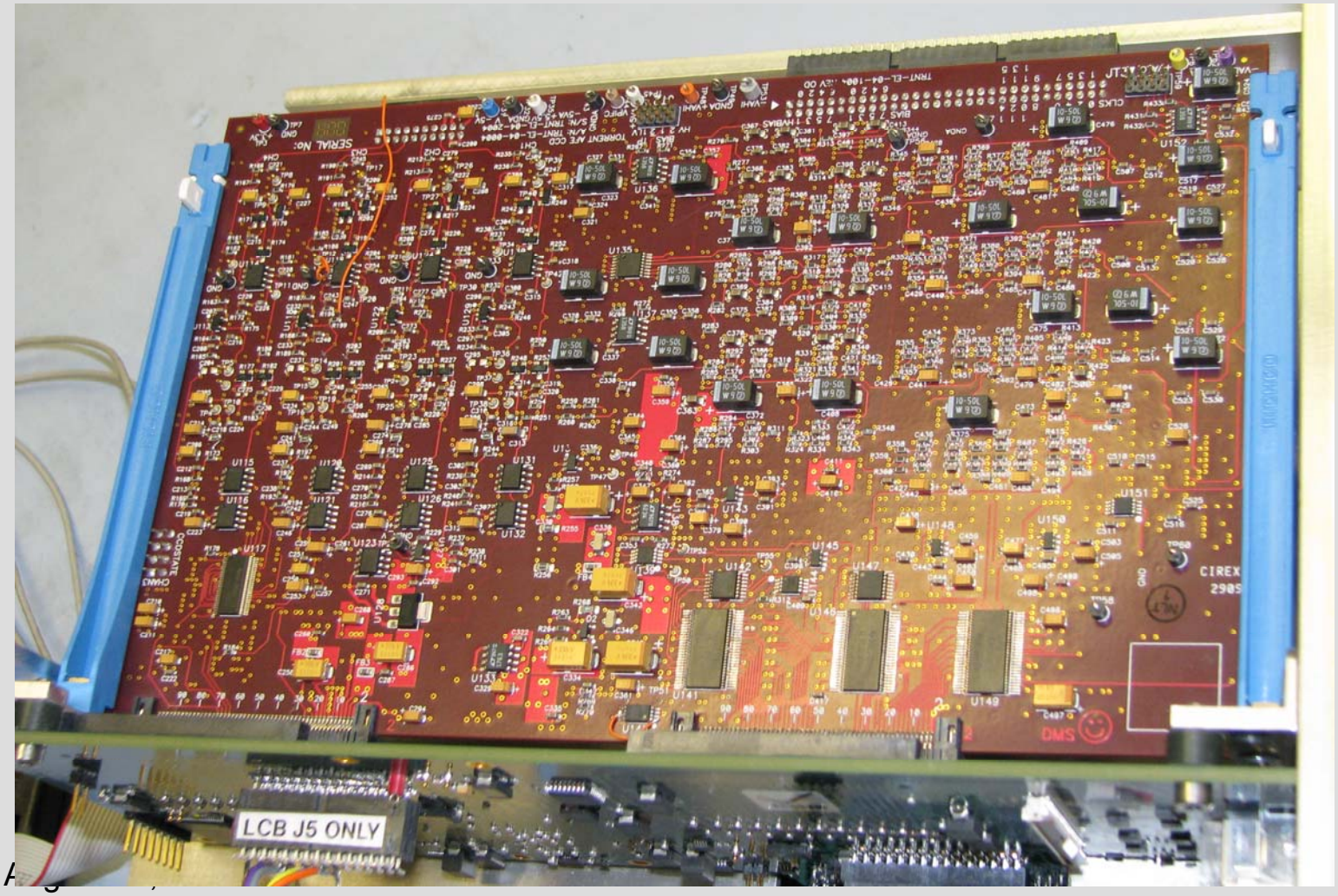
Agenda

	Time		Section	Presenter
1	9:00AM	30 min	Intro	Mark
2	9:30AM	60 min	PSM/LCB/MEZ	Peter
	10:30AM	30min	Break N/Lunch South	All
3	***11:00AM***	***30 min***	***AFE/Flex/Connectors***	***Mark***
4	***11:30AM***	***30 min***	***TSM***	***Mark***
	12:00PM	30 min	Lunch North/Break S	All
5	12:30PM	45 min	Mechanical	Joe
6	1:15PM	45 min	Software	Nick
7	2:00PM	30 min	Mfg & Test	Ron
	2:30PM	30 min	Overall Q & A	All
	3:00PM	60 min	Panel Session	Panel
	4:00PM	15 min	Panel report	Torrent team & Panel

Section 3

- AFE
- Flex cables
- Connectors

CCD AFE



CCD AFE Details

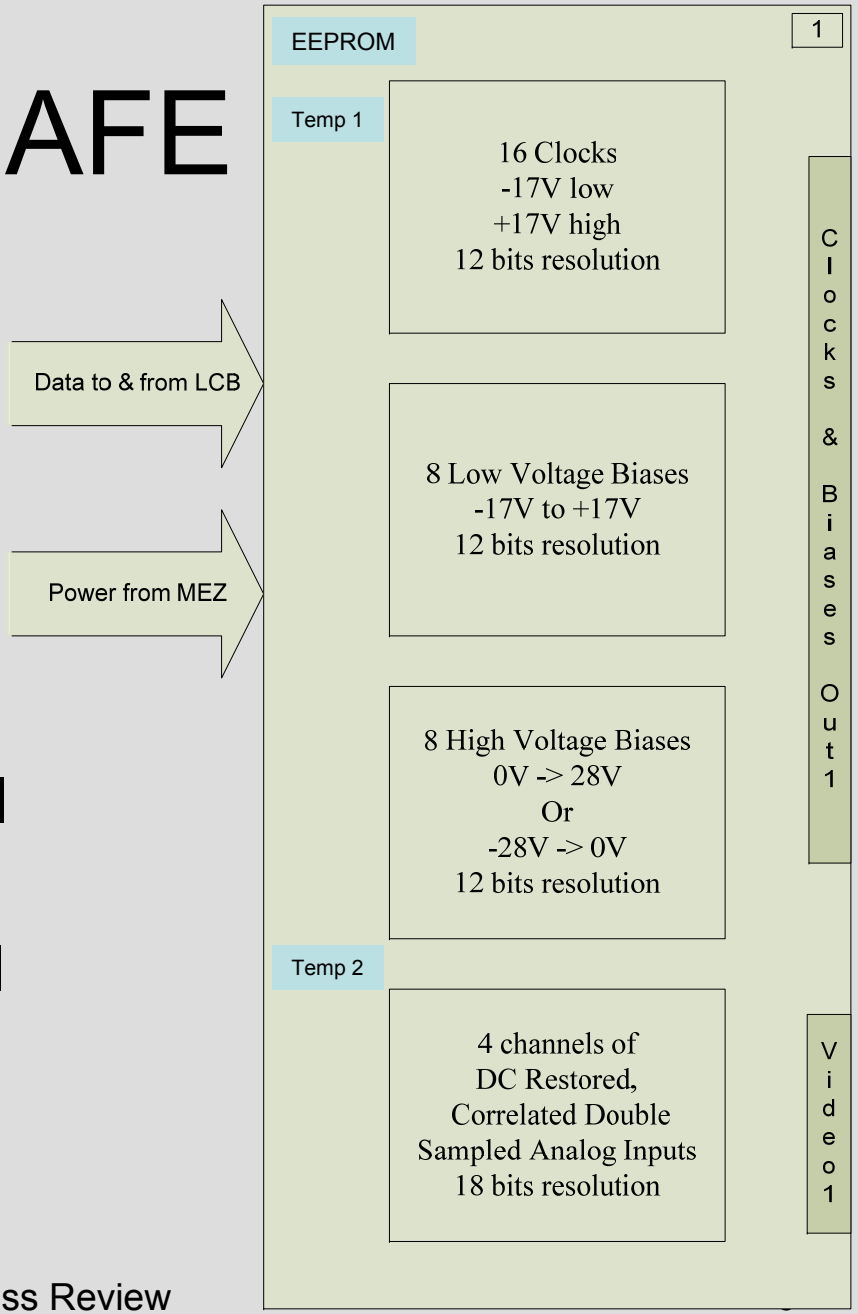
- 4 channels of DC restored, dual slope Correlated Double Sampling (CDS) Video
- 8 channels of Low Voltage Biases: ±17V
- 8 channels of High Voltage Biases:
  - 0 to 28V or -28V to 0
- 16 channels of clocks: ±17V
- On board regulators and references
  - Provides stability over temperature and supply fluctuation

CCD AFE Details

- Optimized for 100 kpix/sec – 350 kpix/sec
  - Maximum design is 500 kpix/sec
- Programmable test points for system debug
  - Allows viewing of clocks and biases on board edge connectors during code development
- EEPROM to hold calibration data
- Temperature sensors at two locations
- Two boards fit in one chassis for the total channel count

Block Diagram of AFE

- Shows the sections of the AFE, showing the relative location of sections also
- Important for noise control
  - Clocks as far away from Video as possible
- Allows ground current control
- Lower chance for ground loops with single board for all connections to CCD



CCD AFE Design

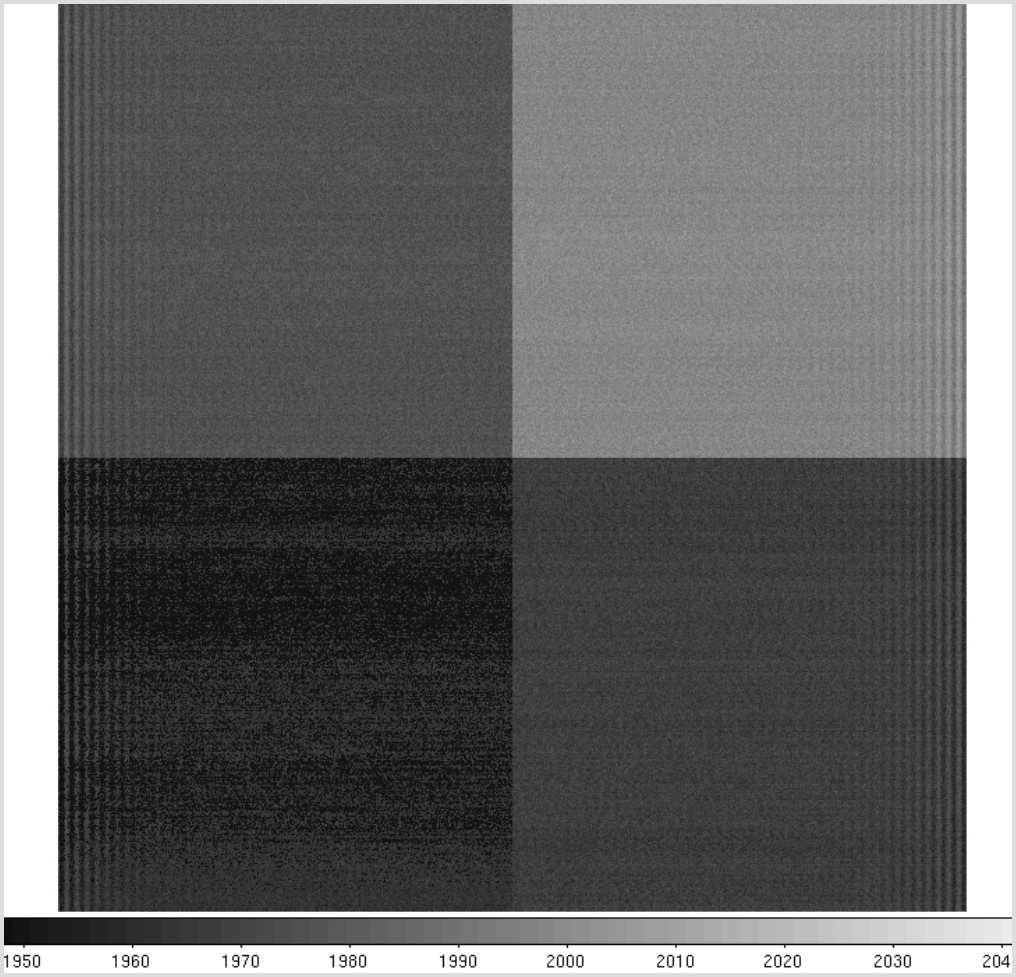
- Designs for Torrent very similar to Orange
  - Clocks, Video processing & Biases identical
- Changes:
  - Higher density/Finer resolution DACS
    - 12 bit vs. 8 bit
    - 16 DACs in a single package for higher density
    - All DAC channels are buffered on chip
  - Different switches for clocks and video
    - Clock switches are smaller and lower R_{on}
    - Video switch no longer needs logic supply
  - First video amplifier placed closer to dewar connectors in TSM
    - Gain and rolloff in this stage
    - Allows interchangeability of controllers

CCD AFE Testing

- ✓ All clocks tested over full range and loads
  - Unloaded rise time of <150 ns
- ✓ All LV Biases tested for drive, range and noise
- ✓ All HV Biases tested for drive, range, noise for both polarities
- ✓ Video channels have several tests for noise to check each section
- ✓ Programmable test points for system debug
  - Allows viewing of clocks or biases on board edge connectors

AFE Video performance

- ✓ Shorted input test of 4 channels on one AFE
- ✓ Shows 2 – 3 ADU of noise on 18 bits
  - Equal to 4μV
  - Dwell time of 1μs



CCD AFE misc

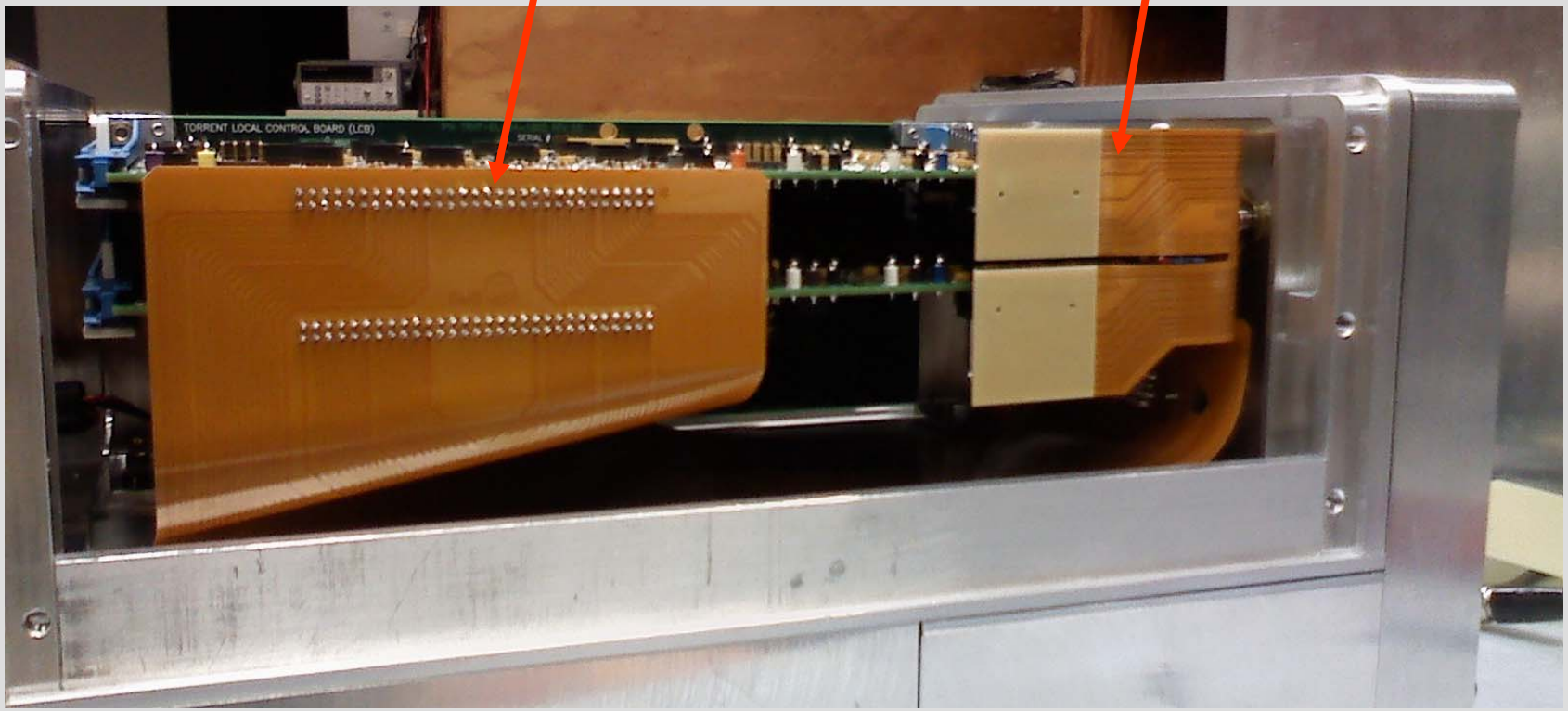
- CCD type done first as opposed to IR
  - More requirements for CCD vs. IR
- We have a reference design for the IR version with 16 channels for each board for a 32 input IR Torrent
- We also have an oversampler design for extremely low noise (<1e^{-}) using statistical oversampling
  - Developed through the Clinic Program with Harvey Mudd Engineering students (www.hmc.edu)

Flex circuits

- We are using flex cables to connect the AFE sections to the TSM
  - One cable carries the Clocks and Biases
  - One cable carries the video inputs
  - Each cable supports two AFE cards
- Selected to help control crosstalk and impedance
  - Controlled by layout of flex cable

Flex cables installed

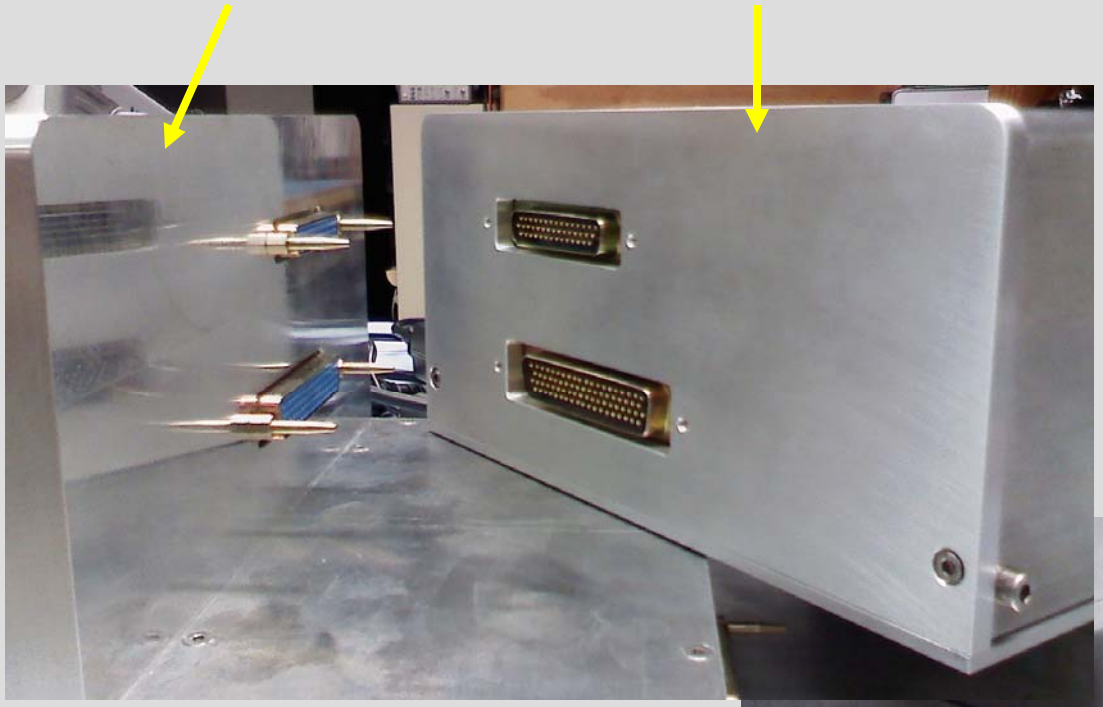
Shows the Clocks & Biases flex and Video flex



Connecting Controller to TSM

- Selected D series connectors from Positronics
  - Two High density connectors for AFE signals
  - Standard D25 for Utility Board
  - Connectors have guide pins for alignment
    - One side floats
    - Other side is fixed
- TSM Present switch in controller to detect:
  - If there is a TSM
  - Removal of controller with power on
- Shorting switch in TSM to short Preamp A_{GND} to shield when controller removed
  - Time between removal of controller & insertion of shorting plug

TSM and Controller Connectors



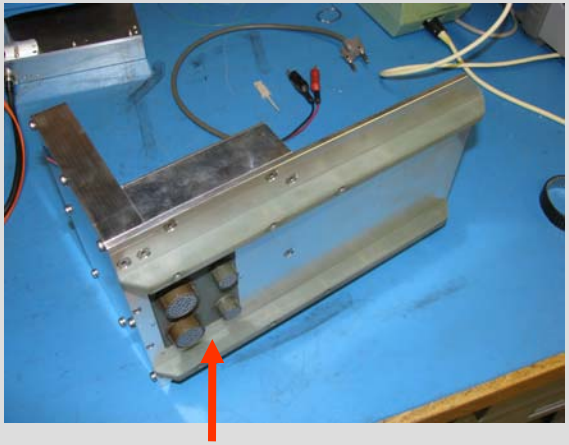
Video – Top

Clock & Bias - Bottom

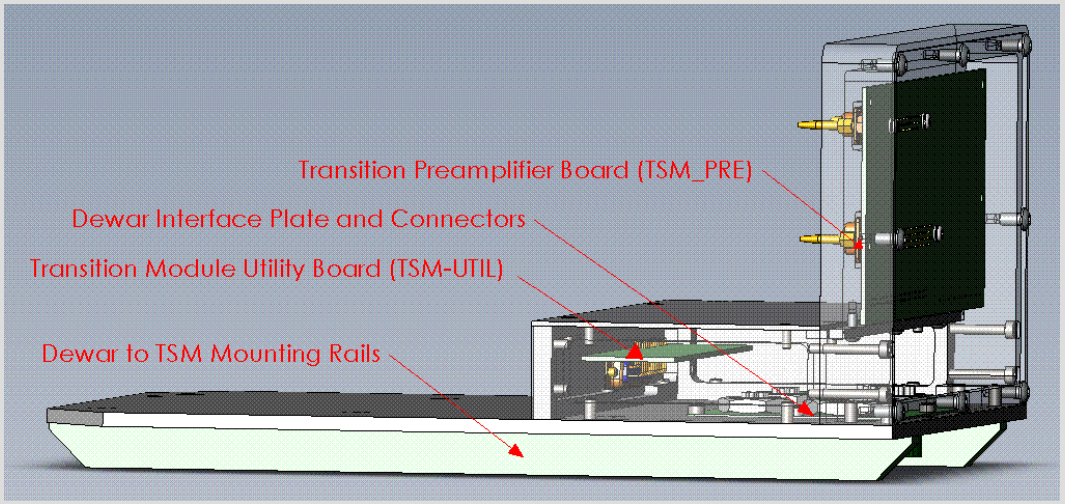
Utility Connector

Section 4

- TSM
  - Preamp, Clock and Bias interface
  - Utility



Dewar Connectors for NOAO North Dewars



Transition Module

- Customizable part of Torrent
- Resides on the Dewar
- Interface to the Dewar
- Preamp with gain and filtering to buffer the CCD
  - Allows controller to be independent of CCD/Dewar
- Shutter output
- Dewar CCD temperature control
- EEPROM to hold system configuration
- Two Internal Temperature sensors, as usual

Interlocks

- The Torrent design has two hardware interlocks between the controller and the Transition Module
  - TSM Present switch on the LCB
    - Senses the presence of the TSM before turning on the outputs
    - Disables the outputs in case of accidental removal with power applied
  - The TSM Grounding switch on the Preamp
    - shorts the A_{GND} to shield when the controller is removed, to protect the CCD

TSM Preamp

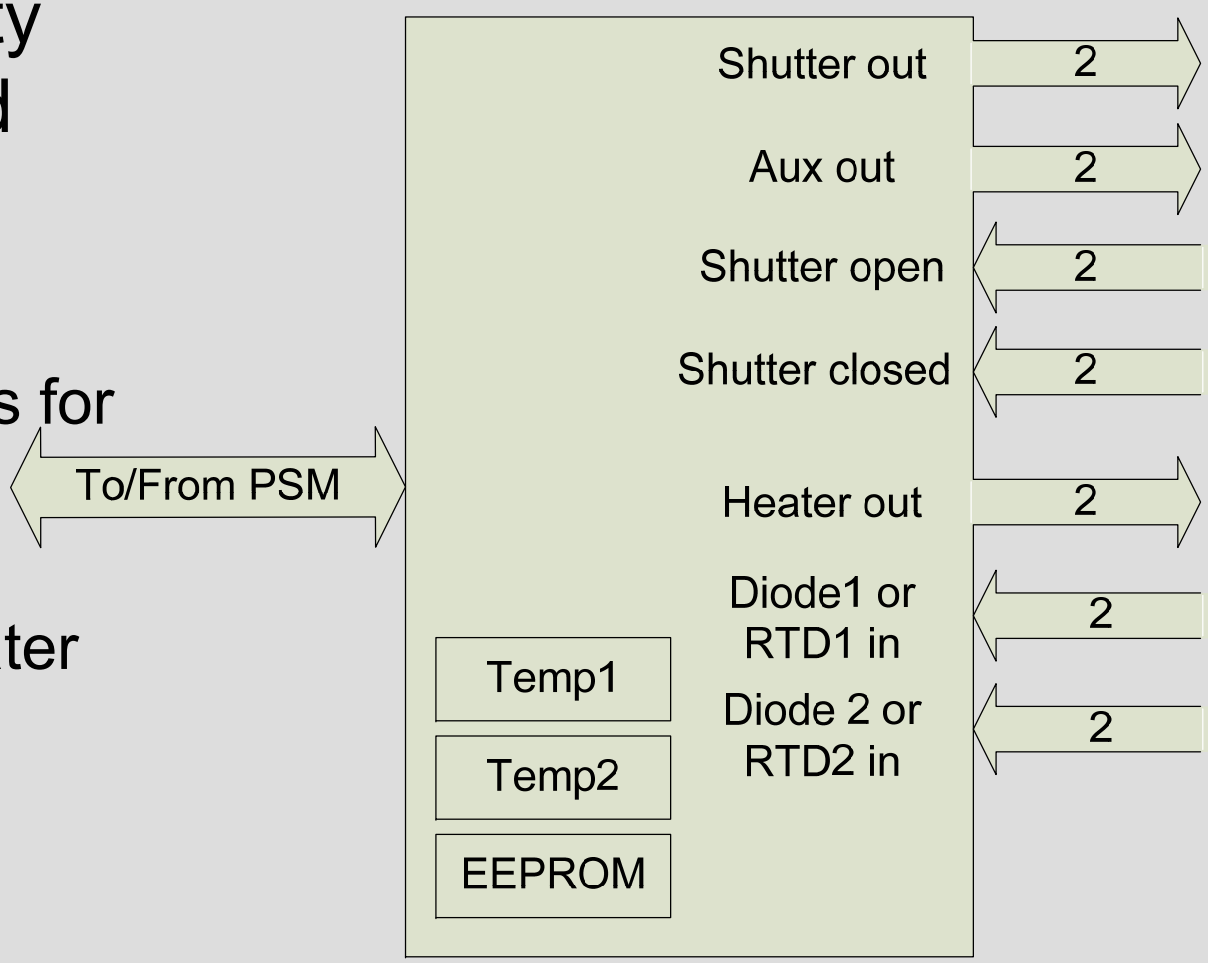
- Same as first stage of Orange design
  - Load resistor for CCD
  - Capacitor for DC removal
  - Initial filtering of CCD signal using low pass in feedback of opamp
- Set the initial gain here for varying CCD sensitivity
  - Makes controller independent of TSM
- Is the connection area for the Video, Biases and Clocks to dewar interface
- Allows filtering for Clocks and Biases
  - Simple RC network for customization
- The TSM is the only customizable part of Torrent!
  - This version will be versatile enough for most applications

TSM U TILITY

- Added to handle functions missing on Orange as well as new functions
- EEPROM and two Temperature sensors
  - EEPROM holds configuration data for system
  - standard on all Torrent boards
- Opto Isolated Shutter and Preflash outputs
- Two Opto Isolated status inputs
- CCD Thermal control
  - Calibrate for Diode or RTD sensors
  - Heater output up to 8W, jumper selectable
- Connectors for (NOAO-N) standard monitoring TCs
- Again - Remember that this is customized for the project

TSM Utility Board

- Shows the Utility board Input and Outputs
- Does not show
  - calibration pots for RTD & Diode calibration
  - Jumper for heater power setting



Connector I/O on the TSM

External:

- Shutter out*
- Aux out (preflash)*
- Status 1 in (shutter open)*
- Status 2 in (shutter closed)*
  - All on a bulkhead mount Lemo 8 pin circular connector
- TC1 (monitor on CCD) and TC2 (monitor on tank)
  - Bulkhead TC Connectors

*Note: These are optically isolated:

- Resistor to power & common needed for OC output
- Series resistor & common to drive the LED for input

Internal:

- Heater out**
- Temp 1 in
- Temp 2 in

**Power level programmed by the heater power selection jumper on Utility board

- Connected back to the LCB through PSM
  - EEPROM
  - Temp1
  - Temp2

End of Section 4

Next is:

30 min	Lunch North/Break S	All
45 min	Mechanical	Joe