# Appendix B - RS-232 Connection

You can control your CGE telescope with a computer via the RS-232 port on the computerized hand control and using an optional RS-232 cable (#93920). Once connected, the CGE can be controlled using popular astronomy software programs.

Communication Protocol:

CGE-i communicates at 9600 bits/sec, No parity and a stop bit. All angles are communicated with 16 bit angle and communicated using ASCII hexadecimal.

Description	PC Command ASCII	Hand Control Response	Notes
Echo	Kx	X#	Useful to check communication
Goto Azm-Alt	B12AB, 4000	#	10 characters sent. B=Command, 12AB=Azm, comma, 4000=Alt. If command conflicts with slew limits, there will be no action.
Goto Ra-Dec	R34AB, 12CE	#	Scope must be aligned. If command conflicts with slew limits, there will be no action.
Get Azm-Alt	Z	12AB, 4000#	10 characters returned, 12AB=Azm, comma, 4000=Alt, #
Get RA-Dec	E	34AB, 12CE#	Scope must be aligned
Cancel Goto	M	#	
Is Goto in Progress	L	0# or 1#	0=No, 1=Yes; "0" is ASCII character zero
Is Alignment Complete	J	0# or 1#	0=No, 1=Yes
Commands below available on version 1.6 or later			
HC version	V	22	Two bytes representing V2.2
Stop/Start Tracking	Tx x = 0 (Tracking off) x = 1 (Alt-Az on) x = 2 (EQ-N) x = 3 (EQ-S)	#	Alt-Az tracking requires alignment
32-bit goto RA-Dec	r34AB0500,12CE0500	#	
32-bit get RA-Dec	e	34AB0500,12CE0500#	The last two characters will always be zero.
Commands below available on version 2.2 or later			
32-bit goto Azm-Alt	b34AB0500,12CE0500	#	
32-bit get Azm-Alt	z	34AB0500,12CE0500#	The last two characters will always be zero.

The cable required to interface to the telescope has an RS-232 male plug at one end and a 4-4 telephone jack at the other end. The wiring is as follows:
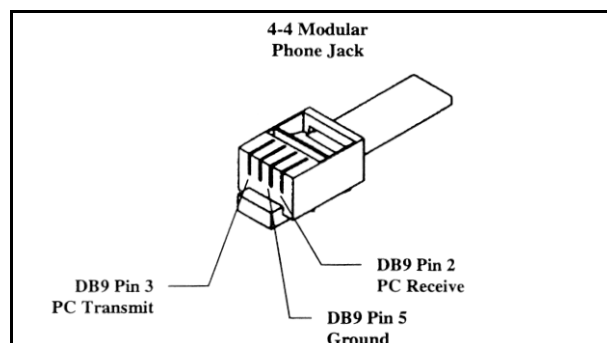
Additional RS232 Commands

Send Any Track Rate Through RS232 To The Hand Control

1. Multiply the desired tracking rate (arcseconds/second) by 4. Example: if the desired trackrate is 150 arcseconds/second, then TRACKRATE = 600
2. Separate TRACKRATE into two bytes, such that (TRACKRATE = TrackRateHigh*256 + rackRateLow). Example: TrackRateHigh = 2 TrackRateLow = 88
3. To send a tracking rate, send the following 8 bytes:
   a. **Positive Azm tracking**:   80, 3, 16, 6, TrackRateHigh, TrackRateLow, 0, 0
   b. **Negative Azm tracking**:80, 3, 16, 7, TrackRateHigh, TrackRateLow, 0, 0
   c. **Positive Alt tracking**:   80, 3, 17, 6, TrackRateHigh, TrackRateLow, 0, 0
   d. **Negative Alt tracking**:   80, 3, 17, 7, TrackRateHigh, TrackRateLow, 0, 0
4. The number 35 is returned from the handcontrol

Send A Slow-Goto Command Through RS232 To The Hand Control
(note: Only valid for motorcontrol version 4.1 or greater)

1. Convert the angle position to a 24bit number. Example: if the desired position is 220°, then POSITION_24BIT = $(220/360)*2^{24}$ = 10,252,743
2. Separate POSITION_24BIT into three bytes such that (POSITION_24BIT = PosHigh*65536 + PosMed*256 + PosLow). Exampe: PosHigh = 156, PosMed = 113, PosLow = 199
3. Send the following 8 bytes:
   a. Azm Slow Goto: 80, 4, 16, 23, PosHigh, PosMed, PosLow, 0
   b. Alt Slow Goto: 80, 4, 17, 23, PosHigh, PosMed, PosLow, 0
4. The number 35 is returned from the handcontrol

Reset The Position Of Azm Or Alt
1. Convert the angle position to a 24bit number, same as Slow-Goto example.
2. Send the following 8 bytes:
   a. Azm Set Position: 80, 4, 16, 4, PosHigh, PosMed, PosLow, 0
   b. Alt Set Position: 80, 4, 17, 4, PosHigh, PosMed, PosLow, 0
3. The number 35 is returned from the handcontrol
4. Note: If using Motorcontrol version less than 4.1, then send:
   a. Azm Set Position: 80, 3, 16, 4, PosHigh, PosMed, PosLow, 0
   b. Alt Set Position: 80, 3, 17, 4, PosHigh, PosMed, PosLow, 0