Stereoboard VLPC Temperature Control

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This note describes certain technical aspects of the VLPC cassette temperature control system as implemented using Stereoboards in Lab 3. For a more general description of the VLPC temperature control system, see the note 'VLPC Temperature Control Hardware' (August 1998)[1], included in the VLPC Cassette Technical Design Report.

1.Overview

The system consists of the following components:

1. Temperature sensor and heater card
2. Cold end pigtail cin::apse connector
3. Flex cable
4. Warm end Cin::apse connector
5. Stereoboard
6. J3 connector interface card
7. Short ribbon cable
8. T-control distribution board
9. Long ribbon cable
10. Long heater cables
11. DIN rail terminal
12. Siemens/TI PLC with RTD modules (sensor) and analog output modules (heater)

2.Details

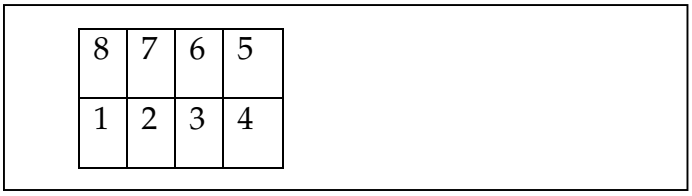
1.Temperature sensor and heater card

From the hardware note: "The VLPC system for the DØ central tracker upgrade will consist of 80 [May 2000: 102] cassettes. Each cassette has 1024 VLPC channels, in 8 modules per cassette, 16 chips à 8 VLPC pixels per module. Each module has a heater/sensor card (HSC) [drawing number 3823.113-MB-317558] containing one temperature sensor and two heaters mounted on the bottom of the isotherm [part number MB-317278]. Electrical connections to the HSC are made via a flex cable and an eight-pin cin::apse connector [drawing number 3823.113-MB-317274]. All the modules in a cassette will be thermally coupled, and in standard operation mode it is intended to use only one temperature sensor per cassette to control all the heaters in that cassette.

The sensor and heater lines will be routed through the right-hand front-end electronic boards to the backplane, from were they will be transmitted through appropriately shielded cables to the control system. Industrial PID controllers will be used."

2.Cold end pigtail cin::apse connector

The connector has eight contact pads:



1 and 8:	heater 1
2 and 7:	heater 2
3 and 4:	Current source and voltage sense for side A of sensor resistor; contact pads 3 and 4 on warm end cin::apse.
5 and 6:	Current source and voltage sense for side B of sensor resistor; contact pads 9 and 10 on warm end cin::apse.

3.Flex cable

4.Warm end Cin::apse connector

5.Right hand Stereoboard

The heaters connect to row 1 and 3 of a 3 by 2 jumper panel (J29/J30, J32/J33,…,J50/J51; see sketch). Resistor 1 connects across pin 1 & 6, resistor 2 across pin 2 & 5. The modules are chained in two parallel series of four modules: Pin 4 chains each module to pin 3 of its left neighbour, or, for modules 1 and 5, to pin A17 of the J3 connector. Pin 3 chains the module to pin 4 of its neighbour to the right or, for modules 4 and 8, to pin A18 of the J3 connector.

1	2
3	4
5	6

Both sensor voltage readback lines connect via 50 Ohm series resistors to the J3 backplane connector (pins A1-A16).
One of the current driver lines connects via pin 5 of the obsolete on-board current driver chips RF1 - RF8 to a common bus, and from there (via a wire from pin 5 of RF8) to the J3 backplane connector (C17, C19, C21,..C25, B21, B23, B25). The other of the current driver lines connects via one of eight special wires from the bottom pin of jumpers J31, J34,…,J52 to its corresponding pin on the J3 backplane connector (pins C18,C20,…,C26, B22, B24, B26).
On Stereoboards equipped with current driver chips pin 5 of those chips has to be cut. To decouple the other line from the current driver chip, either pin 4 of that chip has to be cut, too, or (preferred solution) the 100 Ohm resistor R100, R102,…,R114 connected to pin 4 has to be removed. On new Stereoboards the chips RF1 to RF8 should not be installed.

On right-hand board number 10 J3 pin A1 is broken, and is bypassed via B1. A corresponding modification has to be made to all J3 connector interface cards.

6.J3 connector interface card

C1	B1	A1
C2		
C3		
…		
C32		

A1 - A16: Temperature sensor voltage sense. Not ground free, due to current driver bus (see above).

A17 - A18: Heater double chain. Ground free. Nominally 1250 Ohm cold, greater than 2000 Ohm when one of the two subchains M1 - M4 or M5 - M8 is broken.

C1 - C16: VLPC bias M1 - M8. Remember that we run positive bias to the VLPC pixels via the series resistor packs and signal lines. The lines formerly called 'bias' connect to analog ground.

C17 - C26: Temperature sensor current driver connections for M1 - M5. On the Stereoboard every second (even numbered) pin connects to a common bus line, this connects pin 5 of all on-board current driver chip locations. (There is no current driver chip on the board, but the original layout foresaw one per module). On the interface card, all connections are made to separate wire pairs that run (via the long ribbon cable) to the Siemens/TI cryo controller.

A/B/C 27-32: cut off, to accommodate PC board support rail.

B21 - B26: Temperature sensor current driver connections for M6 - M8.

7.Short ribbon cable

All 16 temperature sensor/driver pairs are brought from the J3 interface card to the cryostat-mounted Temperature Control Distribution Board.

8.T-control distribution board

This board has four slots to plug in the short ribbon cables. Slot 1 corresponds to 'Cassette 1' of the Siemens/TI cryo control system, and reads out all eight temperature sensors. Slots 2 to 4 have connections only to read out module 4.

The heaters for slots 2 to 4 are powered via separate cables, which plug directly into the distribution board next to the short ribbon cable connectors. Since the heater connection is ground free on the cassette side, polarity does not matter.

9.Long ribbon cable

The long ribbon cable contains all 11 temperature sensor connections (2 pairs each), plus the heater driver pair for cryo control 'Cassette 1'. Each pair consists of a coloured and a corresponding brown-beige wire.

10.Long heater cables

There are four separate shielded pair cables with red insulation to drive the heater chains for the four cassettes. The long heater cable for cryo control 'Cassette 1' runs from the back of the cryo control rack towards the cryostat, but then loops back to the DIN rail, where it connects to the long ribbon cable. The other three long heater cables run directly from the back of the cryo control rack to the cryostat.

11.DIN rail terminal

The DIN rail terminal has two levels of connections. Cryo control 'Cassette' 1 uses the back level and connects to the RTD input module in slot 9, 'Cassette' 2 to 4 use the front level, which connects to the RTD module in slot 15. Within a channel, the wire order is preserved from the DIN rail to the RTD for the first (slot 9) RTD, but not for the second (slot 15) RTD.

Each sensor channel has four wires from the long ribbon cable feeding into the bottom of the rail. For the first RTD (serving cryo 'Cassette' 1) the order is, from left to right on the rail, and top down on the RTD: current positive (I+), voltage sense positive (V+), voltage sense negative (G), current negative (H). Indicated in brackets are the markings on the RTD module. The first and second wires are the brown-beige members of their respective pairs, the last two are coloured. These wires connect to four intermediate wires at the top of the rail, which run to the RTD input module: green, red, black, and white. The heater pair for this cassette runs through rail terminals 33 and 34, the third and fourth from the right.

The front level of the rail connects the three sensors for cryo 'cassettes' 2 to 4. Currently (June 2000), only 2 and 3 are hooked up. For these sensors, the intermediate wire order at the RTD is red (I+), black (V+), white (G), and green (H).

At the rail, the order is green, red, black, and white. Correspondingly, the long ribbon pairs have to be connected in a different order, compared to 'Cassette' 1.

12.Siemens/TI Programmable Logic Controller with RTD modules (sensor) and analog output modules (heater)

The RTD input modules[2] have 16 input channels each, with two channels forming a group with common ground. (This channel grouping manifests itself when a broken connection in one channel leads to wrong measurement values for its neighbour.) Care has to be taken to depress the release lever when removing or inserting a wire. Problems observed thus far were related to insufficient length of the inserted bare wire, and to shorting of neighbouring wires right at the RTD input.

Mapping into RTD channels:

Channel	RTD slot 9 Cassette/ Module	RTD slot 15
1		C2-M4
2		C3-M4
3		C4-M4
4		spare
5		spare
6		
7		
8	C1-M1	
9	C1-M2	
10	C1-M3	

11	C1-M4	
12	C1-M5	
13	C1-M6	
14		
15	C1-M8	
16	C1-M7	

The outputs are routed from the analog modules[3] through a DIN rail in the back. The terminals are WY49 and WY61 (in parallel) for 'cassette' 1, WY50/WY62 for 'cassette' 2, WY51/WY63 for 3, and WY52/WY64 for 4. Additional power for the analog modules, to achieve 20 mA through 2 kOhm per channel, is provided by a Hewlett Packard HP E3630A power supply set at 23.3 V. The black wire from the COM terminal connects to a short (4 wide) rail on the back level of the DIN rail behind WY49 - WY52. The red wire from the +20V terminal connects to the bottom terminal of the fuse holder, to the right of WY64.

[1] http://d0server1.fnal.gov/projects/SciFi/Temperature_Control/tc_master_aug_98.ps
[2] http://www.aut.sea.siemens.com/505/manuals/q2807060.pdf
[3] http://www.aut.sea.siemens.com/505/manuals/q2591824d.pdf