



## MULTIPLE MIRROR TELESCOPE OBSERVATORY

Smithsonian Astrophysical Observatory and Steward Observatory, University of Arizona

Reply to: MMT Observatory  
University of Arizona  
Tucson, Arizona 85721  
(602) 626-1558

June 24, 1985

MMTO Technical Memorandum 85-5

From: Bruce O'Connor

Subject: I-CCD and I-VID camera control

### I. INTRODUCTION

The Camera Control System for the MMT provides the necessary electronics to control the I-CCD and I-VID cameras from the operator's hand paddle. The electronics are housed in a box mounted on one of the topbox side panels. The Camera Control Box contains the following: a single intensifier control card for both the I-CCD and I-VID cameras; the Fairchild CCD Camera Control Unit; the DC power supply for the I-CCD; the 6.3 volt DC unregulated supply for the shutters; and the relays for controlling the four AC outlets that face into the Topbox. The shutter control for both cameras is located in the G-position of the Topbox card cage. From the operator's hand paddle the cameras may be switched on and off, their shutters opened and closed, and the intensifier gains adjusted, with a digital readout indicating voltage inputs to the intensifier oscillators. The following is a description and theory of operation for the intensifier control and shutter control. See figure 1 for the paddle layout and figure 2. for the Camera Control System block diagram. The system is scheduled for construction and installation by September 4, 1985.

### II. DESCRIPTION OF PADDLE OPERATION

#### A. SHUTTER CONTROL

The shutter control card provides operator and computer control for two shutters. The camera shutters may be used under computer control to protect the intensifiers during automatic offsetting and when moving to a new object. From the operator's hand paddle the shutter system allows rapid isolation of the intensifiers from the light source in the event that the intensifiers should become over illuminated. The shutters are normally open, and if Topbox power fails they will open. However, intensifier voltages will be zeroed automatically. To keep heat dissipation to a minimum the shutter control card has its own 6.3 VDC power supply in the Camera Control Box. The shutter itself dissipates a maximum of 1.2 watts when closed, and 0 watts when open.

1. On Topbox power up, the shutter control circuitry is enabled with the shutters OPEN. The shutters may be opened and closed at this point, and the indicator lights should go ON when the respective shutter is OPEN. When the computer has control, the user may close the shutters by simply pressing the appropriate CLOSE button, but the OPEN button is inoperative. The MAN OVERRIDE switch on the paddle blocks computer control, and thus allows the operator to open the shutter when the computer has commanded it closed. NOTE: On power up it is necessary to wait a few seconds before attempting to close the shutters.

#### B. INTENSIFIER CONTROL

Assuming Topbox power is on, turning on the INT & CCD ELEC power will enable the intensifier functions (for both cameras) on the hand paddle, and turn on the I-CCD camera. The I-VID camera may be turned on as desired by flipping on its power switch. NOTE: The INT & CCD ELEC switch controls power to the I-VID intensifier electronics as well and thus should remain ON when using either camera.

1. Turning on the INT & CCD ELEC power to enable the intensifier functions on the paddle, the LCD display will read:  
a) approximately 1 volt for both the I-CCD and I-VID cameras, if the NORM/ZERO switches were on NORM; or b) about 0 volts if the NORM/ZERO switch was set to ZERO for the respective camera. The 1 volt power up value will establish some voltage on the intensifiers, but not enough to result in sensitivity to light, thus this value is quite safe.
2. Now the I-CCD is ready to begin viewing, or the I-VID power may be switched on if this camera will be used. In either case the paddle functions described below apply to both cameras.

For normal operation, both the NORM/ZERO and NORM/LO RANGE switches should be set to NORM.

SLEW UP/SLEW DOWN-> Allows the intensifier gain to be slewed up and down. For both the I-CCD and the I-VID the display should range from 0 to 6.75 volts.

CLOCK RATE-> Three rates of slewing are provided on the paddle: these are .50 volts/sec, .25 volts/sec and .10 volts/sec. The fast rate allows for rapid slewing to quickly get to the desired gain level, while the slow rate is good for fine adjustments in gain. By momentarily depressing the slew button it is possible to get .01 volt increments.

NORM/ZERO-> The ZERO function is a safety feature which will bring the intensifier voltage down from its maximum value to zero in about 2 seconds. For emergency purposes it is best to close the shutter first and then zero the intensifier voltage if desired. WARNING: Flipping the NORM/ZERO switch back to NORM after zeroing will restore the level of gain (restoring maximum gain takes about 2 sec.) that was present before zeroing. However, while in the ZERO mode the gain value in memory may be slewed down, but not up. If ZERO is selected when INT & CCD ELEC is powered up the intensifier input voltages will be 0 V, otherwise they will be the default values of 1 V.

NORM/LO RANGE-> This function will limit the maximum gain value. The gain will slew down if it is above the limit value when LO RANGE is selected. The rate of this slew down is determined by the CLOCK RATE switch. This function provides a convenient way to slew down without holding the SLEW DOWN button. It also provides a safety in that the user can slew up without risk of hitting the maximum gain level. The maximum gain value is an internal adjustment.

3. In addition to the above functions the I-VID also has an ERASE function. This is a vidicon function and does not affect the intensifier voltages.

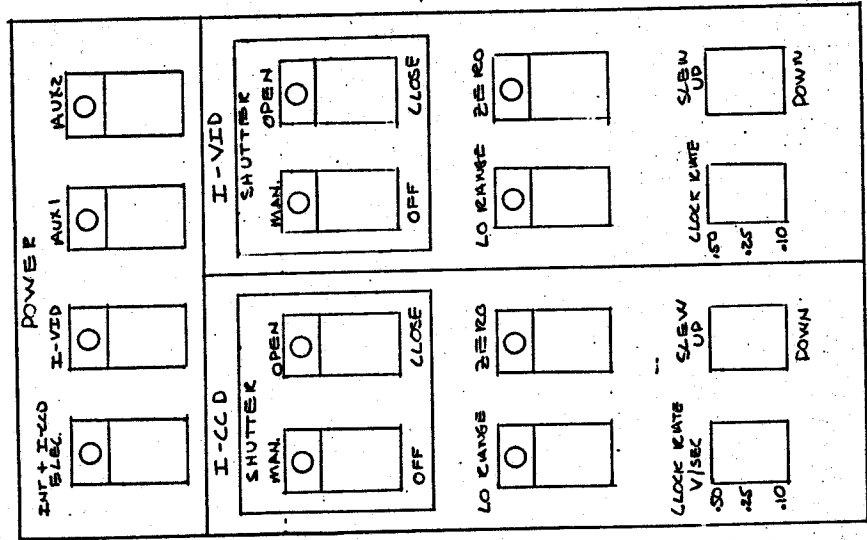
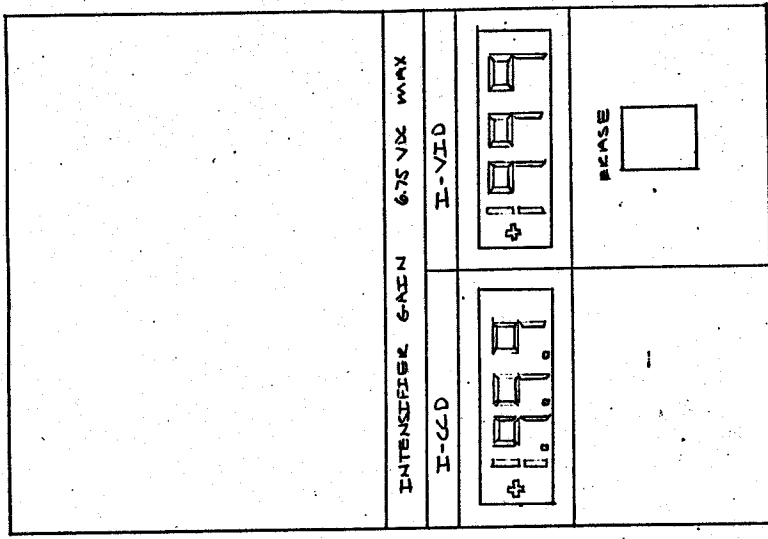
ERASE-> Push and release the ERASE button to erase an old or persistent picture. The field will disappear for about 10 seconds and then return. Multiple erasures are OK.

### III. THEORY OF OPERATION

#### A. INTENSIFIER CONTROL CARD

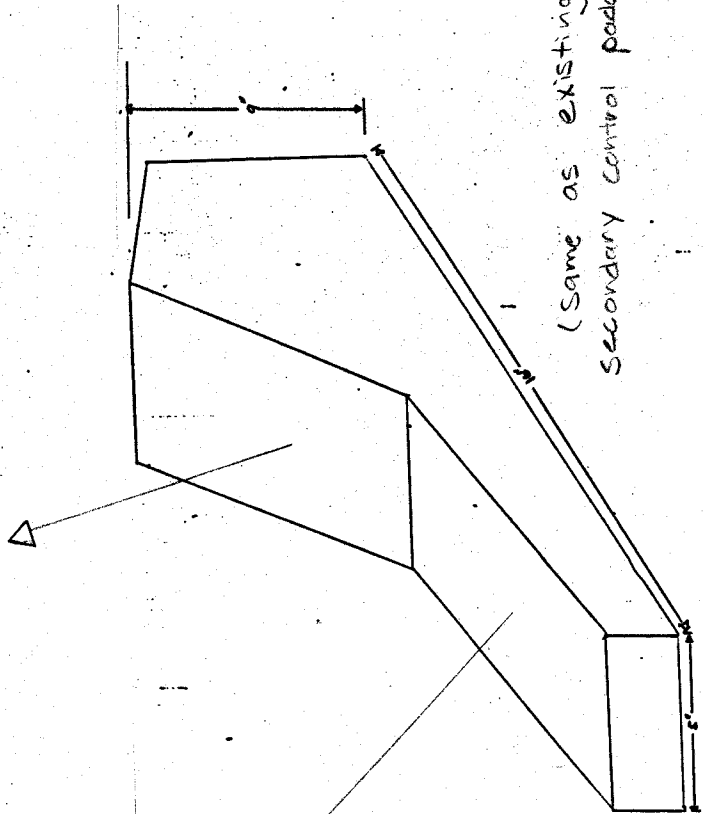
Intensifier gain is controlled by a 10 bit DAC up/down counter. The SLEW UP and SLEW DOWN buttons increment and decrement the counter respectively. The CLOCK RATE function determines at what rate the counter changes. The analog output voltage from the DAC is proportional to the binary counter value. The ZERO switch forces the DAC output to 0 V but retains the register contents. The LO RANGE function forces a comparison of the output voltage to some preset reference voltage. The output voltage is slewed down until it equals the reference. On power up the DAC register is loaded with binary 154 for both the I-CCD and the I-VID cameras, thus setting the initial intensifier voltage. The DAC output is fed to an active low pass filter to slew limit the intensifier gain, thus protecting the intensifier from electrical stress.

Finally as a matter of safety, if one of the 15 pin D connectors should come undone the gain for that particular camera will go to zero.



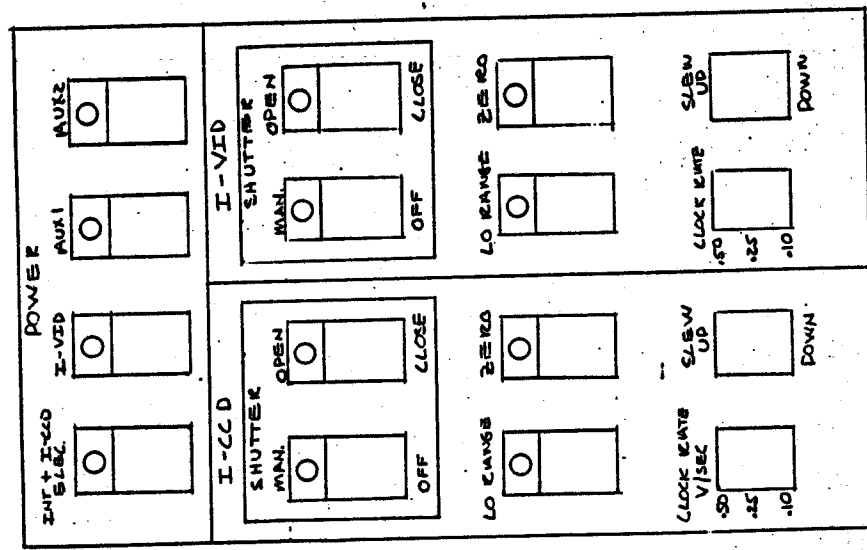
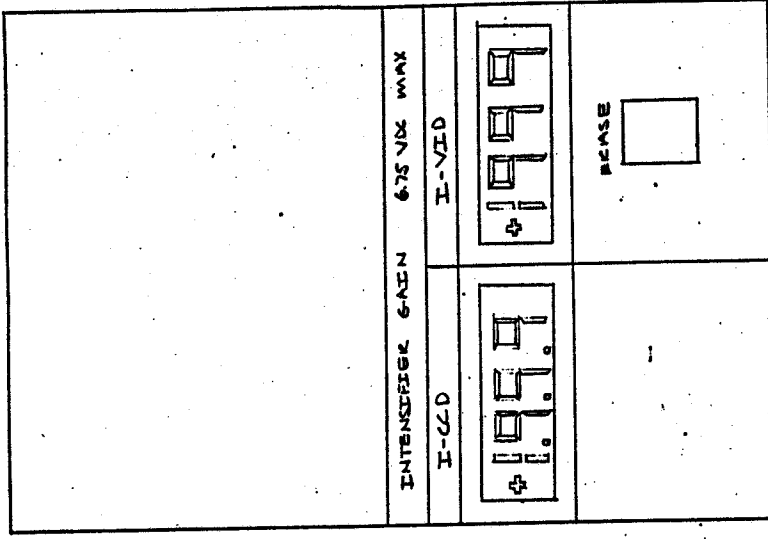
(Note: Switches are C&K rocker-type with some having LED indicator lamp.)

Figure 1.  
Operator's Camera Control Paddle

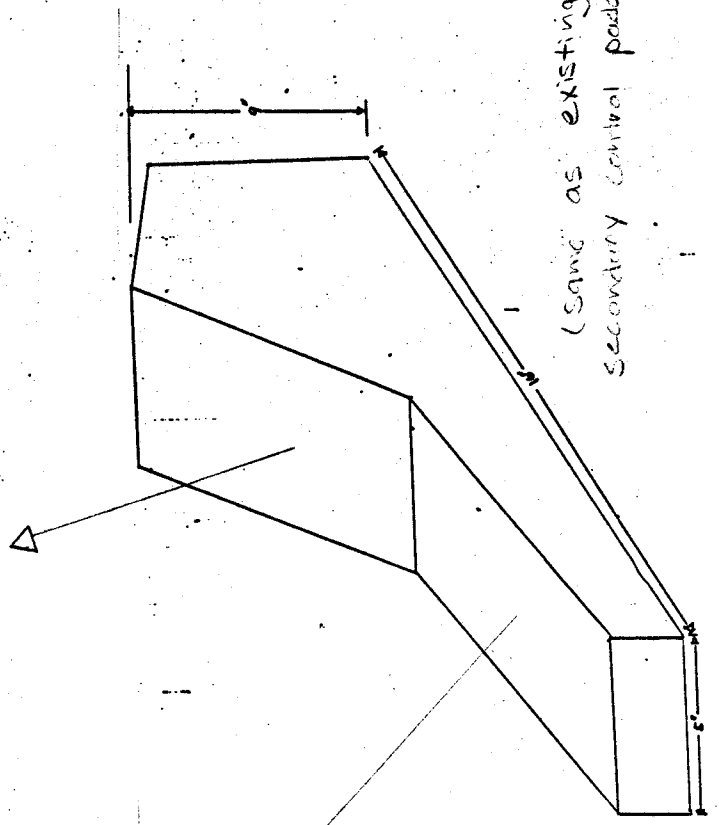


(Same as existing Secondary control paddle.)





(Note: Switches are C&K rocker-type with some having LED indicator lamp.)



(Same as existing secondary control paddle.)

Figure 1.  
Operator's Camera Control Paddle

