

Startup Procedure for Motor Control

For questions or problems, call:

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The startup procedure requires two people, one at the Introl controllers, the other at the stand to trip each of the limit switches. Be sure there are no obstructions or people within the turning arc of the theta-phi stand or the possible travel of the muon stand. The motion of the stands is rather slow, particularly in the horizontal direction, and it may not be immediately apparent that the stand is moving.

- (1) Be sure the "slave" cable from the AC31 board to the Introl enclosure is disconnected so computer input is not available.
- (2) Unlock the front cutout switch for each axis and turn on power. If you do not know the combination or are not authorized to move the stand, call Charlie Paul (Fermilab ext. 2085).
- (3) First check the vertical motion switches (see diagram for position of these switches). If any of these tests do not perform as described, contact an expert.
 - Start the vertical motion going up. Upward motion is positive for the Introl controller, downward is negative.
 - By hand trip the vertical up jog limit switch. The motor should reverse as long as you hold the switch down. When you let up the switch, the controller should display the vertical position and be able to accept further motion commands.
 - Start vertical motion up again.

- By hand trip the vertical up halt switch. The motor should again reverse (much more slowly than for the jog switch) as long as you hold the switch down. When you release the switch, power will be turned off. The Introl controller must be reset before it will accept any further commands.
 - Repeat this process for vertical motion down and the downward limit switches.
- (4) Horizontal limit switches are more difficult to find and check manually because they are located under the stand between the rails. Use a long screwdriver to trip the horizontal switches following the same pattern as with the vertical switches. Motion toward the wall is negative, motion toward the old calorimeter cart is positive.
- Start the motion toward the cart (positive) and check the jog limit switch, then the halt limit switch on the side towards the cart.
 - Then start the motion toward the wall (negative) and check the other jog limit switch and the halt limit switch. Jog limit switches should always leave the controller ready for more commands. Halt limit switches always leave the power off.
- (5) Home each axis so the fixture is centered with respect to the beam.
- (6) Check the TV monitoring system. The display screen in the control room (near the computer controls) should show clearly the theta-phi stand or muon stand. When this is satisfactory, plug in the "slave" cable to the AC31 board.

Motor Control for Fermilab Calorimeter Test - Ex. 790

01 MOTION CONTROL

Each motor is controlled by an IPC2100 motion controller manufactured by Introl (see operating manual). Each motion controller is mounted in a NEMA steel enclosure with the Wertec motor controller. The Introl motion controller can be programmed to provide adjustable accelerations, change operating speeds, choose increment distance, change baud rates, and assign an address to the controller. It provides push buttons located on the front panel for controlling the motor. The front panel also provides a digital readout of position. From this touch panel one can:

- Move to a specific position.
- Move a specific increment, either positive or negative.
- Move in a specific direction as long as the button is pressed (jog).
- Move motor to "Home" position.
- Reprogram the motor speeds and accelerations. For example, we plan to have the motor accelerate for 6 seconds to the standard moving speed, then decelerate 6 seconds before reaching the desired goal. position

In addition to push button control, each motion controller has an RS-422 port for computer control. Most of the manual functions can also be executed under computer control (Homing is only manual). The RS-422 link will be incorporated into an Opto-22 addressing system. This allows us to address directly each Introl controller from the Motorola 147 microprocessor which will control the hardware for the Fermilab test (see diagram of Fermilab Hardware Control system). Each motor is controlled by a separate and independent controller

Each motor provides a pulse signal from built-in Hall effect sensors which correlates to the motor shaft rotation. controller. The pulse count is digitized in

the Introl and can be scaled to account for differing gear ratios or co-ordinate systems. Thus a digital readout can be provided in convenient units.

02 CABLING

All cables (power, control, limit switches, blower power) run in Seal-Tite conduit. Power and control cabling runs in separate conduit. For the 10 hp motor the 120-volt blower connection also runs in separate conduit. All power wires are 14 gauge, except for the 10 hp motor which has 10 gauge. The control cabling is Belden 10-conductor cable.

03 HALT LIMIT SWITCH

Each extrema of motion has two limit switches. The "Halt" limit switch is located directly before the mechanical stop. It is wired in series using a 120-volt circuit. When any "Halt" switch is contacted, all power to the motor controller is turned off. Since this leaves the motor in a position where recovery is difficult (can't turn on power, can't move the stand off the switch), we have wired a bypass. This requires the motor controller reverse direction until it has moved off the switch, then the power is turned off. If the Introl controller is in the midst of a move (rather likely), this process causes the Introl to lose position. To recover, power must be recycled and the motor "Homed" to set the digital readout properly. As a result, this limit switch should be contacted only as a last resort.

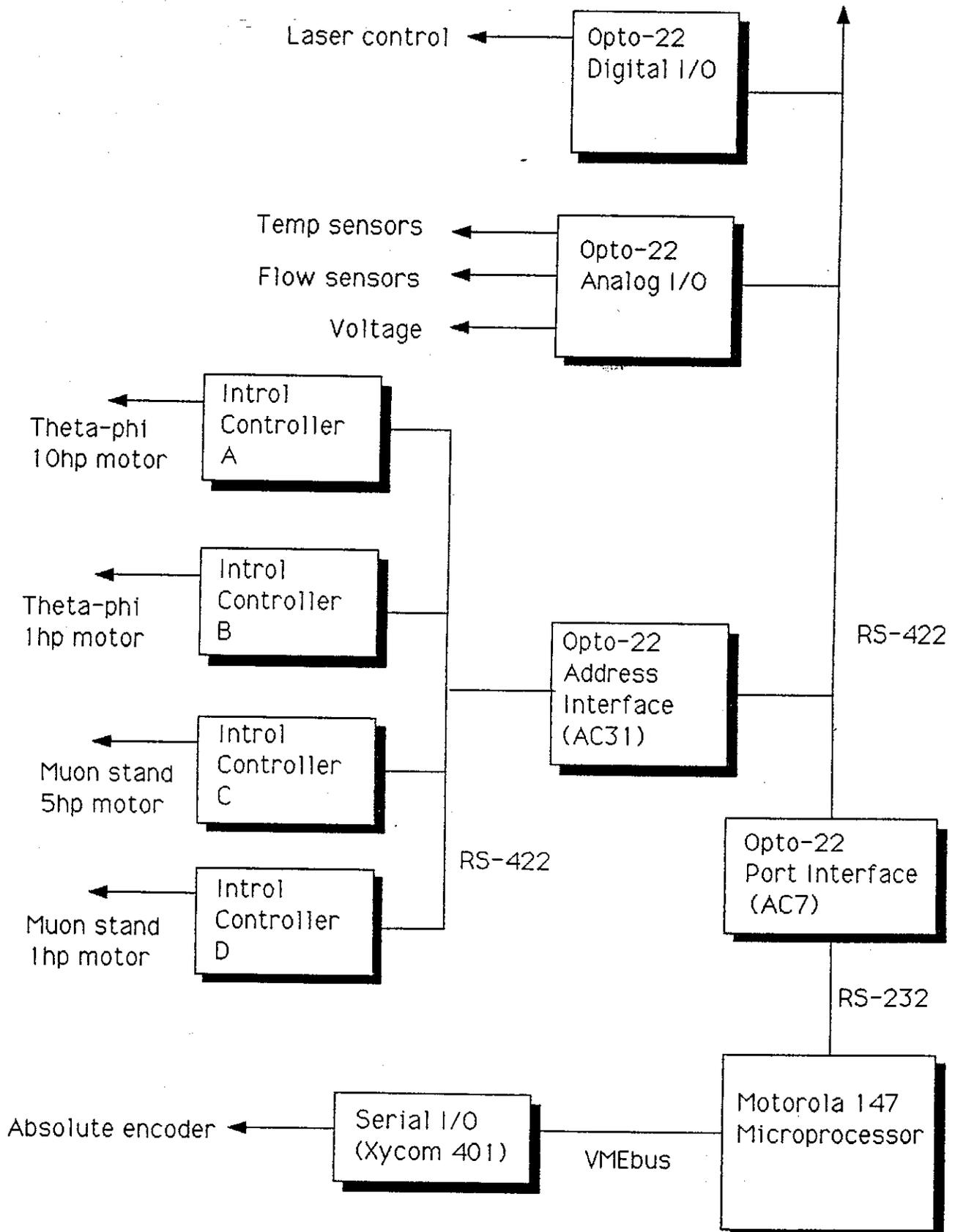
04 JOG LIMIT SWITCH

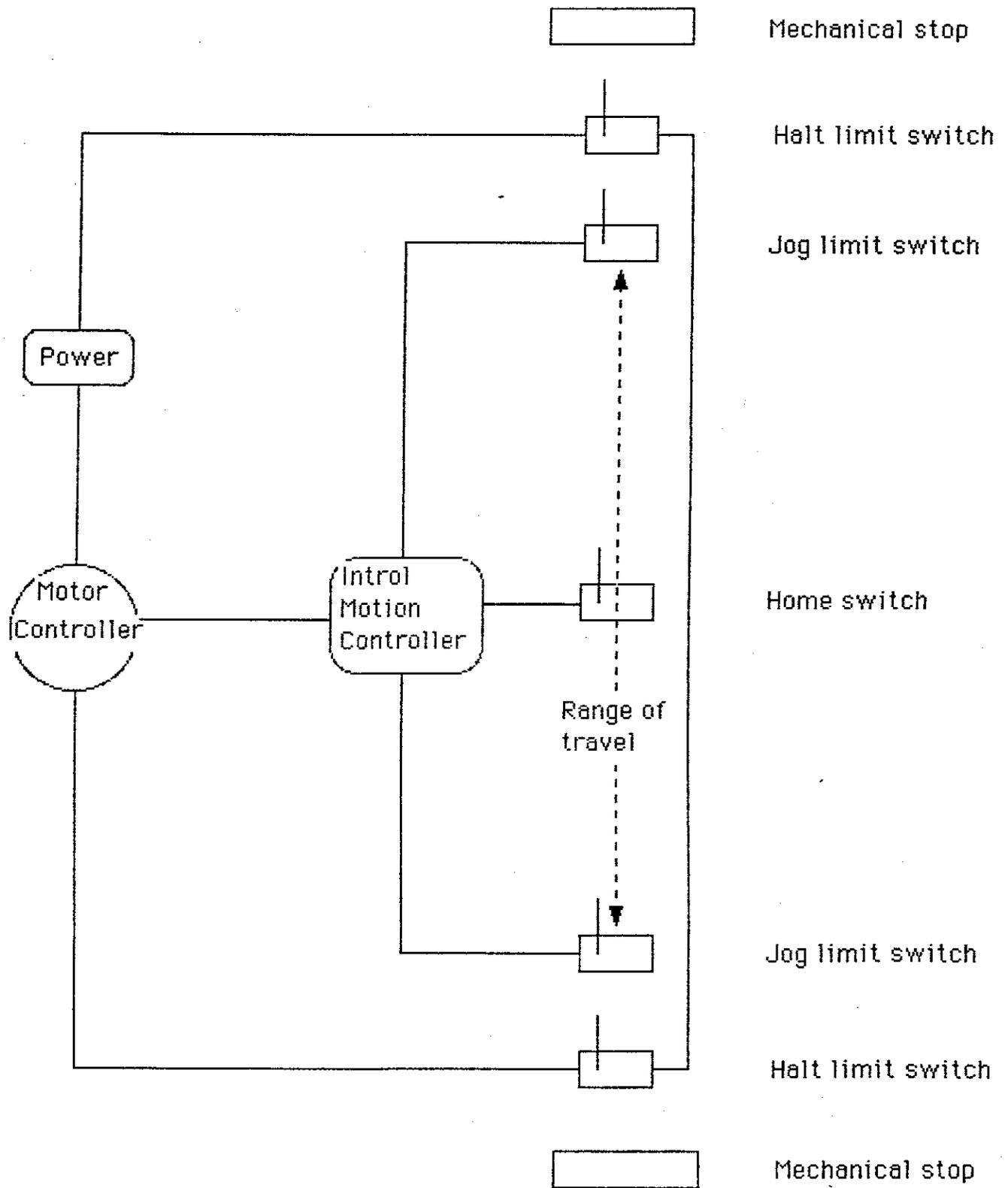
The "Jog" limit switch is located just before the "Halt" switch and wired with 24-volt lines from the Introl controller. When this switch is contacted, the jog line in the Introl is grounded. This overrides any previous command and reverses the direction of motion until the stand has moved off the limit switch. Then motion is stopped, but power remains and the Introl is prepared to execute the next command. Any operator or program mistake will trip the "Jog" limit

switch. Only a hardware fault within the Introl controller (or the Jog limit switch) would cause the "Jog" switch to be ignored. In this case the "Halt" switch would function, power would be turned off, and the stand would need to be recycled.

Fermilab Hardware Control

Exp. 790





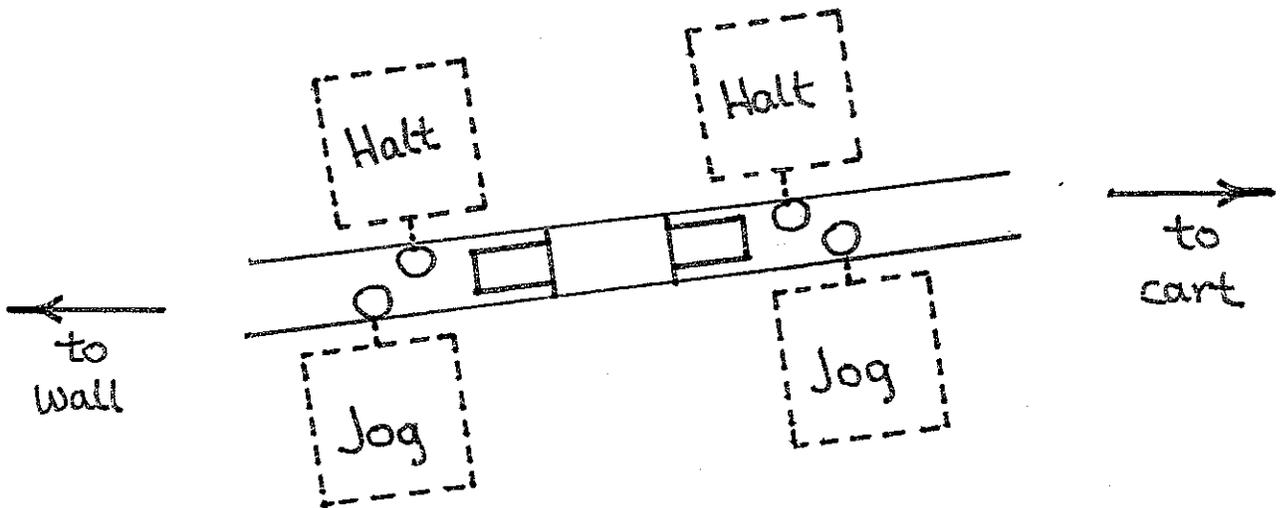
Schematic view of theta-phi stand safety system



Down

Up

Vertical limit switches
(as seen from the front of the stand)



Horizontal limit switches

(as seen from back of stand looking down)