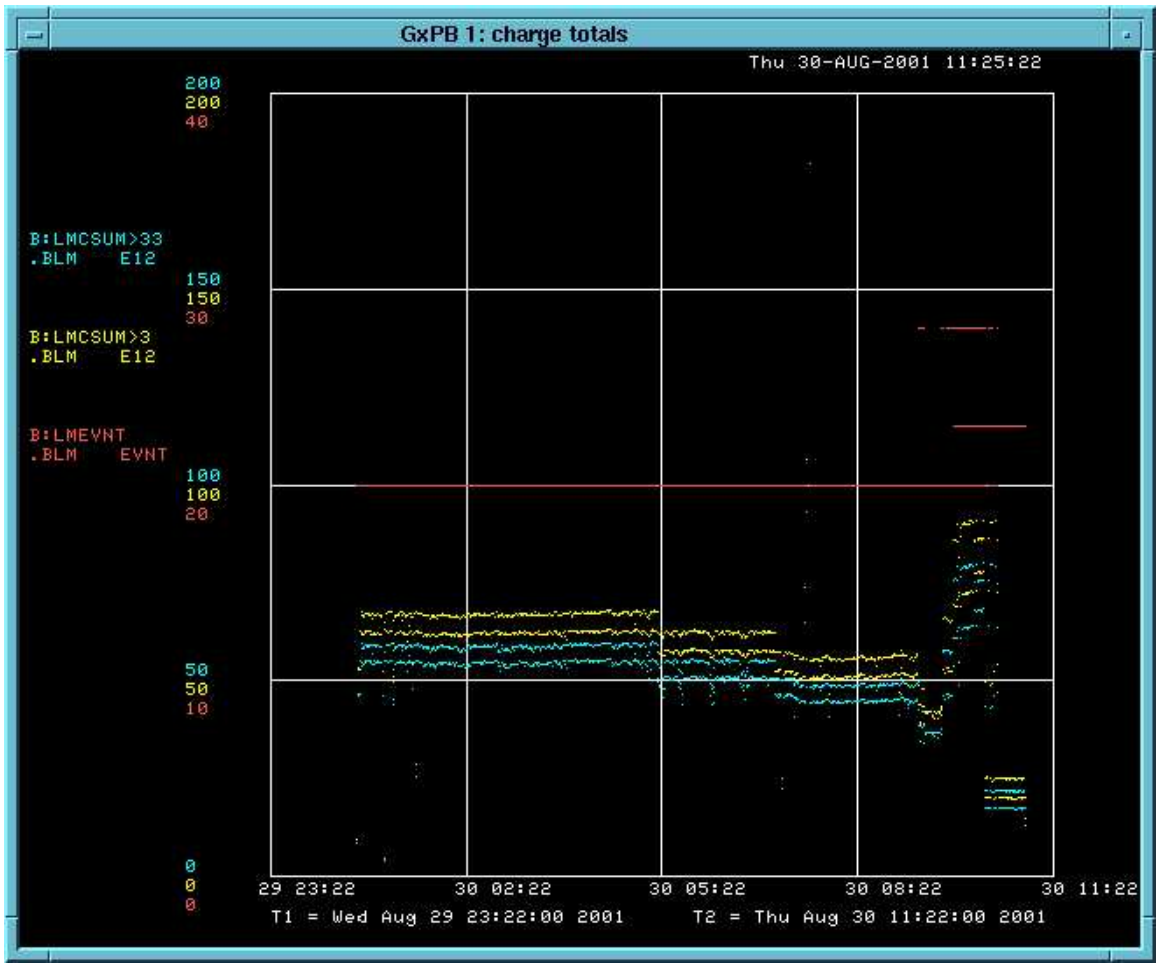


Plot Examples

Total Charge

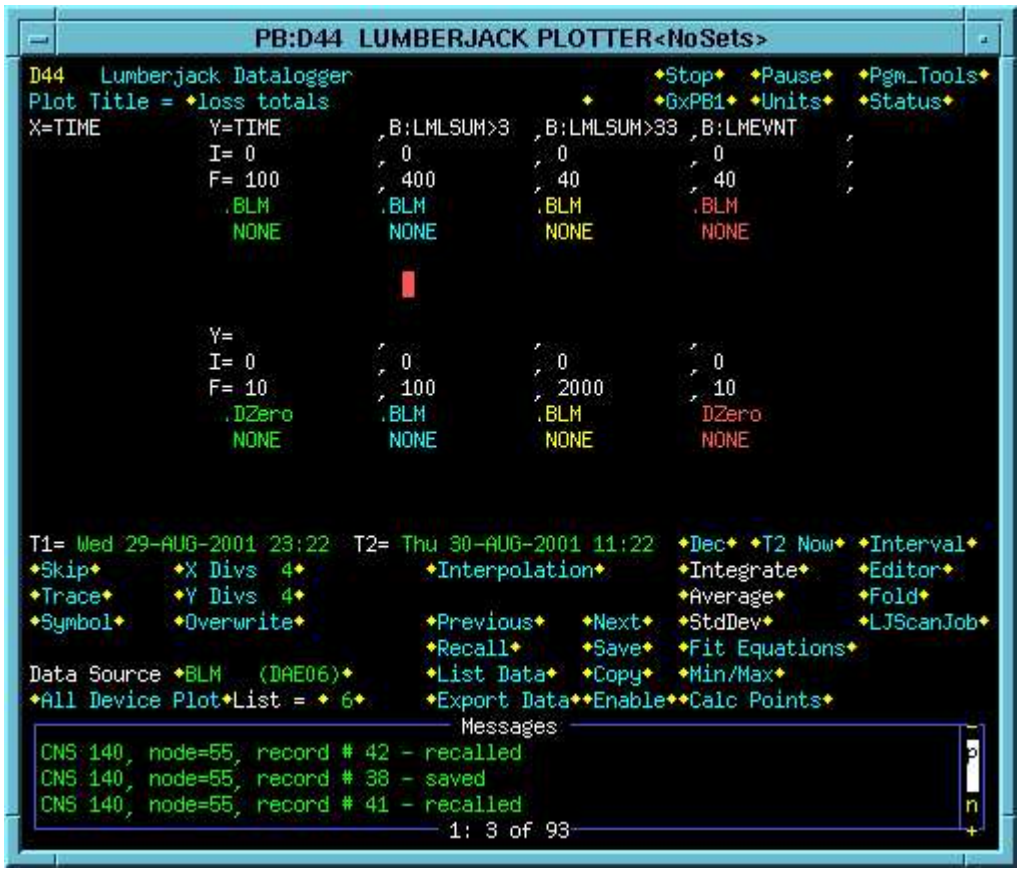
The total charge change at millisecond markers 33 and 3 as well as the detected reset events for a 12 hour period are demonstrated.

The yellow and cyan traces indicate the change in charge accumulators between two collections at millisecond markers 3 and 33 respectively. The red trace indicates reset event 20. (0x14) as well as reset events 0x17 and 0x1B.

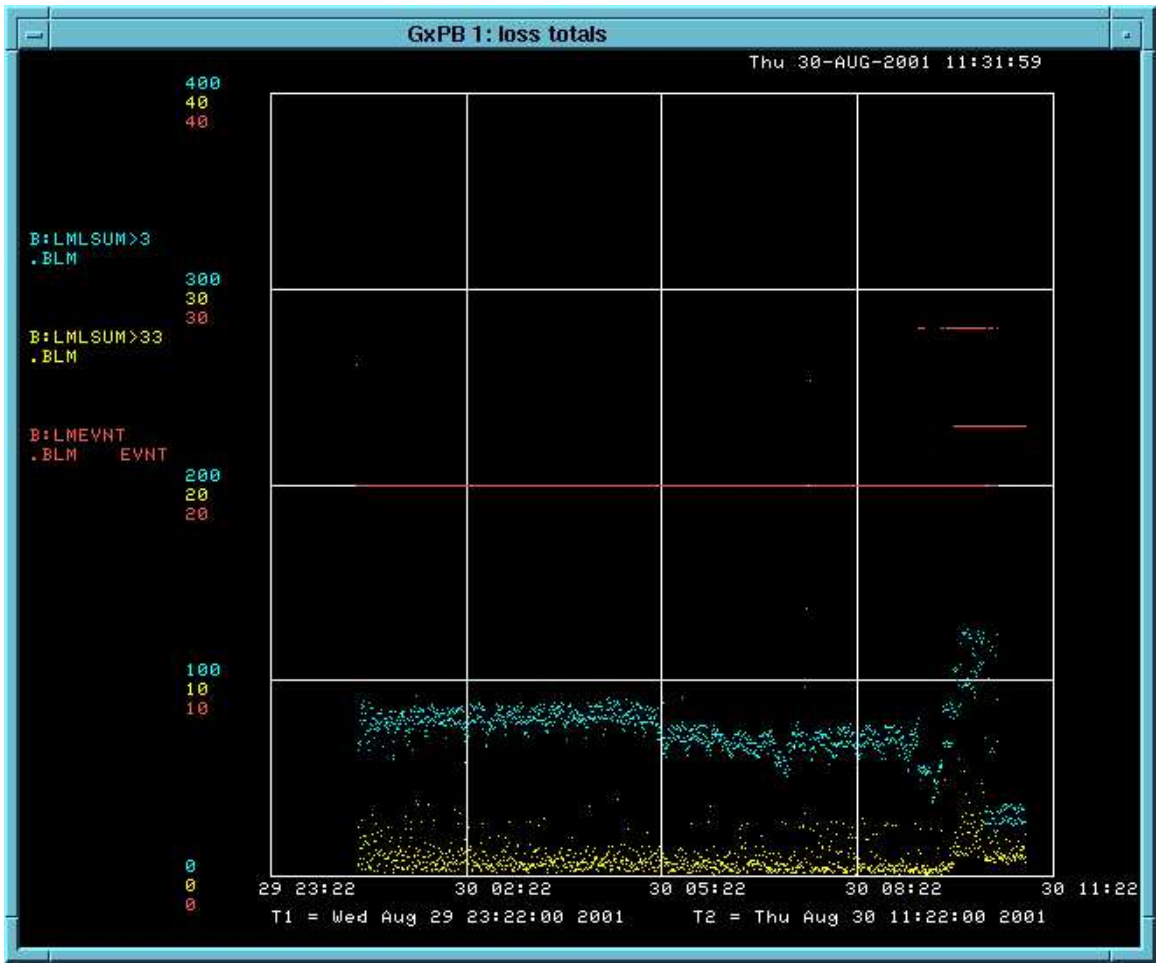


Total Loss

The total loss change at millisecond markers 33 and 3 as well as the detected reset events for a 12 hour period are demonstrated.

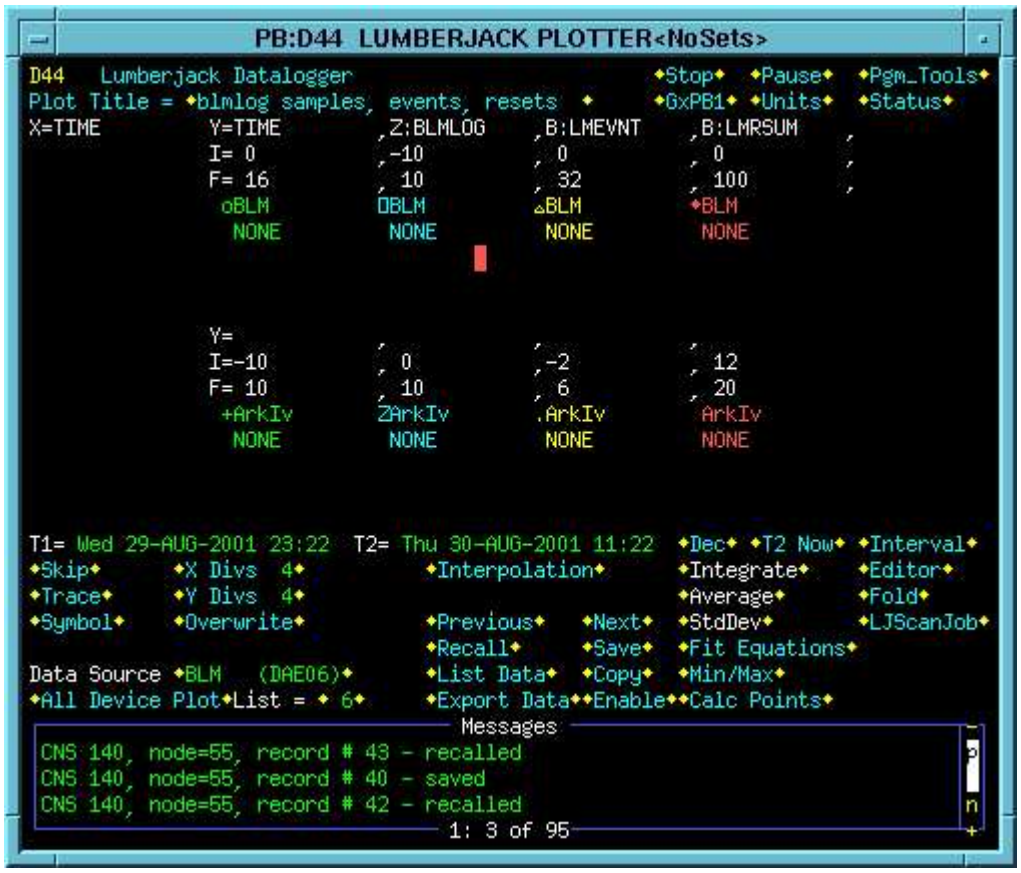


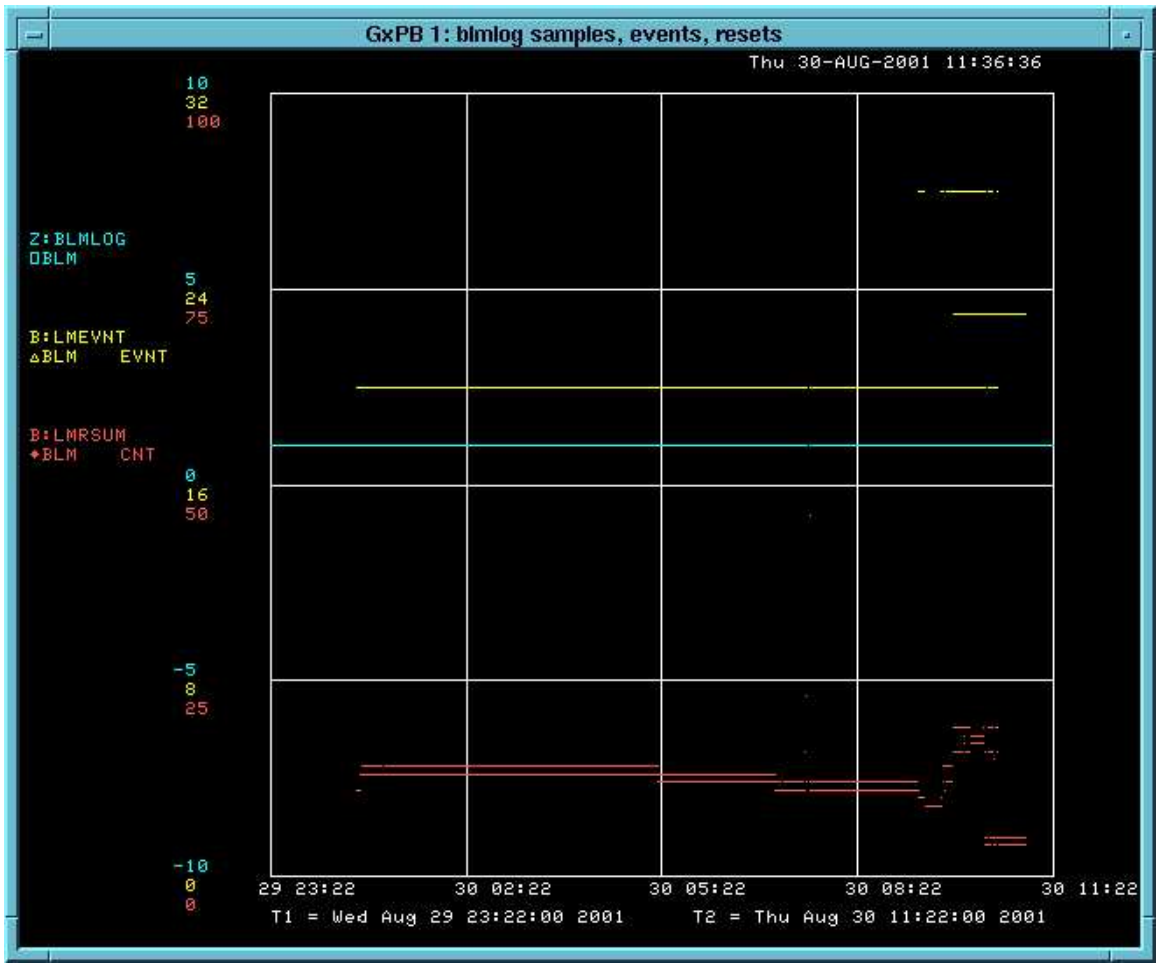
The yellow and cyan traces indicate the change in charge accumulators between two collections at millisecond markers 33 and 3 respectively. The red trace indicates reset event 20. (0x14) as well as reset events 0x17 and 0x1B.



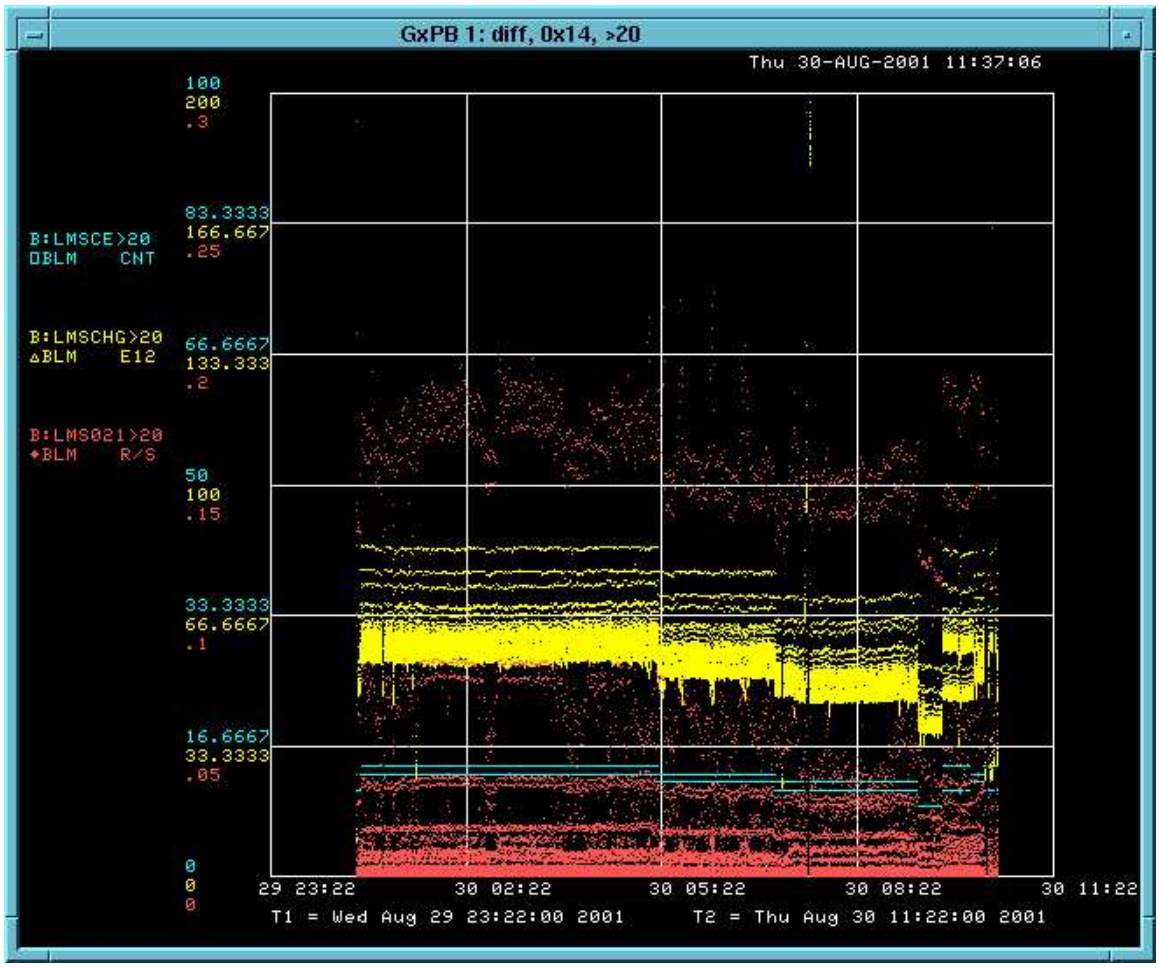
Availability

The data sampling device, detected events device and reset sum between two collections:

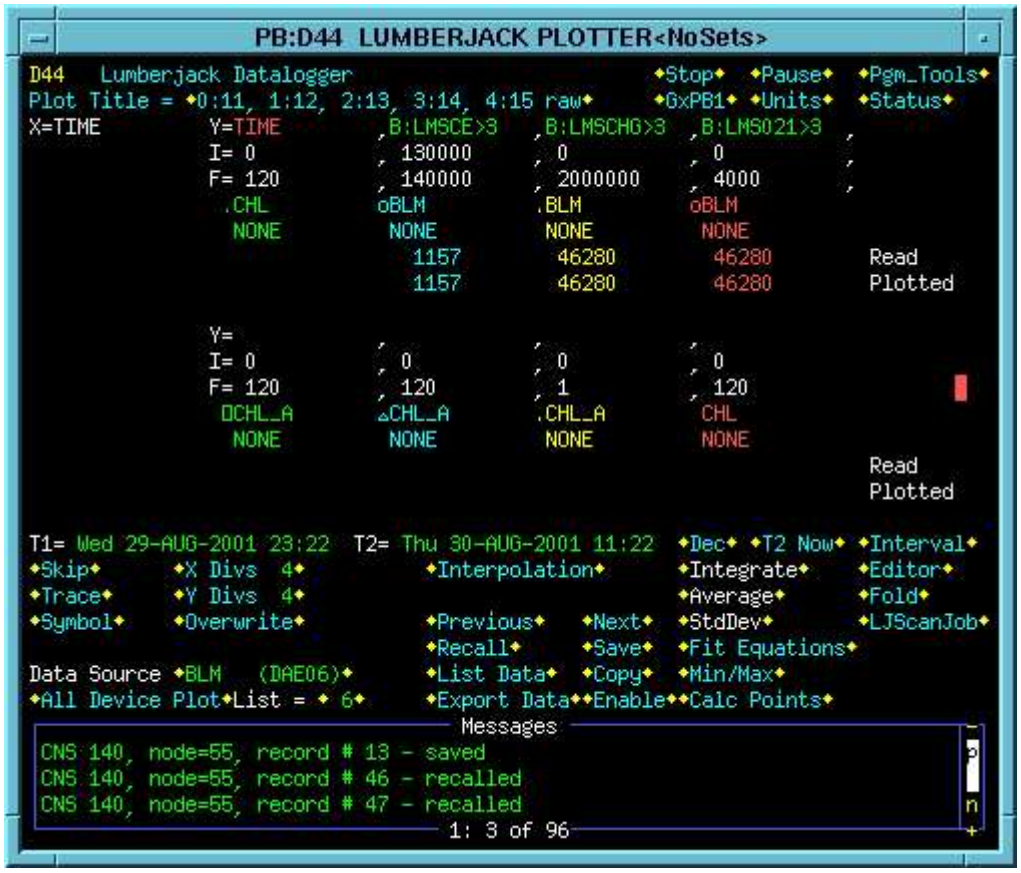

PB:D44 LUMBERJACK PLOTTER<NoSets>
D44 Lumberjack Datalogger
Plot Title = blmlog samples, events, resets
Stop
Pause
Pgm_Tools
GxPB1
Units
Status
X=TIME
Y=TIME
Z:BLMLOG
B:LMEVNT
B:LMRSUM
I= 0
F= 16
-10
10
32
100
oBLM
BLM
NONE
Y=
I=-10
F= 10
0
-2
12
6
20
ArkIv
T1= Wed 29-AUG-2001 23:22
T2= Thu 30-AUG-2001 11:22
Dec
T2 Now
Interval
Skip
X Divs 4
Interpolation
Integrate
Editor
Trace
Y Divs 4
Average
Fold
Symbol
Overwrite
Previous
Next
StdDev
LJScanJob
Recall
Save
Fit Equations
Data Source
BLM (DAE06)
List Data
Copy
Min/Max
All Device Plot
List = 6
Export Data
Enable
Calc Points
Messages
CNS 140, node=55, record # 43 - recalled
CNS 140, node=55, record # 40 - saved
CNS 140, node=55, record # 42 - recalled
1: 3 of 95

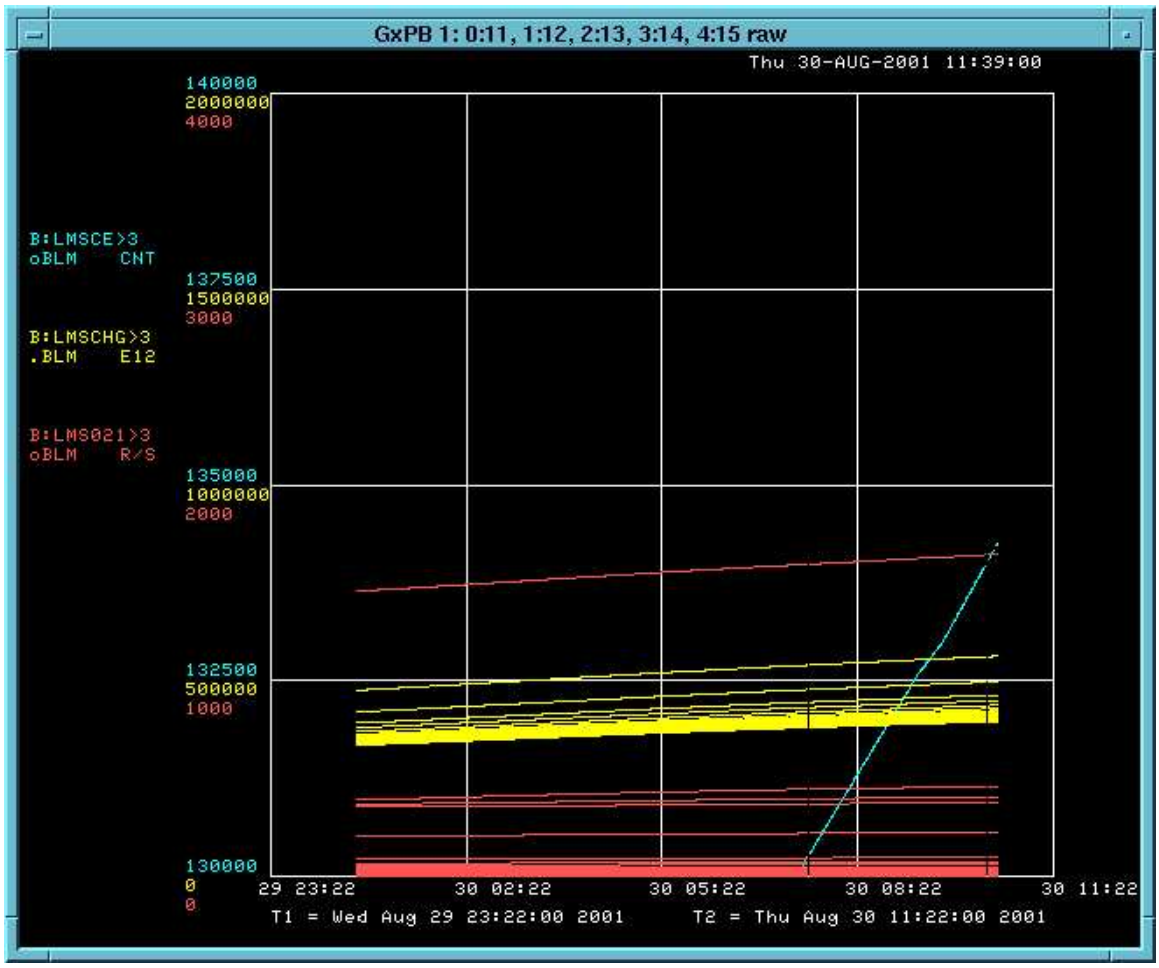

GxPB 1: blmlog samples, events, resets
Thu 30-AUG-2001 11:36:36
10
32
100
Z:BLMLOG
□BLM
5
24
75
B:LMEVNT
△BLM EVNT
B:LMRSUM
♦BLM CNT
0
16
50
-5
8
25
-10
0
0
29 23:22
30 02:22
30 05:22
30 08:22
30 11:22
T1 = Wed Aug 29 23:22:00 2001
T2 = Thu Aug 30 11:22:00 2001

Difference data

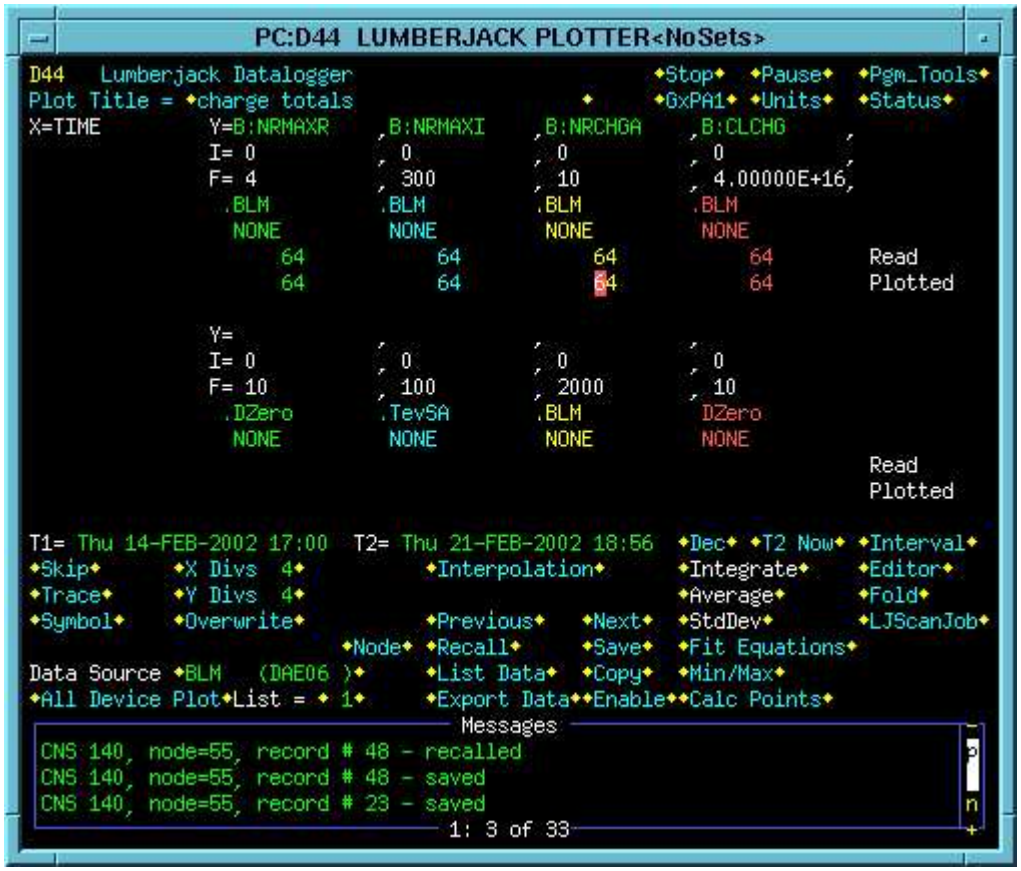

GxPB 1: diff, 0x14, >20
Thu 30-AUG-2001 11:37:06
100
200
.3
83.3333
166.667
.25
B:LMSCE>20
□BLM CNT
66.6667
133.333
.2
B:LMSCHG>20
△BLM E12
B:LMS021>20
♦BLM R/S
50
100
.15
33.3333
66.6667
.1
16.6667
33.3333
.05
0
0
0
29 23:22
30 02:22
30 05:22
30 08:22
30 11:22
T1 = Wed Aug 29 23:22:00 2001
T2 = Thu Aug 30 11:22:00 2001

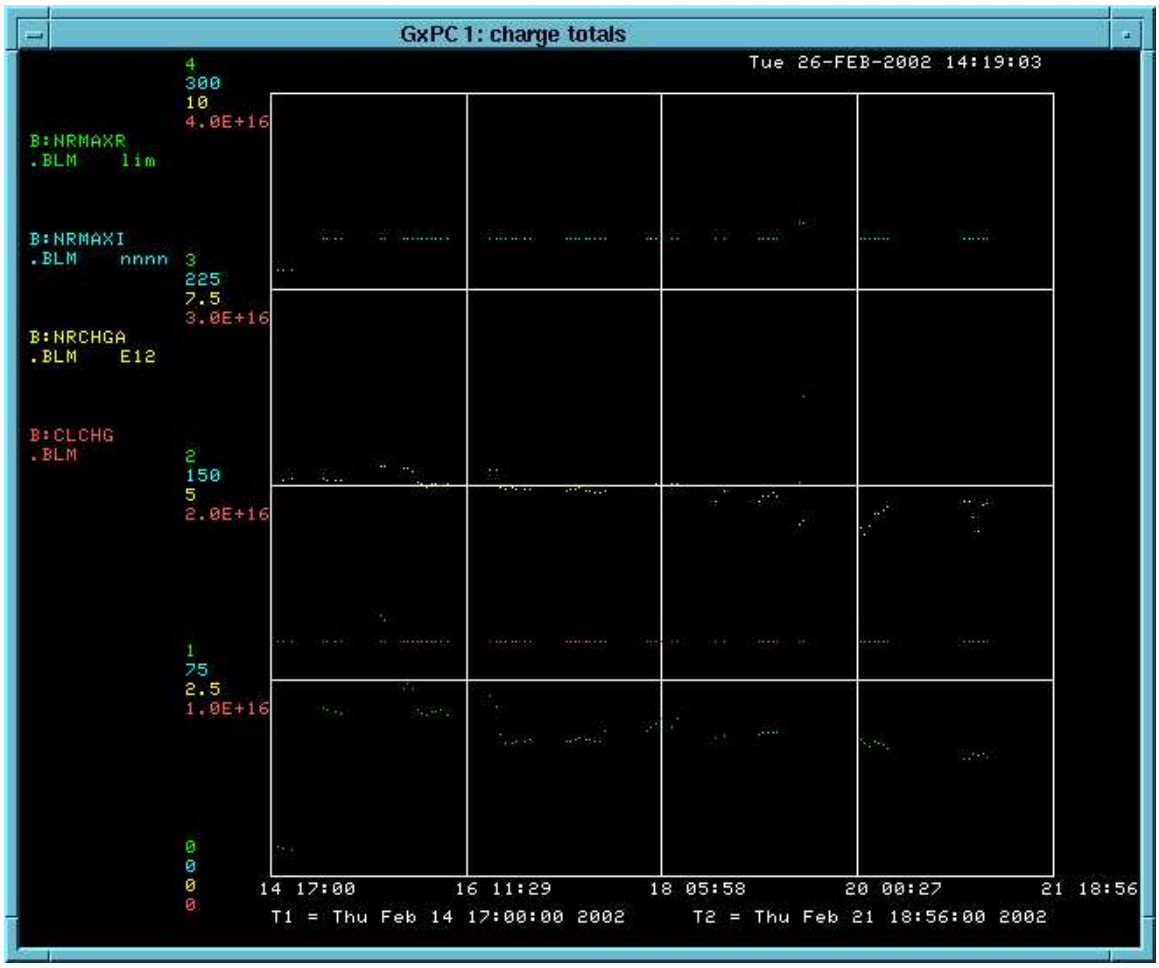
Raw Data


PB:D44 LUMBERJACK PLOTTER<NoSets>
D44 Lumberjack Datalogger
Plot Title = 0:11, 1:12, 2:13, 3:14, 4:15 raw
Stop
Pause
Pgm_Tools
GxPB1
Units
Status
X=TIME
Y=TIME
B:LMSCE>3
B:LMSCHG>3
B:LMS021>3
I= 0
F= 120
130000
140000
0
2000000
0
4000
.CHL
oBLM
.BLM
oBLM
NONE
NONE
NONE
NONE
1157
46280
46280
Read
1157
46280
46280
Plotted
Y=
I= 0
F= 120
0
120
0
1
0
120
CHL_A
CHL_A
.CHL_A
CHL
NONE
NONE
NONE
NONE
Read
Plotted
T1= Wed 29-AUG-2001 23:22
T2= Thu 30-AUG-2001 11:22
Dec
T2 Now
Interval
Skip
X Divs 4
Interpolation
Integrate
Editor
Trace
Y Divs 4
Average
Fold
Symbol
Overwrite
Previous
Next
StdDev
LJScanJob
Recall
Save
Fit Equations
Data Source
BLM (DAE06)
List Data
Copy
Min/Max
All Device Plot
List = 6
Export Data
Enable
Calc Points
Messages
CNS 140, node=55, record # 13 - saved
CNS 140, node=55, record # 46 - recalled
CNS 140, node=55, record # 47 - recalled
1: 3 of 96


GxPB 1: 0:11, 1:12, 2:13, 3:14, 4:15 raw
Thu 30-AUG-2001 11:39:00
140000
2000000
4000
B:LMSCE>3
oBLM CNT
137500
1500000
3000
B:LMSCHG>3
.BLM E12
B:LMS021>3
oBLM R/S
135000
1000000
2000
132500
500000
1000
130000
0
0
29 23:22
30 02:22
30 05:22
30 08:22
30 11:22
T1 = Wed Aug 29 23:22:00 2001
T2 = Thu Aug 30 11:22:00 2001

Chipmunk Data




GxPC 1: charge totals
Tue 26-FEB-2002 14:19:03
4
300
10
4.0E+16
B:NRMAXR
.BLM lim
B:NRMAXI
.BLM nnnn
3
225
7.5
3.0E+16
B:NRCHGA
.BLM E12
B:CLCHG
.BLM
2
150
5
2.0E+16
1
75
2.5
1.0E+16
0
0
0
0
14 17:00
16 11:29
18 05:58
20 00:27
21 18:56
T1 = Thu Feb 14 17:00:00 2002
T2 = Thu Feb 21 18:56:00 2002