

Gemini Level 5, Version 2.1 Serial Interface Command Description

Gemini's LX200-like Commands

The Gemini system supports a subset of the Meade® LX200 Command Set making it compatible to many planetarium programs using this command set. Programs featuring special Gemini drivers can make use of the additional LX200-style extensions. Gemini also supports a Native Command Set as described below. Many of these features and a hub functionality allowing several programs to access the Gemini controller simultaneously can be accessed by using an [ASCOT driver](#).

Syntax: values in <> are (to be) replaced by actual values. Curled brackets {} show alternative characters. Upon completion, ASCII characters or strings are returned, if indicated.

Command	Returns	Remarks
0x06 (ACK char)	B# while the initial startup message is being displayed , b# while waiting for the selection of the Startup Mode, S# during a Cold Start or G# if startup was completed with an equatorial mount selected, A# if startup was completed with an Alt/Az mount selected. NEW in L5.1	Usable for testing the serial link and determining the type of mount (German Equatorial or Alt/Az). During Startup, with a "b#" being returned, the connected device can select the startup mode by sending either a <ul style="list-style-type: none"> • bC# for selecting the Cold Start, • bW# for selecting the Warm Start and • bR# for selecting the Warm Restart.
Synchronize		
:CE<character>#	<character>#	This commands echoes the given character, followed by a hash mark. It can be used to synchronize the serial data exchange. NEW in L5
:Cm#	No object!# or <object name>#	The string "No object!#" is returned if the mount is not aligned or no object was selected, otherwise the name of the selected object used is returned. This command does an "Additional Alignment", (re)calculating the current pointing model parameters and synchronizing to the position of the selected object.
:CM#	No object!# or <object name>#	The string "No object!#" is returned if the mount is not aligned or no object was selected, otherwise the name of the selected object used is returned. The position (RA and DEC) is synchronized to the

		position of the object by setting the Index or Flip parameters of the current model.
:C<n>#	<n>#	Select a pointing model. Currently two models (n=0, n=1) are supported. NEW in L5
:Cc#	<n>#	Selects the currently active pointing model for I/O access. Currently two models (n=0, n=1) are supported. NEW in L5
:C?#	<n>#	Returns the number of the currently active pointing model. Currently two models (n=0, n=1) are supported. NEW in L5
:CI#	No object!# or <object name>#	The string "No object!#" is returned if the mount is not aligned or no object was selected, otherwise the name of the selected object used is returned. An Initial Align is done. The currently selected model is reset and the mount is synchronized to the selected object. NEW in L5
:CR#	<n>#	The currently selected model <n> is reset. NEW in L5
:CU#	<n>#	The last alignment of the currently selected model is reset. NEW in L5
Focus Control		
:F+#		Focus In
:F-#		Focus Out
:FQ#		Stop focusing
:FF#		Focus Fast
:FM#		Focus Medium
:FS#		Focus Slow
Get Information		
:GA#	In Double Precision mode: {+-}<dd>. <dddddd># In High Precision mode: {+-}<dd>:<mm>: <ss># In Low Precision mode: {+-}<dd>°<mm>#	Get Altitude (from L1, V2.0 up)
:GB#	<n>#	Get LED Display Brightness Value(from L1, V2.0 up) n=0: 100% n=6: 6.6% n=7: blank display n=8: test mode (all pixels lit).
:GC#	<mm>/<dd>/<yy>#	Local Calendar Date, month mm, days dd and years yy separated by slashes.
:Gc#	(24)#	Clock Format

:GD#	<p>In Double Precision mode: {+}<dd>. <dddddd>#</p> <p>In High Precision mode: {+}<dd>:<mm>: <ss>#</p> <p>In Low Precision mode: {+}<dd>°<mm>#</p>	<p>Apparent (refraction included) Declination the telescope is pointing to, to the equinox of the date. Except during GoTo operations, the coordinates are corrected according to the pointing model.</p> <p>Signed degrees (-90 to +90), minutes, seconds. The degree sign in Low Precision mode is the character 0xDF.</p>
:Gd#	<p>In Double Precision mode: {+}<dd>. <dddddd>#</p> <p>In High Precision mode: {+}<dd>:<mm>: <ss>#</p> <p>In Low Precision mode: {+}<dd>°<mm>#</p>	<p>Selected object's declination. New in L5.1</p>
:GE#	<hh>:<mm>:<ss>#	Get Alarm time (from L1, V2.0 up)
:GG#	<p>{+}<hh># or {+}<hh>:<mm>: <ss>#</p>	<p>Get the difference between local time and UTC (from L1, V2.0 up). If your local time is earlier than UTC this command will return a positive value, if later than UTC the value is negative. The extended format with minutes and seconds is new in L5. Minutes and seconds will be omitted if both are zero.</p>
:Gg#	<p>{+}<ddd>°<mm>#</p> <p>In Double Precision mode: {+}<dd>. <dddddd>#</p>	Get Site Longitude (from L1, V2.0 up)
:GH#	<p>[->]<hh>:<mm>: <ss>#</p> <p>In Double Precision mode: {+}<hh>. <hhhhhh>#</p>	Hour Angle the telescope is pointing to. From L4, V1.0 up.
:GI#	<Information Buffer Content>#	Get the content of the information buffer. Up to 256 characters, followed by a hash mark. NEW in L5
:GL#	<p><hh>:<mm>:<ss>#</p> <p>In Double Precision mode: {+}<hh>. <hhhhhh>#</p>	Civil Time (UTC time from the internal Real Time Clock + UTC offset), hours, minutes, seconds in 24-hour format.

:Gm#	{EW}#	Get Telescope Mount's Side of Meridian. E# for East or W# for West side is replied. From L4, V1.0 up.
:GM#	<name string>#	Name (up to 15 characters) of the first site stored.
:GN#	<name string>#	Name (up to 15 characters) of the second site stored.
:GO#	<name string>#	Name (up to 15 characters) of the third site stored.
:GP#	<name string>#	Name (up to 15 characters) of the fourth site stored.
:GR#	In Double Precision mode: {+-}<hh>. <hhhhh># High Precision mode: <hh>:<mm>:<ss># Low Precision mode: <hh>:<mm>.<m>#	Apparent (refraction included) Right Ascension the telescope is pointing to, to the equinox of the date. Despite during GoTo operations, the coordinates are corrected according to the pointing model. Hours (0 to 24), minutes, seconds or tenth of minutes.
:Gr#	In Double Precision mode: {+-}<dd>. <dddddd># In High Precision mode: {+-}<dd>:<mm>:<ss># In Low Precision mode: {+-}<dd>°<mm>#	Selected object's right ascension. New in L5.1
:GS#	<hh>:<mm>:<ss># In Double Precision mode: {+-}<hh>. <hhhhh>#	Sidereal Time. From L4, V1.0 up.
:Gt#	{+-}<dd>°<mm># In Double Precision mode: {+-}<hh>. <hhhhh>#	Get Site Latitude (from L1, V2.0 up).
:GV#	<l><vv>#	Get Software Level l(one digit) and Version vv(two digits)
:GVD#	<mm> <dd> <yyyy>#	Get Software Built Date (from L4, V1.0 up)
:GVN#	<l>.<vv>#	Get Software Level l(one digit) and Version vv(two digits) (from L4, V1.0 up)
:GVP#	Losmandy Gemini#	Product String (from L4, V1.0 up)
:GVT#	<hh>:<mm>:<ss>#	Get Software Built Time (from L4, V1.0 up)
	N (for "no	

:Gv#	movement") T (for Tracking) G (for Guiding) C (for Centering) S (for Slewing) ! for Stall	Get Maximum Velocity of both axes.
:GW#	N (for "no movement") T (for Tracking) G (for Guiding) C (for Centering) S (for Slewing) ! for Stall	Get Velocity RA New in L5.
:Gw#	N (for "no movement") T (for Tracking) G (for Guiding) C (for Centering) S (for Slewing) ! for Stall	Get Velocity DEC New in L5.
:Gu#	N (for "no tracking") T (for Tracking) G (for Guiding) C (for Centering) S (for Slewing) ! for Stall	Get Velocity RA, DEC (2 characters) New in L5.
:GZ#	In Double Precision mode: {+-}<hh>. <hhhhh># In High Precision mode: <ddd>:<mm>: <ss># In Low Precision mode: <ddd>°<mm>#	Get Azimuth. From North over East. (From L4, V1.0 up)
Park		
:hP#		Park at Home Position. The Home Position defaults to the celestial pole visible at the given hemisphere (north or south) but can be set by the user at the Gemini.
:hC#		Park at the Startup Position. This position is the position required for a Cold or Warm Start, pointing to the celestial pole of the given hemisphere (north or south), with the counterweight pointing downwards (CWD position). From L4, V1.0 up.

:hZ#		Park at Zenith. New in L5.
:hN#		Sleep Telescope: stop tracking, blank displays.
:hW#		Wake Up Telescope, resume tracking.
:h?#	2: Park operation in progress 1: Park operation completed. The mount is parked. 0: No Prk command received or Park operation failed.	Parking Status Inquiry
Move Telescope		Note: the directions mentioned depend upon the hemisphere of the observing site and the side of the mount the telescope actually is. Directions do not change when crossing one of the poles.
:MA#	0 1Object below horizon.# 2No object selected.# 3Manual Control.#	Slew to an object. The object selection had to be done by sending the Sz and Sa commands with the horizontal (Azimuth and Altitude) object coordinates. This command will be rejected while the system is in Manual Mode, f.i. identifying or selecting an object from the internal databases. From L4, V1.0 up.
:MF<n>	#	Move Find: for 0<256 move n arcmin in a Meander Search pattern at centering speed. Can be interrupted by :Q#. If not interrupted, Move Find will return to the start position after 6 cycles. For n=0 the position is changed ("wobbled") shaping an X with 5 arcmin legs moving at a quarter of the centering speed to detect faint objects.
:ML#	#	Move Lock: Slew commands :MS# and :MA# will be suppressed, error code 3 (Manual Control) will be returned if these commands are sent.
:Ml#	#	Move Unlock: Slew commands :MS# or :MA# will be allowed to be executed again.
:Mf#	0 1Object below horizon.# 3Manual Control.# 4Position unreachable.#	Do a meridian flip and slew to the current coordinates.
:MM#	0 1Object below horizon.# 2No object selected.# 3Manual Control.# 4Position	Slew to an object, doing a meridian flip if possible. Selection has had to be done locally (from Gemini's databases) or by sending the Sr and Sd commands with the equatorial object coordinates. This command

	unreachable.# 5Not aligned.# 6Outside Limits.# 7Rejected - Mount is parked!#	will be rejected while the system is in Manual Mode, f.i. identifying or selecting an object from the internal databases.
:MS#	0 1Object below horizon.# 2No object selected.# 3Manual Control.# 4Position unreachable.# 5Not aligned.# 6Outside Limits.# 7Rejected - Mount is parked!#	Slew to an object. Selection has had to be done locally (from Gemini's databases) or by sending the Sr and Sd commands with the equatorial object coordinates. This command will be rejected while the system is in Manual Mode, f.i. identifying or selecting an object from the internal databases.
:Me#		Move eastwards at the selected speed rate.
:Mw#		Move westwards at the selected speed rate.
:Mn#		Move northwards at the selected speed rate.
:Ms#		Move southwards at the selected speed rate.
:mi<RA steps>;<DEC steps>#		Move axes by a certain amount of motor encoder ticks. The parameter value is multiplied by the factor given by the last :mm command (default 1). The allowed parameter range is 0..65535, signed to select the direction. If this range is not sufficient, a prescaler factor can be set by the :mm command.
:mm<step multiplier>#		Step multiplier for the :mi command. The step count parameter of the :mi command is multiplied by this factor.
Precision Guiding		
:Ma<direction><arcsecs>#		Moves into <direction> "e", "w", "n", "s" for <arcsecs> arc seconds. <arcsecs> are converted into motor encoder ticks, in L4 the result must not exceed 255 or will be cut off modulo 256.
:Mi<direction><steps>#		Moves into <direction> "e", "w", "n", "s" for <steps> (1 <= steps <= 255) motor encoder ticks.
:Mg<direction><time>#		Moves into <direction> "e", "w", "n", "s" for <time> milliseconds. <time> is converted into motor encoder ticks, in L4 the result must not exceed 255 or will be cut off modulo 256.
Object/Observing/Output		
:OC#		Clears the Observing Log.
		Select an object object-id from Gemini's internal databases catalog-id. Catalog-id is a character

:OI<catalog-id><object-id>#		selecting one of the contiguous catalogues: '1': Messier, '2': NGC, '3': IC, '4': Sh2, '7': SAO, ' ': LDN, ' ': LBN. Object-id is a numeric designation of the object in the catalogue; it can be followed by an extension character for NGC and IC catalogues.
:OO#	<current display content>#	Ask for the current content of the output display line (up to 32 characters followed by a hash mark). New in L5.
:Oo#	<previous display content>#	Ask for the current content of the output display line (up to 32 characters followed by a hash mark). New in L5.
:ON<name>#		Tells the Gemini system the name or identification of the selected object. If this command is not used, the name defaults to "PC Object". Using this command is recommended between the :Sr and :Sd commands for equatorial coordinates or the :Sz and :Sa commands for horizontal coordinates respectively. From L4, V1.0 up.
:OR#	<log entry>#	Reads the next line from the Observing Log.
:OS#		Points to the beginning of the Observing Log.
:Oc#		Delete all User Catalogue entries.
:Od<object line>#		Download a User Catalogue entry to the Gemini. The object line consist of <ul style="list-style-type: none"> the object name (up to 10 ASCII characters), a comma ',' as delimiter, Right Ascension <hh>:<mm>:<ss> , Declination {+-}<dd>:<mm>:<ss>. The coordinates have to be given for the epoch 2000.0.
:On#	<n>#	0 <= n <= 4096: Read current number of Gemini's User Catalogue entries.
:Or#	<object line>#	Upload a User Catalogue entry from Gemini.
:Os#		Points to the beginning of the User Catalogue (for downloading).
Precession and Refraction		
:p0#		No precession calculation necessary in the Gemini. Coordinates transferred to the Gemini are already precessed to the equinox of the date. Refraction is not calculated.
:p1#		Precession calculation is to be done by Gemini. Coordinates transferred to the Gemini refer to the standard epoch J2000.0. Refraction is not calculated.

:p2#		No precession calculation necessary in the Gemini. Coordinates transferred to the Gemini are already precessed to the equinox of the date. Refraction is calculated. From L4, V1.0 up.
:p3#		Precession calculation is to be done by Gemini. Coordinates transferred to the Gemini refer to the standard epoch J2000.0. Refraction is calculated. From L4, V1.0 up.
Precision		
:P#	DBL PRECISION or HIGH PRECISION or LOW PRECISION	All strings are 14 characters long (there are 2 blanks between LOW or DBL and PRECISION).
:U#		Toggle between Low Precision (short) and High Precision (long) mode. Gemini is in High Precision mode after starting up.
:u#		NEW in L5 Select the Double Precision mode. Values will be displayed in signed floating point format with 6 digits after the decimal point. "Set" parameters can be send the same way.
Quit Moving		
:Q#		Quit all movements mentioned below.
:Qe#		Quit movement eastwards.
:Qw#		Quit movement westwards.
:Qn#		Quit movement northwards.
:Qs#		Quit movement southwards.
Rate		
:RC#		Rate Centre. Subsequent Move commands will move at Centering Speed.
:RG#		Rate Guide. Subsequent Move commands will move at Guiding Speed.
:RM#		Rate Move. Subsequent Move commands will move at Move/Find Speed.
:Rm[<sign>][<value>]#		Set Move Rate, either to an absolute value (if no sign was specified) given or (if a sign was given) as increment/decrement to the current rate. If no value is specified, Move Rate is set to the default value 50.
:RS#		Rate Slew. Subsequent Move commands will move at Slewing Speed.
:R?#	G#, C#, M# or S#	Currently selected speed for Move commands is returned as one of the characters G, C, M or S followed by a hash mark. New in L5.

Set		
:Sa{+-}<dd>{*°}<mm># or :Sa{+-}<dd>{*°:}<mm>: <ss>#	0 if invalid or 1 if valid	Sets the object's altitude. A negative sign is ignored. Values greater than 90 degrees are set to 90 degrees. It is important that the :Sz# command has been send prior. If the coordinate selection is valid the object status is set to "Selected". From L4, V1.0 up.
:SB<n>#		Set LED Display Brightness Value(from L1, V2.0 up) n=0: 100% n=6: 6.6% n=7: blank display n=8: test mode (all pixels lit).
:SC<mm>/<dd>/<yy>#	0 if invalid or 1 Updating planetary data# <24 blanks>#	Set Calendar Date: months mm, days dd, year yy of the civil time according to the timezone set. The internal calender/clock uses GMT.
:Sd{+-}<dd>{*°}<mm># or :Sd{+-}<dd>{*°:}<mm>: <ss>#	0 if invalid or 1 if valid	Sets the object's declination. It is important that the :Sr# command has been send prior. Internal calculations are done that may take up to 0.5 seconds. If the coordinate selection is valid the object status is set to "Selected".
:SE<hh>:<mm>:<ss>#	1	Set Alarm Time from the civil time hours hh, minutes mm and seconds ss. The timezone has to be set before using this command.
:SG{+-}hh#	1	Set the number of hours by which your local time differs from UTC. If your local time is earlier than UTC set a positive value, if later than UTC set a negative value. The time difference has to be set before setting the calendar date (SC) and local time (SL), since the Real Time Clock is running at UTC.
:S0<name string>#	1	Set name of site #0. The minimum length of site name strings is 1 byte, the maximum length 15 bytes. New in L5.
:SM<name string>#	1	Set name of the first site stored. The minimum length of site name strings is 1 byte, the maximum length 15 bytes.
:SN<name string>#	1	Set name of the second site stored.
:SO<name string>#	1	Set name of the third site stored.
:SP<name string>#	1	Set name of the forth site stored.
:SL<hh>:<mm>:<ss>#	1	Set RTC Time from the civil time hours hh, minutes mm and seconds ss. The timezone has to be set before using this command.
:Sg{+-}<ddd>*<mm>#	1 if valid	Sets the longitude of the observing site to ddd degrees and mm minutes. The longitude has to be specified positively for western latitudes (west of Greenwich, the plus sign may be omitted) and negatively for eastern longitudes. Alternatively, 360 degrees may be added to eastern longitudes.

:Sp#	No object!# or 1 if object coordinates were set.	Precess coordinate transmitted by means of :Sr and :Sd to the equinox of the date.
:Sr<hh>:<mm>.<m># or :Sr<hh>:<mm>:<ss>#	0 if invalid or 1 if valid	Sets the object's Right Ascension and the object status to "Not Selected". The :Sd# command has to follow to complete the selection. The subsequent use of the :ON...# command is recommended.
:St{+-}<dd>*<mm>#	1 if valid	Sets the latitude of the observing site to dd degrees, mm minutes. The minus sign indicates southern latitudes, the positive sign may be omitted.
:Sw<n>#	1 if valid	Sets the Slewing rate for the Move commands
:Sz<ddd>{*°}<mm># or :Sz<ddd>{*°:}<mm>: <ss>#	0 if invalid or 1 if valid	Sets the object's azimuth. From L4, V1.0 up.
Site Select		
:W<n>#		Select stored Site n with 0<=n<=3.
:W?#	0<=n<=3.	Stored Site n
:WQ#		Query a connected GPS receiver.

Gemini Native Commands

Many of Gemini's system settings that cannot be accessed using the LX200-like command set can be read or modified using the native command set implemented in Gemini. The native commands follow a simple syntax:

<<id>:<checksum>#	<parameter value><checksum>#	Get Value(from L2 up)
><id>:<parameter value><checksum>#		Set Value(from L2 up)

Id's and possible values in Level 5, Version 1.0:

Id	Get Parameters	Set Parameters	Get Return Values	Description and Remarks
0..8			0: Custom Mount 1: GM-8 2: G-11 3: HGM-200 4: MI-250 5: Titan 6: Titan50 7: G-10 8: G-12	Mount Type. Custom mount support (Id 0 and also commands 21..28) was introduced in L4. Attention: The CI-700 entry was replaced by the MI-250. CI-700 can be supported as a custom mount.
			10: Neither use	

10, 11..15			encoder nor end switches 11: Use Encoder 12: Test Encoder 13: Ignore Encoder 14: Use end switches 15: Don't use end switches	Axis Encoder port status. 10 can be used for requesting.
21		{+-}80..720	{+-}80..720	RA worm gear ratio. The sign indicates the direction. Note: The 1,296,00 arcsec of a circle divided by the product of worm gear ratio, spur gear ratio and motor encoder resolution define the step size per encoder tick. Gemini L4 supports step sizes from 0.2 arcsec/tick to 2.5 arcsec/tick. Combinations exceeding this range are not allowed.
22		{+-}80..720	{+-}80..720	DEC worm gear ratio. The sign indicates the direction. See note for command 21.
23		10..150	10..150	RA spur gear ratio. See notes for commands 21 and 27.
24		10..150	10..150	DEC spur gear ratio. See note for command 21.
25		100..2048	100..2048	RA motor encoder resolution. See notes for commands 21 and 27.
26		100..2048	100..2048	DEC motor encoder resolution. See note for command 21.
27			2000..25600	Number of RA steps for one worm revolution (since is a product of spur ratio and motor encoder ratio,this command can only be used for reading out the maximum step count, not for setting it). Note: This product must not exceed 25600. If higher values are reported the combination of RA spur gear ratio and motor encoder is invalid.
28			2000..25600	Amount of DEC steps for one worm revolution (since is a product of spur ratio and motor encoder ratio,this command can only be used for reading out the maximum step count, not for setting it).
33		10..150	10..150	RA spur gear ratio in "double" format. See notes for commands 21 and 27.

34		10..150	10..150	DEC spur gear ratio in "double" format. See note for command 21.
51			0 .. 1	Gemini mainboard version. Returns '0' for the original rectangular unit, '1' for the square "mini" controller. NEW in L5.2
81				Enquiry to get a coordinates and states string. See separate ENQ macro description. NEW in L5.1
91		0 or 1	0 or 1	Native Command checksum behavior. 0: MSB bit is cleared (modulo 128), 1: MSB bit is not cleared. NEW in L5
92		0 .. 2	0 .. 2	Park behavior. 0: Every Move command wakes up the mount (default), 1: Only GoTo and Unpark commands wake up, 2: Only a WakeUp command wakes up the mount. NEW in L5.1
96			1: Configuration data reloaded from SD card, 2: SRAM variables structure was changed by the new firmware version, 4: Wrong SRAM checksum, f.i. after changing battery, 8: reserved, 16: RTC and location updated by GPS, 32: RTC had to be initialized, 64: reserved, 128: reserved.	Startup circumstances, a bitwise combination of several indications regarding the static ram (SRAM) containing the setup and the real-time clock RTC (both running on battery while Gemini is powered off) NEW in L5.1
97			Eight revision characters 1: Site, 2: Date/Time, 3: Mount Parameter, 4: Display content,	State Check. This string of characters can be requested periodically to be compared with a former state. Whenever one of these characters was changed, the corresponding serial commands can be used to get the latest information. The characters are initialized to a '0' (0x30),

			5: Modelling parameters, 6: Speeds, 7: Park, 8: reserved.	will be incremented up to '~' (0x7E) and will then start at '0' again. There can be multiple changes between requests. NEW in L5
99			Decimal sum of 1: Telescope is Aligned, 2: Modelling in use, 4: Object is selected, 8: GoTo operation is ongoing, 16: RA limit reached, 32: Gemini assumes object coordinates to refer to J2000.0 and precesses them to the equinox of the date.	Status Inquiry.
100		{+-}2048..32768	{+-}2048..32768	Encoder Resolution in RA.
101			0..Encoder Resolution RA-1	Get Encoder Value RA.
110		{+-}2048..32768	{+-}2048..32768	Encoder Resolution in DEC.
111			0..Encoder Resolution DEC-1	Get Encoder Value DEC.
120		20..2000	20..2000	Manual Slewing Speed.
121		20..2000	20..2000	Manual Slewing Speed in RA. New in L5.
122		20..2000	20..2000	Manual Slewing Speed in DEC. New in L5.
130, 131..137			131: Sidereal 132: King Rate 133: Lunar 134: Solar 135: Terrestrial Mode 136: Closed Loop 137:	Tracking Rate. 130 can be used for requesting.

			Comet/User Defined	
140		20..2000	20..2000	GoTo Slewing Speed (for both axes).
141		20..2000	20..2000	GoTo Slewing Speed in RA. New in L5.
142		20..2000	20..2000	GoTo Slewing Speed in DEC. New in L5.
145		20..2000	20..2000	Move Speed (for both axes). New in L5.
146		20..2000	20..2000	Move Speed in RA. New in L5.
147		20..2000	20..2000	Move Speed in DEC. New in L5.
150		0.2..0.8	0.2..0.8	Guiding Speed (for both axes).
151		0.2..0.8	0.2..0.8	Guiding Speed in RA. New in L5.
152		0.2..0.8	0.2..0.8	Guiding Speed in DEC. New in L5.
160, 161..163			161: Visual Mode 162: Photo Mode 163: All Speeds	Classical Hand Controller Mode. 160 can be used for requesting.
170		1..255	1..255	Centering Speed (for both axes).
171		1..255	1..255	Centering Speed in RA. New in L5..
172		1..255	1..255	Centering Speed in DEC. New in L5.
180, 181..182			181: Alarm Off 182: Alarm On	Alarm Mode. 180 can be used for requesting.
190, 191..192			191: RA Motor stopped. 192: RA Motor moving.	RA Motor Movement. Command 190 can be used to obtain the current status, 191 for stopping and 192 for restarting the tracking.
200		0..255	0..255	TVC Step Count.
201		{+-}0..65535	{+-}0..65535	Modelling Parameter A (Polar Axis Misalignment in Azimuth), in seconds of arc.
202		{+-}0..65535	{+-}0..65535	Modelling Parameter E (Polar Axis Misalignment in Elevation), in seconds of arc.
203		{+-}0..65535	{+-}0..65535	Modelling Parameter NP (Axes Non-Perpendicularity at the Pole), in seconds of arc.
204		{+-}0..65535	{+-}0..65535	Modelling Parameter NE (Axes Non-Perpendicularity at the Equator), in seconds of arc.
205		{+-}0..65535	{+-}0..65535	Modelling Parameter IH (Index Error in Hour Angle), in seconds of arc.
206		{+-}0..65535	{+-}0..65535	Modelling Parameter ID (Index Error in Declination), in seconds of arc.
				Modelling Parameter FR (Mirror Flop/Gear

207		{+-}0..65535	{+-}0..65535	Play in RA), in seconds of arc.
208		{+-}0..65535	{+-}0..65535	Modelling Parameter FD (Mirror Flop/Gear Play in Declination), in seconds of arc.
209		{+-}0..65535	{+-}0..65535	Modelling Parameter CF (Counterweight & RA axis Flexure), in seconds of arc.
211		{+-}0..65535	{+-}0..65535	Modelling Parameter TF (Tube Flexure), in seconds of arc.
220			<ddd>d<mm>; <ddd>d<mm>	Set the respective Safety Limit to the current position. The Get function returns the eastern and western safety limits currently set. Note: Gemini will automatically compensate if you change hemispheres by swapping the eastern and western limits. This is because the mount is oriented northwards in the northern hemisphere and southwards in the southern hemisphere and so the side of the mount that faces east in the northern hemisphere will face west in the southern hemisphere and vice versa.
221		<ddd>d<mm>	<ddd>d<mm>	Get/Set eastern Safety Limit with respect to the meridian in degrees ddd and minutes mm. See note at command 220.
222		<ddd>d<mm>	<ddd>d<mm>	Get/Set western Safety Limit with respect to the meridian in degrees ddd and minutes mm. See note at command 220.
223		<ddd>d<mm>	<ddd>d<mm>	Get/Set Western GoTo limit (with respect to the meridian) in degrees ddd and minutes mm. GoTo operations will include a meridian flip if necessary to stay outside this limit. Note: If the RA angles usable for GoTo operations (East Safety Limit to Western GoTo limit) are not sufficient to point to any location, GoTo operations to unreachable locations will be refused and the hand controller will display "Interrupted". A zero value (000d00) indicates that the GoTo Limit wasn't set yet and the default (002d30, allowing for at least 10 minutes tracking the object) is to be used.
225			<seconds>	Get Amount of steps (motor encoder ticks) to Western GoTo Limit. NEW in L5
226			<seconds>	Get Tracking Time to Western GoTo Limit in seconds. NEW in L5
230			<east>;<west>	Get physical Safety Limits in clusters of 256 motor encoder ticks. See note at command

				221.
231			<east>;<west>	Get Amount of steps (motor encoder ticks) to the Safety Limits. NEW in L5
235			<ra_clusters>; <dec_clusters>	Get current physical RA and DEC axes position in clusters of 256 motor encoder ticks.
236			0..255;0..255	Get the remainders of the current physical RA and DEC axes position clusters.
237			<ra_clusters>; <dec_clusters>	Get the size of a half physical circle in clusters of 256 motor encoder ticks.
238			<ra_ticks>;<dec_ticks>	Get the size of a half physical circle in motor encoder ticks. NEW in L5
239			<ra_ticks>;<dec_ticks>	Get current physical RA and DEC axes position in motor encoder ticks. NEW in L5
245			<ra_lag>;<dec_lag>	Get current physical RA and DEC servo motor offsets, -390..390. If the result is always zero, this command may require a new servo motor firmware. NEW in L5.1
246			<ra_lag>;<dec_lag>	Get current RA and DEC servo motor duty cycle, -100..100. If the result is always zero, this command may require a new servo motor firmware. NEW in L5.1
311		0..15	0..63	Feature Port Status. 4 bits (0..15) can be used for setting input/output bits, 6 bits (including two additional input only bits 16 and 32, extending the range to 0..63) are available for input.
312			0..15	Encoder Port Status. 4 bits (0..15) can be used for reading or setting input/output bits if it is not intended to connect mount axis encoders but to use these channels alternatively.
321			Floating point value	Main battery voltage in volts. NEW in L5.2
322			Floating point value	Lithium battery voltage in volts. NEW in L5.2
411		Up to L4: 256..65535 L5: 0..4294967295	Up to L4: 256..65535 L5: 0..4294967295	RA (comet) tracking rate divisor. Up to L4, the RA timer runs at 1.5 MHz, using this divisor the tracking rate can be adapted to the (mount dependent) speed of an object to be tracked. Attention: up to L4, several internal prescalers may be used for further dividing down the frequency. NEW in L5 The divisor corresponds to a

				12.0 MHz timer.
412		Up to L4: {+-} }0..65535 L5: {+-} }0..2147483647	Up to L4: {+-} }0..65535 L5: {+-} }0..2147483647	DEC comet tracking rate divisor. Attention: Changed Meaning! In L3, there was no timer for DEC comet tracking available, the DEC divisor referred to the number of RA steps to be done for one step in DEC. In L4, the divisor value counts the number of internal timer ticks (at 22.888 18359 Hz) per one step in DEC, independently from RA. This corresponds to 0.657154312 arcsec/tick NEW in L5 The divisor corresponds to a 12.0 MHz timer. The sign indicates the direction. A zero value disables DEC tracking.
413		Up to L4: 256..65535 L5: 0..4294967295	Up to L4: 256..65535 L5: 0..4294967295	RA- (slow, eastwards) guiding rate divisor. L4: While guiding eastwards, an additional 4x prescaler is active. L4: A value of zero returned means a timer set to the maximum of 65536. NEW in L5 The divisor corresponds to a 12.0 MHz timer.
414		Up to L4: 256..65535 L5: 0..4294967295	Up to L4: 256..65535 L5: 0..4294967295	RA+ (fast, westwards) guiding rate divisor. See description to command 413. NEW in L5 The divisor corresponds to a 12.0 MHz timer.
415		Up to L4: 0..65535 L5: 0..4294967295	Up to L4: 0..65535 L5: 0..4294967295	DEC guiding rate divisor. NEW in L5 The divisor corresponds to a 12.0 MHz timer.
416		0..4G (4294967295)	0..4G	DEC guiding rate Prescaler. NEW in L5.1 The prescaler multiplies the value of the DEC comet tracking rate divisor to achieve very slow movements in DEC.
421			0..4G	RA sidereal tracking rate divisor. NEW in L5.1
422			0..4G	Equivalent 1x DEC sidereal tracking rate divisor. NEW in L5.1
501		0..PECmax	0..PECmax	Current RA PEC counter in steps, from 0 to the maximum step count per worm revolution PECmax. This maximum is the product of RA motor encoder resolution and spur gear ratio. It can be calculated multiplying the return values of the <23 and <25 commands or can be obtained directly by <27.
				Guiding Speed used for training PEC. Only

502			0.2 .. 0.8	valid if PEC was trained or PEC data were downloaded, see command 509. The set command can be used without parameters and sets the guiding speed back to the value used for training.
503		0..25600	0..25600	Maximum RA PEC counter in steps, from 0 to the maximum step count per worm revolution PECmax. This maximum is calculated as the product of RA motor encoder resolution and spur gear ratio at startup and whenever mount type or mount parameter are changed. Using this command, PECmax can be set to user defined values, f.i. to allow multiple worm cycles to be recorded.
504		0..255	0..255	Maximum consecutive RA PEC steps. 0 disables step supervision. Higher values define the maximum count of PEC steps in a row to enforce tiny corrections. After this maximum count is reached, normal tracking speed is reestablished.
508		0..1	0..1	Enable (1) or disable (0) PEC playback at boot time, if PEC data are available. NEW in L5.2
509		0..63	0..63	PEC status. Decimal sum of: 1: PEC active, 2: freshly trained (not yet altered) PEC data are available as current PEC data, 4: PEC training in progress, 8: PEC training was just completed, 16: PEC training will start soon, 32: PEC data are available.
511	offset	value;offset;repeat count	value;repeat count	Currently used PEC data. [value] can be 0 (=normal tracking), 1 (RA-, guiding eastwards) or 8 (RA+, guiding westwards). [offset] ranges from 0 to PECmax-1. [repeat count] indicates the number of equal values starting at the given offset.
512	offset	value;offset;repeat count	value;repeat count	Saved PEC data. [value] can be 0 (=normal tracking), 1 (RA-, guiding eastwards) or 8 (RA+, guiding westwards). [offset] ranges from 0 to PECmax-1; [repeat count] indicates the number of equal values starting at the given offset. Obsoleted in L5 by SD card PEC files.
			RA-/slow step	

521			count; normal step count; RA+/fast step count	PEC statistics. Three decimal values, summing up the steps at the three speeds.
530				Start PEC training. The training phase will start about ten seconds after this command was issued. NEW in L5
531				Switch PEC replay on, if there are valid PEC data available. NEW in L5
532				Switch PEC replay off. NEW in L5
535			'0': No PEC training was ongoing. '1': PEC training was aborted before it started '2': PEC training was aborted	Abort PEC training . NEW in L5
550				Load/Store PEC data from/to SD card file \PEC\CurrPEC.pec. NEW in L5
551	<filename>	<filename>		Load/Store PEC data from/to SD card file <filename>. NEW in L5
601				Select English as language for the following display outputs. NEW in L5
602				Select German as language for the following display outputs. NEW in L5
603				Select French as language for the following display outputs. NEW in L5
604				Select Spanish as language for the following display outputs. NEW in L5
700		Mount Design	Mount Design	Basic mount design: 0: Equatorial, 1: Alt/Az. NEW in L5.1
801		IPv4 address	IPv4 address	IP version 4 address in decimal dotted notation. Activates new network settings immediately. NEW in L5
802		IPv4 netmask	IPv4 netmask	IP version 4 netmask in decimal dotted notation. Activates new network settings immediately. NEW in L5
803		IPv4 default gateway	IPv4 default gateway	IP version 4 gateway address in decimal dotted notation. Activates new network settings immediately. NEW in L5
804		IPv4 primary	IPv4 primary	IP version 4 name server address in decimal

		name server address	name server address	dotted notation. Activates new network settings immediately. NEW in L5
805		IPv4 secondary name server address	IPv4 secondary name server address	IP version 4 name server address in decimal dotted notation. Activates new network settings immediately. NEW in L5
810		0: don't use DHCP 1: use DHCP	0: don't use DHCP 1: use DHCP	Decides whether DHCP is activated at startup or not. NEW in L5
811		IPv4 address	IPv4 address	IP version 4 address in decimal dotted notation. NEW in L5
812		IPv4 netmask	IPv4 netmask	IP version 4 netmask in decimal dotted notation. NEW in L5
813		IPv4 default gateway	IPv4 default gateway	IP version 4 gateway address in decimal dotted notation. NEW in L5
814		IPv4 primary name server address	IPv4 primary name server address	IP version 4 name server address in decimal dotted notation. NEW in L5
815		IPv4 secondary name server address	IPv4 secondary name server address	IP version 4 name server address in decimal dotted notation. NEW in L5
816		Network Time Protocol server address	IPv4 NTP server address	IP version 4 NTP server address in decimal dotted notation. NEW in L5.2
818		Ethernet port MAC address	Ethernet port MAC address	Ethernet port MAC address in hexadecimal notation. NEW in L5
826			'0' or '1' to indicate if a asynchronous NTP server query was started.	Query the predefined Network Time Protocol Server. NEW in L5.2
910	filename		'0' if file not found '1' if file was opened	Open a file for downloading it
911			'0' if error '2' followed by data	Read file data
912	filename		'0' file not deleted '1' file deleted	Delete a file.
43610			'1' file loaded/stored '0' file not loaded/stored	Load/Store the SRAM configuration data from/into the file \config\Gemini.cfg. NEW in L5

43611	filename	filename	'1' file loaded/stored '0'file not loaded/stored	Load/Store the SRAM configuration data from/into the file filename. NEW in L5
43690				Reset to Losmandy HGM default values.
43691				Reset to Mountain Instruments default values.
65533				Reboot the Gemini controller software, enforcing a Cold Start.
65534				Reboot the Gemini controller software.
65535				Reboot the Gemini controller software.

Using the native commands:

- The Identification tag is interpreted as an integer value, leading zeros are ignored.
- Parameters are separated from the Id and from each other by hyphens.
- The checksum for the native commands is calculated by a bitwise XOR operation of the transmitted characters, including the Get/Set command sign ('<', '>') and colon ':'. The highest significant bit of the result is cleared (modulo 128 operation) and 64 is added.
- Undefined Ids are ignored in Set operations. For Get operations, only a hash mark will be returned.
- In Debug Mode, the expected and the received checksum are displayed on the hand controller display in hexadecimal format whenever a discrepancy is detected. A command sent with a wrong checksum will not be executed.

Examples

- Get the Mount Type: "<0:v" and "<00:F#" are equivalent.
- "<1:w#" and "<2:t#" and "<3:u#" will deliver the same result, f.i. the string "1q#" if the mount type is set to GM-8 or "2r#" if G-11 is selected.

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