IMACS TABLE OF CONTENTS

IMACS MOTION CONTROL SYSTEM MCS MANUAL

The MCS PC uses a 15-slot ISA back plane along with a Single Board Computer SBC, four Mycom motor Indexer cards and five ComputerBoards digital IO cards. A 16MB silicon disk is used for storage of the auto booting DOS control program. A floppy disk drive is installed but not connected. A hard disk containing all software and development programs is installed but not connected, an inbuilt backup of the system. The contents of the hard disk and the silicon disk, a subset of the hard disk, is also contained in the CD packed with the IMACS MCS 11x17 documentation binder.

The Mycom PPC2410 ISA card is a four axis motor controller with encoder feedback and various IO lines. No interrupts are used, and clock signals are of the ¨two-clock¨variety – one pulse train for clockwise motion and another pulse train for counter-clockwise motion.

DESIGN PHILOSOPHY

BRAKES

All motors with brakes utilize a fail-safe design that requires the brake coil to be energized before the motor can be moved. The computer has to command the brake release and no hard stop may be active before the motor will move.

FAILSAFE HARDSTOP LOGIC

In addition to failsafe brakes, fail-safe circuitry is provided to remove computer control of an individual motion stage if a hard stop limit has been activated. In order to restore normal operation, a technician must go out and remove the fault condition and then reset the hard stop logic. For each motion stage two functions pass through the hard stop logic.

1. The current cutoff to the motor driver and
2. Energization of the brake.

In the event of a hard stop trigger the Altera logic will immediately turn off the associated motor driver current and remove current flow from the brake release coil. To be able to move the stage off the hard stop, the associated hard stop bypass switch must be placed into the up position and will allow the computer to back out of the hard stop. When the fault condition is removed, the bypass switch may be reset and normal operation may once again take place.

COMPONENTS

Off the shelf components used in the MCS are the same as used in the C40, C100, CM1 and CM2

- Opto22 Input Output modules
- Mycom drivers UPS50 and INS50 star connection bi-polar constant current chopper.
- Mycom indexer cards
- Mycom 5phase stepper motors, 0.72 degrees step, 500 pulses rev.
- ComputerBoards Digital IO ISA cards, 48 lines.

HEAT DISSIPATION

A Rittal model SK3218.100 air-water heat exchanger is used to remove the heat generated by the MCS electronics to the telescope cooling fluid. The telescope provides 5 gal/min , 300 gal/hour flow of an ethylene glycol mixture at 2 to 3 degrees C above ambient temperature. The unit is rated at 3500W of cooling at 100 gal/hour; the approximate heat generation of the electronics is 750W, so there is a comfortable margin of heat removal capacity. The air water heat exchanger requires no maintenance. The fan of the air circuit is designed to run continuously. The thermostat for the solenoid valve has been disconnected and the solenoid valve is wired to be on continuously. Because the fluid temperature will never be below ambient temperature, condensation ought not to be a problem.

CHASSIS LED INDICATORS

All rack-mounted chassis are provided with a switch to turn off all LED indicators.

INDICATORS OF CORRECT OPERATION

Most if not all of the motor drivers have an LED that flicker when commands to move are given. The Mycom UPS50 drivers have an LED facing the back of each chassis, which are covered with aluminum tape.

The Renishaw encoders LED will glow green when the read head is a proper distance from and focused on the read tape. When the read head passes the home position, the LED will pulse red. These LEDs are also covered to prevent light pollution and will need to be uncovered in order to precisely reposition soft stops. A less accurate alternative is to take a laptop up to the platform and observe the appropriate GUI to see when a soft stop has been triggered.

Soft stops may be tested by running into the stop and checking the appropriate indicator in the user interface GUI.
Manually activating the hard stop and observing the LED indicators on the appropriate chassis may test hard stops.
As long as the hard stop LED is on, a fault condition remains.

Disconnected or inappropriately connected cables may be detected by observing two or more soft stops and hardtops on at the same time at the user interface GUI.

L05 focus motors are best tested by putting an ear near the collimator inside the instrument and listening to each motor move. Otherwise you will have to rely upon the encoder counts observed in the user interface GUI.

The science camera dewar focus mechanism has a shaft that can be seen turning at the back of the camera. As well, the GUI can be observed for proper encoder counts.

Most digital input or output signal or command status may be observed by looking at the LED indicators on the Opto22 units inside chassis 1 through 4.
Some of these signals go straight to the motor indexer cards and may be probed at the high density 80 pin to Phoenix contact breakout boards located in the inside front of each chassis.

Heat exchanger operation may be confirmed by observing the internal rack temperature as monitored by the data acquisition unit, as well as by fan noise.

PROTOCALS and CONVENTIONS

The long camera subsystems are designated as 1 because they were designed and built first. Example: Filter Server 1, DSP1 TRIG.
DSP1 TRIG refers to the Long Camera begin integration signal provided by the Long Science Camera saddlebag DSP board to initiate the opening and closing of the Long Camera shutter.
The short camera subsystems are designated as 2, example: Filter Server 2, DSP2 TRIG.
Except for the science camera dewar focus motor drivers, all motor drivers run in ¨two-clock¨¨bi-clock¨mode where a separate pulse waveform is required to move CW and to move CCW.
Brakes are run in fail-safe mode, where a current must be supplied before the brake will turn off.
Hard stops are operated in fail-safe mode, where a disconnect anywhere in-line will trigger the hard stop.

SAFETY

The AC power input to the system first enters a rack mounted TripLite noise and surge suppressor. Each chassis has three metal oxide varistors MOV that protect hot to chassis ground, neutral to chassis ground and hot to neutral. Note that their failure mode is a dead short. Circuit breakers and-or fuses are incorporated into each chassis.

Lamp 6 has a fuse located on the digital phase control board located in the back of chassis 3.
Appropriate Opto22 modules are fused and accessed through the top of the module.

Each solenoid in the instrument has a back EMF diode installed. Three switched inductors in the MCS have back EMF diode protection.

The power supply chassis has a ground fault circuit breaker mounted inside. It tripped whenever a chassis 3 disperser grating tilt cable was plugged in so was bypassed. It is not known if this fault has been removed.

AC power is sent through the Lamps Fans wrap cable to the black ABS box. This AC power is controlled by a heavy duty milspec switch on the front panel of Chassis 3 and is used to turn off power to the black ABS box when switching the high voltage piezo control lines plugged into the PI chassis contained within the black ABS box. Turn this switch off when you work inside the black ABS box if you want to avoid receiving an electrical shock! The air pressurization and air circulation fans are also powered by 117VAC.

Chassis 1 controls Filter Server 1 and Filter Server 2, as well as the Mask Server and the Center Field Guide Camera.

Filter Server 1 uses

- 1 Mycom UPS50 5 phase stepper motor driver
- 1 Mycom PS596AM motor with a brake
- 1 Renishaw RGH22 encoder
- 2 soft limit switches
- 1 near switch
- 2 hard limit switches
- 2 air cylinder retract limit switches
- 2 air cylinder extend limit switches
- 1 air solenoid
- 2 air cylinders

Digital IO Rack MR1B uses

- 5 SNAP IDC5 Opto22 input modules
- 1 SNAP ODC5SRC Opto22 source output module

The Slit Mask Server uses

- 1 Mycom UPS50 5 phase stepper motor driver
- 1 Mycom PS596AM motor with a brake
- 1 Dynamic Research Corp DRC LB4A 0320 EL L03XXB0 encoder
- 2 soft limit switches
- 1 near switch
- 2 hard limit switches
- 2 air cylinder retract limit switches
- 2 air cylinder extend limit switches
- 2 air solenoids
- 2 air cylinders
- 1 mask installed sensor Turck Bi2 K11 AN6 inductive
- 8 mask position open sensors Turck Bi2 K11 AN6 inductive

Filter Server 2 uses

- 1 Mycom UPS50 5 phase stepper motor driver
- 1 Mycom PS596AM motor with a brake
- 1 Renishaw RGH22 encoder
- 2 soft limit switches
- 1 near switch
- 2 hard limit switches
- 2 air cylinder retract limit switches
- 2 air cylinder extend limit switches
- 1 air solenoid