

# ASTRO-PHYSICS GTO GERMAN EQUATORIAL MOUNTS

## RS-232 COMMAND LANGUAGE

### Version "G"

Commands effective: 06-30-04

Text modified: 03-05-05

These are the commands associated with version G of the ROM chip in the GTOCP3 Control Box. You can check the version of your chip by opening the cover of the control box. If your GTOCP3 Control Box has a chip designated as G with a date prior to 6-30-04 or F, contact Astro-Physics for a replacement.

#### Abbreviations used:

DD or DDD degrees or day of the month depending on the context  
HH hours  
MM minutes or month depending on the context  
MM.M minutes and tenths of minutes  
s + or - sign , assumed to be + if omitted  
SS seconds  
SS.S seconds and tenths of seconds  
YY last two digits of the year

### **General Telescope Information:**

**Command:** :SG sHH# or :SG sHH:MM.M# or :SG sHH:MM:SS#

**Response:** "1"

Sets the offset from Greenwich mean time. Command may be issued in any length format regardless of whether long format has been selected. Although any length format is acceptable, only the hours field is typically of interest. Data entered with this command will be "remembered" through a power cycle and automatically re-applied on the next powerup. The offset can be entered in unsigned 24-hour format (0-23 hours) or in signed format (-12 to +12) hours.

**Command:** :Sg DDD\*MM# or :Sg DDD\*MM:SS#

**Response:** "1"

Sets the current longitude. Command may be issued in long or short format regardless of whether long format has been selected. Data entered with this command will be "remembered" through a power cycle and automatically re-applied on the next powerup.

**Command:** :St sDD\*MM# or :St sDD\*MM:SS

**Response:** "1"

Sets the current latitude. Command may be issued in long or short format regardless of whether long format has been selected. Data entered with this command will be "remembered" through a power cycle and automatically re-applied on the next powerup.

**Command:** :SL HH:MM:SS#

**Response:** "1"

Sets the current local time. Command may be issued in long or short format regardless of whether long format has been selected.

**Command:** :SC MM/DD/YY#

**Response:** 32 spaces followed by "#", followed by 32 spaces, followed by "#"

Sets the current date. Note that year fields equal to or larger than 97 are assumed to be 20<sup>th</sup> century, Year fields less than 97 are assumed to be 21<sup>st</sup> century.

**Command: :GG#**

**Response: West Longitude HH:MM.M# or HH:MM:SS.S# if long format  
East Longitude Refer to the chart below in the section entitled "Communicating with your Mount when writing your own program".**

Gets the offset from Greenwich mean time. Although typically only hours field is of interest, the return value will be in standard 24-hour format. If the value was entered in signed (-12 to +12 hour) format, and the value entered was negative (east of Greenwich), see the section below entitled "Communicating with your Mount when writing your own program".

**Command: :Gg#**

**Response: +DDD\*MM# or +DDD\*MM:SS# if long format**

Gets the current longitude.

**Command: :Gt#**

**Response: sDD\*MM# or sDDD\*MM# if short format  
or sDD\*MM:SS# or sDDD\*MM:SS if long format**

Gets the current latitude.

**Command: :GL#**

**Response: HH:MM.M# or HH:MM:SS.S# if long format**

Gets the current local time in 24 hr. format. Overflows from 23:59:59 to 00:00:00. Updates calendar day on overflow.

**Command: :GS#**

**Response: HH:MM.M# or HH:MM:SS.S# if long format**

Gets the current sidereal time in 24 hr. format.

**Command: :GR#**

**Response: HH:MM.M# or HH:MM:SS.S# if long format**

Gets the current Right Ascension.

**Command: :GD#**

**Response: sDD\*MM# or sDD\*MM:SS# if long format**

Gets the current Declination.

**Command: :GA#**

**Response: sDD\*MM# or sDD\*MM:SS# if long format**

Gets the current Altitude.

**Command: :GZ#**

**Response: sDD\*MM# or sDD\*MM:SS# if long format**

Gets the current Azimuth.

**Command: :GC#**

**Response: MM:DD:YY#**

Gets the current calendar day. Leading zero appears only in the year field.

## Telescope Motion

**Command:** :MS#

**Response:** "0" if command accepted,  
(none) if command not accepted,  
"1Object is below horizon #"  
if the horizon check is turned on, and the desired object is below 0 degrees altitude.  
(8 trailing spaces before "#", 32 total characters plus "#")

Target command: Slew to the most recently defined RA and DEC coordinates in RA-DEC mode, or most recently define ALT and AZ coordinates in ALT-AZ mode. Slewing is performed at the currently selected slew rate. If the horizon check is turned on, and the object is below the horizon, this will be stated, and no slewing will occur.

Note that the keypad, DigitalSky Voice software and TheSky software all have their own internal horizon check routines.

**Command:** :Mn# :Ms# :Me# :Mw#

**Response:** (none)

Command motion in the direction specified (n=north, s=south, e=east, w=west) at the currently selected guide or centering rate. Motion will continue until a quit command is issued.

**Command:** :Mnxxx# :Msxxx# :Mexxx# :Mwxxx#

**Response:** (none)

Command motion for xxx milliseconds in the direction specified at the currently selected guide rate. If xxx has a value of zero, motion is continuous and requires a quit command to terminate. Otherwise a quit command will not terminate.

**Command:** :NS#

**Response:** (none)

This command swaps the functions of the north and south buttons. Subsequent commands :Mn# and :Ms# are affected.

**Command:** :EW#

**Response:** (none)

This command swaps the functions of the east and west buttons. Subsequent commands :Me# and :Mw# are affected.

**Command:** :Qn# :Qs# :Qe# :Qw#

**Response:** (none)

Stop motion in the specified axis. Note that :Qn# is identical to :Qs#, and :Qe# is identical to :Qw#. Motion is terminated only if it was not started by a slew (:MS#) command.

**Command:** :Q#

**Response:** (none)

Motion in both axes is stopped, regardless of how the motion was invoked.

**Command:** :RG# :RG0# :RG1# :RG2#

**Response:** (none)

Selects guide rate for the N-S-E-W buttons. Optionally selects 0.25x (:RG0#), 0.5x (:RG1#), or 1.0x (:RG2#). If no index is provided (:RG#), the previously selected guide rate will be used, else the power up default of 0.5x will be assumed by the motor drive.

**Command:** :RC# :RC0# :RC1# :RC2# :RC3#

**Response:** (none)

Selects centering rate for the N-S-E-W buttons. Optionally selects a rate of 12x (:RC0#), 64x (:RC1#), 600x (:RC2#), or 1200x (:RC3#). If no index is provided (:RC#), then the previously selected speed will be used, else the power up default of 64x will be assumed by the motor drive. These rates are predefined selections for the command :RCxxx# as shown below.

**Command:** :Rcxxx#  
**Response:** (none)

Sets the centering rate for the N-S-E-W buttons to xxx. Xxx is an integer from 1 to 255.

**Command:** :RS# :RS0# :RS1# :RS2#  
**Response:** (none)

Selects the slew speed used by the telescope move functions. This command has no effect on the use of the N-S-E-W buttons (therefore, :RS# has no effect). The default slew speed is 1200x. Slewing can be done at 1200x (:RS2#), 900x (:RS1#), or 600x (:RS0#).

**Command:** :RT0# :RT1# :RT2# :RT9#  
**Response:** (none)

This command selects the tracking rate. It selects lunar (:RT0#), solar (:RT1#), sidereal (:RT2#), or zero (:RT9#). The sidereal rate is assumed as a default by the motor drive if nothing is specified. This command has no effect on the use of the N-S-E-W buttons. Zero tracking rate is useful in ALT-AZ mode. These rates are predefined selections for the command :RR sxxx.xxx# as shown below.

**Command:** :RR sxxx.xxx# :RD sxxx.xxx#  
**Response:** "1"

This command selects the tracking rate in the RA axis ("RR") or DEC axis ("RD") to xxx.xxx. The rate added to the standard sidereal rate and can be positive or negative.

**Command:** :Bd DD\*MM:SS# :Br DD\*MM:SS#  
**Response:** "1"

This command sets the amount of backlash compensation employed each time a servo motor axis reverses direction. Bd sets the backlash of the DEC axis, Br sets the backlash of the RA axis. Resolution of the backlash is in arc seconds. Typically, the degrees and minutes fields are zero to specify the amount of backlash only in seconds. Values of backlash above 00\*54:36 may be truncated, depending upon which mount is used (this is a ridiculously large value, typical values should be well under 00\*01:00). The default DEC backlash is 00\*00:00, the default RA backlash is 00:00:15 (same as 00\*03:50). Backlash in either axis will be properly interpreted whether expressed as DD\*MM:SS or HH:MM:SS.

**Command:** :KA#  
**Response:** (none)

This command invokes the parked mode. The tracking stops and the motors are de-energized when slewing has completed. The mount will remain parked, even if power is cycled, until a move, quit, calibrate, or park-off command is issued. However, a power surge or glitch may cause the mount to start tracking once again.

**Command:** :PO#  
**Response:** (none)

Park-off. This command un-parks the mount and also restores calibration. To restore proper calibration, the mount must receive date and time (:SC mm/dd/yy# and :SL hh:mm:ss#) prior to receiving the Park-off command. If park-off is received when the mount is not actually parked, calibration error will be introduced. A :CM# command can be used, however, to establish accurate calibration.

**Command:** :pS#  
**Response:** "East#" or "West#"

This command returns the side of the pier on which the telescope is currently positioned. It is useful for remote observatories where it is not possible for the viewer to see the mount. Initially, the mount must be manually positioned on the proper pier side for the calibration object and calibrated using the :CM# command. The correct pier side will be returned after subsequent move, recalibrate, park and unpark commands are completed.

**Command:** :p# :pR# :pP#  
**Response:** (none)

This command either invokes PEM record mode (:pR#), invokes PEM playback mode (:pP#), or turns playback off (:p#). The record function will remain active for one full revolution of the worm gear and cannot be terminated. If :p# or :pP# is received during record, it will be ignored. The time required for a record cycle depends upon which mount is used and how

much correction is applied. Commands to slew will be ignored during record. Commands to select centering speed will become active only after the record cycle has been completed.

When playback is selected, it remains active until turned off. Playback is also temporarily turned off when a command to slew is issued or any of the N-S-E-W buttons are pressed. It is automatically reinvoked when the commanded position has been reached and none of the N-S-E-W buttons are pressed.

**Command:** :EM#  
**Response:** (none)

Equatorial Fork: This command is intended for software developers. If used with a fork mount, it overrides the manufacturing default and invokes a meridian flip. The manufacturing default (no meridian flip) is restored after a power cycle.

German Equatorial: This command is the manufacturing default, which invokes the meridian. If :FM# had been used to eliminate the meridian flip, this command restores the mount back to a normal equatorial mount.

## Position

**Command:** :CM#  
**Response:** "Coordinates matched. #" (there are 5 spaces between "Coordinates" and "matched", and 8 trailing spaces before the "#", the total response length is 32 character plus the "#").

Calibrate mount. Current Right Ascension and Declination become the commanded Right Ascension and Declination respectively if in RA-DEC mode. If in ALT-AZ mode, then the commanded Altitude and Azimuth become the current. This command assumes that the mount has been manually positioned on the proper pier side for the calibration object. This command is ignored if slewing is in progress. This command should be used for initial calibration. It should not be used after the mount has been tracking unless it is known that it has not tracked across the meridian.

**Command:** :CMR#  
**Response:** "Coordinates matched. #" (there are 5 spaces between "Coordinates" and "matched", and 8 trailing spaces before the "#", the total response length is 32 character plus the "#").

This command performs a function very similar to the :CM# command with one exception. It does not assume that the user has manually positioned the mount on the proper pier side for the object in view. It assumes that the pier side has not changed since the most recent :CM# or :MS# commands. It allows re-calibration on known coordinates even if the mount has tracked across the meridian. This command should not be used to perform the initial calibration. This command is ignored if slewing is in progress.

**Command:** :Sr HH:MM:SS# or :Sr HH:MM:SS.S#  
**Response:** "1"

Defines the commanded Right Ascension, RA. Command may be issued in long or short format regardless of whether long format has been selected. RA specified as DD\*MM:SS will also be interpreted properly if greater precision is required, but this is not typically how RA is expressed. This command automatically selects RA-DEC mode. Move and calibrate commands operate on the most recently defined RA if in RA-DEC mode.

**Command:** :Sd sDD\*MM# or :Sd sDD\*MM:SS#  
**Response:** "1"

Defines the commanded Declination, DEC. Command may be issued in long or short format regardless of whether long format has been selected. This command automatically selects RA-DEC mode. Move and calibrate commands operate on the most recently defined DEC if in RA-DEC mode.

**Command:** :Sa sDD\*MM# or :Sa sDD\*MM:SS#  
**Response:** "1"

Defines the commanded Altitude, ALT. Command may be issued in long or short format regardless of whether long format has been selected. Move and calibrate commands operate on the most recently defined ALT. This command automatically selects ALT-AZ mode, however tracking rate is unaffected.

**Command:** :Sz DDD\*MM# or :Sz DDD\*MM:SS#  
**Response:** "1"

Defines the commanded Azimuth, AZ. Command may be issued in long or short format regardless of whether long format has been selected. Move and calibrate commands operate on the most recently defined AZ. This command automatically selects ALT-AZ mode, however tracking rate is unaffected.

## Miscellaneous

**Command:** #  
**Response:** (none)

Sending a # clears the input buffer. Advisable to do this before sending the very first command on power up.

**Command:** :U#  
**Response:** (none)

Select long format, valid only for the communication port through which this command is issued, ports are controlled independently. Unlike the Meade definition, though, once long format has been selected it cannot be deselected without powering down the unit. Only the first occurrence of :U# acts upon the port in question. Long format only defines the format of the return strings, Input data (using the set command) will be recognized in any format whether or not long format has been selected.

**Command:** :B+# :B-#  
**Response:** (none)

Incrementally increases (B+) or decreases (B-) reticle brightness. Command to be sent over RS-232 each time a button is pressed to increase or decrease brightness. When the brightness is at the maximum, subsequent :B+# commands are ignored. When the brightness is at the minimum, subsequent :B-# commands are ignored. On power up, the brightness is at the minimum (off).

**Command:** :F+# :F-# :FF# :FS# :FQ#  
**Response:** (none)

Advances (F+) or retracts (F-) focus adjust motor on the eyepiece. F+ or F- commands commence adjustment and :FQ# stops it. This works the same way the N-S-E-W keypad works (it may even be an operating mode of the same keys). If :FS# has been issued previously, then the focus adjustment will be slow. If the :FF# command has been issued, then the adjustment will be fast. If neither FF nor FS is specified, the powerup default of FS is assumed.

**Command:** :de# :dn#  
**Response:** (none)

This command invokes the data feed through function between COM 1 and the keypad. The purpose is to allow software and database updates to the keypad, through the servo drive, without special connectors. For code downloads, :de# is used to provide transparent communications between COM 1 and the keypad with even parity. For database downloads, :dn# is used to provide transparent communications with no parity. Once either command is issued, normal operation (or parity change) can only be resumed by powering down the servo drive. COM 2 cannot be used in the transparent mode. Once the pound sign of the command has been received by the servo drive, all subsequent bytes received from COM 1 or the keypad are reflected to the other. Data received on COM 2 is ignored, and no data is transmitted from COM 2.

**Command:** :V#  
**Response:** (current servo controller software version number)

This command returns the current servo controller software version (followed by "#"). Software versions prior to B do not return anything since the version command is introduced in version B.

**Command:** :ho# :hq#  
**Response:** (none)

This command turns on (:ho#) and off (:hq#) the horizon check. The horizon check, when turned on, is performed when a "go-to" (or :MS#) is issued. If the coordinates define a location below zero degrees altitude, then the string "1Object is below horizon. #" is returned instead of "0". No compensation of coordinates for atmospheric refraction is made. On power-up, the horizon check is off since it is currently performed in the handheld controller, Digital Sky Voice, and Software Bisque's TheSky.

## Communicating with Your Mount When Writing Your Own Programs

The command set is written in ASC11 character format and can be used to write your own programs. The commands are case sensitive. Nothing is sent to any ports unless you send a request per the AP protocol. You can use either serial port on your GTO Control Box.

In order to properly initialize the mount with your software, you must issue the following commands when you establish your link:

```
#          (to clear the buffer)
:U#
:SL HH:MM:SS#
:SC MM/DD/YY#
:St sDD*MM# or :St sDD*MM:SS (if not done in a previous session, command remembered through power cycle)
:Sg DDD*MM# or :Sg DDD*MM:SS# (if not done in a previous session, command remembered through power cycle)
:SG HH# or :SG HH:MM.M# or :SG HH:MM:SS# (remember to calculate daylight savings, if needed) (if not done in a previous session, command remembered through power cycle)
:PO#
:Q#
```

If you plan to poll the mount for its position while it is slewing, read this section. If the mount has a "D" "KD" or earlier chip installed, there is a possibility that an extraneous character might occur during a slew. This character will be a non-integer and will appear in the declination number in this manner where "A" represents a non-integer: -A33\*23:15# This character will not affect the accuracy of the slew in any way, it may simply affect your computer display of the mount position. We recommend that you write your program to ignore this character.

Considerations for E longitude locations. Negative offsets sent to the mount will be interpreted correctly. If you plan to use the :GG# command to read the offset from the mount, you will need to allow for the return values as shown in the chart below. The values shown do not have any numerical significance, but represent the corresponding time zones.

Time Zone	Return value for offset of GMT
-01	:A5:MM.M# or :A5:MM:SS.S#
-02	:A4:MM.M# or :A4:MM:SS.S#
-03	:A3:MM.M# or :A3:MM:SS.S#
-04	:A2:MM.M# or :A2:MM:SS.S#
-05	:A1:MM.M# or :A1:MM:SS.S#
-06	:00:MM.M# or :00:MM:SS.S#
-07	:@9:MM.M# or :@9:MM:SS.S#
-08	:@8:MM.M# or :@8:MM:SS.S#
-09	:@7:MM.M# or :@7:MM:SS.S#
-10	:@6:MM.M# or :@6:MM:SS.S#
-11	:@5:MM.M# or :@5:MM:SS.S#
-12	:@4:MM.M# or :@4:MM:SS.S#

Please note that Astro-Physics does not support any programs that you write yourself or any program distributed as an after-market product. Please contact the manufacturer for questions relating to after-market programs.

### RS-232 Port Settings:

```
Baud Rate:      9600
Parity:         none
Data bits:      8
Flow Control:   none or Xon/Xoff
Start Bits:     1
Stop Bits:      1
```

## Command not functional

**Command:** :FM#

**Response:** (none)

Equatorial Fork: This command is the manufacturing default, which eliminates the meridian flip.

German Equatorial: This command is intended for software developers. It turns off the meridian flip and makes a German Equatorial mount behave like a fork mount. It is not to be used by individuals without slewing safeguards. It is mainly intended as a tool for writers of mount control software to implement slewing past the meridian during imaging, and then only with the proper limits and controls to prevent the telescope from slewing into the pier or other abnormal motions. It overrides the manufacturing default. The manufacturing default (meridian flip) is restored after a power cycle.

Note: This command produces incorrect behavior during some subsequent commands to slew. This is true whether the mount is a fork mount or equatorial mount.