FLASH MO Diagnostics

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Master Oscillator – Overview and History

- From Simple box to a Master Oscillator System
- Generated frequencies: 50 Hz, 1 MHz, 9 MHz, 13.5 MHz, 27 MHz, 81 MHz, 108 MHz, 1.3 GHz, 1.517 GHz, 2.856 GHz
- Complex distribution system with many tens of outputs
- Battery backed-up power supply
- Reliability required → supported by diagnostics with on-line readouts
MO System Racks

Injector Area

H3 Extension Subdistribution
MO Boxes – Integrated Diagnostics (1)
MO Boxes – Integrated Diagnostics (2)
AmpVis Board and Front Panel Display
Diagnosed Parameters - Summary

Measured are:

- Power levels
- Phase changes over amplifiers
- VSWR of most important cables
- Crate and component temperatures
- PLL lock status
- VCO control voltages
- Power supply voltages and currents
- Phase changes between various frequencies (Frequency Supervision Boxes)
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Diagnostic Data Acquisition Hardware

Data Acquisition PCB

Monitorig Crate and Patch Panel
Acquisition boards (AQBs) - location

Hardware

AQB

MO RACK 2

1.3GHz DISTRIBUTION BOX
0.1MHz DISTRIBUTION BOX
108MHz DISTRIBUTION BOX
9MHz DISTRIBUTION BOX
FREQ. COMPARISON BOX
AQB (Data Acquisition)
AQB Patch Panel

RF Cables
Rack 2, page 7
Rack 2, page 8

Distribution Cables

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**Acquisition boards (AQB}s) - overview**

Slaves: 0 to 7 modules; 8 x 16-bit channels analog data each
Master: 1 module; 8 x 16-bit channels analog data + 8-bit digital data
Ethernet module: communication
Server – main loop

- Start
- Create servers
- Handle Connection
- Receive & Translate Data
- Alarms
- Data Recording
- Correlation Coefficient
- Update Panels
# Server – creation process

- **Configuration File:**
  - One file – many servers
  - Connection parameters
  - All channels' attributes
    - Units
    - Signals' types
    - Signals' names
    - Alarm conditions

```plaintext
SLAVE0_AIN7.DESC: "LPP Crate Temperature"
SLAVE0_AIN7.TYPE: 2
SLAVE0_AIN7.PARAM: 107020
SLAVE1_AIN0: 0.483226
SLAVE1_AIN0.FILT: 1000100
SLAVE1_AIN0.EGU: 0030"V"
SLAVE1_AIN0.DESC: "HPA1300 Transducer Gain"
SLAVE1_AIN0.TYPE: 1
SLAVE1_AIN0.PARAM: 10250.5
SLAVE1_AIN1: 186.991
SLAVE1_AIN1.FILT: 1000100
SLAVE1_AIN1.EGU: 0030"V"
SLAVE1_AIN1.DESC: "HPA1300 VSWR Amplitude"
SLAVE1_AIN1.TYPE: 1
SLAVE1_AIN1.PARAM: 10250.5
SLAVE1_AIN2: 202.506
SLAVE1_AIN2.FILT: 1000100
SLAVE1_AIN2.EGU: 0030"V"
SLAVE1_AIN2.DESC: "HPA1300 VSWR Phase"
SLAVE1_AIN2.TYPE: 3
SLAVE1_AIN2.PARAM: 1018010
SLAVE1_AIN3: 2.26053
SLAVE1_AIN3.FILT: 1000100
SLAVE1_AIN3.EGU: 0030"V"
SLAVE1_AIN3.DESC: "HPA1300 Output Amplitude"
SLAVE1_AIN3.TYPE: 1
SLAVE1_AIN3.PARAM: 10250.5
SLAVE1_AIN4: 118.81
SLAVE1_AIN4.FILT: 1000100
SLAVE1_AIN4.EGU: 0030"V"
SLAVE1_AIN4.DESC: "PLL1300 Post Amplitude Phase"
SLAVE1_AIN4.TYPE: 3
```

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Server – connection

- **Connection:**
  - TCP/IP
  - Two types of devices:
    - Ethernet to RS232
    - LAN/GPIB Gateway
  - Automatic reconnect
  - Reporting bad links
Server – receiving & translating data

- Up to 15 signal types per server:
  - Voltage
  - Temperature
  - Phase
  - Digital Data
  - Power
  - Voltage Standing Wave Ratio
  - ...

<table>
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<tr>
<th>D-sub 25 Pin no.</th>
<th>D-SUB 9 Label</th>
<th>D-SUB 9 Pin no.</th>
<th>Controller Board</th>
<th>Controller Board Input</th>
<th>Signal Name</th>
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<td>1</td>
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<td>9MHz OCXO Amplitude</td>
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<td>Master</td>
<td>AIN1</td>
<td>81MHz VCXOPA Amplitude</td>
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<td>AIN2</td>
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<td>M D</td>
<td>1</td>
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<td>8</td>
<td>Master</td>
<td>AIN7</td>
<td>9Mhz Amplitude</td>
</tr>
</tbody>
</table>
Server – alarms

- Global alarm
  - 1 alarm per device

- 3 types of signal alarm
  - Value too low
  - Gradient too big
  - Value too high

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Server – signals – data recording

- Recording system:
  - Handling multiple files simultaneously (no limit)
  - On demand
  - Raw data for external processing
  - Long recording period possible (weeks/months)
  - Pause in recording possible
Server – signals – correlations

- Correlations system:
  - Pearson's correlation coefficient for up to 15 signal pairs per server
  - On demand recording
  - Long recording period possible (weeks/months)

\[ \rho_{X,Y} = \frac{E(XY) - E(X)E(Y)}{\sqrt{E(X^2) - (E(X))^2} \sqrt{E(Y^2) - (E(Y))^2}}. \]
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Server – user interface – main panel

MASTER OSCILLATOR SYSTEM

EXP HALL

ACCELERATOR TUNNEL

EXPERIMENTAL HALL

HALL 3 EXT

NOT CONNECTED

HALL 3 EXTENSION

TTF CONTROL ROOM

INJECTOR
EXPERIMENTAL HALL
FREQUENCY-PHASE
SUPERVISION BOX

Temperature: 37.301
Phase: 106.4
Phase: 407.6
Phase: 434.6

Amplitude: 0.908
Amplitude: 1.0231
Amplitude: 2.6982

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Server – user interface - FSB
Server – user interface - injector

[Image of a computer interface for the MASTER OSCILLATOR SYSTEM - INJECTOR, showing various components and measurements like DB 1300MHz, DB 81MHz, PLL 1517, and HPA 1300.]
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Work status

- In progress:
  - Hall 3 Ext & Master Oscillator 2 connections to AQB

- To do:
  - Adjust filters and alarms
  - Hall 3 Ext. user panels
  - Remote reset signals

```c
void EqFctMO::init() {
    char HistFile[80];
    // Init history
    sprintf(HistFile, "%s/DATA_%s.hist", "hist", name_str());
    arch = new ArchiveFile( HistFile, "mo_channels", NOINDEX );
    cont_di hist_book_hist( arch, name_str(), ring_buffer, memory_buffer );
    for(int i=0; i<_trig+2; ++i)
        p_Modules[i]->setArchive(arch);
    MOstat_mnet_init( arch, name_value() );
    online();
    reconnect_cnt_ = 0;
}
```
Thank you for your attention