CMB-S4

DAQ -LAT INTERFACE CONTROL DOCUMENT

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REVISION HISTORY

Version	Revision Date	Author: Notes
v1	06/29/2020	Initial draft
v2	11/4/2021	capture updates

REFERENCED & APPLICABLE DOCUMENTS

The requirements in the following documents apply, but this document supersedes if there is a conflict.

RReference used within this doc	VVersion	Title & Description, including Document number if applicable	Notes, relevant part of document

TABLE OF CONTENTS

1. PURPOSE AND SCOPE

This document defines and describes the interfaces between the DAQ and the LAT. The Observation Control System (OCS) interfaces with the Telescope Control System (TCS) and cryostat PLC with the main physical interfaces being through ethernet cabling and a control PC that houses the OCS. The OCS sends high level user control signals to the TCS and PLC and in return receives monitoring data.

The low level cryo control and monitoring is handled through the LAT Cryogenic PLC (LAT scope). Low level Telescope control is performed by the TCS (LAT scope).

Telescope control system to be provided as a turnkey system from telescope vendor.

Bolometer control/readout is part of the DAQ/Readout interface.

2. ABBREVIATIONS AND DEFINITIONS

2.1 ABBREVIATIONS

DAQ	Data Acquisition and Control
LAT	Large Aperture Telescope
LATR	Large Aperture Telescope Receiver
OCS	Observation Control System
PDU	Power Distribution Unit
PLC	Programmable Logic Controller
PPS	Pulse Per Second
TCS	Telescope Control System
UPS	Uninterruptible Power Supply

2.2 DEFINITIONS

PLC	In the context of this document refers to the LATR PLC which controls the cryostat vacuum and cryogenic systems.

3. MECHANICAL/STRUCTURAL INTERFACES

DAQ-LAT-0010 DAQ computer Physical location/needed support

There is a computer which functions as both data acquisition and control, located in a centralized facility. Plan is for one rack-mounted DAQ computer per LAT. (An option exists to consolidate systems).

DAQ-LAT-0020 Warm Readout Cable Path

Readout control will be done within layout from warm electronics to readout control application the same hardware that the OCS is located in. .

DAQ-LAT-0030 Network cable layout to TCS and LATR PLC

Primary mechanical interface will be a cable from the TCS and LATR PLC to a PTP-capable switch.

Cables (ethernet, one cable, or more with IRIG) will need to be routed from TCS to the nearest DAQ ethernet switch in the LAT. Data cables will then run from these switches to individual systems (listed in section 5).

Cable path through LAT and supporting structure, i.e. cable trays and the switch locations within LAT and on the LATR is shown in drawing: CMBS4-####

Cable arrangement to the sensors and actuators within the LAT and from the TCS are a LAT internal interface.

DAQ-LAT-0040 Ethernet switch mounting detail

The ethernet switches are mounted to the LATR.

Switch mount detail is shown in drawing: CMBS4-####

4. SIGNAL INTERFACES

4.1 TCS

DAQ-LAT-0050 TCS communication interface

Interface is IP based interface: control words to move telescope to position and readout data. IP interface will provide both the control interface and the data interface.

Because timing is also being supplied on the network, this will also provide absolute PTP timing to the TCS. Optionally and if different absolute timing is required (eg, IRIG), DAQ can supply a boundary clock which takes PTP timing and can produce analog or other clock signals.

DAQ-LAT-0060 TCS Data rates

DAQ has two data systems. 200Hz data from the az/el/boresight, and slow data (~1Hz) on other fields (motor currents, status, temperatures, etc).

4.3 CRYOGENICS AND CRYOSTAT HOUSEKEEPING SIGNALS

DAQ-LAT-0050 PLC OCS Interface

Cryogenics is responsible for providing an OCS agent for high level control of the DR, pulse tubes, and vacuum equipment (high level = turn on/off). Access to these control commands will be managed by the OCS system such that there will be fine-grained control over which users can access OCS cryogenic commanding.

An example of one way this is accomplished is that a PLC from the cryogenics group performs low level control of cryogenics and vacuum systems for the cryostat. OCS provides high level supervisory control (user interface). PLC writes interfaces with OCS through an OPC server. OCS writes historical values to the DB.

Two way communication is required between OCS and cryogenics (OPC?). Monitoring information travels from PLC to OCS, control information travels from OCS to PLC.

DAQ-LAT-0060 Cryostat/Cryogenic monitoring

Monitor signals include, but are not limited to: cold thermometry, status and state variables for DR valves and other components, pressures, helium mixture flow, compressor cooling water temperatures, heater power, AC resistance bridge settings. It is generally assumed this readout is measured at ~1-5x per minute, with the possible exception of a few faster-cadence thermometry signals (which would be measured at a few Hz).

List if of monitor signals coming from PLC to OCS is located at:

https://drive.google.com/file/d/123yG-J80bFZ7sDWQVBnhXzaghCt_AHHM/view?usp=sharing

(Format: Instrument / Location / Sample rate)
(Example: 100mK Temperature sensor located on focal plane # samples per second)

DAQ-LAT-0070 Cryostat/Cryogenic Control

The OCS will need to send a set of control signals from OCS to PLC….

Control signals:

List if of monitor signals coming from PLC to OCS is located at:

https://drive.google.com/file/d/123yG-J80bFZ7sDWQVBnhXzaghCt_AHHM/view?usp=sharing

DAQ-LAT-0080 Timing Signals

What signals (time-of-day and frequency reference) does the cryogenics system need, in what format, and delivered to where? In particular, need to think about phase-locking cryogenics readout involving AC-biased thermometers to detector readout.

Currently intended to get timing from readout. This would only be needed as a fallback/alternative. Plan is to provide a 1PPS signal at the cryo readout (same box also can make 10 MHz, other frequencies).

4.4 GROUNDING

4.5 OTHER LAT HOUSEKEEPING

The list below is of LAT systems and components that will have a data connection with the OCS.

This list will be moved to a more detailed spreadsheet located at #######

There is a lot of individual data corresponding to each of these items, voltage, timing, etc.

- Observatory wide (eg):
  - weather monitor (temperature, wind speed, baro pressure)
  - timing (synchronized, GPS lock, etc)
  - water vapor radiometer
- Monitor power at the telescope
- PDU (ibootbar)
- UPS
- vacuum pressure
- Cooling water:
  - Temperature
  - Flow
  - pressure
- Calibration, eg: (what of these need to be controlled, and how?) (Kam and John)
  - FTS (may require control)
  - chopper (may require control)
  - wire grid (may require control)
- Covered elsewhere:
  - Bolometer readout
  - telescope platform (TCS)
  - cryogenics, including pumps, DR, pulse tube compressors, valve settings, air pressure for valves, and cryogenic thermometry

5. THERMAL INTERFACES

DAQ-LAT-0110 TCS/OCS cooling requirement/ heat load

Only ethernet switches and boundary clocks. Allocate 50 W per 48-port ethernet switch (derated from 30 at sea level), 10 W per PTP->IRIG converter.