

Using the NavLabs Reference Receiver

All models of the Navigation Laboratories Inc (NavLabs) GPS Constellation Simulators come with a built-in GPS reference receiver. Originally it was included so we could use it to assist us with technical support for our customers. However, it has become quite popular with our customers and we felt a brief description of how to interpret and use the output data would be useful.

When your simulator is delivered, this receiver is configured automatically and in general requires no user intervention for its operation.

Details of the Receiver:

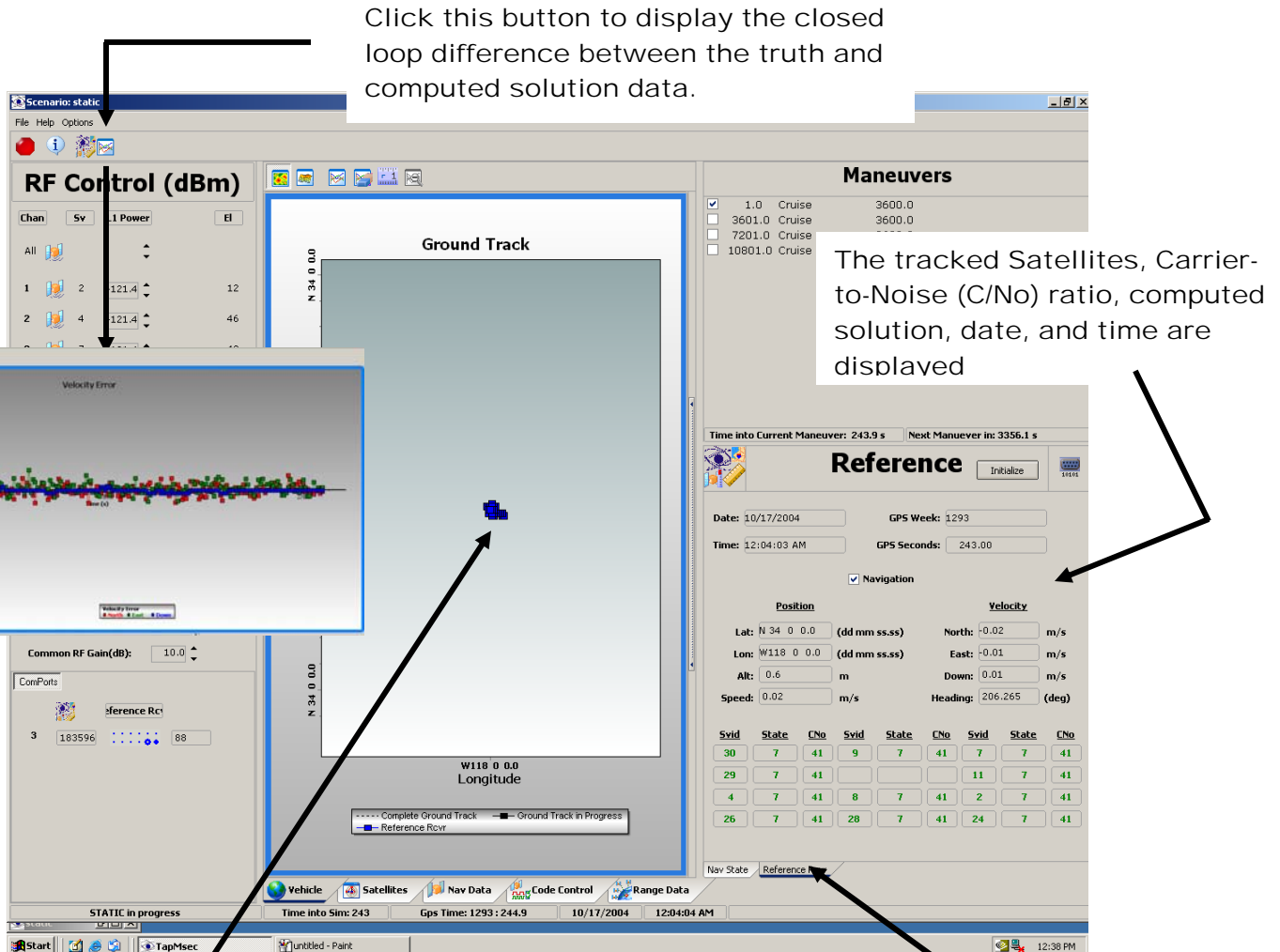
The receiver is an OEM product based upon the SiRF chipset. The receiver serial data output is connected internally to our simulator via a USB Header Pin connector. The associated data is feed into our run-time executive (Run Scenario) real-time such that the following outputs can be computed and displayed while the simulation is running

- Tracked Satellites and measurement status.
- Measured Carrier to Noise (C/No) ratio.
- Computed Navigation solution comprised of: Time, Position, Speed, and Heading.
- The *difference* between the truth data from the simulator (position and velocity) and the computed data from the receiver.
- The logged results of the closed loop accuracy comparison and the raw receiver output data in text file formats.

The Graphical Display

The following screen capture is a typical example of the GUI associated with the run-time executive (see the Run Scenario user's manual). The items specific to the reference receiver are indicated.

Click this button to display the closed loop difference between the truth and computed solution data.



The tracked Satellites, Carrier-to-Noise (C/N₀) ratio, computed solution, date, and time are displayed

Velocity Error

Common RF Gain(dB): 10.0

Reference Receiver

Maneuvers

Maneuver	Type	Altitude
<input checked="" type="checkbox"/> 1.0	Cruise	3600.0
<input type="checkbox"/> 3601.0	Cruise	3600.0
<input type="checkbox"/> 7201.0	Cruise	3600.0
<input type="checkbox"/> 10801.0	Cruise	3600.0

Reference

Date: 10/17/2004 GPS Week: 1293

Time: 12:04:03 AM GPS Seconds: 243.00

Navigation

Position

Lat: N 34 0 0.0 (dd mm ss.ss) North: -0.02 m/s

Lon: W118 0 0.0 (dd mm ss.ss) East: -0.01 m/s

Alt: 0.6 m Down: 0.01 m/s

Speed: 0.02 m/s Heading: 206.265 (deg)

Svid	State	CNo	Svid	State	CNo	Svid	State	CNo
30	7	41	9	7	41	7	7	41
29	7	41				11	7	41
4	7	41	8	7	41	2	7	41
26	7	41	28	7	41	24	7	41

Nav State: Reference Receiver

Vehicle Satellites Nav Data Code Control Range Data

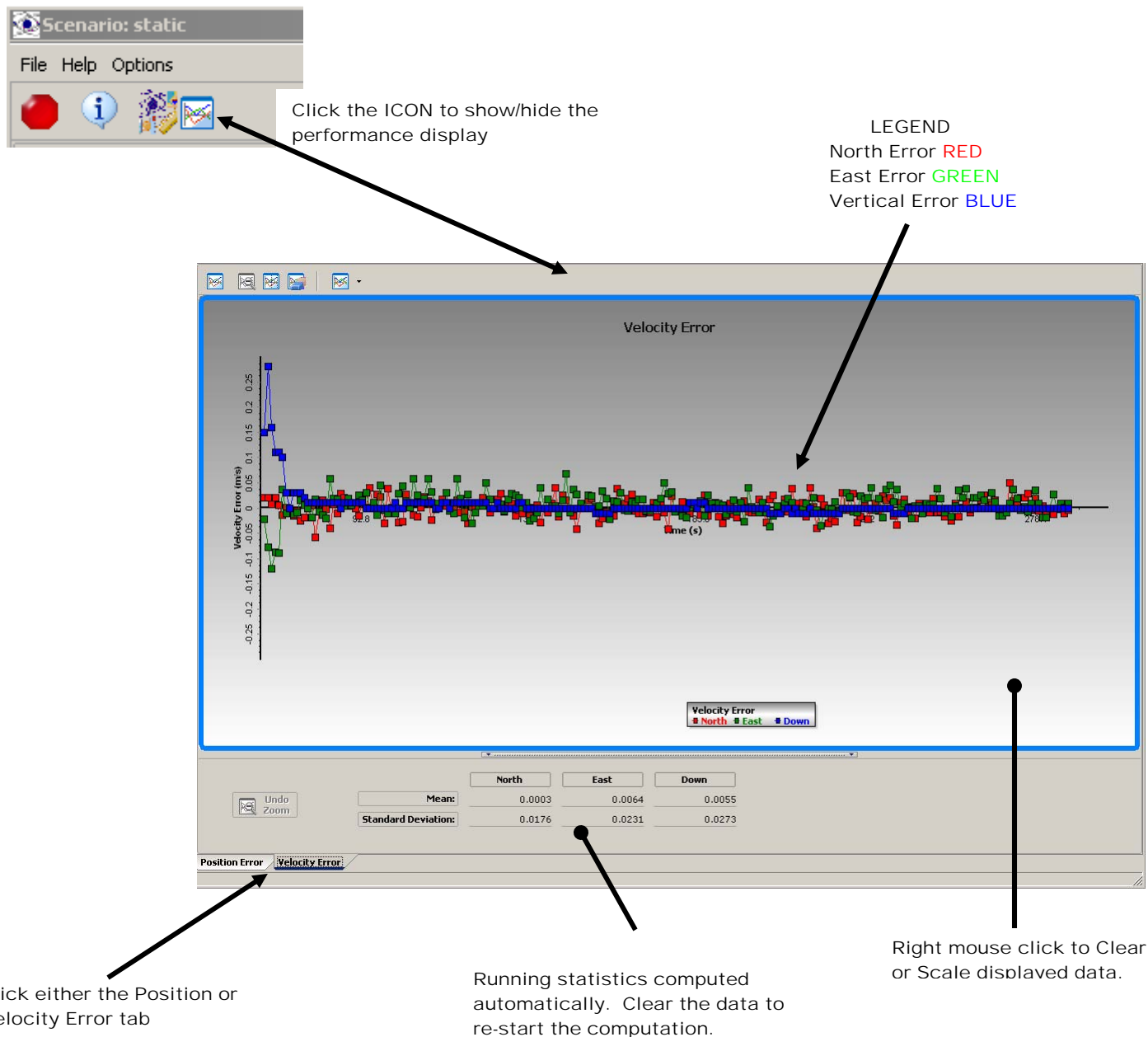
STATIC in progress Time into Sim: 243 Gps Time: 1293 : 244.9 10/17/2004 12:04:04 AM

The real-time Ground Track Display has the receiver data overlaid in BLUE

To Display the reference receiver details, click the REFERENCE

The Closed Loop Display

The Icon Buttons installed upon the Run Scenario menu bar control the display of the closed-loop data constructed from synchronizing the navigation data collected from the reference receiver with the truth data associated with the Constellation Simulator.



Scenario: static

File Help Options

Click the ICON to show/hide the performance display

LEGEND
North Error RED
East Error GREEN
Vertical Error BLUE

Velocity Error

Velocity Error (m/s)

Time (s)

	North	East	Down
Mean:	0.0003	0.0064	0.0055
Standard Deviation:	0.0176	0.0231	0.0273

Position Error Velocity Error

Click either the Position or Velocity Error tab

Running statistics computed automatically. Clear the data to re-start the computation.

Right mouse click to Clear or Scale displayed data.

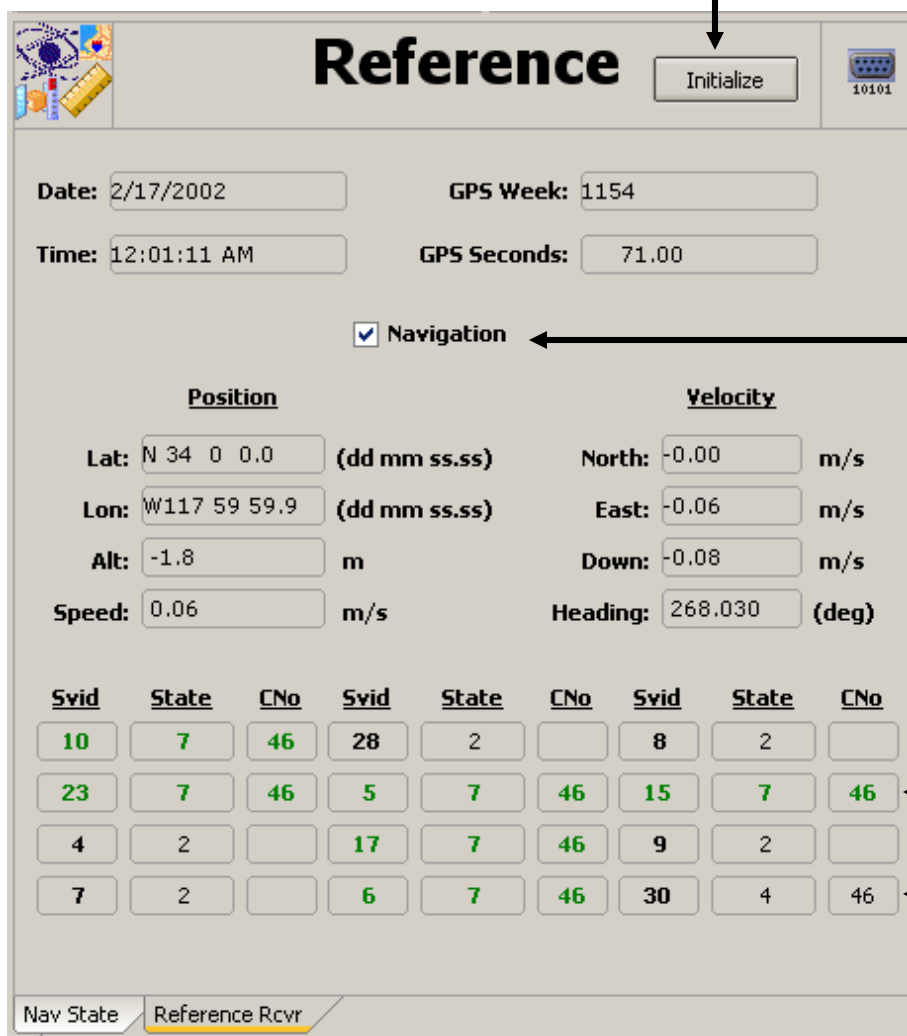
Note. The results displayed, the computed North, East, Vertical position and velocity errors, are saved in a file TEXT within the scenario folder. The file name is **POSVELERR.DAT**. You can import this file into Excel or an equivalent program. Also note, when you restart the simulation, the PosVelErr.dat file is overwritten so if you want to save it, copy it out of the folder before you restart the simulation.

Interpreting the Reference Receiver Display

The purpose of the reference receiver is to provide a known reference against which the end-unit under test can be compared too. In particular it is used to monitor signal power, general operation of the simulator, and a sanity check.

To use the receiver to its full potential, it is important to understand the color scheme of the display, the status display, and the operation vis-à-vis power and operability of the receiver.

The following display illustrates the items of interest.



Reference

Initialize

Date: 2/17/2002 GPS Week: 1154

Time: 12:01:11 AM GPS Seconds: 71.00

Navigation

Position

Lat: N 34 0 0.0 (dd mm ss.ss)

Lon: W117 59 59.9 (dd mm ss.ss)

Alt: -1.8 m

Speed: 0.06 m/s

Velocity

North: -0.00 m/s

East: -0.06 m/s

Down: -0.08 m/s

Heading: 268.030 (deg)

Svid	State	CNo	Svid	State	CNo	Svid	State	CNo
10	7	46	28	2		8	2	
23	7	46	5	7	46	15	7	46
4	2		17	7	46	9	2	
7	2		6	7	46	30	4	46

Nav State Reference Rcvr

By default we automatically initialize the receiver with the correct date and time at simulation startup. However, pressing this button sends the initialization message again and forces a soft reset.

If unchecked, the reference receiver solution has not converged vis-à-vis the internal receiver integrity checks.

If the satellite is **GREEN**, then it is being used within the navigation computation of the reference receiver. In this case the STATE = 7 indicates that the ephemeris is gathered and all internal checks are passed

If the satellite is **BLUE**, (none of these are shown) then the satellite is NOT being used in the navigation solution because the elevation angle is $< 5^\circ$. The STATE = 6 for this condition.

If the satellite is **BLACK**, then it either not acquired (C/No should be < 10) or the ephemeris has not been collected (this takes ≈ 30 seconds after acquisition). If the ephemeris is being collected the STATE = 4.

BLACK also may indicate heavy dynamics for this satellite ($> 4\text{-}5$ G's) and it has come out of lock

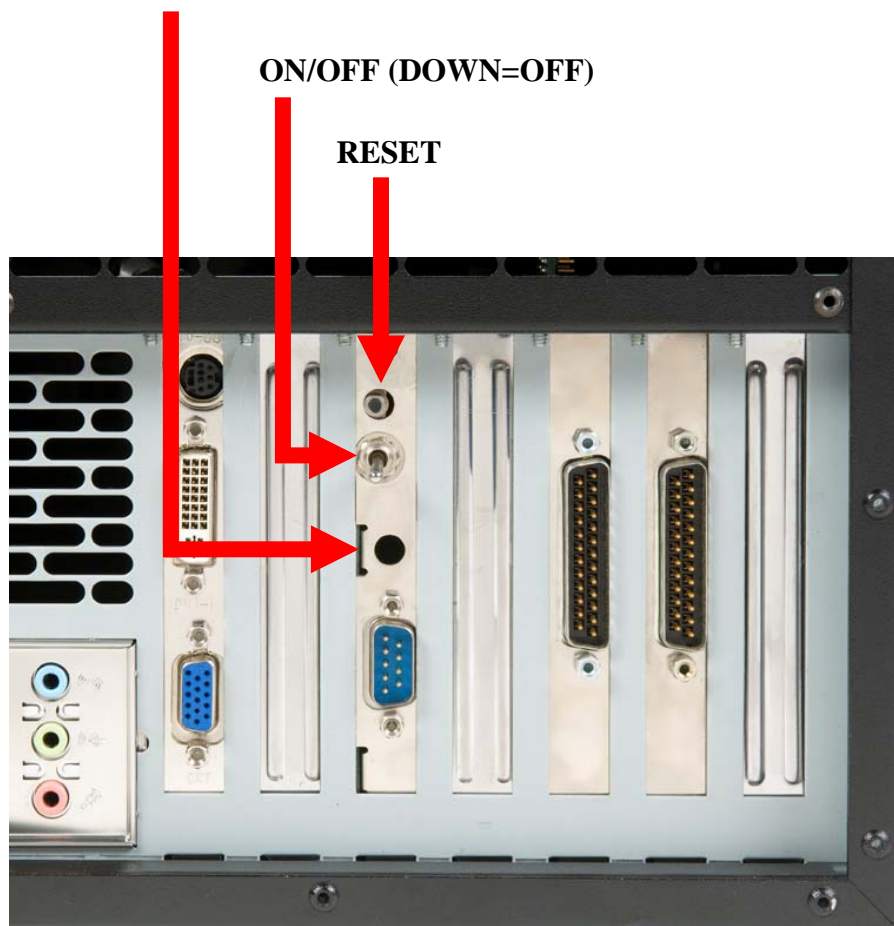
Turning the Reference Receiver OFF/ON [NOT APPLICABLE FOR SIRF CHIPSET]

If you are making very long runs – for example > 12 hours or so, the reference receiver and the associated data displays can noticeably bog down the Run Scenario GUI. On delivery, we configure the reference unit to clear the reference receiver display buffers every hour but Windows has memory leaks and the “buffer clear” is not perfect. For long runs it is recommended the reference receiver be turned off for the bulk of the run. You can periodically turn it on to monitor the solution (this is an example of when you would want to use the INITIALIZE button on the display) and then turn it back off.

To control the reference receiver power, examine the back of the simulator. You will find a panel blank with a toggle switch and a push-type button. If the toggle switch is UP the reference receiver is ON and the Run Scenario GUI will be updating that portion of the display. If the switch is DOWN the reference receiver will be powered off and the Run Scenario reference receiver display will not be updating. The push button forces hardware reset to the Reference Receiver.

GPS REFERENCE RECEIVER

RECEIVER BASED 1-PPS

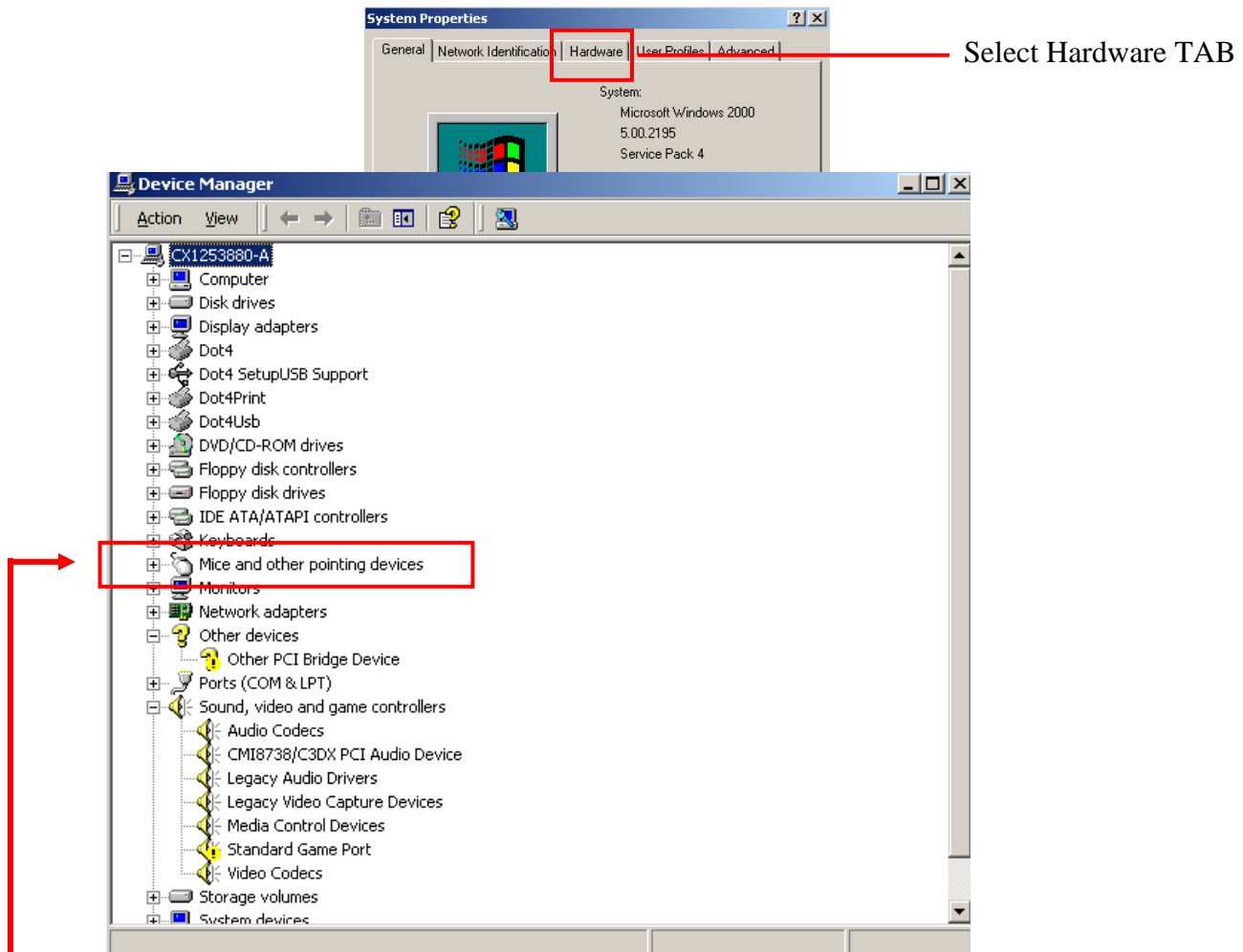




IMPORTANT: Following a boot – the cursor (mouse) is bouncing about the screen

As quickly as possible, switch the toggle switch DOWN on the reference receiver. What has happened is Windows thinks a SERIAL MOUSE has been installed and automatically loads a driver for it. When we ship the unit we wait for this event to occur and disable the serial mouse driver. However, more often than we would like, Windows decides to start up the driver again. If this occurs in your system do the following:

1. Turn off the reference receiver with the toggle switch by pushing it down.
2. Click on START -> SETTINGS -> CONTROL PANEL -> SYSTEM



Select Hardware TAB

3. Find **Mouse and Other Pointing Devices** and expand it. You will see Serial Ball Mouse (or something similar to it). Right click on it and **DISABLE** the device (don't remove it or it will just come back again!). Click OK and turn your reference receiver back ON. Everything will be OK now.