Guider Camera Control

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Guider Camera Control System Interface

Starting the Camera

To start the camera interface, press the reset button on the computer. The program will start automatically from the flash disk. If the camera stops operating for any reason, the command “DSPI” will reset the processor inside the camera and re-load the program. The camera should start running again.

Running the Camera

The camera runs in two modes. The full-frame mode is used for field acquisition and to take Shack-Hartmann images. The field in full-frame mode is 1000 x 1000 native pixels. Each native pixel is 13.5 microns square, corresponding to 0.092 arcsec when the offset guider is configured for field acquisition. The full field of view is 92 arcsec square. The full frame is displayed in the center of the screen. When the camera is in full-frame mode, a magnified image of the region-of-interest

(selected by adjusting the position of cursor number 5) is displayed above and to the left of the full-frame image. The region-of-interest is 71 (native) pixels square. The subraster mode is used for guiding. In subraster mode the full-frame display does not update. Only the magnified region-of-interest display is used.

In either mode the camera read-out is actually binned either 2x2 or 4x4. In full-frame mode the resulting image is actually either 500x500 or 250x250. In guider (subraster) mode the resulting image is actually either 36x36 or 19x19. However, in all cases the cursor coordinates and image displays are referenced to the original 1000x1000 native pixel format.

The exposure time in full-frame mode can be changed by entering the “TF” command. The shortest possible exposure in full-frame, binned-2 mode is 0.71 sec. The shortest exposure in full-frame, binned-4 mode is 0.25 sec. Entering a smaller value for TF (including zero) will result in the shortest possible exposure, which will be displayed in the ACQ (for acquisition time) entry on the screen.

The exposure time in guide mode can be changed by entering the “TG” command. The shortest possible exposures in guide mode vary from about 0.02 to 0.04 sec, depending on the location of the guide box on the CCD.

Note that the temperature readout of the CCD requires a minimum time between successive readouts of 0.05 seconds. If less than 0.05 sec is available, the temperature readout will not update. Entering a value for TF of 0.75 sec in binned-2 mode, or 0.3 sec in binned-4 mode will guarantee that there is enough time between readouts to update the temperature reading. In guide mode, a value for TG of 0.1 sec will guarantee that enough time is available to update the temperature.

Scaling the Display

The program will automatically adjust the zero-point of the display by estimating the intensity value in the CCD readout which corresponds to a certain percentile in the overall distribution of intensities for all of the pixels in each frame. The program will then scale the output so that the percentile CCD intensity corresponds to a given brightness on the TV screen. To adjust the percentile of the estimate, use the command “PCT”. This might be necessary, for example, if there is a strong gradient in the intensity of the CCD image. To adjust the corresponding brightness of the display, use the command “BKG”.

To turn off the automatic adjustment of the zero-point, enter the value “PCT 0”. Then choose a fixed zero-point (corresponding to black on the display) by using the “ZERO” command. The “SPAN” command is used to adjust the range of intensities on the CCD which is displayed between the black and white values on the TV screen.

Guiding

In order to guide, the camera needs to know the orientation of the image. This is accomplished using the “PA” command. The sign of PA is used to indicate the parity of the image, so a value of 0.0 is not allowed. Use + or – 360. instead. The value of PA is the same as the value of PA which is displayed in the TCS program when set for this camera via the CN command. If APA is enabled (which it is by default), the PA symbol on the screen will be green instead of black, and the PA angle will be read automatically from the TCS. The guider should be able to work properly as long as the value of PA is accurate to within about 20 degrees.

The guider also needs to know the pixel size (this is the native pixel size, which is independent of binning). The value for the camera in the X-Y guider is 0.092 arcsec. Note that the on-screen display of the pixel size is shown without a decimal point (integer thousandths of an arcsec).

In full-frame mode, choose a star to guide on which is adequately bright. Move the square cursor to the desired position, then press <F3> and the camera will start guiding. Note that the centroiding algorithm currently only works with a binning value (BG) of 2.

The centroiding algorithm will use a square region of the subraster which is determined by the “BX” (box) command. Larger boxes with more data take longer to calculate, and are more susceptible to problems caused by cosmic rays. The calculation time can be estimated from the “mx” value shown in the input box (mx is the maximum cycle time for the program status loop, in milliseconds). Use a box which is somewhat larger than the image, but not too much.

Once the camera is guiding, a number of quantities will be displayed. TC is the total count (in data numbers) in the image. MX is the maximum value in DN. Avoid using a star with a value of MX greater than 10,000 – it may be saturated. BK is the background value. FW is the full-width at half-maximum in arcseconds. IT is the number of iterations required to obtain convergence. DX and DY are the positions of the image centroid in pixels.

The guider works best when the error signal is used to move the telescope promptly. Delays introduce phase lags which degrade the value of the error signal and can cause the position feedback to become unstable. The problem is that the TCS only updates the position of the telescope (using a command to the main drives) every 0.4 second. So it is not a good idea to use exposure times (TG) which are much smaller than this value. 0.3 is OK. Also, it is not a good idea to use exposure times which are a multiple of 0.4 sec, because the latency might get stuck at a high value for a long time. Odd values of the guider exposure time (0.3 or 0.5 sec) are better for this reason.

The sensitivity of the guider is controlled using the SN command. A value for SN of 0.5 is conservative and should be very stable. Increasing the value of SN may improve the rms position residuals as shown in the graphical display, but too large a value will start to make the feedback unstable, and the position residuals will get worse. A value of 0.6 or 0.8 will probably OK, and for long exposures (1.0 sec or greater) a value of 1.0 might be good.

Note that the sensitivity of the guider is independent of the averaging parameter (AVG). Using an averaging parameter of 2 (or in some cases even 3 or 4) is recommended, because the centroiding algorithm will converge more rapidly, and the smoother graphical displays of the position error will provide a more realistic estimate of the guider performance.

The graphical display of TC is scaled to the value for the first frame after pressing <F2> or <F3>. Sometimes the first frame will be atypical (for example if the star is not quite in the data box), and the scale for TC will be wrong. To re-scale the TC display, just press <F2> or <F3> again.

The graphical display for FW is scaled from 0 to 2.0 arcsec. The graphical displays for the AZ and EL error values are scaled to +/- 1.0 arcsec.

Recording Data

A single frame can be sent over the ethernet connection to the active optics computer, by typing the “SEND” command. Successive frames can be sent every n seconds by entering the command “SEND n”. To stop sending successive frames, enter “SEND 0”.

Commands Summary

Camera Commands

TF n

Set the exposure time (in seconds) for full-frame mode

TG n

Set the exposure time (in seconds) for guide mode

BF n

Set the pixel binning for full-frame mode (n = 2 or 4)

BG n

Set the pixel binning for guide mode (n = 2 or 4)

AVF n

Set the leaky-memory averaging parameter for full-frame mode (n = 0 to 99)

AVG n

Set the leaky-memory averaging parameter for guide mode (n = 0 to 99)

SKY

Save a sky frame for later subtraction

SUB

Enable/disable sky subtraction of stored frame

Guider Commands

SN n

Set the guider sensitivity (n = 0.1... 2.0)

BX n

Set the centroid data box to n pixels (odd n, 7... 69)

PX n

Set the pixel size in arcseconds

APA

Toggle automatic setting of camera position angle from the TCS

PA n

Set the camera position angle in degrees manually

GM n

Set the guider mode (n = 1,2,3). (Currently does nothing.)

FM n

Set the function key mode (n = 1,2,3).

<F1> or FONE

Switch to full-frame mode (guider off). But if FM is 2, do not do that, but rather save the current values of AVF, TF, and SEND, and then set them all to 0.

<F2> or FTWO

Switch to subraster (guide) mode, calculate only.

<F3> or FTHR

Switch to subraster (guide) mode, calculate and move telescope. But if FM is 2, do not do the above, but rather restore the values of AVF, TF, and SEND, that were last saved by F1.

<F4> or FFOU

Like F2, but center the box on the star first

<F5> or FFIV

Like F3, but center the box on the star first

<F6>

Switch to subraster mode. Box follow object.

<F9> or FNIN

Send a FLDn command to the Guider Probe Control program

<F10> or FTEN

Send a SHAn command to the Guider Probe Control program

TC s

Send a TCS command (s = string TCS command)

Other Camera Commands

DSPI

Initialize (or re-initialize) the DSP

TEC n

Set the thermoelectric cooler current to n amps (n = 0... 2.5).

SEND

Send one frame over the ethernet link

SEND n

Send a frame over the ethernet link every n seconds (0 = never).

SH n

Indicate that the next frame sent is of the Shack-Hartmann mask and that the Shack-Hartmann correction loop should be triggered. (n=1 → YES, n=0 → NO).

SPAN n

Set the black-to-white scaling of the image display to n DN

PCT n

Set the percentile value of the intensity histogram for auto-zero.

ZERO n

Set the black level of the image display in DN (if PCT is 0).

BKG n

Set the grayscale level corresponding to the percentile value (n = 1... 63).

AMP n

Select right (n = 1) or left (n = 2) on-chip amplifier

GATE n

Set the CCD output gate voltage to n volts (n = -5.0... -9.0).

ES

Toggle the output of extended guiding commands to the TCS. Used to record tracking errors.

Cursor Commands

XY n

Select the active cursor (n = 1... 5). XY 5 controls the square cursor. The XY 1 cursor is controlled by the TCS trackball

XYS n x y

Set cursor n to position x, y (0-999.9)

XYR n x y

Move cursor n delta x,y (-999.9 to 999.9) relative to its present position

MM n

Set the mouse mode to n (1-3). When the left mouse button is clicked while holding down the right mouse button, mode 1 moves the box to the mouse position, mode 2 moves the guide probe so that the star at the mouse position moves into the box, mode 3 (default) moves the telescope so that the star at the mouse position moves into the box. (Without holding down the right mouse button, the move is one tenth the amount.)

MC n

Simulate a mouse button click. n = 1 for the left button, n = 2 for the right button, n = 3 for both.

<Del>

Increase the cursor motion step size (.1, 1, 4, 40).

<Ins>

Decrease the cursor motion step size (40, 4, 1, .1).

<Up>

Move the selected cursor up one step

<Dn>

Move the selected cursor down one step

<Lf>

Move the selected cursor left one step.

<Rt>

Move the selected cursor right one step

<Home>

Move the selected cursor up and to the left one step

<Pg Up>

Move the selected cursor up and to the right one step

<End>

Move the selected cursor down and to the left one step

<Pg Dn>

Move the selected cursor down and to the right one step

Message Commands

Ctrl-<Up>

Scroll system message display back one line

Ctrl-<Pg Up>

Scroll system message display back one page

Ctrl-<Dn>

Scroll system message display forward one line

Ctrl-<Pg Dn>

Scroll system message display forward one page

Ctrl-<Home>

Set system message display to show the first message

Ctrl-<End>

Reset system message display to show the current message

Other Commands

EXIT

Exit the program.

Guider Camera Configuration

GCAM.INI file, Magellan I

Camera1

200

28

147

28

5700

Camera2

200

28

147

28

5701

Camera3

200

28

147

28

5702

GCAM.INI, Magellan II

Camera1

200

28

147

59

5700

Camera2

200

28

147

59

5701

Camera3

200

28

147

59

5702

GCAM.INI Description

Control System Serial Communication Standards

General explanation here (http://espejo.lco.cl/hwcontrol/ser_com_stand/ser_com_stand.html)

EDS messages

Error Messages

000 DOS date error, code = xxx

001 PCI BIOS not present

002 PCI interface not found

003 Error opening S-record file

004 EOF encountered in S-record file

005 at record xxxx

006 Unrecognized S-record format

007 at record xxxx

008 Checksum error at record xxxx

009 expected xxxx, received xxxx

011 record =xxxx, FIFO count = xxxx

012 Checksum timeout at record xxxx

013 Error, final FIFO count

014 DSP test FIFO count error

015 DSP test timeout error

020 DSP initialization failure

021 Tmp. query error code xxxx

022 DSP FIFO error, code = xxxx

023 Initial FIFO count = xxxx

024 Final FIFO count = xxxx

025 DSP time-out, xxxxxx words to go

026 DSP read-back error, code = xxxx

027 DSP error count exceeded

028 DSP FIFO Counter sync error

029 DSP read-back error, item = xxxxx

030 TCS error messages suspended

041 TCS guide cmd transmit error

041 TCS angle command checksum error

041 TCS cursor com checksum error

041 TCS EDS command response error

041 TCS camera com checksum error

041 TCS com checksum error

041 TCS UT com checksum error

043 TCS guide command data error

043 TCS angle command data error

043 TCS cursor command data error

043 TCS EDS command data error

043 TCS camera command data error

043 TCS command data error

043 TCS UT command data error

044 TCS guide command com error X

045 GPS UT time not available

046 Cannot parse TCS UT msg

047 Error syncing RTC to GPS time

044 TCS angle command com error X

044 TCS cursor command com error X

044 TCS EDS command com error X

044 TCS camera command com error X

044 TCS command com error X

044 TCS UT command com error X

101 TCP Open Socket failure

102 TCP connection timeout

103 TCP write timeout error XXX YYY

104 TCP connection broken

105 TCP write socket overflow

105 TCP communications suspended

Success Messages

974 RTC sync to GPS time

975 DSP function test OK

976 Running DSP function test

977 xxxx S-records read, no errors

978 Loading DSP program

979 TCP communications resumed

979 Final FIFO count

980 DSP initialization success

980 TCP socket opened

980 Initial FIFO count

981 Resetting DSP

982 PT1, PT2 map xxxxxxxx, xxxxxxxx

983 PT1, PT2 adr xxxxxxxx, xxxxxxxx

984 I/O base adr xxxxxxxx

985 Reading config registers

986 PCI device number is xxxx

987 Checking for PCI interface

988 PCI BIOS vx.x detected

989 Checking for PCI BIOS

990 TCP connection established

991 TCP buffer size

992 TCP buffer address

994 UT set by TCS to HH MM SS.FF

997 TCS error messages resumed

998 UT clock initialized by CPU

EDS Log Messages

The EDS log is the same for GCAM1, GCAM2 and GCAM3.

801 Information about centroid display for guider cameras.

```
801;fffffgxxxxxyyyyycccccc
```

fffff fwhm (arcseconds)

g guide flag

1 off or no guide corrections calculated

2 guide corrections in progress (no TCS motion commands)

3 motion command sent to TCS, motion in progress

xxxxx

x correction in pixels

yyyyy

y correction in pixels

ccccc

Total Counts

802

Camera temperature

```
802;aaaaaa
```

aaaaaa temperature in degrees, signed real with two decimals precision

82i

Cursor positions

```
82i;xxxxyyyy
```

i cursor number (1-5) where n=1 is mouse cursor, and n=5 is box

xxxx x position * 10 (0000-9999)

yyyy y position * 10 (0000-9999)

810

Operator entered command

```
810aaaaaaaaaaaaaaaaaaaaaaa
```

aaaaaaaaaaaaaaaaaaaaaaa Command

811

tcs entered command

```
810aaaaaaaaaaaaaaaaaaaaaaa
```

aaaaaaaaaaaaaaaaaaaaaaa Command

808

Command error response

809

Command error response

Guider Camera Control System differences between Magellan I and II

Troubleshooting

Appendix A

GCAM.TXT

Notes for programming guider cameras.

```
Linux device driver startup report:

insmod amcc

amcc_init >>> START <<<

amcc_dev.major = 125

amcc: pcidev_base_address[0] = 0x0000e001

amcc: IO_MAP BADR[0] = 0x0000e000

amcc: Getting configuration for PT regions

amcc: PT[1] base_address [e9000000]

amcc: PT[2] base_address [e9020000]

amcc: PT[3] base_address [e9040000]

amcc: PT[4] base_address [e9061000]

amcc: pt[1] mask fffe0000 val e9000000

amcc: PT[1] size 131072 Phys e9000000 Virt c2875000

amcc: pt[2] mask fffe0000 val e9020000

amcc: PT[2] size 131072 Phys e9020000 Virt c2896000

amcc: pt[3] mask fffe0000 val e9040000

amcc: PT[3] size 131072 Phys e9040000 Virt c28b7000

amcc: pt[4] mask fffffe00 val e9061000

amcc: PT[4] size 512 Phys e9061000 Virt c28d8000

amcc_init: ICSR: 0x00000c0c

amcc_init: RCR: 0x00000000

amcc_init: MBEF: 0x80000000

amcc_init: PTCR: 0x00000000

amcc_init: function terminated successfully

amcc: AMCC S5920 Rev 0.5
```

To reboot from Linux, ctrl-alt-del is OK.

```
Pass-thru 1 sends and receives data.

Pass-thru 2 has counter for number of words in FIFO.

Pass-thru 3 and 4 not used.

Pass-thru 1 and 2 have NO address decoding. They act like single 32-bit

registers, but only the LEAST significant 16-bits get sent or received.

When you write, must wait about 2 usec to allow data to be transmitted

serially. When the frame sync bit is high, the transmit register is
busy.

When you read, a 16-bit word gets popped out of the FIFO.

The mail box register has a bit which indicates the transmit register is

busy, and a bit which indicates that the FIFO has data:

MB_TX_BUSY 0x01000000

MB_RX_RDY 0x02000000
```

There is a PROM on the DSP which contains the program which starts on reset or power-up. It is looking for a program to load, appearing in the input register.

The load sequence consists of a byte count, an address, and the data. The DSP returns a checksum. There are load sequences of different type depending on the memory area to be loaded. A special type (8) starts the program from the specified address.

The memory is 24 bits, so two 16-bit words are used for each memory location. One byte is discarded.

Once running, the top level routine is looking for a command word which specifies what the camera is supposed to do next.

The DSP program is in S-file format. DON’T use the S-record checksum. The DSP checksum is the 16-bit sum of the characters in the record. Note that the first two characters of each S-record (i.e. "S0" or "S2" are not transmitted and not counted in the checksum).

Appendix B

GCCOM.SRT

ampcom ---------- DSP control settings

ampcom dspset gcds1

ampcom gcset gcset

ampcom main gcam

avpcom ---------- leaky memory params

avpcom dspchk gcck3

avpcom main gcam

bincom ---------- pixel binning params

bincom dspload gcds1

bincom dspset gcds1

bincom gcset gcset

bincom main gcam

clkcom ---------- UT / Julian time

clkcom clock2 gcck2

clkcom gcset gcset

clkcom puteds gceds

clkcom putmsg gcmsg

clkcom utclk gcutc

clkctl ---------- clock rate and mode

clkctl gcset gcset

clkctl utclk gcutc

clklog ---------- clock interrupt error log

clklog clkerr gcck2

clklog dspmsg gcmsg

clkvar ---------- clock control

clkvar clock2 gcck2

clkvar utclk gcutc

colors ---------- video palette info

colors gcset gcset

cr1com ---------- cursor positions

cr1com curval gcim1

cr1com curvid gcim2

cr1com curwrt gcim2

cr1com dspset gcds1

cr1com gcset gcset

cr1com magnif2 gcim1

cr1com magnif4 gcim1

cr1com main gcam

cr1com screen gcim1

cr2com ---------- cursor saved data

cr2com currst gcim2

cr2com curvid gcim2

cr2com curwrt gcim2

drfake ---------- dophot calculation flag

drfake plsphot gcpho

drfake pseud2d gcpho

dspcom ---------- DSP status values

dspcom dspchk gcck3

dspcom dspload gcds1

dspcom dsprun gcds2

dspcom dspset gcds1

dspcom gcset gcset

dspcom main gcam

edscom ---------- engineering message queue

edscom puteds gceds

expcom ---------- Exposure time values

expcom dspchk gcck3

expcom dsprun gcds2

expcom dspset gcds1

expcom main gcam

fifcom ---------- FIFO buffer status

fifcom dsprun gcds2

fontcom ---------- screen fonts

fontcom gcset gcset

fontptr ---------- pointers to fonts

fontptr gcset gcset

frmcom ---------- grays for screen panels

frmcom gcset gcset

imgcom ---------- CCD image buffer

imgcom curval gcim1

imgcom dspchk gcck3

imgcom dsprun gcds2

imgcom magnif2 gcim1

imgcom magnif4 gcim1

imgcom screen gcim1

magcom ---------- magnified image buffer

magcom magnif2 gcim1

magcom magnif4 gcim1

magcom screen gcim1

msgcom ---------- system message log

msgcom dspmsg gcmsg

msgcom putmsg gcmsg

msgctl ---------- message display params

msgctl dspmsg gcmsg

msgctl main gcam

pcicom ---------- PCI interface params

pcicom dspchk gcck3

pcicom dspget gcck3

pcicom dspload gcds1

pcicom dsprun gcds2

pcicom dspsend gcds1

pctcom ---------- histogram search params

pctcom dspchk gcck3

pctcom gcset gcset

pctcom main gcam

pctcom screen gcim1

scbcom ---------- screen buffer

scbcom curvid gcim2

scbcom gcset gcset

scbcom screen gcim1

sdtcom ---------- autolink control

sdtcom main gcam

sdtcom screen gcim1

sndcom ---------- TCP/IP link control

sndcom main gcam

sndcom screen gcim1

sndcom tcp gctcp

timcom ---------- clock interrupt timers

timcom clock2 gcck2

timcom dspload gcds1

timcom dsprun gcds2

timcom main gcam

timcom screen gcim1

timcom tcp gctcp

timcom utclk gcutc

tmpcom ---------- temperature sensor values

tmpcom dspchk gcck3

tmpcom dsprun gcds2

tune14 ---------- dophot report level

tune14 chisq gcpho

tune14 plsphot gcpho

typcom ---------- image type flag

typcom magnif gcim1

typcom screen gcim1

uplcom ---------- uplink variables

uplcom tcp gctcp

xfscom ---------- full-frame/subraster exp

xfscom dspchk gcck3

xfscom dspset gcds1

xfscom gcset gcset

xfscom main gcam

zptcom ---------- zero and span values

zptcom gcset gcset

zptcom magnif2 gcim1

zptcom magnif4 gcim1

zptcom main gcam

zptcom screen gcim1

zrocom ---------- screen intensities

zrocom gcset gcset

zrocom magnif2 gcim1

zrocom magnif4 gcim1

zrocom main gcam

zrocom screen gcim1

Appendix C

GCCOM.TXT

ampcom ---------- DSP control settings

avpcom ---------- leaky memory params

bincom ---------- pixel binning params

clkcom ---------- UT / Julian time

clkctl ---------- clock rate and mode

clklog ---------- clock interrupt error log

clkvar ---------- clock control

colors ---------- video palette info

cr1com ---------- cursor positions

cr2com ---------- cursor saved data

drfake ---------- dophot calculation flag

dspcom ---------- DSP status values

edscom ---------- engineering message queue

expcom ---------- Exposure time values

fifcom ---------- FIFO buffer status

fontcom ---------- screen fonts

fontptr ---------- pointers to fonts

frmcom ---------- grays for screen panels

handcom ---------- clock hand params

imgcom ---------- CCD image buffer

magcom ---------- magnified image buffer

msgcom ---------- system message log

msgctl ---------- message display params

pcicom ---------- PCI interface params

pctcom ---------- histogram search params

scbcom ---------- screen buffer

sdtcom ---------- autolink control

sndcom ---------- TCP/IP link control

timcom ---------- clock interrupt timers

tmpcom ---------- temperature sensor values

tune14 ---------- dophot report level

typcom ---------- image type flag

uplcom ---------- uplink variables

xfscom ---------- full-frame/subraster exp

zptcom ---------- zero and span values

zrocom ---------- screen intensities

msgctl main gcam

dspcom main gcam

timcom main gcam

expcom main gcam

xfscom main gcam

zptcom main gcam

zrocom main gcam

cr1com main gcam

avpcom main gcam

bincom main gcam

sndcom main gcam

sdtcom main gcam

pctcom main gcam

ampcom main gcam

clkcom gcset gcset

clkctl gcset gcset

cr1com gcset gcset

dspcom gcset gcset

xfscom gcset gcset

bincom gcset gcset

ampcom gcset gcset

scbcom gcset gcset

pctcom gcset gcset

zptcom gcset gcset

zrocom gcset gcset

colors gcset gcset

fontptr gcset gcset

fontcom gcset gcset

frmcom gcset gcset

clkcom clock2 gcck2

clkvar clock2 gcck2

timcom clock2 gcck2

clklog clkerr gcck2

clkcom utclk gcutc

clkvar utclk gcutc

clkctl utclk gcutc

timcom utclk gcutc

dspcom dspchk gcck3

tmpcom dspchk gcck3

imgcom dspchk gcck3

pcicom dspchk gcck3

xfscom dspchk gcck3

expcom dspchk gcck3

avpcom dspchk gcck3

pctcom dspchk gcck3

pcicom dspget gcck3

pcicom dspload gcds1

dspcom dspload gcds1

timcom dspload gcds1

bincom dspload gcds1

pcicom dspsend gcds1

dspcom dspset gcds1

xfscom dspset gcds1

expcom dspset gcds1

bincom dspset gcds1

cr1com dspset gcds1

ampcom dspset gcds1

pcicom dsprun gcds2

dspcom dsprun gcds2

tmpcom dsprun gcds2

fifcom dsprun gcds2

timcom dsprun gcds2

imgcom dsprun gcds2

expcom dsprun gcds2

timcom screen gcim1

imgcom screen gcim1

cr1com screen gcim1

zptcom screen gcim1

zrocom screen gcim1

scbcom screen gcim1

typcom screen gcim1

magcom screen gcim1

pctcom screen gcim1

sndcom screen gcim1

sdtcom screen gcim1

typcom magnif gcim1

imgcom magnif2 gcim1

cr1com magnif2 gcim1

zptcom magnif2 gcim1

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