PC to Sky Tracker Communication

Version 3.0

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The Sky Tracker system allows the user to slew an alt-azimuth telescope to the selected object and to track on that object. The system consists of the Sky Commander digital setting circle computer with its optical encoders and the Sky Tracker microstepping driver box with stepper motors attached to each axis of the scope. The Sky Commander and Sky Tracker are connected together through a serial communications cable. This allows the tracker to receive information from the Sky Commander such as the distance and direction to the target, or the tracking speed, once the target is reached. The Sky Tracker also has a hand controller box for manual control of slewing and fine positioning. It is also possible to control the scope via a PC.

PC communications with the Sky Commander has been supported for a number of years. The Sky Commander provides positional information to the PC and allows the PC to upload coordinates of special objects. With the introduction of the Sky Tracker, communications protocol changes slightly. This is because the Sky Commander has only one serial port and the Sky Tracker now takes it up. The Sky Tracker however has other serial ports, one of which can be connected to the PC. This provides a satisfactory hardware solution. There is still one problem however. The Sky Commander must be shared between the PC and the Sky Tracker. Each requires different information. The Sky Commander cannot service both at the same time. Therefore the following simple protocol has been worked out which solves the problem:

When the PC needs to communicate with the Sky Commander, it will send 'Q' for bus reQuest. The PC then waits for up to100ms for a bus grAnt, 'A'. In most instances the grant will be given immediately, but if the Sky Tracker is in the middle of receiving information for its own use from the Sky Commander, then the PC will have to wait. Upon receiving the bus grant, the PC will send it's request and receive the response from the Sky Commander in the normal way. During this exchange the Sky Tracker is essentially transparent and simply relaying characters as they are received. After the reply is received, the PC must release the bus with 'q'. 'q' is seen by the Sky Tracker and interpreted as the end of the exchange and is not echoed. In this way the Sky Tracker does not have to understand the context of the communication. It can simply keep relaying characters until 'q' is received from the PC. After receiving the bus release 'q', the Sky Tracker can initiate it's own request for information from the Sky Commander if it needs to.

Bus requests should not be used when sending commands to the Sky Tracker itself. Any commands or data sent after the bus has been acquired are simply passed to the Sky Commander. If those commands were not meant for the Sky Commander, they will be lost or possibly misinterpreted.

The PC should not hold the bus any longer than is necessary to complete one task, such as requesting and receiving position information. Keep in mind that the bus is a shared resource and holding it for a prolonged period may cause undesirable operation of the Sky Tracker.

Sky Tracker Commands

The following commands are defined for communication from the PC to the Sky Tracker.

'U' - UTILITY Mode. This command causes the Sky Tracker to enter UTILITY mode. The scope can be slewed in any desired direction (up, down, left or right) at up to 4 degrees/second with ramp up and ramp down speed. ~~Note: The 'u', 'd', 'l' and 'r' commands do not work in UTILITY mode. The hand controller buttons must be used.~~

'T' - Track Mode.   This command causes TRACK mode to be entered. In TRACK mode the scope will track an object using rate information supplied by the Sky Commander. The 'u', 'd', 'l', 'r', and 'b' commands discussed below can be used for fine positioning and guiding. Note: Executing the 'T' command will cause GUIDE mode to be turned off.

'D' - **GUIDE Mode.** This command causes GUIDE mode to be entered. The Sky Tracker must already be in TRACK mode for the 'D' command to work. GUIDE and TRACK mode are *not* mutually exclusive; in GUIDE mode the scope tracks normally when no guiding corrections are being made. Note: use the 'T' command to turn off GUIDE mode.

'B' - Standby Mode. This command causes the Sky Tracker to enter STANDBY mode. DC drive to the stepper motors is cut, thus saving battery power.

'O' – Resume Operate. This command restores power to the stepper motors after being in STANDBY mode. TRACK mode is entered.

'G' - Go To.   This command causes the Sky Tracker to move the scope to the selected object. After target is reached, TRACK mode is invoked.

'u' - **Press Up** – this command causes the UP directional button to be pressed, e.g. to make a guiding correction.

'd' - **Press Down** – this command causes the DOWN directional button to be pressed, e.g. to make a guiding correction.

'l' - **Press Left** – this command causes the LEFT directional button to be pressed, e.g. to make a guiding correction.

'r' - **Press Right** – this command causes the RIGHT directional button to be pressed, e.g. to make a guiding correction.

'b' - **Button Release** – this command causes all directional buttons to be released, e.g. end of guiding correction.

<u>New Sky Commander Commands</u>

The following commands have been added or revised to the existing set.

'N' - Realign to current object

'L99' - Load Temporary Object Position. The 'L00' through 'L58' commands are used to store object coordinates in Sky Commander EEPROM memory. L99 has a special meaning. The coordinates that follow will be put into RAM memory and become current for the purpose of going to the object or realigning to it.

Operating Examples

To make the PC link useful, the user needs to send object coordinates to the Sky Commander and make them 'current' in memory so that scope can be positioned there. The following is the sequence of commands:

PC:	Q	bus request (to S.T.)
ST:	A	bus grant (from S.T.)
PC:	L99 12.345 +67.890<cr>*	upload of object coordinates (to S.C.)
ST:	A	acknowledge (same as grant, from S.C.)
PC:	q	bus release (to S.T.)
PC:	G	command to go to the object (to S.T.)

*<cr> indicated carriage return character (hexadecimal 0D).

The L value of 99 in the above sequence is specially defined and tells the Sky Commander to put the coordinates into RAM and make them current. L values of 00 to 58 (as previously defined) are used to store object coordinates into EEPROM memory and do not cause the object to become current.

Upon reaching the target coordinates, the Sky Tracker will revert to TRACK mode automatically. Note: The scope does not have to be on any object in order to track. It will track properly at any position it happens to be at. The Sky Commander provides rate information based on the scope's position only.

A GOTO can be aborted. For instance if the user issues a G command the scope starts to move to the current object. If the user changes his mind while the scope is moving, it may be stopped by sending the U (UTILITY) command. This will ramp down the speed, stop the scope and put it in the UTILITY mode. Tracking can be resumed by sending the T command for instance, or another G command could be sent to start the GOTO again.

Realigning to an object's coordinates

Often it is desirable to realign the Sky Commander on a known star or object. This can now be done from the PC using the command sequence below.

PC:	Q	bus request (to S.T.)
ST:	A	bus grant (form S.T.)
PC:	L99 12.345 +67.890<cr>	upload of desired object coordinates (to S.C.)
ST:	A	acknowledge (same as grant, sent from S.C.)
PC:	N*	Realign Command (to S.C.)
PC:	q	bus release (to S.T.)

*The realign command, 'N' is directed to the Sky Commander. Therefore it must be sent before releasing the bus.

Special Requirements

At the time of this writing it appears that at a very minimum, two stop bits will be required when sending more than one character at a time; as in sending coordinates for instance. This is due to the fact that the serial port to the PC is not buffered. Characters, which are not read by the Sky Tracker microprocessor before the start of the next character, will be lost or corrupted. Only 9600 b/s can be used.