

## GENERAL USER MANUAL FOR MAGIC II

General User Manual for MagIC II .....	1
1. Introduction to MagIC II .....	2
2. The SiTe and e2v CCDs .....	3
2.1. Overview of the SiTe .....	3
2.2. Overview of the e2v .....	3
3. Control Software (LOIS) .....	3
3.1. Overview .....	3
3.2. Startup .....	4
3.3. Offsetting to the center of the CCD (revised April 2008) .....	6
3.4. Recording data .....	7
3.5. Shutdown .....	12
4. Operational Issues .....	13
4.1. Rotator offsets for catalog files .....	13
4.2. LOIS scripts .....	13
4.3. Known problems and shortcomings .....	17
4.4. Trouble .....	18
5. Amplifier definitions for the SiTe .....	18
5.1. Introduction .....	18
5.2. Quad-amplifier frame organization .....	18
5.3. Dual-amplifier frame organization .....	19

## 1. INTRODUCTION TO MAGIC II

The Raymond and Beverly Sackler Magellan Instant Camera (MagIC II) hosts two CCDs within the same dewar: a 2k x 2k SITe CCD and a 1k x 1k e2v CCD. *NOTE: The e2v frame-transfer CCD that has not yet been commissioned for general use.* The dewar is continuously cooled by a CryoTiger to hold a detector temperature of  $-120\text{C}$ .

The dewar is mounted to a dual filter wheel which contains 18 positions for 4-inch square filters, so that 16 filters can be mounted at one time (there is an open position in each wheel). Both the SITe and the e2v share the same filters. The standard mounted filters are the Harris *B*, *V*, *R*, *I* and Sloan *u'*, *g'*, *r'*, *i'*, *z'* as well as a custom *VR* filter.

Both CCDs are run using the Lowell Observatory Instrumentation System (LOIS). Only one CCD can be operated at a time, and switching between them requires physically swapping the optical fibers on the instrument computer and the shutter cable to the instrument power supplies. Full instructions on how to switch between them are given in the Mountain Support Manual. *Only an instrument specialist should switch between the SITe and the e2v; this should not be attempted by the observer.*

**Table 1: Standard Filters**

Filter	Central $\lambda$ (Å)	Passband FWHM (Å)	Throughput <sup>a</sup>	
			Mag for 1 e-/sec	Extinction coefficient
Harris <i>B</i>	4303	1045	27.13	0.21
Harris <i>V</i>	5430	971	27.17	0.12
Harris <i>R</i>	6393	1524	27.42	0.10
Harris <i>I</i>	8372	2102	26.79	0.04
<i>VR</i> <sup>b</sup>	6100	836		
Sloan <i>u'</i>	3522 <sup>c</sup>	634 <sup>c</sup>	25.09	0.49
Sloan <i>g'</i>	4803 <sup>c</sup>	1409 <sup>c</sup>	27.51	0.09
Sloan <i>r'</i>	6254 <sup>c</sup>	1388 <sup>c</sup>	27.44	0.16
Sloan <i>i'</i>	7668 <sup>c</sup>	1535 <sup>c</sup>	27.17	0.04
Sloan <i>z'</i>	9114 <sup>c</sup>	1409 <sup>c</sup>	26.21	0.04

<sup>a</sup> Measurements are based on engineering observations taken on 2004 March 8.

<sup>b</sup> custom filter for KBO observations, see [Jewitt, D., Luu J., & Chen J. 1996 \*Astron. J.\*, 112, 1225.](#)

<sup>c</sup> Fukugita, M., Ichikawa, T., Gunn, J. E., Doi, M., Shimasaku, K., & Schneider, D. P. 1996, *AJ*, 111, 1748

## 2. THE SITE AND E2V CCDS

### 2.1. Overview of the SITE

At the  $f/11$  focus of Magellan, the 2k x 2k SITE CCD has a plate scale of 0.069 arc seconds/pixel (the full field is 2.36 arc minutes square. The read noise in the four quadrants lies in the range 4.5-6.2 electrons, with gains in the range 1.90-2.04 e-/ADU. Table 2 gives the approximate readout times based on binning and amplifier settings. *Note: there may be problems with the binning modes.*

**Table 2: SITE Readout Time Estimates**

<b>Binning</b>	<b>Single Amp (sec)</b>	<b>Quad Amp (sec)</b>
1x1	73	23
2x2	24	8
4x4	11	

### 2.2. Overview of the e2v

At the  $f/11$  focus of Magellan, the 1k x 1k SITE CCD has a plate scale of 0.037 arc seconds/pixel (the full field is 40 arc seconds square. The read noise in the left and right amplifiers is 6.0-6.5 electrons, with gains in the range 2.4-2.6 e-/ADU. Table 3 gives the approximate readout times based on binning and amplifier settings. *Note: there may be problems with the binning modes.*

*The e2v is not currently commissioned for general use.*

**Table 3: e2v Readout Time Estimates**

<b>Binning</b>	<b>Dual Amp (sec)</b>
1x1	5

## 3. CONTROL SOFTWARE (LOIS)

### 3.1. Overview

Data acquisition for MagIC II is carried out using version 4 of the Lowell Observatory Instrumentation System (LOIS). LOIS-4 runs on a Sun computer, *magic-site.lco.cl*, located in the equipment room of the Baade telescope. The observer can use either observer workstation in the Baade control room – *burro.lco.cl* or *llama.lco.cl* – to run the script “magic”, which will automatically log into *magic-site.lco.cl* and start LOIS. LOIS can be configured to launch one of several modules that control various aspects of the system: a telescope interface, a camera interface (SITE or e2v), an instrument interface (the filter wheel), and a display interface.

The same version of LOIS controls both the SITE and the e2v, with only minor differences (mostly options for readout modes and binning). Thus the instructions below apply to operating either camera. The LOIS module to run the SITE is called “magic” and the module to run the e2v is “magiceiv”.

### 3.2. Startup

Normally, an the instrument specialist will already have MagIC II set up and your data directory for the night created. If so, the only remaining step you need to take before taking data is to copy your scripts, if any (see §4.2), to the LOIS home directory using the FTP program Transmit. If LOIS is running, you can skip to §3.3.

*Make a data directory:*

An internal disk on the magic-site computer, intended only for data storage, is mounted as */data* on *magic-site.lco.cl*. Create a directory under */data* for the night's data. This is temporary data storage and should be erased at the end of each run. To transfer data between the magic-site computer and *llama* or *burro*, use the *MAGIC* shortcut inside Transmit. No password is required. You should copy your data over to */Data\_Burro* or */Data\_Llama*, where it can be stored during your run. (A useful feature for keeping the *Data\_Burro* directory up to date during the night is the “Synchronize” button in Transmit.) The observer machines have DVD drives that you can use to create a copy of your data for transport home.

#### *Start LOIS*

Before starting the software, confirm with the telescope operator that the CCD electronics for either the SITE or the e2v have been powered on and that the fibers for that CCD are connected to the PCI card on *magic-site.lco.cl*. (This should be done as part of the instrument setup.) From an observer workstation, generate an *xterm* window. Then run the startup script:

```
xterm> magic
```

There will be some diagnostic messages indicating that old files have been cleaned up. The startup script will configure the required environment variables and path names, start the default display tool (ds9), kill any previous LOIS or ds9 processes, and start the main LOIS program.

The display tool window (ds9) will appear on the screen first, followed by the "LOIS system console" (Figure 1). The LOIS system console is divided into two windows – a command window on the left and a log window on the right.

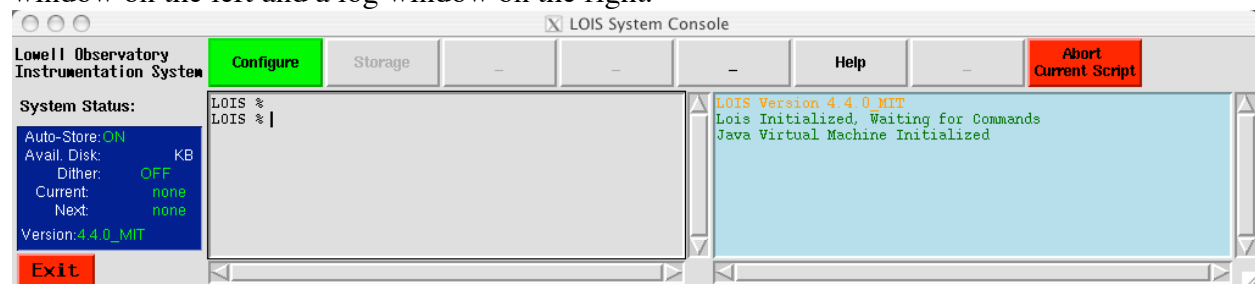


Figure 1. LOIS System Console startup screen.

#### *Open modules*

In the "LOIS System Console" click on the "Configure" button. This will display the configuration window found in Figure 2.

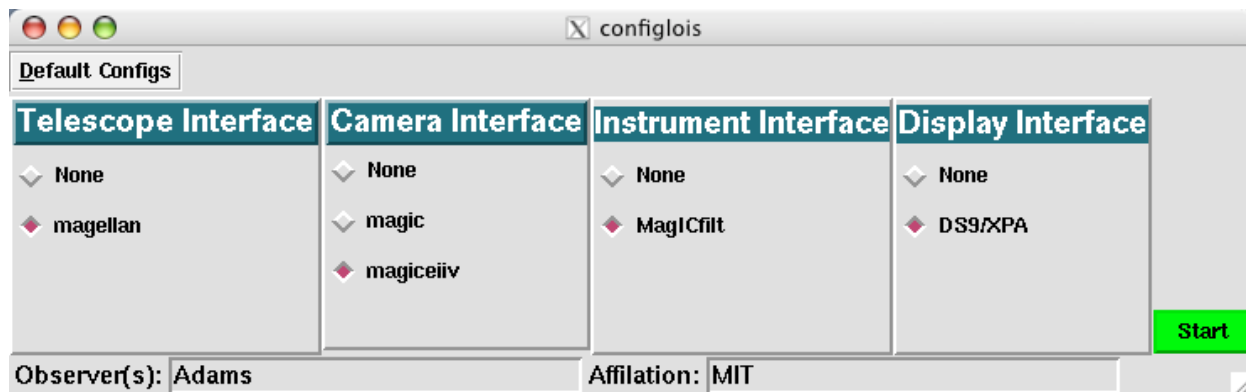


Figure 2. LOIS configuration window. Set telescope, camera, instrument and display interfaces here as well as observer information (names and affiliations). Select “magic” for the SITE CCD and “magiceiv” for the e2v.

The standard configuration should be the *magellan* telescope module, the *magic* camera module (for the SITE) OR the *magiceiv* camera module (for the e2v), the *MagICfilt* instrument module and the *DS9/XPA* display interface. You also have the option to disable any of these modules. After choosing your configuration, fill in the fields for Observer and Affiliation and click on "Start."

The camera, instrument, and telescope modules will be loaded and initialized. This process can take a few minutes, mostly for the initialization of the filter wheels. Three new GUI elements should appear, which are described in the follow section: a “Camera Control Module”, an “Instrument Module”, and a “Telescope Control Module”. Information regarding what is being loaded and what else is occurring can be found in the LOIS Console window log screen.

#### *Set up data storage on magic-site.lco.cl*

In the "LOIS System Console," click the "Storage" button. The Storage window (see Figure 3) will allow you to choose the directory on *magic-site.lco.cl* to save your data in. If this directory does not exist, it will be created; it should be a directory only one level below */data*. You can also set the root file name and exposure start number. Note that if you restart LOIS, the file number will skip a number from the last exposure you took in order to indicate the restart (and avoid overwriting data in the event of a crash).

The disk space on the instrument computer is recycled after each run, so you will want to copy the files to a directory on the observer workstation and to removable media that you can take with you when you leave. If you need help in doing this, ask the instrument specialist.

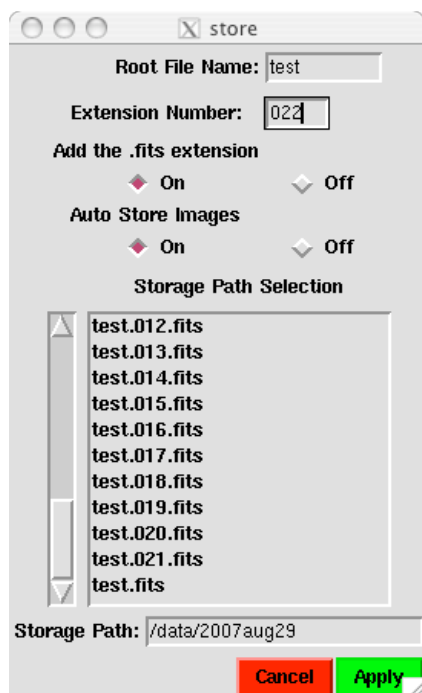


Figure 3. In this window, set the pathname and file structure for the data and click on "Apply". Store your data on *magic-site.lco.cl* in "/data/whatever\_directory\_you\_created". If you type a path that does not exist the directory will be created.

### 3.3. *Offsetting to the center of the CCD (revised April 2008)*

With MagIC-II, both the SITE and the e2v are now physically offset from the optical axis. Thus, each time you move to a new object you must offset to the center of your chosen CCD. This is currently handled using the iraf script "tomagic". To run this script, first launch an iraf window using the Big Red Button on the observing computer. Then load the magic tools:

```
ec1> magic
```

Edit the parameter file to indicate which CCD you are using:

```
ec1> epar tomagic
```

Set "ccdname" to "e2v" or "site" (no quotes). Select "yes" to send offsets to the telescope control system (TCS) and "no" to performing a coordinated offset. Type ":q" to exit.

Run the script any time you move to a new target:

```
ec1> tomagic
```

The magnitudes of the offsets to the two CCDs are constant and have been set in "tomagic" to be {50, 5} for the SITE and {-92,6} for the e2v (note that the SITE is in the opposite direction from the center of the e2v). These values are given in arcseconds along the detector axes, and the corresponding values in cardinal directions depend on the rotator angle. For example: for the e2v in EQU 0.0, an object to the south will be offset 92" W and 6"N, while for the SITE the same object would be offset 50" E and 5" N. Which offset to use is determined automatically so long as the correct CCD is specified in the parameter file.

```

IRAF
Image Reduction and Analysis Facility

PACKAGE = magic
TASK = tomagic

(ccdname=      e2v) Move to CCD center ('site' or 'e2v')
query1 =      yes Send RA/DEC offset to TCS?
query3 =      no  Do coordinated offset?
(mode =       q1)

magic>

```

Figure 4. Parameter file for IRAF script tomagic. Set ccdname to either “site” or “e2v

### 3.4. Recording data

#### Camera control

The camera is controlled through the “MagIC CCD Camera Control” module displayed in Figure 5. This module is where the observer controls the execution of exposures using either the “test” or “go” buttons. Table 4 describes each of the inputs for this module.

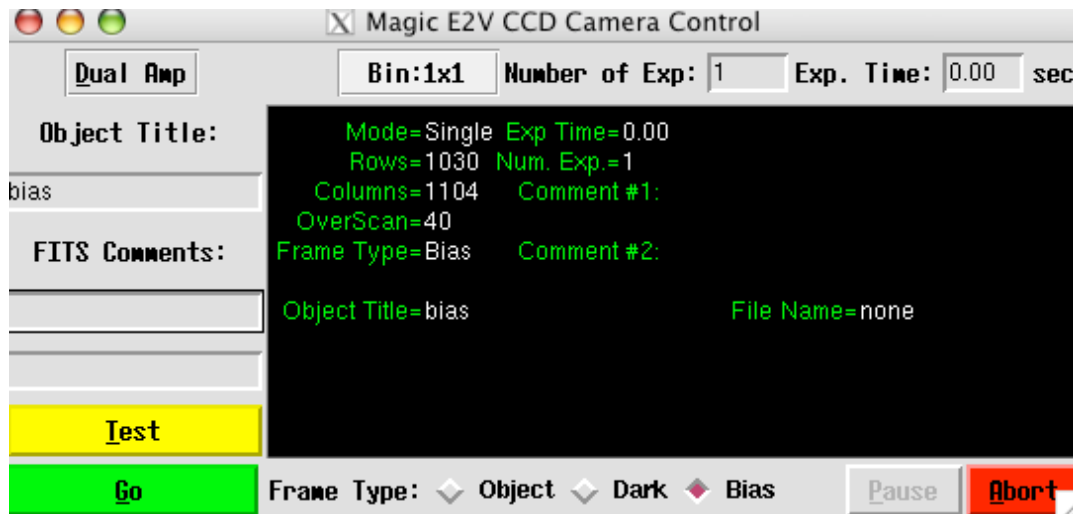


Figure 5. MagIC CCD Camera Control module. Use this module to define the number of exposures, exposure time, object title, type of image, binning, readout mode and comments. Exposures are taken by selecting either the “test” or “go” buttons.

**Table 4: MagIC II Camera Control Module Inputs**

<b>Input</b>	<b>Description</b>
Detector Mode	<b>SITe:</b> Quad-, double-, and single amp readouts with gains of 1 (approx 2e/ADU) are available. <b>e2v:</b> Double-amp readout is available.
Binning	<b>SITe:</b> 1x1, 2x2, or 4x4 <b>e2v:</b> 1x1
Number of Exp	Enter the number of exposures in a sequence.
Exp Time	Enter the exposure time in seconds.
Object Title	Enter the object title. This will be entered into the FITS header as Object.
FITS Comments	Provides two comment lines for the FITS header.
Frame Type	Choose the frame type for the FITS header. Object opens the shutter; Dark and Bias do NOT open shutter.
Test	Takes the current exposure and writes to the temporary file "test.fits". This file will be overwritten by subsequent test images if not renamed.
Go	Takes the current exposure (or sequence) and writes the data to the configured data directory. These files will not be overwritten on the host machine even if you use the same filename.
Abort	Abort the current exposure or the current series of exposures. This does not handle aborting scripts, which must be done from the LOIS system console. It is safer to abort while the status is "Exposing", or LOIS may crash.

All information entered into the input fields will be mirrored to the Status window and recorded in the FITS header. After you choose either Test or Go, a "process bar" (Figure 6) keeps you apprised of what the camera is doing. The process bar is blue while the camera is exposing or reading out the chip. A timer counts down the remaining exposure time and shows what exposure number is being collected.



Figure 6. MagIC CCD Camera Control status while exposing.



Once an exposure is complete the process bar says "Reading" (Figure 8) until the file is read out, at which point it briefly says "Storing". When the system is ready for the next action, the bar turns green and says "Camera Ready".

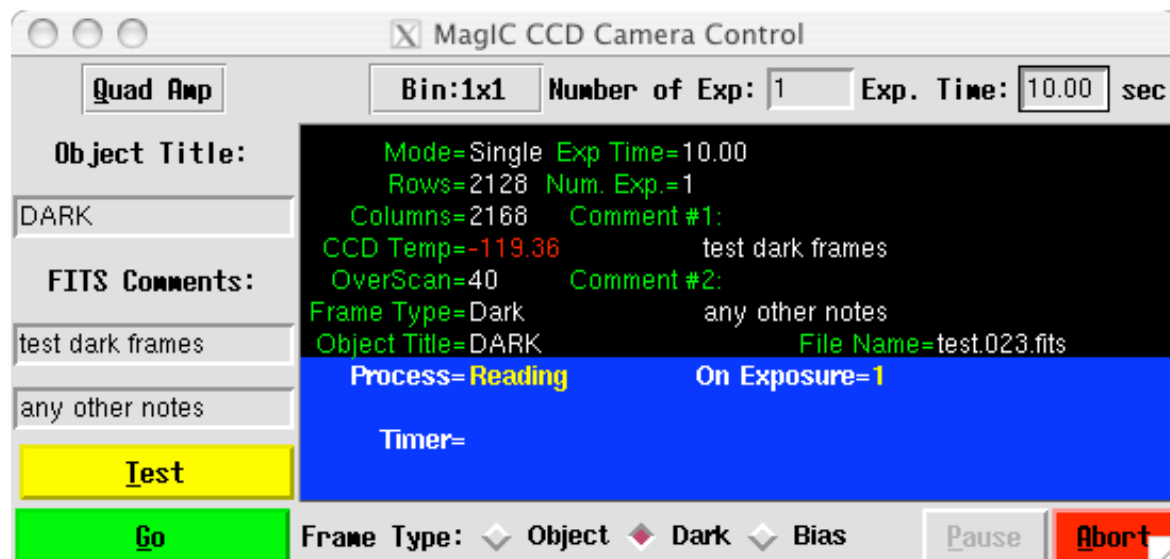


Figure 7. MagIC CCD Camera Control status while reading out.



Figure 8. MagIC CCD Camera Control status when ready to take the next exposure

#### Displaying data

All images are automatically displayed to the *ds9* window. *SAOimage ds9* (Figure 9) is a standard image display and analysis tool that is fully documented with its own help files. It is also fully integrated with the IRAF display tools installed on both of the instrument computers. For modifying the display on future images, the following command may be entered into the LOIS System Console command window:

LOIS% : **disp\_set state=on min=XXX max=XXX scale=<loglinear|rawlauto>**

It may be helpful to display images in another *ds9* window using standard IRAF commands. See the weblink for "Reducing MagIC Images with IRAF" for more details.

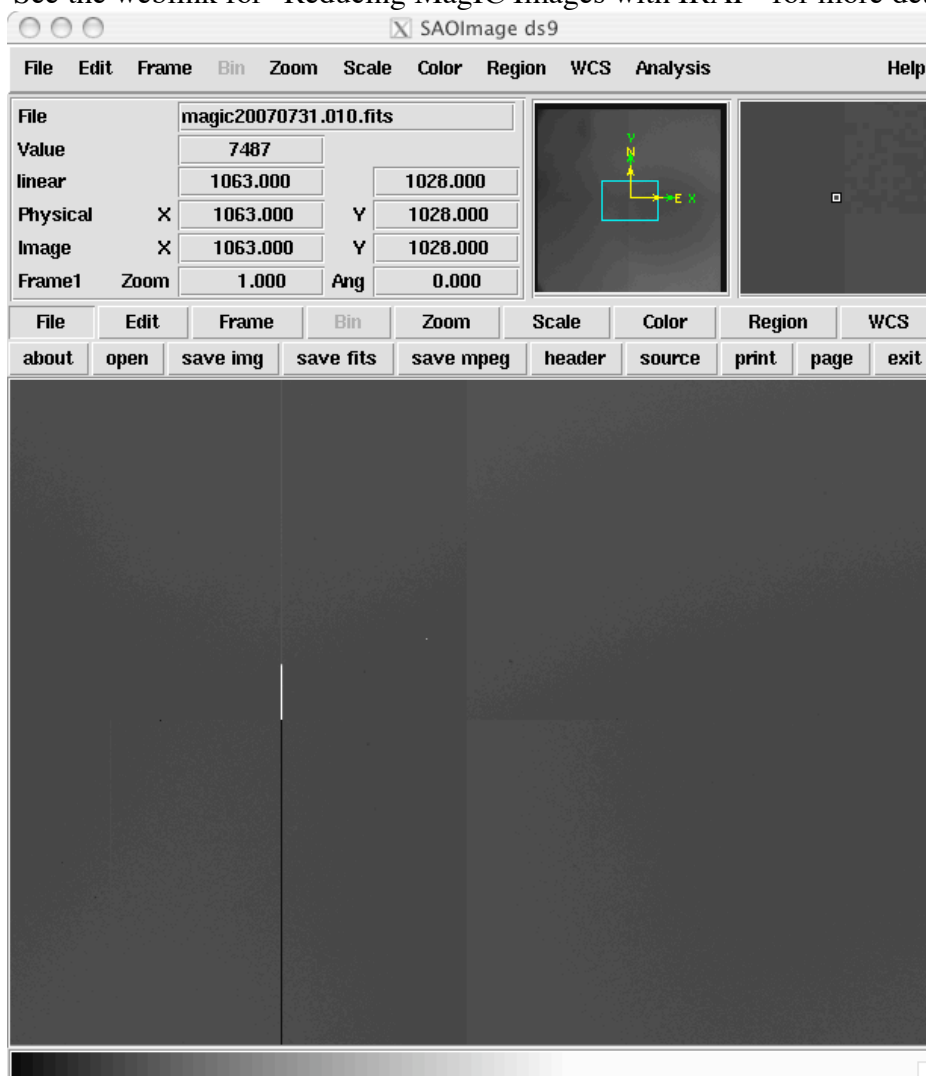


Figure 9. Sample of ds9 display tool for LOIS.

#### *Instrument module (filter wheel)*

The filter wheel is controlled through the "MagIC Filter Wheel Control" window. At startup, the GUI pops up without specifying filter names. Once initialization, which can take a minute or two, is complete, the wheel positions should all have the correct filters identified (Figure 10).

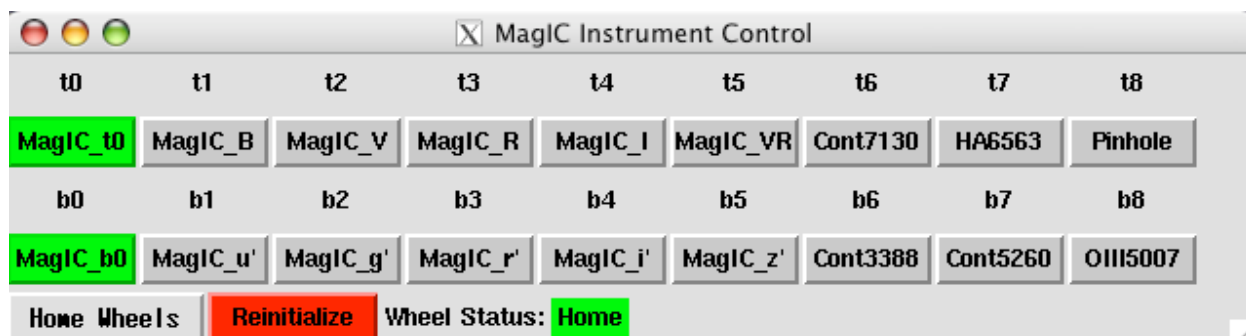


Figure 10. MagIC Filter Wheel Control after initialization.

The current filter on the wheels will be green. To move the filter wheels, click on the desired filter name. During movement to another filter position, the previous filter on the wheels is yellow and the chosen filter on the wheels will be red (Figure 11).

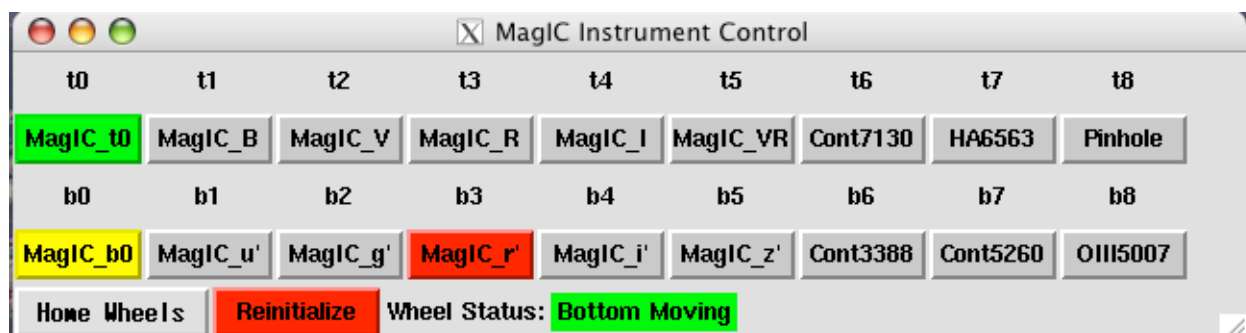


Figure 11. MagIC Filter Wheel Control while moving to a new filter. Yellow indicates the filter that the wheel is moving from, red the filter the wheel is moving to.

When the filter is in position it will be colored green (Figure 12). Only one filter from each wheel can be selected at any one time, and one of those filters should be in the OPEN position (MagIC\_t0 or MagIC\_b0). BE SURE THAT THE WHEEL NOT CONTAINING THE DESIRED FILTER IS IN THE OPEN POSITION. To home the filter wheels, click on the "Home Wheels" button. **Please home the filter wheels at the end of the night** to keep the filters from being exposed to unnecessary dust.

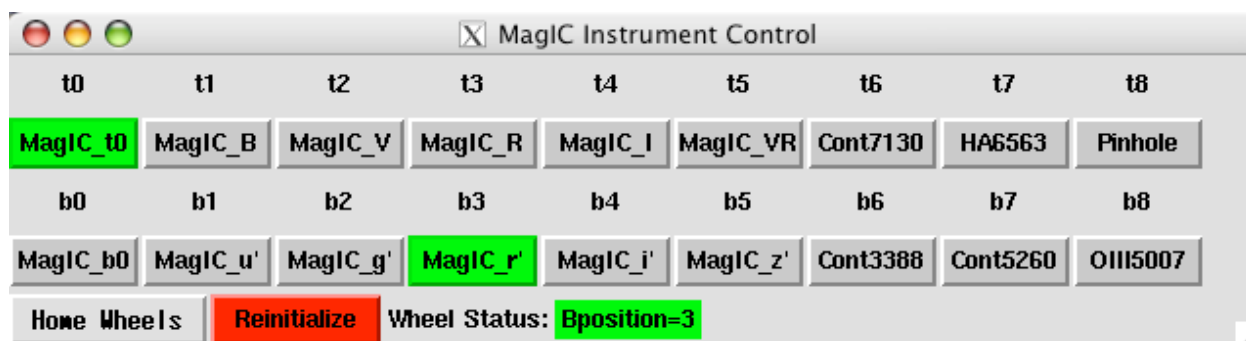


Figure 12. MagIC Filter Wheel Control after selection of a filter. The current filters are in green. Be sure one of these is OPEN (MagIC\_t0 or MagIC\_b0).

### Telescope control module

The “Magellan Telescope Control Module” provides a communication link to the Magellan TCS. Whenever you take an exposure (either via Test or Go), the TCS module will automatically be updated at the beginning of the exposure and the information in Table 5 will be included in the FITS header. The information in the window is NOT a real time display of the TCS information. To get current information, you can click on the “Update” button. *Since the FITS header is written after the exposure is over, you should not try to update the telescope module after beginning an exposure.* If you do, the most recent update information will be written to the header instead of the original exposure information.

The "Coord Move" button opens a pop up window which is used to execute a "coordinated offset" – moving the telescope and moving the guiders so as to keep the guiders tracking the guide- and wavefront stars. The "Rel Move" button offsets the telescope without moving the guiders. Make sure the telescope is not guiding before using this button.

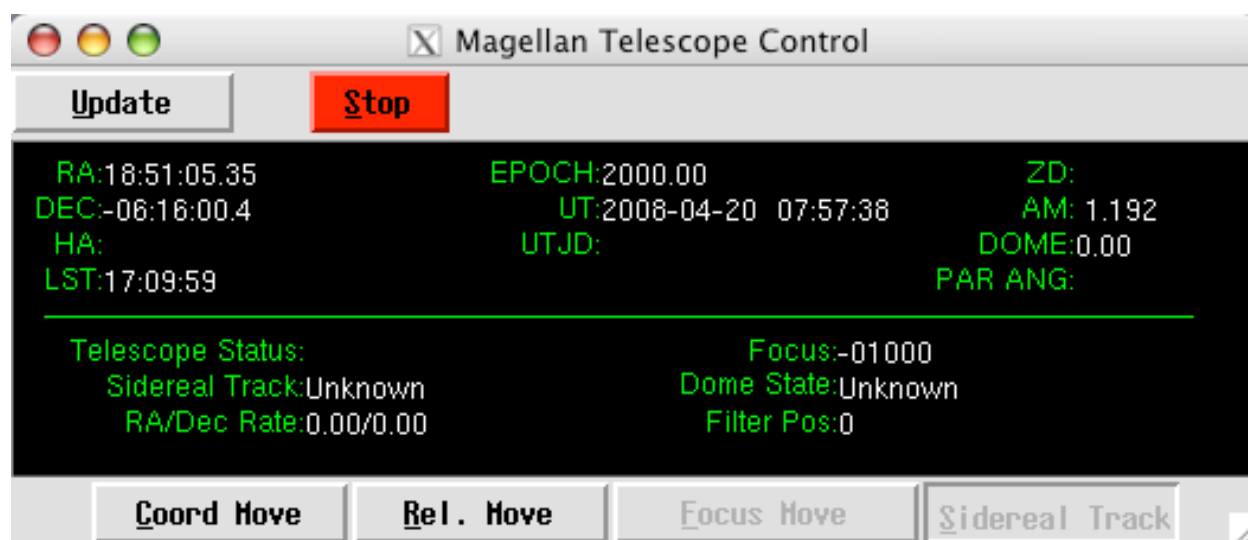


Figure 13. Magellan Telescope Control.

**Table 5: FITS header information from TCS**

Header Keyword	Definition
TELRA	Right Ascension of the telescope pointing
TELDEC	Declination of the telescope pointing
EQUINOX	Equinox of TELRA and TELDEC
AIRMASS	Airmass
TELFOCUS	Telescope focus readout

### 3.5. Shutdown

Normally, shutdown will be handled by an instrument specialist at the end of your run. Should you want the shut down the system (for example, if LOIS has a serious error as discussed in §4.3), first home the filter wheel (this prevents the filters from being exposed to unnecessary

dust when not in use). Then hit the "Exit" button on the "LOIS Console Window". A dialog box (Figure 14) will be displayed to verify your request.

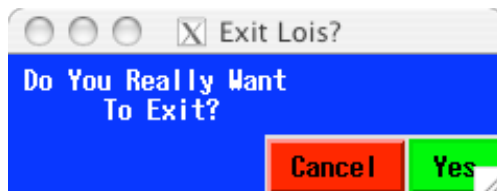


Figure 14. Dialog box confirming desire to exit LOIS.

Remember to REMOVE your data from the host computer *magic-site.lco.cl* prior to the end of your observing run, *AFTER YOU MAKE A COPY OF THE DATA* to the observer computer *llama* or *burro* or elsewhere. The data copy on *magic-site.lco.cl* is intended as temporary data storage, not permanent data storage, which should be on *your* DVD, hard drive or other media.

## 4. OPERATIONAL ISSUES

### 4.1. Rotator offsets for catalog files

At the central folded port on the Baade telescope, the rotator angle offsets (which are included in the .cat files for the telescope operator) for target positions are different that those adopted at the Nasmyth ports. Most observers will chose "0.0 EQU" for columns #8 and #9 of their catalog file that they give to the telescope operator (see <http://www.lco.cl/telescopes-information/magellan/instruments-1/observing-catalogs-1> for a full description of the fields required in a catalog file). This will produce images that are North-right and East-down for southern targets and North-left and East-up for northern targets.

### 4.2. LOIS scripts

*Note: parts of this section may need updating as of May 2008.*

Scripts written in Tcl can be written to take a series of exposures, change filters and move the telescope as needed. For use, scripts should be added (using the MAGIC shortcut in Transmit) to the top level of the observer home directory on *magic-site.lco.cl*, */home/observer*, since this is where LOIS will look for active scripts. At the end of your run, save your scripts elsewhere, and erase them from */home/observer*. Some example scripts are located in */home/observer/SCRIPTS*. At important caveat for scripts is that **THEY WORK ONLY FOR THE QUAD-AMP, 1x1 BINNING MODE FOR THE SITE**. Scripts must first be loaded and then run. Both tasks are executed by commands entered in the LOIS system console command window. To load a procedure in the command window, type:

```
LOIS% source script_file_name
```

To run a script, in the command window type:

```
LOIS% procedure_name
```

Scripts can be aborted using the red "Abort current script" button on the LOIS system console. Table 6 describes the command line information necessary in scripts. If a value is not

specified it is assumed to be zero in the case of a floating point input. For example, using `delta_rot=0` means that the rotation does not change from whatever it was defined as, but it is not necessary to specify this in order to keep the same orientation.

**Table 6: Commands for LOIS Scripts**

Command	Options	Definitions and Notes
<code>filter wheel</code>	0 or 1	Top or bottom filter wheel
<code>pos</code>	0 – 8	Filter position on the wheel
<code>go</code>	—	Command, starts an exposure, followed by <code>frame=xx</code>
<code>frame</code>	bias, dark, object	Type of frame
<code>nexp</code>	float	Number of exposures
<code>etime</code>	float	Exposure duration (seconds)
<code>set_amplifier</code>	—	Command to set amplifiers to use, followed by <code>amp=xx</code>
<code>amp</code>	A,B,C,D,AB,CD,ALL	Amplifiers to use, case sensitive
<code>offset</code>	—	Command to set telescope offset, followed by <code>delta_ra=&lt;float&gt;</code> <code>delta_dec=&lt;float&gt;</code> ... <code>delta_rot=&lt;float&gt;</code>
<code>delta_ra</code>	float	Offset in ra, arcseconds
<code>delta_dec</code>	float	Offset in dec, arcseconds
<code>delta_az</code>	float	Offset in altitude
<code>delta_el</code>	float	Offset in elevation
<code>delta_rot</code>	float	Offset in rotation
<code>timeout</code>	int	Integer, default timeout is 90s
<code>-noguide</code>	-noguide	Used for a relative move <sup>a</sup>
<code>epoch</code>	float	The epoch of the coordinates that you are offsetting from and is require for an offset w/o guiders. <sup>a</sup>

<sup>a</sup> Note the -noguide and epoch are used in a relative move that is not coordinated with the guiders. xx what is meant by "epoch" here? xx

How you use the keywords defines the type of offset you want. For a coordinated RA and DEC offset with the guiders:

```
offset delta_ra=<value> delta_dec=<value>
```

With the instrument rotator:

```
offset delta_ra=<value> delta_dec=<value> delta_rot=<value>
```

Offset move in RA and DEC without the guiders:

```
offset delta_ra=<value> delta_dec=<value> epoch=<value> -noguide
```

Add the `delta_rot` value for to include the instrument rotator.

Offset move in azimuth and elevation:

```
offset delta_az=<value> delta_el=<value> delta_rot=<value>
```

*Example #1: stdstar*

The following script takes a set of exposures through a series of filters and exposure times. The script is defined in detail in Table 7.

```

proc stdstar {} {
filter wheel=0 pos=0
filter wheel=1 pos=1
go frame=object nexp=2 etime=5
log_3 {u filter has finished}
filter wheel=1 pos=2
go frame=object nexp=2 etime=5
log_3 {g filter has finished}
filter wheel=1 pos=3
go frame=object nexp=2 etime=5
log_3 {r filter has finished}
filter wheel=1 pos=4
go frame=object nexp=2 etime=5
log_3 {i filter has finished}
filter wheel=1 pos=5
go frame=object nexp=2 etime=5
log_3 {z filter has finished}
filter wheel=1 pos=0
filter wheel=0 pos=2
go frame=object nexp=2 etime=5
log_3 {V filter has finished}
filter wheel=0 pos=3
go frame=object nexp=2 etime=5
log_3 {R filter has finished}
log_3 {stdstar has finished}
}

```

**Table 7: Detailed description of LOIS "stdstar" Script**

Script line	Explanation of command
proc stdstar {} {	Define procedure name, open script
filter wheel=0 pos=0	Move top filter wheel to OPEN position
filter wheel=1 pos=1	Move bottom filter wheel to Sloan u' filter position
go frame=object nexp=2 etime=25	Execute an object frame: 2 exposures, 25 seconds each
log_3 {u filter has finished}	Write to LOIS log screen: u filter set has finished
filter wheel=1 pos=2	Move bottom filter wheel to Sloan g' filter position
go frame=object nexp=2 etime=10	Execute an object frame: 2 exposures, 10 seconds each
log_3 {g filter has finished}	Write to the LOIS log screen: g filter set has finished
filter wheel=1 pos=3	Move bottom filter wheel to Sloan r' filter position
go frame=object nexp=2 etime=5	Execute an object frame: 2 exposures, 5 seconds each
log_3 {r filter has finished}	Write to the LOIS log screen: r filter set has finished
filter wheel=1 pos=4	Move bottom filter wheel to Sloan i' filter position
go frame=object nexp=2 etime=5	an object frame: 2 exposures, 5 seconds each
log_3 {i filter has finished}	Write to the LOIS log screen: i filter set has finished
filter wheel=1 pos=5	Move bottom filter wheel to Sloan z' filter position

Script line	Explanation of command
go frame=object nexp=2 etime=5	an object frame: 2 exposures, 5 seconds each
log_3 {z filter has finished}	Write to the LOIS log screen: z filter set has finished
filter wheel=1 pos=0	Move bottom filter wheel to OPEN position
filter wheel=0 pos=2	Move top filter wheel to V filter position
go frame=object nexp=2 etime=5	an object frame: 2 exposures, 5 seconds each
log_3 {V filter has finished}	Write to the LOIS log screen: the V filter set has finished
filter wheel=0 pos=3	Move top filter wheel to R filter position
go frame=object nexp=2 etime=5	an object frame: 2 exposures, 5 seconds each
log_3 {R filter has finished}	Write to the LOIS log screen: the R filter set has finished
log_3 {stdstar has finished}	Write to the LOIS log screen: the stdstar script has finished
}	Close script

### Example #2: dither

The following script sets the filter wheel, takes an exposure, executes a coordinated offset and takes another exposure.

```
proc dither {} {
  filter wheel=0 pos=0
  filter wheel=1 pos=3
  go frame=object nexp=1 etime=60
  log_3 {r filter position 1 has finished}
  offset delta_ra=-10 delta_dec=0 delta_rot=0
  go frame=object nexp=1 etime=60
  log_3 {r filter position 2 has finished}
  offset delta_ra=0 delta_dec=-10 delta_rot=0
  go frame=object nexp=1 etime=60
  log_3 {r filter position 3 has finished}
  offset delta_ra=10 delta_dec=0 delta_rot=0
  go frame=object nexp=1 etime=60
  log_3 {r filter position 4 has finished}
  log_3 {dither has finished}
}
```

### Example #3: dither2filter

The following script sets the amplifier to single readout mode then sets the filter wheel, takes an exposure, executes a coordinated offset and takes another exposure, changes the filter, takes an exposure, executes a coordinated offset (back to the original position) and repeats the process 3 times.

```
proc dither2filter {{nexp 3}} {
  set_amplifier amp=D
  log_3 {set amplifier to single amp D}
```



```

for {set i 0} {$i < $nexp} {incr i} {
  filter wheel=0 pos=0
  filter wheel=1 pos=3
  go frame=object nexp=1 etime=60
  log_3 {r filter position 1 has finished}
  offset delta_ra=-10 delta_dec=-10 delta_rot=0
  go frame=object nexp=1 etime=60
  log_3 {r filter position 2 has finished}
  filter wheel=1 pos=4
  go frame=object nexp=1 etime=60
  log_3 {i filter position 2 has finished}
  offset delta_ra=10 delta_dec=10 delta_rot=0
  go frame=object nexp=1 etime=60
  log_3 {i filter position 1 has finished}
  log_3 {dither2filter has finished}
}
}

```

### 4.3. *Known problems and shortcomings*

#### *Aborting exposures and scripts*

This can be done only when neither the telescope nor the filter wheel is moving. It is safer to abort a script when the process bar on the camera module is blue, indicating that the camera is either exposing or reading out. LOIS may crash if aborted during read out.

#### *Phantom pixels at row 1991 (single-amp mode) of the SITE*

When reading out in single amp mode the software inserts two bogus pixels at row 1991. The sky data is seen shifted. This can in principle be corrected in software, but in practice it lies so close to the edge of the field (4 arcseconds) that one may not want to go through the effort.

#### *Saturation levels for the SITE*

Note that amplifiers C and D (the top two quadrants in quad amp mode, as viewed in the *SAOimage ds9* window) saturate at about 35K ADU, well before the other two amplifiers (A and B) reach saturation.

#### *File numbers*

When you restart LOIS after running a series of exposures, the file number skips one: if the last frame you took in the previous session was 010, the next frame will by default be 012. Check the Storage button on restart to make sure you have the desired file number. This is actually a feature, not a bug: a skipped file number indicates that LOIS was restarted.

#### *Duplicate files (with different file names)*

Occasionally LOIS has been noted to write out duplicate files of the same image, so you should watch for this when taking sequences of the same exposures (including darks and

biases!). The duplicate files will have different numbers. The cause of this bug is unknown. You should notify the technical staff if it appears.

#### *Failure to write FITS files*

LOIS sometimes fails to write out FITS files with the error:

Error Unable to write the Fits File!! Status=413

Error Unable to Close the Fits File!

If this occurs, you must restart LOIS for it to figure out how to write files properly again, or else it will hang while trying to write out subsequent exposures. Usually everything works fine on restart. The cause of this bug is also unknown, and it is somewhat common.

#### **4.4. Trouble**

Under ideal circumstances the system will have be started and tested ahead of your observing run by the instrument specialist, and it will remain ready to be powered for your run. When properly set up, the operation of MagIC under LOIS has proven reasonably robust.

In the case that odd error messages occur during the startup, simply exit the current LOIS session and run the start script again. If you still have problems, ask the instrument specialist or telescope operator to reset the PCI card on the instrument computer (*magic-site.lco.cl*). If that does not solve the problem, the instrument specialist or telescope operator will cycle power on the electronics boxes and reboot the instrument computer.

## 5. AMPLIFIER DEFINITIONS FOR THE SITE

LOIS/MagIC Information Document Number: 001

**Title:** Amplifier Definitions

**Author:** Brian W. Taylor

Started: 11/04/2005

Last Revised: 08/31/2006

### **5.1. Introduction**

The MagIC SITE 424a CCD has four amplifiers and an image area of 2048 columns and 2049 rows. Each amplifier when used will generate 20 prescan pixels. With MagIC along with these prescan pixels there are 40 overscan columns per amplifier and 20 parallel over clocked rows in each frame.

### **5.2. Quad-amplifier frame organization**

Frame organization for the quad amp as shown in the above image demonstrates the location of each amplifier in the final deinterlace of the image and are defined as follows using the IRAF inclusive image block [x1:x2, y1:y2] or [column 1:column 2, row 1:row2].

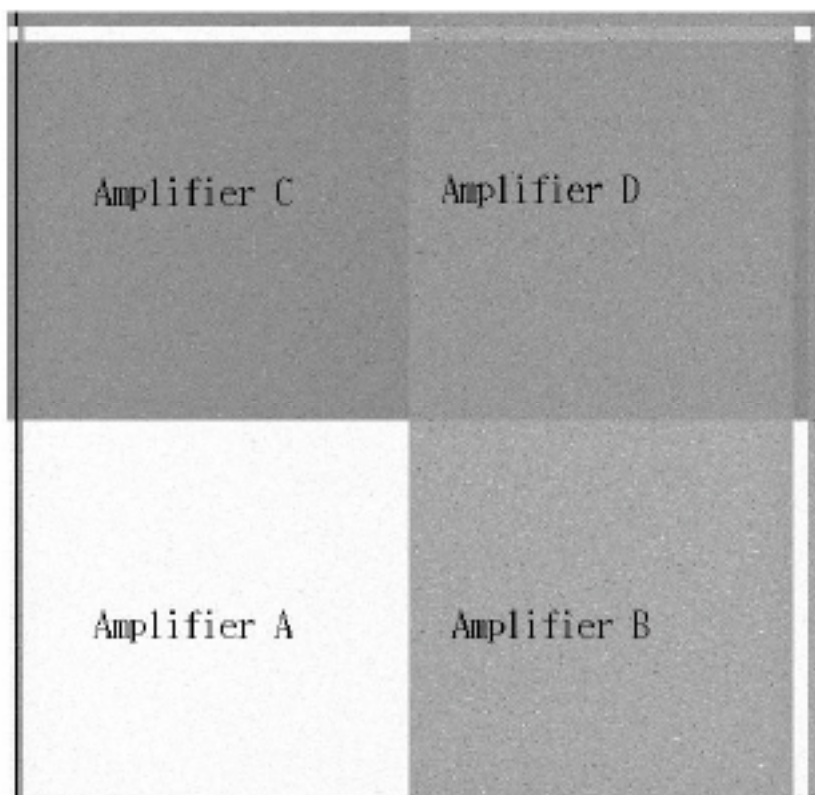
Prescan Amplifier A: [1:20,1:1025]

Prescan Amplifier B: [21:40,1:1025]

Prescan Amplifier C: [1:20,1026:2049]

Prescan Amplifier D: [21:40,1:2049]

Image Amplifier A: [41:1064,1:1025]  
 Image Amplifier B: [1065:2088,1:1025]  
 Image Amplifier C: [41:1064,1026:2049]  
 Image Amplifier D: [1065:2088,1026:2049]  
 Overscan Amplifier A: [2089:2128,1:1025]  
 Overscan Amplifier B: [2129:2168,1:1025]  
 Overscan Amplifier C: [2089:2128,1026:2049]  
 Overscan Amplifier D: [2129:2168,1026:2049]  
 OverClock Amplifier A: [42:1065,2050:2088]  
 OverClock Amplifier B: [1066:2089,2050:2088]  
 OverClock Amplifier C: [42:1064,2090:2128]  
 OverClock Amplifier D: [1065:2089, 2090:2128]



### 5.3. *Dual-amplifier frame organization*

This reference is for the dual amp readout for Amps C and D. If switching to dual amp readout for Amps A and B, the values are the same using A for C and B for D.

Prescan Amplifier C: [1:21,1:2049]  
 Prescan Amplifier D: [21:40,1:2049]  
 Image Amplifier C: [41:1064,1:2049]  
 Image Amplifier D: [1065:2088,1:2049]  
 Overscan Amplifier C: [2089:2128,1026:2049]  
 Overscan Amplifier D: [2129:2168,1026:2049]  
 OverClock Amplifier C: [42:1064,2050:2068]

OverClock Amplifier D: [1065:2089,2050:2068]  
Last Modified: 08/31/2006

