

TestDAQ Requirements

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LBL TestDAQ Workshop 24 July 2003

DOM Firmware & Software Requirements for TestDAQ

- Acquire waveform transients with sufficient duration and resolution for InIce and IceTop physics requirements.
 - Inter-capture timestamp
 - Rate monitors
 - Noise (and signal) time structure
 - Flexible trigger conditions:
 - Forced
 - Background capture
 - Discriminator threshold crossing
 - PMT pulse capture
 - External event (Internal pulser, LED flasher, L.C.)
 - Special calibration modes
- Acquisition should be able to read out without significant ($< 1\%$) downtime. For TestDAQ, viz. DAQ, we do not require continuous readout (because of cable bandwidth) but only continuous readout for $O(1000)$ hits.
 - Rate monitors
 - Limited DAQ testing
- Support dynamic reconfiguration of DOM internal state (DACs, flags, ...) *and event logging into monitor stream.*
- Monitoring stream read out at regular intervals (10 s)
 - Internal state change
 - FPGA scaler rates
 - ADC values
 - HV?
- Inter-DOM clock calibration
 - Dynamic range tests
 - Tests of system timing
- DOMApp directly 'interfaces' to surface software with data records. Their format is specified.

DOMHub Hardware (DOR) and Software Requirements for TestDAQ

- Support up to 60 DOMs per DOMHub chassis.
- Driver supports software programmable poweron/poweroff of DOMs, DOM discovery.
- Simultaneous readout from DOMs and write to clients.
- Implements **DOMHubCom** remote interface
 - Remote poweron/poweroff (DAQControl is master)
 - DOM discovery information
 - DOM state (idle, running, rebooting, ...)
 - DOM configuration (DAC settings, trigger flags, ...)
 - Negotiation of data sockets for 'raw' transmission of HITS/MONI/TCALIB data packets from DOM

StringProcessor Requirements for TestDAQ

- Implements **DataCollectorFactory** and **DataCollector** interfaces.
- Asynchronous read from DOMHub generated sockets – minimal latency so that DOMHub does not block on writes. Support for 60 x 3 data sockets (60 DOMs, 3 data feeds per DOM)
- Stream merging into 3 output streams: HITS, MONI, TCALIB
- Writes files of specified format: ZIP archives with HEADER, HITS, MONI, TCALIB entries:
 - Header is XML descriptive header with defined XML schema
 - HITS, MONI, TCALIB are wrapped engineering data streams.
- (TODO) performs real-time time calibration and RAP calibration analysis to provide globally-referenced time tagging of hits
- Does not provide any triggering services or any real event building – the output streams are simply unassociated hits.

Field	Size (Bytes)
Byte count	4
Format ID	4
DOM ID (12 character Hex string)	12
Blank pad	4
UT timestamp	8

DAQControl Requirements for TestDAQ

- DAQControl at other end of remote discovery and configuration of DAQ resources such as DOMs and data processors.
- Management of DOM configuration data (scheme for assigning DOM configurations from files).
- In some ways may have to be more complex than DAQ because 'test-only' data-taking mode permits possibility of changing the DOMs' internal configurations (e.g. HV or bias) dynamically during runs. This points toward a scriptable DAQControl

Analysis Requirements

- See Martin K.'s talk ...

Test Plans

from DESY-Zeuthen DOM Production Workshop

Canonical Test Plan Descriptor : Toward a Formal Test Document

- **What are you testing?**
Description of the quantity or quantities under test including reference to system requirement.
- **How are you testing it?**
Description of the procedure. The requirements documents will reference these paragraphs.
- **What quantities are the product of testing?**
Description of the data analyzed from the test which will be stored in the testing database and which will enter the test report
- **Format of the test report**
Description of the report generated for this test item. These should be brief summations including graphics where appropriate that can be brought up in a web browser.

What are we testing? (and calibrating?)

- Initial basic function test (STF)
- Gain and P/V vs. HV, T (essential)
 - Reject OMs that cannot achieve $5E7$ at 2000V
 - P/V rejection threshold (for dark spect) TBD
- Dark noise at $1E7$ gain (essential)
 - Rejection threshold TBD
- RAPCal timing accuracy (essential – but deferred until hw and sw is avail.)
- PMT jitter (secondary)
- DOM system linearity (secondary)
- DOM relative optical efficiency (secondary)
- DOM angular efficiency (secondary)
- DOM absolute efficiency (tertiary – difficult measurement)
- Other tests?

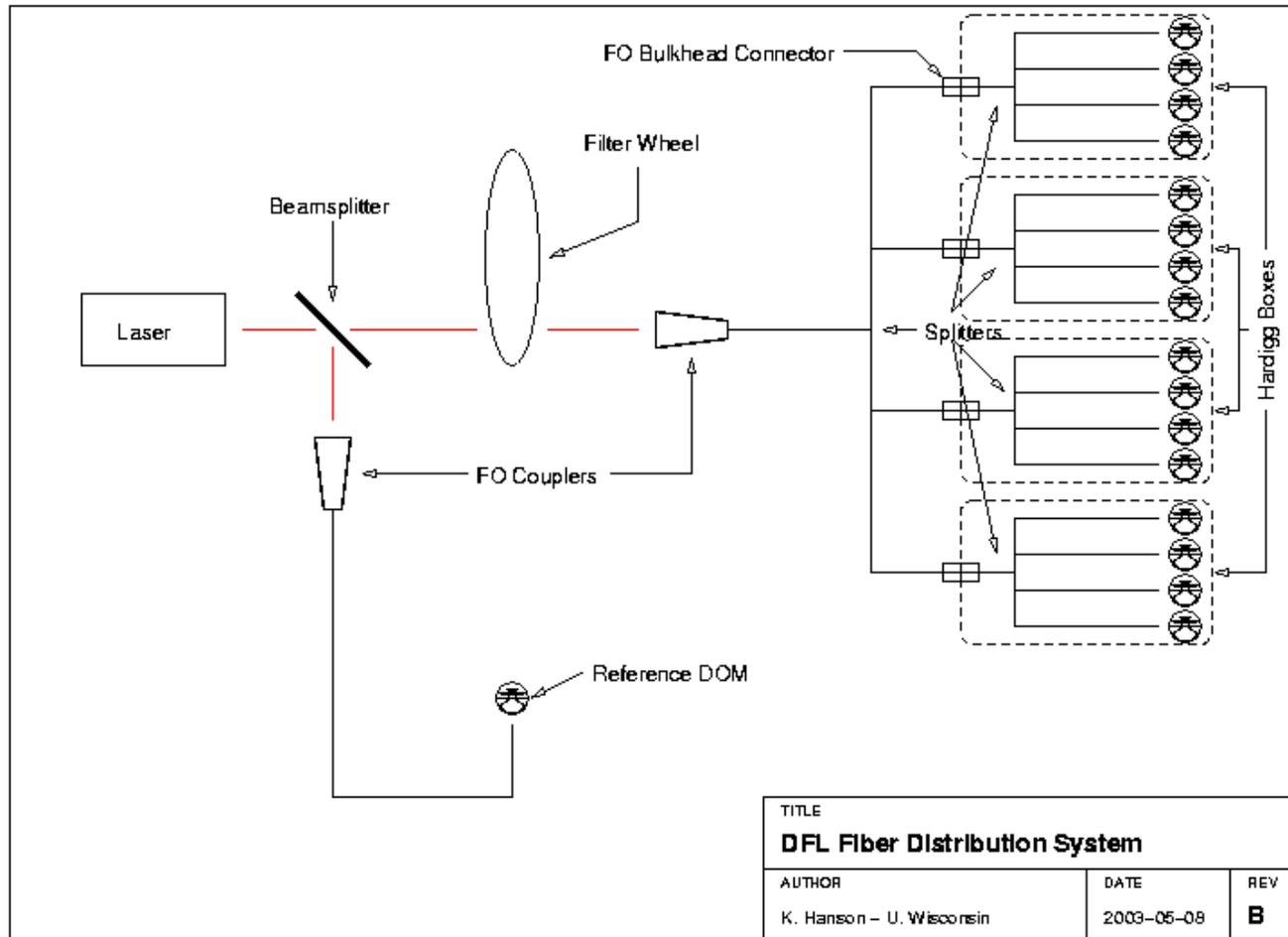
Gain Assay

- $G(V, T)$ first mapped out
- Calibrate using *spe* peak of dark spectrum
- Map gain at fixed points of T and V :
 - $T = 0, -10, -20, -30, -40, -50$
 - $V = 1200 - 2000$ V, 100 V increments
- Analysis software analyses waveforms, extracts charge, peak voltage from ATWD – stores in matrix versus T and V . P/V is also analyzed and stored.
- DOM internal discriminator sweep function
- Rate limited by cable bandwidth (to about 20 Hz per DOM) – for 100000 hits require 1 hour run
- Test report contains fitted $G(V, T)$ and $P/V(V, T)$ and plotted data points

Dark Noise

- Set gain to 10^7
- Use Hardigg box as additional isolation against residual light levels
- Common knowledge that taping spheres in black electrical tape reduces noise by X%. This is impractical in DFL freezer tests, so will characterize this X% *a priori*.
- Long-period testing (days to weeks) – will additionally monitor
 - HV stability
 - Gain stability
 - PMT intrinsic
 - DOM analog electronic gain
- Test report will contain ‘stripchart’ and statistical parameters for the monitored quantities.

Optical Fiber Fanout System



Status

- DataCollector/DAQ Control initial release completed – works with dummy DOMHub software interfaces
- Testing has begun! Using IceBoot and python – slow but is flexible.
- Short term tests: gain, p/v, noise – want to begin taking data and analysing ASAP.
- Long term tests: time resolution, time synchronization, dynamic range – Fall timescale.