Purpose of this Manual

The purpose of this manual is to train the user in the fundamentals of operating the *Commander II* data system and the *Track Master, Command Link, and Command View* software.

It is NOT the purpose of this manual to teach you "how to analyze race vehicle data". Ways of going about educating yourself in the actual analysis of performance data are addressed in one of the later chapters of this manual.

Acknowledgement

Competition Data Systems Incorporated would like to thank all those individuals who have provided valuable input over the years regarding the design and features of the Track Master and Command Link series of software. A special thanks to those who have assisted in beta testing the products.

We are deliberately not listing the names of these people as they are so numerous that to do so would risk leaving someone out by oversight.

Without the help of these people, this software would not be the leading edge, state of the art product that it is.

Copyright and Software License

Dedication

This work is dedicated to the memory of two of the original stock holders of the company, Charles Cullinan and Thomas J. Kelly Jr.

Chapter 1 Getting Started

Introduction

Thank you for your purchase of Track Master Software. Please read, utilize, and follow this manual in learning to use your new software. If you are a new user of Track Master, please have your software installed and computer running as you follow along the tutorial of chapters 1-7.

2 Programs - Track Master and Command Link

Your software is made up of 2 separate programs, Track Master 2000 and Command Link 2000. After installation, you will see 2 separate icons on your desktop, one for each program. Briefly, the difference between these programs is:

What Track Master 2000 is:

- Used for all plotting and analysis of data.
- Controls all the global parameters which both TM and CL use
- Referred to in this manual as Track Master, Track Master 2000, or TM

What Command Link is:

- Used to Configure and Communicate with Commander II hardware
- Used to download data from Commander II or from a memory card
- Contains the program option "Command View", for graphical view live and data capture.

NOTE: Those users who are used to a DOS environment are in the habit of constantly closing an application when they are done with it. TM and CL are pure Windows applications, leave both of them running all the time when you are working on the dyno. Constantly closing and reopening them is nothing more than extra work that will only distract you from the real job at hand.

Different Modes of Track Master

Track Master has several modes it can run in, depending on the application. Most users only run the program in 1 mode, and therefore never need to switch modes.

- The *Hardware key*, which plugs into your printer or USB port on your PC, determines which mode(s) your program will run in.
- Switching between modes is covered later in this manual

IMPORTANT NOTE:

This manual is designed to cover all the different Track Master modes or applications. Certain sections of this manual only apply to certain modes.

- When you see the following icons at the start of a section, that section applies only to the modes listed.
- If there is no icon at the start of the section then that section applies to ALL modes.

Section applies ONLY to **Circle Track & Road Race mode**

Section applies ONLY to **Drag Race mode**

Section applies ONLY to **Dyno mode**

What's New in Versions 5.2 and 5.3

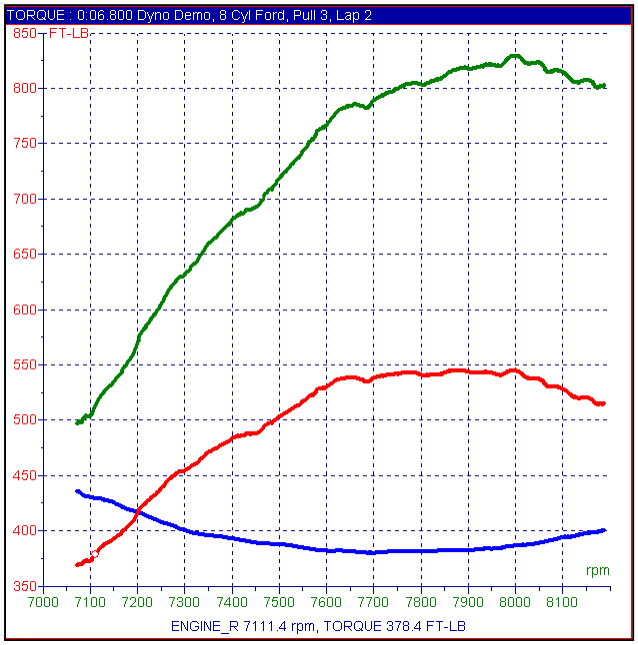
As with most software, this new release includes a combination of new features, enhancement to existing features, and bug fixes. Here is a broad overview of the new features and enhancements.

New Track Master Features

Signal vs Signal Plot Type

The biggest new feature in Track Master is an improved Signal vs Signal plot type.

This new plot type has the following improvements over the previous versions:



- Any number of signals can be Y-axis plotted at once. Previously only 1 signal could be plotted against another. In the above example, torque, power, and fuel consumption (bsfc) are all plotted against engine rpm.
- The signal vs signal plot is now independent. Previously it was necessary to data-source link it to a time or distance plot. It can now stand on its own.
- It can now be zoomed independently. Previously it needed to be linked to a time or distance plot in order to zoom it.

New *Dyno* Mode

A new mode has been added specifically for using Track Master, Command Link and Command View in stand alone Dynamometer applications. This mode includes:

- Changes in syntax and nomenclature. For example, data is not separated into "laps", it is broken up into sections called *warmup, run, and cooldown* Data is automatically separated into these 3 sections when logging data using *Command View.*
- There is no "map lap" or distance base required in Dyno mode
- Special views suitable for dyno use are supplied with the program
- Preprogrammed formulas for torque and power include provision for weather and inertia correction.

All new *Command View*

Command View is a new program option in Command Link that enables:

- Graphical viewing, zeroing, and calibration of sensors using "virtual gauges" useful in all applications
- Simultaneous recording and viewing of live data at rates up to 100 Hz (requires a Commander II with ROM 33 or higher)

Command view has many useful applications including in-car system checkout and calibration as well as stand-alone dyno instrumentation.

Enhancements

- **Clear Over Plots** enables you to clear all over plots in any plot while keeping the data source plotted. Very useful when making comparisons to several laps. Previously, clearing a plot would erase all signals in a plot including the data source.
- **Improved *Reference* dialog** streamlines the process of selecting, activating, and de-activating reference laps.
- **User defined names for markers** such as "pit straight max speed" are now displayed in marker reports.
- **The user interface** has been streamlined in several other areas as well.

Compatibility With Win 2000, ME, and XP

The previous versions (5.2) of TM and CL were produced prior to the release of Windows 2000 Professional and Windows ME. If you are running either of these operating systems you need to upgrade TM and CL to assure compatibility.

Windows 2000 in particular has some communication problems when running TM/CL 5.2.

Increased Reliability

A large part of our software development over the past 2 years has focused on improving the reliability of Track Master. Over 100 known bugs have been fixed in version 5.2, including all known sources of page fault crashes and other fatal errors. Version 5.2 is the most developed, tested, and robust version of Track Master ever!

Software Installation

Before attempting to install this software, please verify that your PC meets the minimum requirements (as listed below) for the software components you will be using.

Minimum PC Requirements

Here are the *minimum* requirements for your PC to run Track Master, Command Link and Command View.

Operating System

Windows 98 version 4.10 or higher (Windows 98 SE highly recommended)

Windows 2000 (Professional) and NT are acceptable

Windows ME is not recommended

Windows 95 is not recommended and Command Link will not run properly under Win 95

Processor

Pentium or higher. (Pentium 3 recommended for new purchases)

Pentium II or higher ***Required*** for Command View

Pentium II or higher recommended for high sample rate data

Display

800 x 600 x 16 bit color minimum. (1024 x 768 highly recommended)

Memory

32 MB minimum (64 MB or more recommended)

Other Requirements

Compatible CD ROM drive

Compatible 9 pin COM port available

Compatible 25 pin LPT port or USB port for hardware key

User Requirements

In order to use this software, understand this manual and communicate with CDS technical support people, the user (you) must have a basic familiarity with personal computers and the Windows 98 operating system.

At a minimum, you must:

- Know how to boot, shut down, and restart a PC
- Be familiar with the Start menu, Desktop, and Task Bar
- Be familiar with starting, closing, and switching between windows application programs
- Be able to use Windows Explorer, the file management software included with Win 98.
- Be familiar with key terminology used in the software and in this manual.

If you do not feel that you have this knowledge, please seek out someone who can educate you (such as friends, children, courses through various local agencies and learning institutions) or, better yet, sit down and educate yourself on the basics using any of the introductory type books on the subject (sold at all bookstores).

Please note that CDS cannot provide technical support to you unless you have this basic knowledge, nor can we train you in PC and Windows literacy over the phone.

Doing a Fresh (Full) Install

As with all Windows applications, **NEVER ATTEMPT TO INSTALL THE PROGRAM BY COPYING FILES OR DRAGGING AND DROPPING FILES OR FOLDERS IN WINDOWS EXPLORER**. Doing so will almost always guarantee failure.

To install:

1. Close all open applications.
2. Plug your Track Master Key into the printer or USB port of your computer.
3. Insert the Track Master 2000 CD in your drive. The Install Wizard should automatically launch. If it does not, Click on **Start**, then **Run**, then **Browse**, and navigate to your CD ROM drive, and run the **Setup.Exe** program.
4. In most cases, it is best to accept the default settings for the install location of the software.
5. You will be asked if you want Command Link to start each time you start your PC. If you answer YES, the install will put a shortcut to Command Link in your *Startup* folder.
6. Follow the prompts. After setup completes, it will automatically restart your computer.
7. After restart, you should have icons (shortcuts) for both Track Master and Command Link on your desktop.

Note: You may receive messages telling you a read-only DLL has been found. In general, answer these messages so as to over-write the existing files with the new files from the Track Master CD.

Upgrading from a Previous Windows Version of Track Master

Note: If you have the math channels option and you have made modification to any of the standard CDS supplied formulas, the install will override your modifications and reset those formulas to their defaults. To preserve your changes, export your settings now, then import them after you run the install.

---

1. Check the Windows Taskbar to be sure that Command Link and Track Master are not running.
2. Follow the steps above. The install wizard will search for existing versions of Track Master, and ask you to upgrade, answer YES.
3. If you experience problems when updating from Track Master 97 to Track Master 2000, please see the TM 97 Update Troubleshooting in Appendix A.

How to “Force” a Full Install

If you are upgrading a PC from a previous version but would like to do a full install, including all sample data etc, follow the following:

1. Using Windows Explorer, navigate to C:\PROGRAM FILES\TRACK MASTER and delete the TRACK MASTER.EXE and COMMAND LINK .EXE files
2. Install TM 2000

Configuring Your PC for Memory Cards

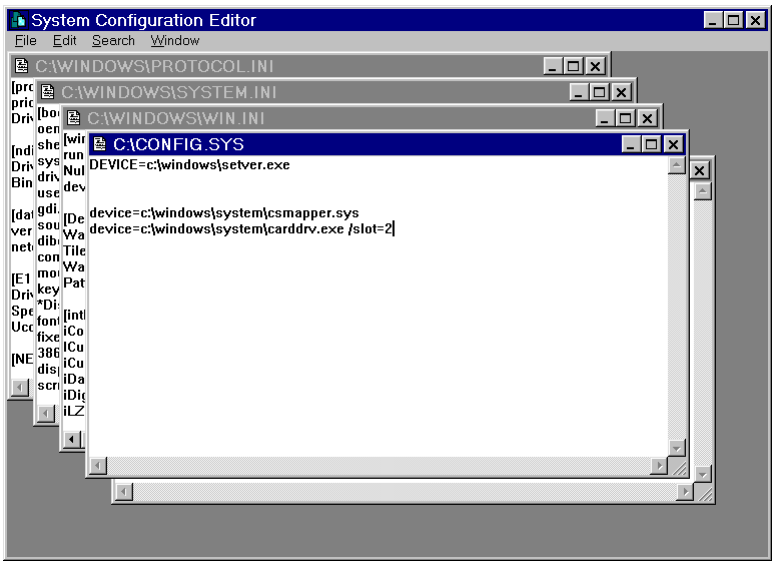
Many Commander II systems include the *removable memory card* option. IF your system has this option then you need to follow the instructions in this section.

CDS memory cards must be recognized as *removable drives* by the operating system in order to work properly with Command Link. Special steps must be taken to do this as follows:

Windows 98

Plug & Play under Windows 98 does not result in SRAM PC cards being properly recognized. The best way to set up your Win 98 PC to use memory cards is to load the 2 *real mode* drivers included with Win 98 as follows:

1. Click *Start* then *Run*, type in **Sysedit** and hit <enter>
2. You will see 5 cascaded windows:



3. Click on the CONFIG.SYS window and type in the following text:

   device=c:\windows\system\csmapper.sys

   device=c:\windows\system\carddrv.exe /slot=**n**

4. For the value of n, type the number of PC card slots on your computer. This is usually 1 or 2.
5. Close the *Configuration Editor* window. You will be prompted to save the changes. Answer yes. Re-start your PC and go to the *Verifying that your PC recognizes the cards properly* section of this chapter.

Windows NT

Windows NT does not have drivers built in to support SRAM memory cards. You must purchase drivers from Systemsoft , M Systems, or other driver suppliers. Visit the www.systemsoft.com for details.

Windows 2000 & XP

Plug & Play under Windows 2000 & XP Professional sometimes results in SRAM PC cards being properly recognized. Simply plug in a SRAM PC card and your PC should recognize it as a removable drive. If it does not, refer to the Memory Card Driver Installation section of Appendix C.

There are several things "different" about Windows 2000:

- A quirk of the Win 2000 & XP operating system is that the *removable drive* for your cards will only exist in "*My Computer*" WHEN THE CARD IS INSERTED IN THE MACHINE.
- Windows 2000 & XP are very intolerant of removing memory cards (and other PCMCIA devices) without first shutting them down. If you have removed a card without going thru the proper Win 2000 procedure, you have already discovered this. See the section titled **"Set your memory card drive letter in Command Link**" later in this chapter for the proper procedure.

Windows ME

While we do not recommend that you use Windows Millennium (ME), if you are stuck with it, configure your PC as follows:

1. In Windows Explorer, go to the \Drivers\Storage\Flash folder on your Windows ME CD
2. Right-click the file *Trueffs.inf*, and then click *Install*.
3. Restart your computer.

- A quirk of the Win ME operating system is that the *removable drive* for you cards will only exist in "*My Computer*" WHEN THE CARD IS INSERTED IN THE MACHINE

Formatting Memory Cards

If you did not purchase your memory card from CDS, or if you suspect that there are problems with the card, you must *Format* it just as you would format a hard or floppy disk prior to using it.

Windows 98 & Windows ME

- Go to the *Start* menu, select *Programs* then *MS DOS Prompt.*
- Type *Format <DRIVE LETTER>: <ENTER>*
  - *DRIVE LETTER* is the designation for your removable drive. See the next section to determine this if you do not know.
  - *ENTER* means ENTER key, not typing E-N-T-E-R
- The PC should format the card and produce a report showing the number of free bytes on the card.

Windows 2000 and Windows XP

- Go to *Start,* select *programs,* then *accessories,* then *command prompt*
- Type *Format <DRIVE LETTER>: /FS:FAT <ENTER>*
  - *DRIVE LETTER* is the designation for your removable drive. See the next section to determine this if you do not know.
  - *ENTER* means ENTER key, not typing E-N-T-E-R
- The PC should format the card and produce a report showing the number of free bytes on the card.

Verifying That Your PC Recognizes the Cards Properly

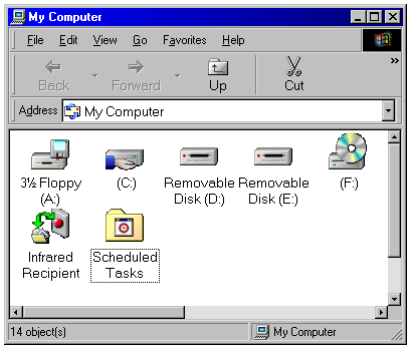
Windows 2000, Windows XP and Windows ME

Insert your memory card into 1 of the slots. Wait until the PC beeps. Follow the instructions below.

- NOTE that with 2000, XP and ME, you will only see 1 removable drive in *My Computer*. It will correspond to the drive (slot) that the card is currently inserted in.
- Another quirk of XP is that the drive letter for the card will only be shown *while the card is in the slot*. When you stop and remove the card the drive letter will disappear.

Look for card drive letter in *My Computer*

Verify that Windows recognizes your PC SRAM card as a removable drive by opening *My Computer* (double click on the icon on your desktop)



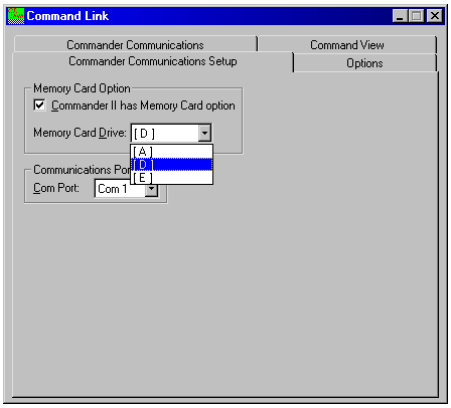
You should have removable drives shown for each of your PC card slots. In this example there are 2 drives, D: and E: (except in XP as noted above)

If you have more than 1 card slot (Drive), determine which letter is assigned to which slot as follows:

1. Insert your memory card into 1 of the slots, wait for the beep to indicate Windows has recognized the card.
2. Right click on one of the drive icons, then left click on *Properties*
3. The *properties* dialog should show a *Capacity* corresponding to the size of the memory card. If it does, then you have found drive letter assigned to the slot that the card currently is in. Make note of it.
4. If it shows a *Capacity* of 0 KB, try the other removable drive(s)

Set Your Memory Card Drive Letter in Command Link

Start *Command Link* by double clicking on its icon. Click on the *Commander Communications* tab.



Important note: If you are running under Windows XP, 2000 or ME, your memory card ***must*** *be in the slot to do the following steps:*

1. Check the *Commander II has memory card option* box.
2. Pull down the *Memory Card Drive:* list and select the drive letter determined in step 3 of the previous section.
3. Close Command Link

Removing Memory Cards When Running Windows 2000 & XP

IMPORTANT NOTE:

When running Windows 2000 & XP, it is very important that you follow this procedure when removing your memory card. When you wish to remove the card from the PC:

1. Point at the "Eject Hardware" icon on your task bar:

2. Single click on it and you will see:

3. Single click on the message and you will see:

4. Click OK and then remove the memory card.
    1. If you forget to perform this procedure you will receive a warning from Windows 2000, and the next time you inset the card Command Link will not recognize it. If this happens, simply eject the card properly and re-insert it and then CL will recognize it.

IF YOU FAIL TO DO THE ABOVE STEP YOU MUST RE-BOOT YOUR PC. BE SURE TO THANK BILL GATES FOR THIS

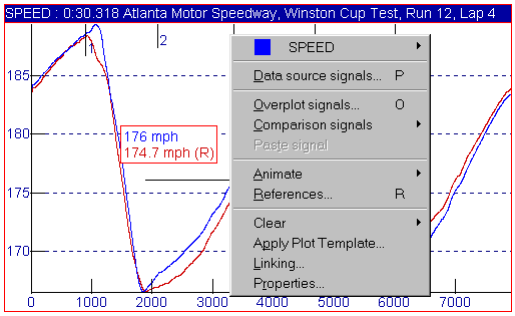
Understanding Track Master

Learning to utilize Track Master, Command Link and Command View to their fullest potential can only be achieved if you have an understanding of the design philosophy and underlying principles of the programs,

The User Interface

Track Master utilizes a state of the art Windows 98 style user interface. The interface:

- Includes standard pull down menus, toolbars, and tool tips
- Makes EXTENSIVE use of context-sensitive menus (activated by "right clicking" on objects)



Design Philosophy

Program Options (controlled by key)

Track Master, Command Link and Command View have several program options and modes. For maximum consistency and ease of maintenance of the software, all programs and versions run off of the same executable. Options and modes are enabled for the user via the *hardware key.*

These options include:

- Chassis analysis and animation option
- User programmable math option
- Import of pi data option
- "Lite" option
- Circle Track & Road Race/Drag Race/Dyno modes

Multi Page Concept

Track Master uses a multi page design concept whereby the user can have any number of active *plot pages* "loaded" in the active *view.* What this means is that the user has easy access (via just 1 mouse click) to any number of pre-configured graphic layouts displaying the data.

User-Configurable Page Layouts

Each individual *plot page* can be configured, re-arranged, or otherwise designed to suit the needs of the user. The limitations of hard coded, inflexible screen layouts do not exist in Track Master.

Linking

With lots of *plot pages* active or loaded, data management would become a nightmare if not for the extensive data, zoom, and time linking present in Track Master

The big idea – Let the software do the grunt work

The above key features (and many more) are in Track Master primarily for 1 reason. LET YOUR SOFTWARE DO ALL THE TEDIOUS REPETITIVE work associated with repeatedly analyzing lots of they type of data that comes off of a modern racing vehicle or dyno.

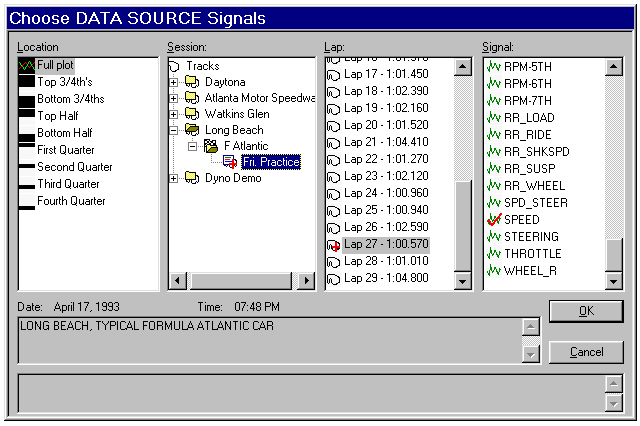
This frees the user to actually ANALYZE the data rather than constantly have to work simply to display and graph it.

This is the primary difference between Track Master and all other data acquisition system software in the performance industry.

How Track Master organizes data

Data is arranged in several layers of *folders* for easy organization. See the chapter titled *Transferring settings and data to another PC* for a full description of the folder and file structure used.

Command Link automatically creates this folder structure when downloading data.



CT RR Circle Track & Road Race mode

Data is organized by TRACK, EVENT, and SESSION

- The TRACK is the physical track the data is from, such as *Watkins Glen* or *Talladega*. ALL DATA FROM THE SAME PHYSICAL TRACK SHOULD BE STORED UNDER 1 TRACK FOLDER
- The EVENT is the event name when the data was recorded, such as *2000 Trans Am Race* or *April Test Day 1* etc.
- The Session name is the name you give to the recording event such as *Friday AM Practice,* or *Day 1 Run 2* or simply *Session 1, Session 2* etc.

DRAG Drag mode

Data is organized by TRACK, EVENT, and PASS

- The TRACK is the physical track the data is from, such as *Rockingham* or *Houston*. ALL DATA FROM THE SAME PHYSICAL TRACK SHOULD BE STORED UNDER 1 TRACK FOLDER
- The EVENT is the event name when the data was recorded, such as *2000 Race* or *April Test Day 1* etc.
- The PASS is the name you give to the recording event such as *Qualifier 1, Elimination round 2* or simply *Pass 1, Pass 2,* etc.

DYNO Dyno mode

Data is organized by TYPE, NAME or NUMBER, and RUN

- The TYPE refers to ENGINE TYPE if you are testing engines, or VEHICLE TYPE if you are using the system on a chassis dyno. For an engine dyno, possible types might be *F 2000,* or *Cup Restrictor Plate* etc.
- NAME or NUMBER is the serial number of the engine under test, or the name of the customer who owns the vehicle, etc.
- The RUN is the name you give to the recording event such as *Final test after rebuild,* or *Baseline,* or simply *Run 1, Run 2,* etc.

terminology

There are several key terms used both in the software and in this manual. In order to get the most out of your software, and effectively communicate with CDS technical support people, you must familiarize yourself with certain terms. The most important terms are:

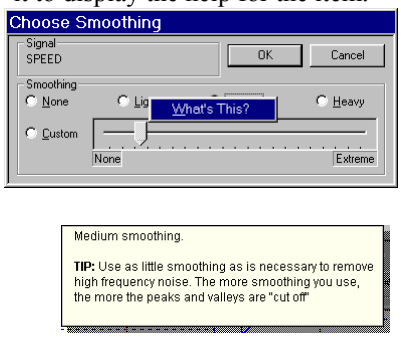
View	*Plot page*
Plot	*Display*
Focus	*Selected*

These terms are all defined as they are introduced in the next several chapters.

On line help

There is a great deal of context-sensitive on-line help in most of the *dialog boxes* in TM. It is accessed by pointing to an item in a dialog box and right clicking. The Windows "What's This" ox will appear:

Left Click on ***What's This?*** it to display the help for the item.



When pointing to a *tool* (in a tool bar), a small help box known as a *tool* tip appears next to the mouse pointer, containing a help message.

Also, when you point to a *Tool* (in a Tool Bar) or a *Menu Item*, the *Status Line* gives a brief help message.

Chapter 2 Starting to use Track Master

In this chapter you will learn all the basics of how to use Track Master. We highly recommend that you sit down in front of your PC and run the program, going through this chapter at least 1 time in one sitting.

It is very important that you fully understand all the concepts and terminology in this chapter BEFORE you attempt to analyze your actual data.

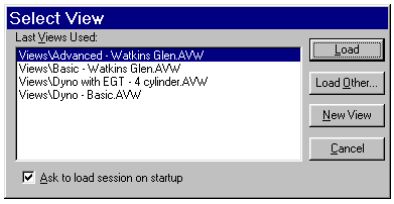
Loading a *View*

What is a *View?*

Think of a *view* as a collection of *plot pages.* The *view* contains all the information TM needs to re-create the plot pages, AND it contains information on *which data* was used in the view the last time it was saved. (The view **does not** contain the actual data files).

Start Track Master by double clicking on its icon on the desktop

You will se the *Select View* dialog box:



This box lists the most recently loaded *views*, ordered from the most recent one at the top of the list. You will see this dialog whenever you start track Master.

Choosing which *View* to load

The list of views you see in the *Select View* dialog will depend on the *options and modes* your copy of TM is enabled for. The name of each view provides clues as to what the view contains:

- Views containing “Daytona” or “Atlanta” are Circle Track views
- Views containing “Long Beach” or “Watkins Glen” are Road Racing views
- Views containing “Basic” are based on basic data including G, throttle, steering, RPM, and speed.
- Views containing “Advanced” are based on data including the basic channels *plus* suspension channels.
- Views containing “Alcohol Funny Car”, “Pro Mod Car”, or “AHDRA Bike” are Drag Racing views.
- Views containing “Dyno” are Engine Dyno views

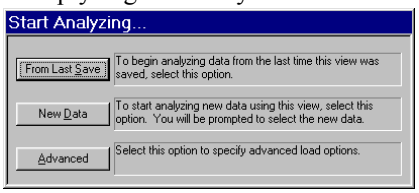
Choose a view from the list that is most appropriate for the type of system you will be using. For example, if you are doing Trans Am racing and monitoring suspension sensors as well as the basic sensors, choose *Advanced – Watkins Glen.*

Note: If you load an *advanced* view and you do not have the *Chassis analysis and animation* option in your software, you will have some blank areas in the view when you load it.

Decide on which view to load based on the above rules, click on the view name in the list, then click *Load*

Loading “from last save”

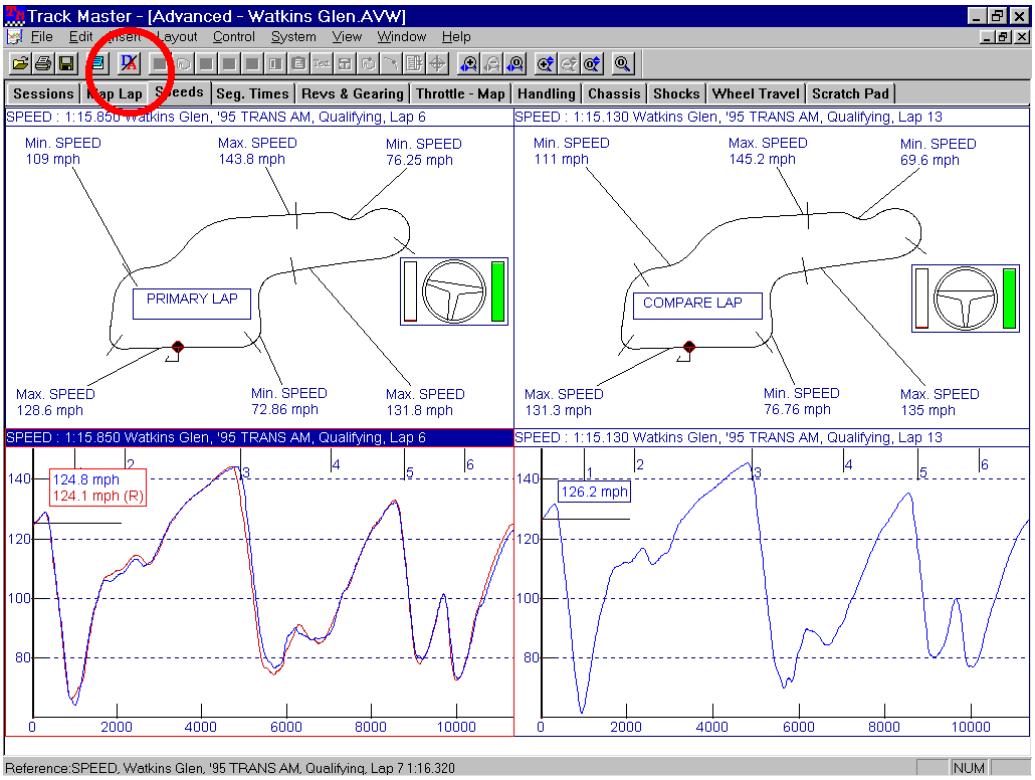
You will see the *Start Analyzing* dialog, which enables you to choose which data to load into the view. Most of the time it is easier to simply begin where you left off with the *view*, which means you should



load "*From Last Save*". Click that button now.

Be in *Analyze* mode

If you loaded one of the Watkins Glen views, your screen should look something like this:



If you loaded a different view your plots will look different, but you should still see the same menus and toolbar at the top.

Notice the tool that is circled above. This is the *Design/Analyze* switch. It controls whether or not you can make modification to the design of the view, such as re-arranging pages etc. It has no effect on your ability to change which data is plotted however.

For now we want to be in *Analyze* mode, so if your D/A tool looks like this: 

Click on it so that it looks like this: 

This will assure you are in *Analyze* mode for now.

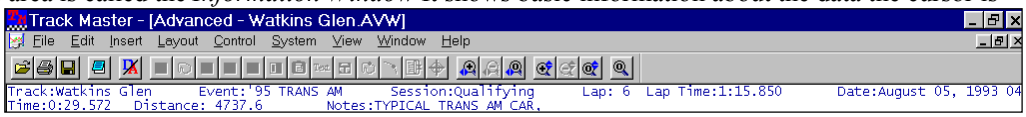
Note: If you have the *Lite* version of Track Master, you are permanently in the Analyze mode. The *Lite* option disables the ability to create or modify views.

Navigating from page to page

The Information Window

Notice the area directly under the toolbar. When the mouse pointer is NOT in this area it looks like this:

This area is called the *Information Window* It shows basic information about the data the cursor is



currently "on"

When you move the mouse pointer over this area it changes its appearance to display the *page tabs* like this:

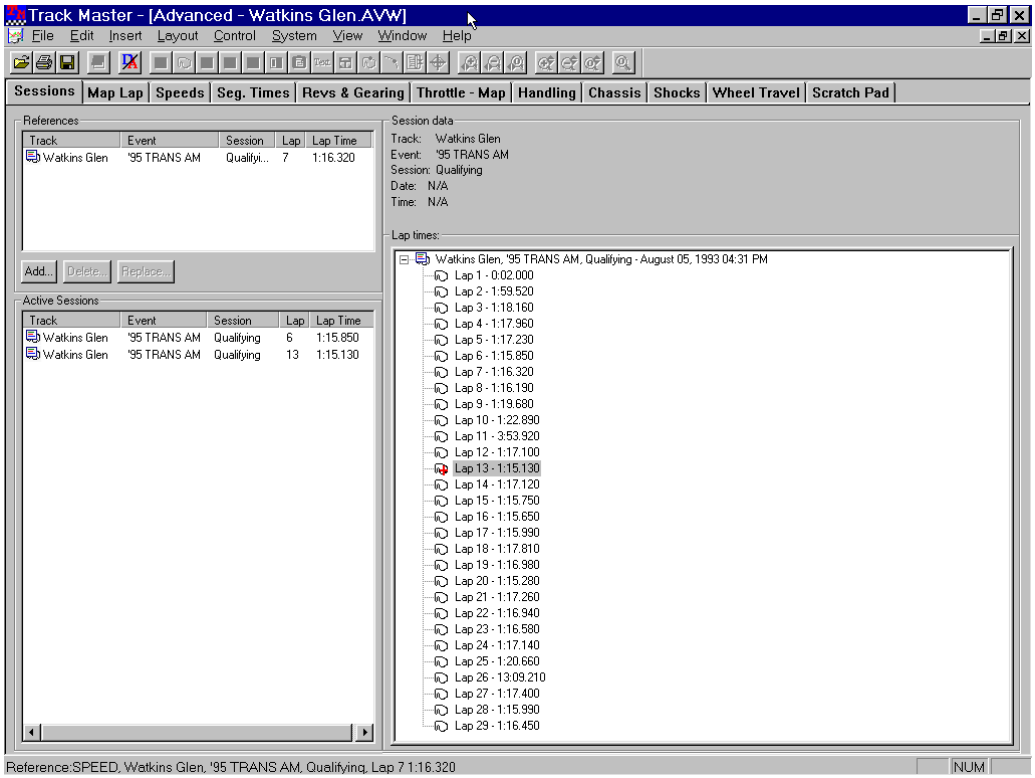
Page Name Tabs

These page name tabs show the "friendly name" given to each plot page by the designer of the *view*. The actual page names you see will depend on which view you loaded.

Point at one of the page names and left click to switch to it. Move around from page to become comfortable with switching pages.

The *Sessions, Passes, or Runs* page

The very first page tab will be called *Sessions* (for CT RR software), *Passes* (for DRAG software), or *Runs* (for DYNO software). Click on it now.

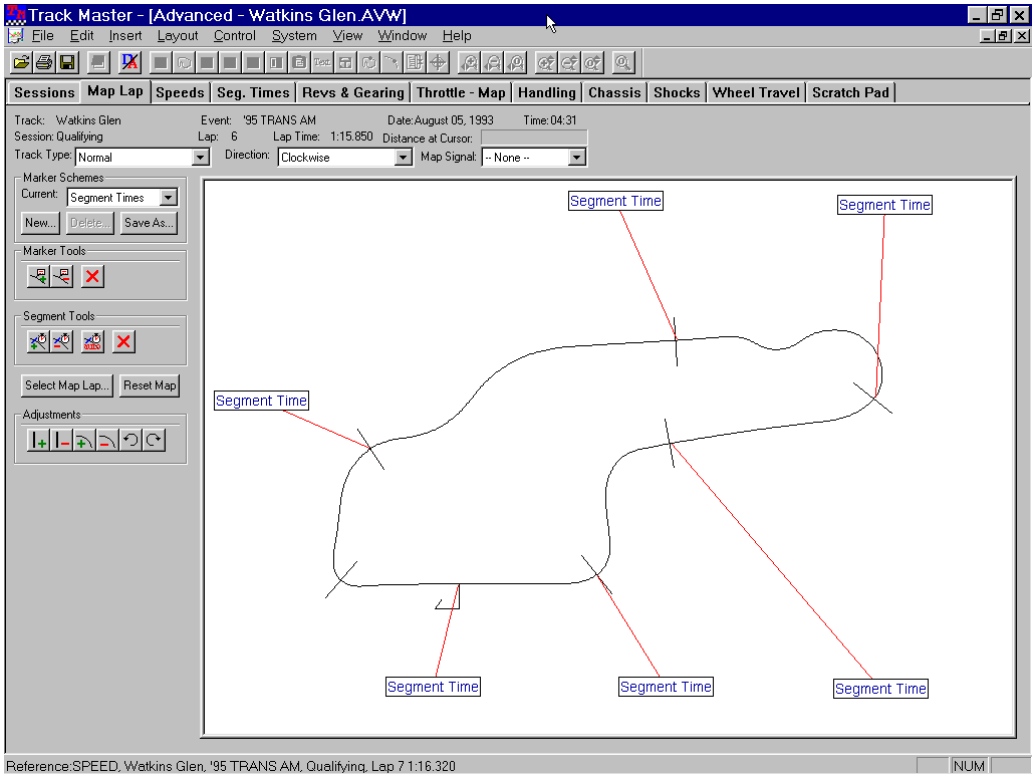


This page is primarily an information-only page. It lists all the data currently plotted in the view. It can be useful for several tasks as we will see later.

The *Map Lap* page

CT RR

Click on the Map Lap tab to switch to that page.



Many tasks are accomplished on this page including:

- Setting the “Map Lap” and adjusting the appearance of the map
- Segmenting the map
- Creating *markers* and *marker schemes*

All of these tasks will be discussed in great detail later in this manual.

Plot pages

All of the page tabs to the right of the Map Lap tab are referred to as *Plot Pages,* since they can have plots (graphs) on them. Now switch to one of the *plot pages.*

Identifying different *Objects* on plot pages

This next section is an introduction to all of the various objects available to make up *plot pages*. It is merely an overview to teach you how to identify each object. Later sections of this manual will cover all of the technical details of each object.

As you go through this next section, switch from page to page in the view you have loaded, see how many of the objects you can identify. After completing the next section you should be able to easily identify each and every object in any of the views you open.

2 Types of Objects, *Plots* and *Displays*

There are 2 distinct types of graphic objects in TM, *Plots* and *Displays*.

What is a plot?

- A plot is an object that generally shows an entire lap or run of data at one time. A graph of Engine RPM vs Time is an example of a plot.
- A plot can be **completely independent** in that you can *directly* specify which lap or run of data is shown in the plot. A plot can also be linked to other plots.
- All the different plot types are covered in the next section.

What is a display?

- A display is an object that generally shows either 1 data point at a time, or a condensed summary of a entire lap or run of data. A bar graph of Engine RPM is an example of a display.
- A display is always **dependent** on, and must be linked to a plot.
- All the different display types are covered in the next section.

The difference between plots and displays

From the above, it is easy to see that the chief differences between plots and displays are:

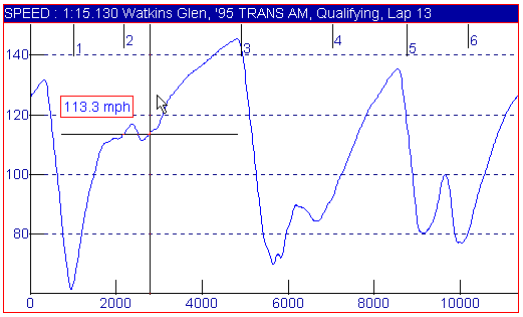
- Plots can be independent while displays always depend on a plot
- Plots show an entire lap or run of data at once, while displays show one data point at a time, or a summary.

Plots

Signal vs Distance plot

CT RR

The most common type of plot is the signal vs distance plot. In this example we have a graph of vehicle speed plotted vs lap distance (in feet).



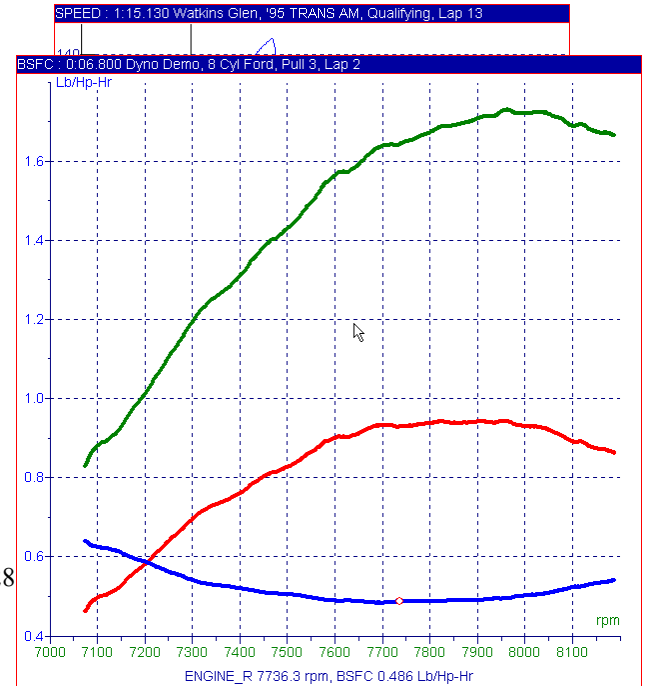
It is easy to identify this as a distance plot due to the magnitude of the numbers on the X (horizontal) axis, i.e.: 2000, 3000 etc. Obviously these numbers must be feet or meters rather than time (seconds).

The distance plot is used most commonly in circle track and road racing so that laps of different times can be easily over plotted.

Signal vs Time plot

Here is the exact same data plotted in a signal vs time plot. Notice now that the X axis numbers are much different (10, 20, 30 etc). Now the X axis is in units of time.

Time plots are used extensively in drag racing and dyno applications. They can also be used if you wish in circle track & road race applications.



Signal vs Signal plot

The signal vs signal plot shows 1 signal plotted against another. Here is a typical dyno plot showing power, torque, and fuel consumption all plotted against engine RPM.

The signal vs signal plot is used to discover and investigate how one signal changes with another, rather than how they change simply with time.

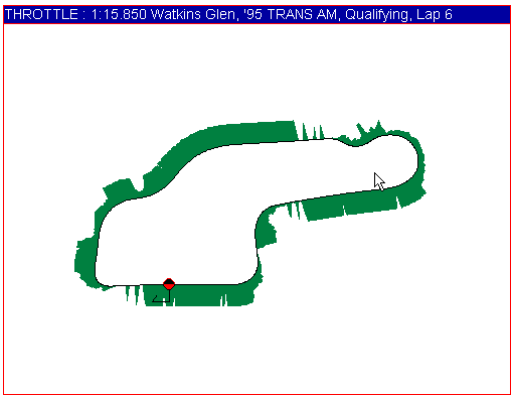
This type of plot is very useful for serious analysis and can frequently enable you to discover causes and effects that would never become apparent if you were simply plotting vs time or distance.

Other typical applications of this type of plot include G vs G, Handling vs G, etc.

Track plot

CT RR

The track plot shows data superimposed on a map of the track. This is a very visual type of plot that many data acquisition novices find extremely easy to interpret. In this example we are showing throttle position on a track plot.

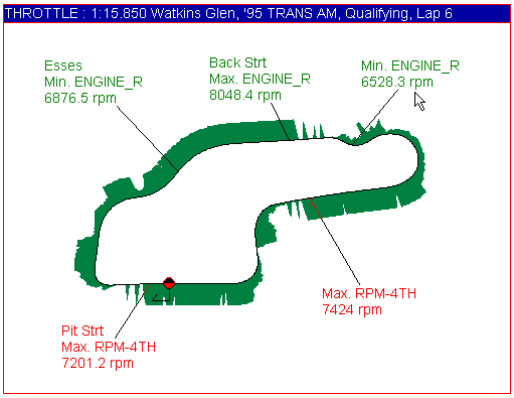


With one glance it is obvious where the driver is wide open throttle, where he is lifting, etc.

Putting 2 track plots side by side to compare drivers or laps can be very informative.

The track plot enables quicker and easier data interpretation in certain cases.

Additional information, known as *Markers* can be shown on track plots too. Here is an example of the same plot, with minimum and maximum rpm shown as a *marker scheme*.



The user has complete control of the design and usage of these *marker schemes*. There is an entire chapter later in the manual dedicated to their usage.

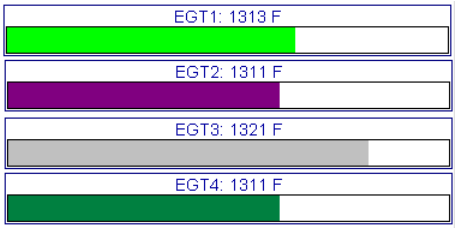
Displays

As stated previously, a display generally shows either 1 data point at a time, or a condensed summary of a entire lap or run of data. Here are the types of displays in TM:

Reminder: as you go through this chapter you should be moving from page to page in the view you have open, and be trying to identify the objects as they are introduced.

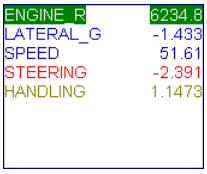
Bar display

The bar display, also known as a bar graph, shows 1 data point at a time in bar format. It is most useful for showing the relative value of a signal in a easy to interpret graphical format. Multiple bar displays grouped together are very useful for showing the relative value of several signals at once, as in this example of 4 EGT (exhaust gas temperature) readings.



Data display

The data display simply shows the numeric value of 1 or more signals. As with many displays, it only shows 1 data point at a time. How does it "know" which data point to show? Previously we learned that a display is always **dependent** on, and must be linked to a plot.



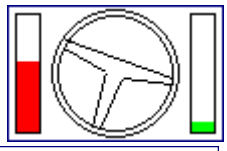
The display "knows" which data point to show because it is linked to the cursor in the plot it is dependent on. More on this later.

Driver controls display

CT RR

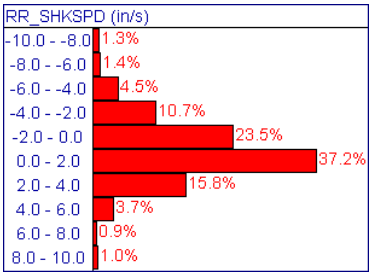
DRAG

The driver controls display is a visual picture of what the driver is doing. The steering wheel reflects the readings from the steering sensor. The green bar graph on the right shows the throttle. The red bar graph reflects the braking, and can be driven via G sensor, brake position, or brake pressure sensors.



Histogram display

A histogram summarizes data. It sorts data into "bins" or ranges and then displays the percentage of the time "spent" in each "bin" or range. They are very useful in understanding shock speed data. In this example, the shock speed spent 15.8% of the time in the range between 2 and 4 inches per second.

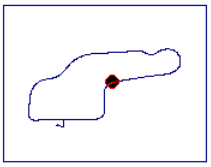


Another useful application of histograms is to see what percentage of the time the driver is at wide open throttle.

Map and turn locator display

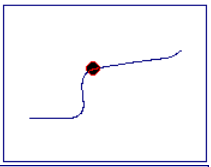
CT RR

The map and turn locators provide a quick, visual reference of where you "are" on the racetrack. How do these displays "know" where to place their round cursors?

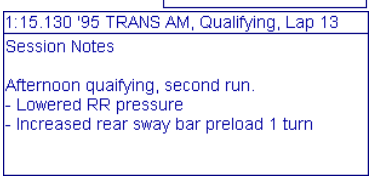


Again, The display "knows" which data point to show because it is linked to the cursor in the plot it is dependent on.

These locators, when linked to a signal vs time, distance, or signal plot, show the precise *on-track* location of the cursor in those plots.



Notes Display



All sessions or runs have their own *notebook*. Among other things, setup notes and changes can be kept in this notebook.

The notes display enables you to show those notes on a plot page, rather than having to "drill down" into the notebook editor to see them.

Report display

A report display shows summary data in text based tabular format. A report can take on many different forms. In this example it shows minimums, maximums, averages, and ranges for selected signals for 1 lap. It can also show this type of information for many laps, or it can show things like lap times and segment times.

1:15.130 Watkins Glen, '95 TRANS AM, Qualifying, Lap 13

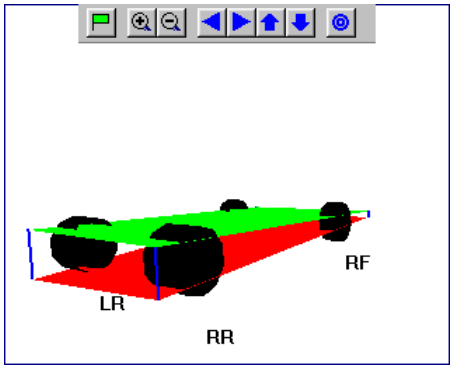
Signal	Minimum	Maximum	Average	Range
ENGINE_R	5036.5	8436	7224.3	3399.5
FRNT_RIDE	-0.7656	0.1406	-0.1844	0.9062
FRNT_ROLL	-0.2878	0.2686	-0.003722	0.5563
REAR_RIDE	-1.787	0.6	-0.7402	2.387
REAR_ROLL	-0.7272	0.584	-0.1403	1.311
SPEED	61.19	145.2	102.5	83.96

Suspension display

CT RR

DRAG

The suspension display, included only with the *chassis animation and analysis* option, shows a picture 2 "planes". One represents the chassis at static ride height (sitting still), and the other, moving plane, depicts the movement of the chassis as the car goes around the track. The planes can be solid (as shown here) or "wire frame". There is a separate little toolbar on this display to enable you to rotate the view in 2 axis, increase or decrease the size, and to begin or end animation of the picture.



This display is very useful in quickly determining basic chassis movement, and frequently you can see things in a few minutes that would take much longer to find if you were just looking at time based or distance based plots of the data.

Text display

The text display enables you to make arbitrary notations on plot pages. It is a simple box that you type the text in that you want on the page. It essentially is the "electronic post-it" of Track Master.

PRIMARY LAP

Manipulating a plot

Now that we have introduced all the different object types in the program, lets begin to learn how to actually use them.

What is *Focus?*

As you can see from looking around in the view you have open, there can be several (or even many) objects on a particular page. When you want to "do something" to an object, (particularly with hot keys) TM needs to know *which object* you want to manipulate.

You apply *Focus* (or focus on) an object to tell TM that is the object you want to manipulate.

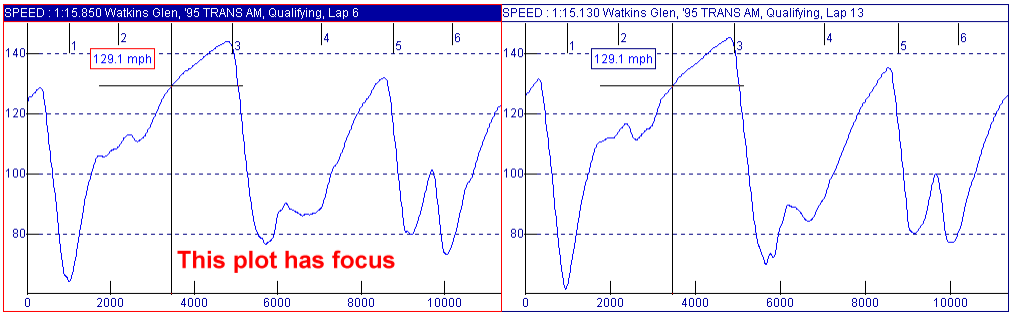
How to apply *Focus*

- Focus is applied to any object simply by left clicking on it.

- TM provides visual feedback to let you know it recognizes that you have focused on an object.

Plot *focus*

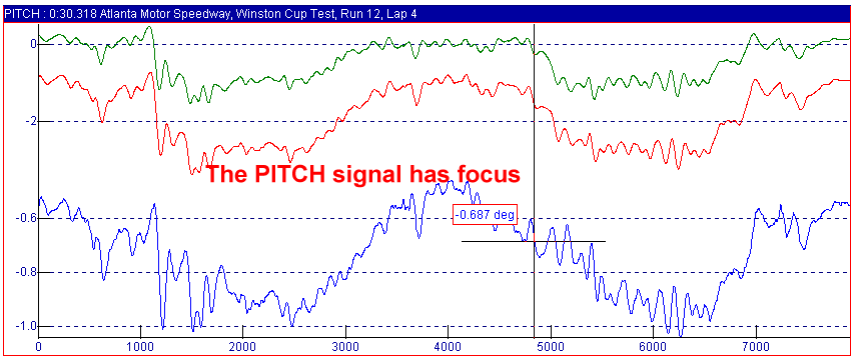
Left click on one of the plots in your view. Notice that the *title bar* at the top of the plot changes to white letters on blue background, and the border changes from blue to red.. This is the visual feedback TM provides to indicate focus.



Signal *focus*

Find a plot in a view that has more than one signal in it. Notice that the cursor is on 1 signal. The name of the signal that has focus is the name shown in the title bar of the plot (in this example, PITCH). Use the up arrow key to move the cursor from signal to signal. Notice that the signal name in the title bar changes.

- Focus is changed from signal to signal in a plot by the *up arrow* and *down arrow* keys.



Moving the cursor

The cursor is moved in a plot as follows:

- Apply focus to the plot
- Use the *right arrow* and *left arrow* keys to move the cursor 1 data point at a time. The left arrow moves the cursor "back in time", while the right arrow moves it "forward in time".
    - In time or distance plots, "forward" in time is always left to right.
    - In signal vs signal plots or in track plots, "forward" in time could mean from right to left on your screen.
- Point and click with the mouse to arbitrarily re-position the cursor at any point on a plot
- Note that you **cannot** switch focus from 1 signal to another in a plot by pointing and clicking.

Time linking

Notice that as you move the cursor in your plot, the displays on the plot page update constantly to reflect the data at the new cursor position. All of the displays on your plot page are *Time linked* to the plot.

Magnifying a plot to full screen

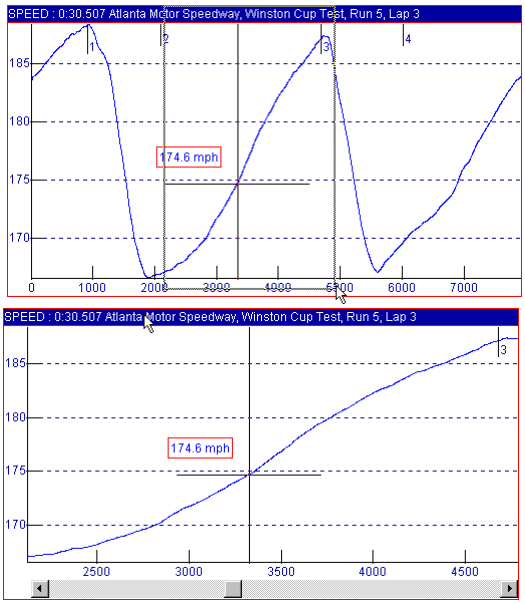
Apply focus to a plot. Now hit the "F" key. Notice that the plot magnifies to full screen. This is very useful when you have a number of plots on the screen and you want to temporarily get a "bigger" look at one of them.

Press "F" again to put the plot back to its original size and location.

Zooming

We will now learn how to zoom in on sections of data in a plot. As with most windows applications, there is usually at least 2, (and frequently more) ways of doing the same thing.

Horizontal zooming



Horizontal zooming allows you to stretch out the X axis, zooming in on just a section of time or a section of track.

- Apply focus to a time or distance plot in your view
- Point to the place on the X axis where you want to start the zoom.
- Left click and drag to the right
- Release the left mouse button at the point you want the zoom to end
- Your plot is x-axis or horizontal zoomed.

Zoom linking

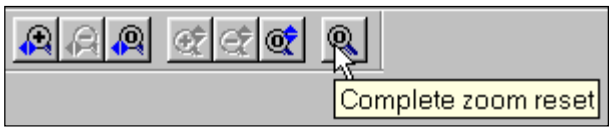
If you have been working on a plot page that has more than 1 plot on it, you have already noticed that when you X axis zoomed on plot, they all zoomed to the same perspective. This is called *zoom linking*.

Switch to another plot page. Most likely the plots on this page are zoomed as well.

- Zoom linking (and in fact all linking) can take place across "page boundaries", i.e., from 1 page to another.

Re-setting the *zoom*

Reset the zoom on the plot as follows:



- Apply focus to the plot
- Click on the *complete zoom reset* tool in the toolbar

Another way to zoom

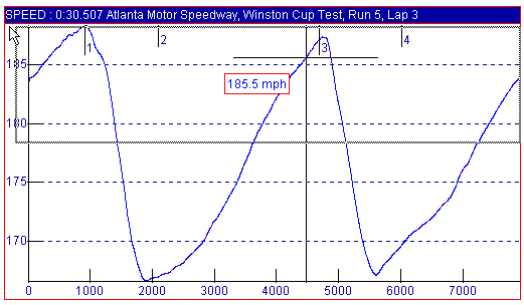
Another way to X Axis zoom is to:

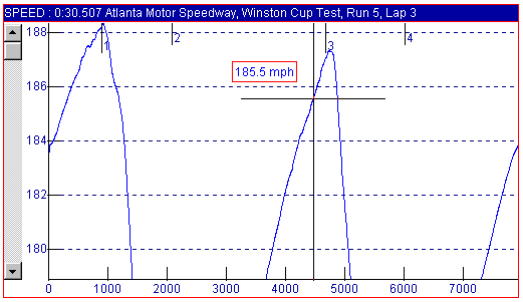
- Apply focus to the plot

- Position the cursor at the center of the area you want to zoom
- Click on the *zoom* X *axis* tool in the toolbar.

Vertical zooming

Vertical zooming is done in much the same manner as horizontal zoom:

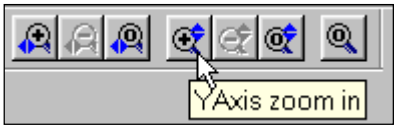




- Either by click, drag, and release in the Y axis

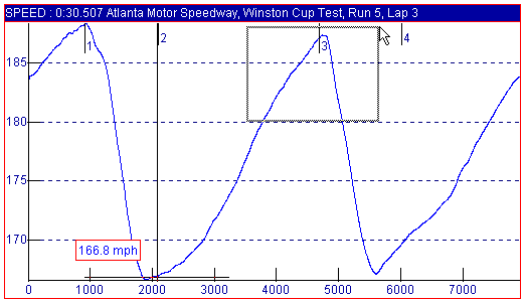
- or-

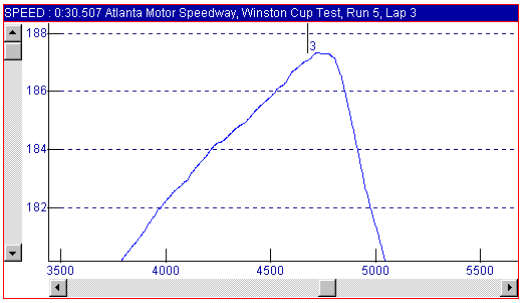
- Clicking the *zoom Y axis* tool in the toolbar



Arbitrary (Box) zooming

Arbitrary or box zooming can be done on time or distance plots simply by click, drag, and release in the plot area:





Zooming on a *Track Plot*

CT RR

Zooming a track plot is a little different. Rather than drawing a box with the mouse, the procedure is:

- Point at the place on the track where you want the zoom to begin.
- Left click and drag along the path of the Track.
- Release the mouse button at the point where you want the zoom to end.

The context-sensitive menus

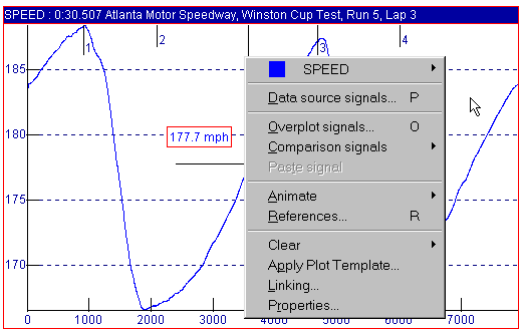
In addition to the pull-down menus, TM makes extensive use of *context sensitive menus* ***(CSM)***. All objects have a context-sensitive menu that is activated by placing the mouse pointer on the object and right-clicking. Context sensitive menus can be summarized in 1 sentence:

> *You point at the object you want to do something to, right click, and up pops of menu of actions you can do to that object.*

This concept is very important because using the CSM is frequently the quickest way to do things in TM.

The plot's CSM

Right click on a time or distance plot in your view and you will see its context-sensitive menu (CSM):

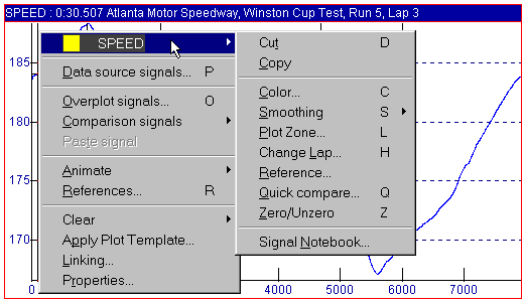


This is the *plot CSM.* Actions done in this menu affect the entire plot.

The signal's CSM

Notice that the first items listed in the plot's CSM are *signal names*. Each signal in the plot is listed, so if you have 4 signals in the plot, there will be 4 signal names.

Place the pointer on one of the signal names at the top of the plot's CSM. You should see:



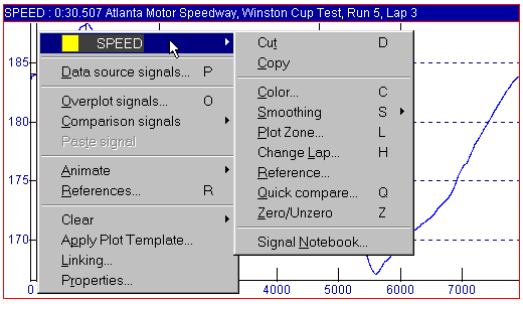
You get this menu when you point at a signal name is the *signal CSM.* Actions done in the signal CSM only affect that signal. For example, point at and click on *color* in the signal's CSM. You will get a dialog that enables you to change color of that signal.

If you accidentally right click on a plot, you can make the CSM go away by either Left clicking anywhere **off of** the CSM or hit the Esc key.

Experiment with the plot and signal CSM to see what the various actions do. When you are done, close your view, and do not save the changes. Then re-open the view and load from last save.

Introduction to hot keys

Right click on a plot in your view to call up its CSM. Point at one of the signal names in the menu:



Notice the single letters next to some of the menu items. These are hot keys that can be used to do things *without having to call up the CSM.*

Notice that some of keys are in the plot CSM, and some are in the signal CSM. All of these hot keys are always active.

- When you hit one of the keys listed in the plot CSM (P for example), TM will perform the action *on the plot that currently has focus.*
- When you hit one of the keys listed in the signal CSM (C for example), TM will perform the action *on the **signal** that currently has focus in the **plot** that currently has focus.*

Experiment with the plot and signal hot keys to see what the various actions do. When you are done, close your view, and do not save the changes. Then re-open the view and load from last save. All of the hot keys are listed in appendix E and on your quick reference guide.

Changing a plot to show different data

We have learned how to change the appearance of a plot by zooming, now we will learn how to change the *contents* of the plot. First we will learn to change the *data source.*

What is a *Data Source?*

As you may have noticed by now, plots can contain data from several laps. However, they must have data from at least 1 lap.

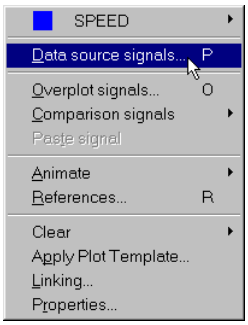
- The D*ata Source* is the main data shown in the plot.
- All comparisons, either by over plotting or using the reference, are done relative to the data source (we will get to over plots and references later).
- If there is no data source defined for the plot then the plot is blank..

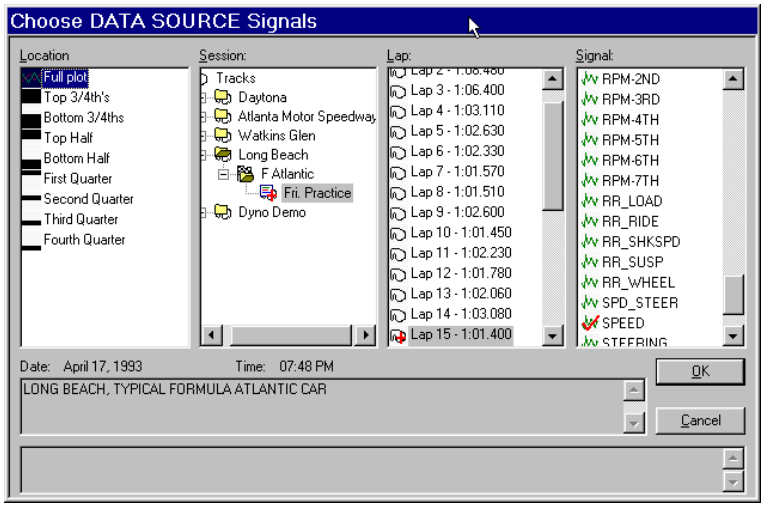
The *choose data source signals* dialog box

Right click on a time or distance plot as you did above. You will see its CSM.

Now place the pointer over the menu item *Data Source Signals…*

Next, Left click. Up will come the *choose data source signals* dialog box.





Notice that the lap or run that was displayed in the plot is now highlighted in the dialog. Also notice that the signal(s) that are currently in the plot are checked.

- The *Chose data source signals* dialog reflects the current state of the plot.

Changing *Data Source* to a different lap or run from the same track

CT RR

In the *Lap* window of the dialog, click on a different lap from the one which is highlighted. Click OK.

- Notice that the plot is updated to show the same signals as before, but the data is from the new lap you selected. (verify this by looking at the title bar of the graph)
- KEY POINT: Note that you did not have to re-specify which signals to plot, or any other information. All you had to do was change the item you wanted to be different in the plot, i.e. the lap (the *data source).*

Data source linking

Experiment with changing the data source of some of the plots in your view. Notice that when you change lap, some of the plots update to the new data and some do not. This is because some of the plots are *data source linked* to each other.

DRAG

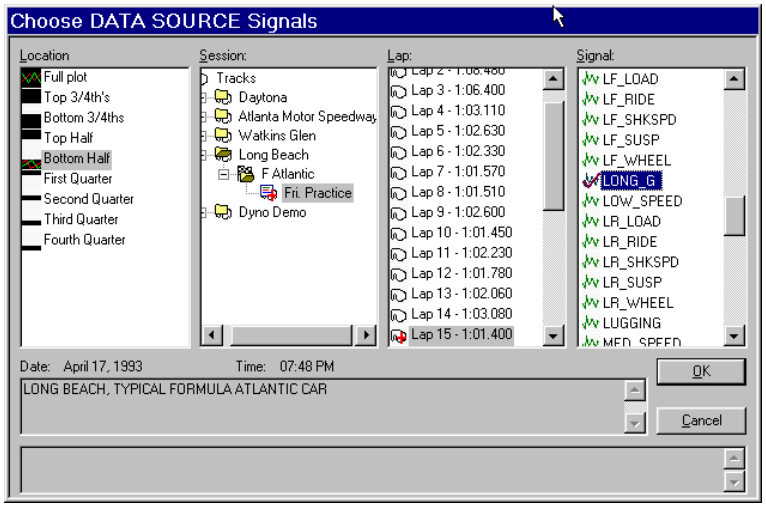
In the *Pass* or *Run* window of the dialog, click on a different pass from the one which is highlighted. Click OK.

DYNO

- Notice that the plot is updated to show the same signals as before, but the data is from the new pass you selected (verify this by looking at the title bar of the graph).
- KEY POINT: Note that you did not have to re-specify which signals to plot, or any other information. All you had to do was change the item you wanted to be different in the plot, i.e. the pass or run (the *data source)*

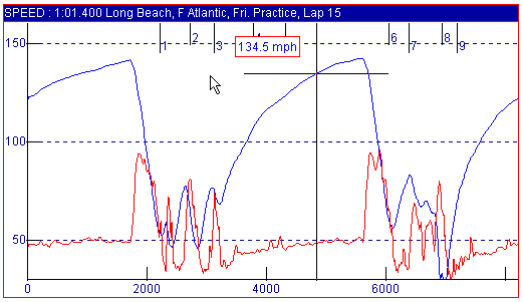
Experiment with changing the data source of some of the plots in your view. Notice that when you change the pass or run most (if not all) of the plots update to the new data. This is because the plots are *data source linked* to each other.

Changing the signals that are plotted



Get back into the *choose data source signals* dialog for one of your plots. This time, instead of changing lap or run, click on *Bottom Half* in the *Location* window of the dialog, then click one of the signals in the *signal list* that is not currently checked. Click OK

In this example we clicked on LONG_G (longitudinal or for-aft G force). Our result was:



- Notice that Speed, the original signal, is still plotted. Also plotted is the LONG_G, in the bottom half of the plot as we specified.
- The KEY POINT to learn here is that when you go into the data source dialog to make a change to a plot, THE ONLY THINGS THAT GET CHANGED are the things you specify, all other aspects of the plot remain the same.
    - This is a powerful concept, think about if you had a complicated plot of 4 or 6 signals, and you wanted to look at the next lap of data. You simply change to the next lap, the plot "remembers" all the signals, colors, locations etc. and simply updates itself.
- From the data source dialog you can change any aspect of the plot's data source, such as change to a different track, session, lap, run, different signals etc

How TM determines which *signals* to show in the signal list

You may have noticed that there can be a large number of signals listed in the *signal list* in this dialog. Obviously some of them are *Recorded Data* signals (from sensors) and some are *Calculated.*

The calculated signals are created from *Built-In* analysis formulas in TM and, if you have the *user programmable math* option, from user-entered formulas.

IMPORTANT: The *signal list* includes ONLY those calculated signals that it can create from the recorded data, using the current formulas entered in TM. It will not list those calculated signals it cannot compute due to missing signals.

- For example, a very common calculated signal is SPEED, which is calculated from WHEEL_R (recorded data) and the tire circumference. If your recorded channels do not include WHEEL_R, you will have no SPEED signal in your list of signals to plot.
- For advanced users with the math option, the existence of signals in the *signal list* is a first level validity check on your formulas. Much more on this topic later.

Changing to a different track

CT RR

When you change a data source to a different track, TM will ask you if you want to update the Map Lap. Usually you should answer YES because most CT & RR views include track plots, and it would not make physical sense to plot data from 1 track onto a map from another track.

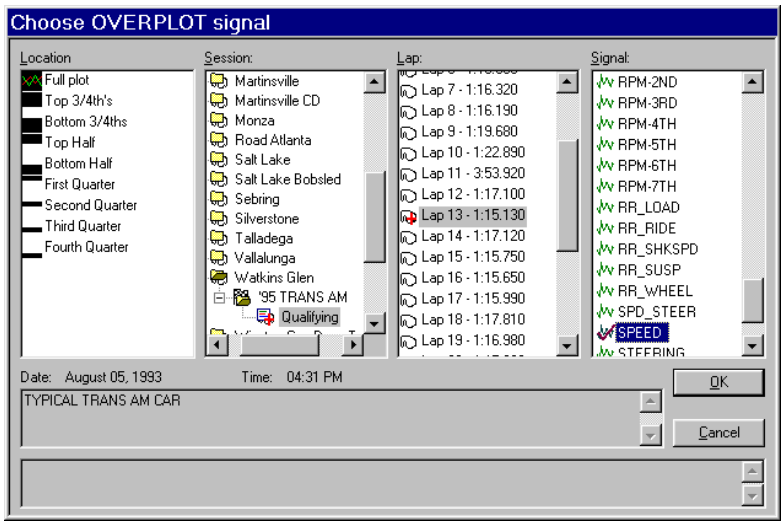
Putting more than 1 lap in a Plot

There are 2 features in TM to enable plotting more than 1 lap of the same signal in a plot. They are the *Overplot Signals* feature and the *Reference* feature.

The *Overplot Signals* Feature

This feature enables you to over plot as may laps of data as you like. In many cases you will just be comparing 2 or 3 laps at once, but in some situations you way want to over plot many laps of the same information. There is no built-in limitation to how many laps you can over plot in TM.

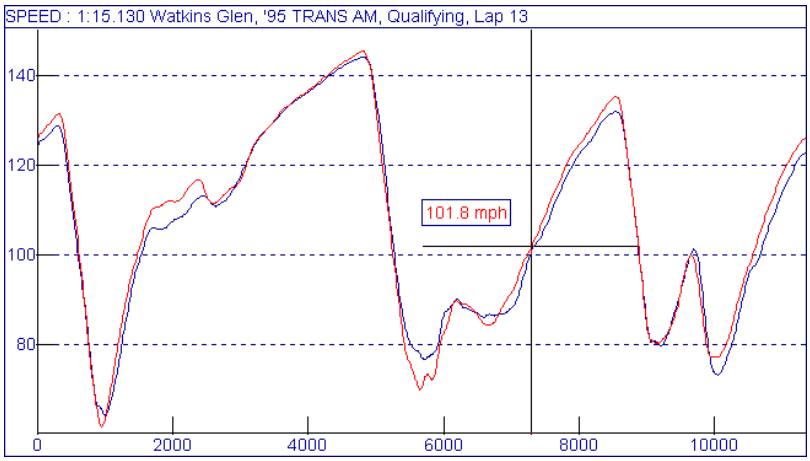
Here is an example of how to over plot. Apply focus to a plot containing SPEED. Right-click on the plot, then left-click on *Overplot Signals…*:



Click **Full Plot** in the *Location* window, click the lap you want to overplot (Lap 13 in this example), then click the signal you want to overplot. Then Click OK.

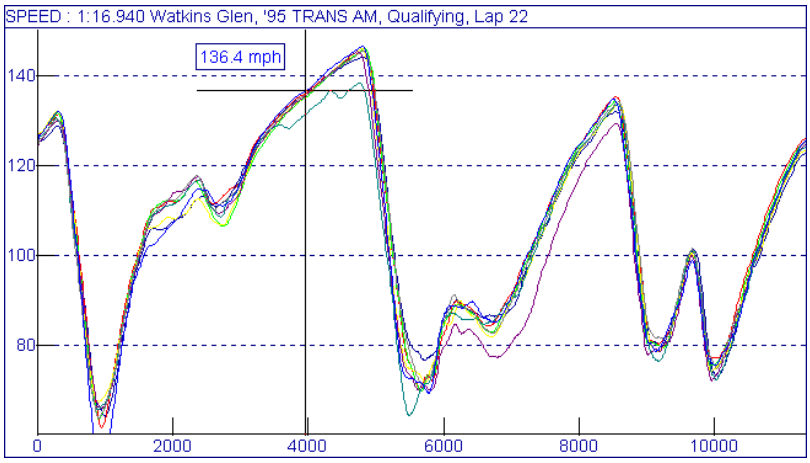
- If you want to select multiple laps, hold down the **Ctrl** key while you click on the laps. You can also use the **Shift** key and click at the beginning then the end of a consecutive set of laps to select them.

- Note that the hot key for overplotting is “O”



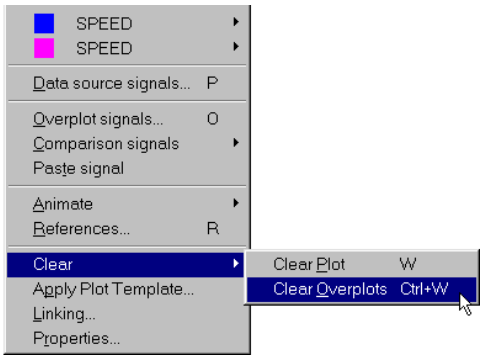
If you just selected 1 lap, your plot should look like this:

If you selected many laps, your plot would look like this:



Over plotting many (or even all) the good laps from a session enables you to see trends and identify places on the track where inconsistencies occur (which are usually the places where you need to work on improving).

Clearing the Over Plots



To clear (erase) just the over plot signals from a plot (leaving the data source for the plot intact), simply right-click on the plot, point at *Clear,* then click *Clear Overplots.*

- Note that the hot key for this is Ctrl + W (hold down the Ctrl key and hit W).

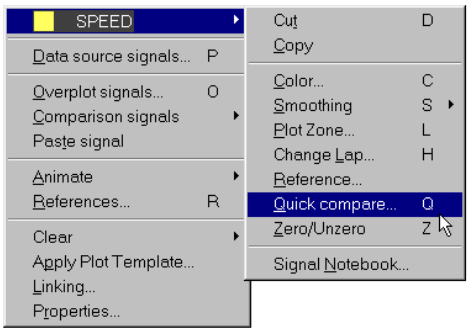
Over Plot Shortcut – the *Quick Compare*

Frequently you will want to compare a signal to the same signal from the fastest lap from either the current session or another session. The *Quick Compare* enables this. The *Quick Compare* over plots the

signal that has focus (SPEED, for example) from the fastest lap of the session you choose. All you have to do is select the session. The signal and the fastest lap are selected automatically for you.

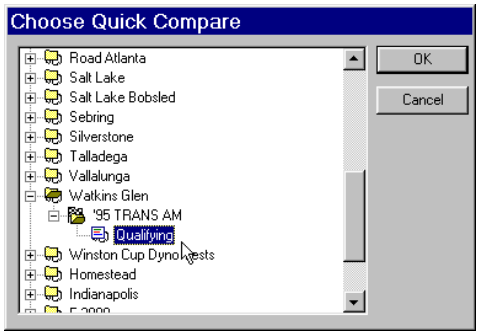
For example, have a plot with just SPEED in it. Apply focus to it, and right-click. Point at SPEED, then click on *Quick Compare…*

- Note that the hot key for this is "Q".



Next, simply click on the session you want to make the quick compare to. The SPEED signal from the fastest lap from the session you choose will be over plotted in the plot.

- Pitfall: IF you already had the fastest lap from a session plotted, and you do a *Quick Compare* and choose the same session, you will wind up with 2 copies of the same signal plotted. (1 as a data source, and 1 as an over plot).



The *References* Feature

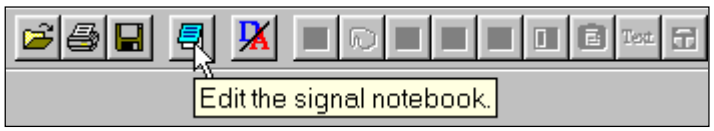
References enable you to quickly compare the Data Source signals to a reference lap or run which you designate. The *References* feature also enables you to plot the **difference** between those 2 signals. See the chapter titled "Track Master Analysis Functions" for complete details of this feature.

Introduction to the *Notebook*

When we introduced the notes display earlier in this chapter, we stated that every session, pass, or run has its own notebook. Lets explore what is in that notebook.

Getting into the *notebook*

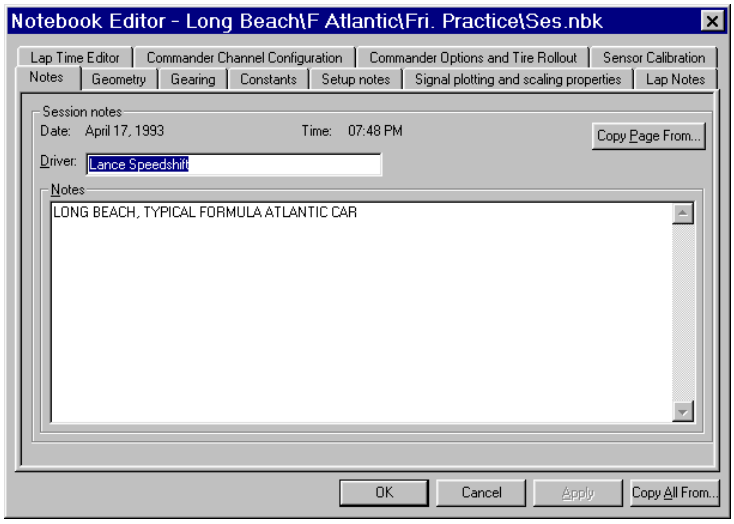
Apply focus to one of the plots in your view. Click the *Edit Signal Notebook* tool



You will see the notebook editor:

Explore the various tabs in the notebook to begin to see all of the various information that gets tracked and kept with each and every session. We will go over all of these tabs in full detail later.

When you are done, click *Cancel* so that you do not accidentally change any items in the notebook for now.



Saving the *view*

After making changes to your view, you can save it either with the same name, or with a new name.

Saving with the same name

As with most Windows applications, you can save a view anytime (under the same name) by simply clicking the save tool in the toolbar.

Saving with a new name

If you make significant changes to a view, or change the track that the data is from, we recommend you save it under a new name. Do this from the *File* menu, *Save view as…* item.

Chapter 3 Track Master Analysis Functions

This chapter introduces the built-in or "pre-programmed" analysis functions in Track Master.

Introduction

TM has many built-in features that enable even the newest user to quickly "go beyond" simply looking at recorded data and begin to actually get answers from it. These built-in analysis functions fall into 4 categories:

1. **Pre-programmed signals** – Loaded from the *Data Source* dialog just as recorded signals are.
2. **Comparison signals** – Loaded from the plot's context sensitive menu or from the *Control* pull-down menu.
3. **Reference laps -** Loaded from the plot's context sensitive menu or from the *Control* pull-down menu
4. **Map markers –** Created on the *Map Lap* page and activated from the *properties* dialog of a map plot.

Learning about these functions

As you go through this chapter, have TM running and look through some of your sample views for examples of usage of these functions. Also, experiment with the functions in this chapter using your sample views and data.

Also, refer to Buddy Fey's book, *Data Power*, for additional information on analyzing data.

Pre-programmed signals

Pre-programmed signals are essentially math formulas which help "boil down" recorded data into answers. Pre-programmed signals are available in TM regardless of whether or not you have the math option. If you do have the math option, then you also have the option of not only writing your own formulas but modifying the CDS supplied, pre-programmed ones.

This chapter describes the pre-programmed signals in the Base version of TM. The *Chassis Animation & Analysis* option includes many additional pre-programmed signals. See the chapter dedicated to that option for a full listing.

Loading a Pre-programmed signal

These are loaded exactly the same as "raw" data signals, i.e. from the *Data Source Signals* dialog box. Review Chapter 2 in this manual if you are not familiar with how to do this.

Details of formulas

This chapter will list and describe the built-in formulas. Many of these signals require certain recorded data *and* user-entered information. See Appendix A for a complete, detailed listing of the actual formulas and their component requirements.

User-entered data for pre-programmed signals

See the chapter titled *"Gather and enter information about YOUR vehicle"* for details on how and when to enter the user-provided data required by these signals.

Signals in all versions

Signal Name: SPEED

Description: Vehicle speed in MPH or KPH. Calculated from WHEEL_R and tire rollout.

How it is used: One of the most important and fundamental signals used for comparison of one lap to another in on-vehicle applications.

Signal Name: ENGINE_RATE

ALL

Description: Is the acceleration or deceleration rate of the engine RPM.

How it is used: In track applications for finding "soft spots" in torque, deciding on shift points, and even comparing engine performance. Used in Dyno applications for inertia correction.

Signal Names: CV_RUN_START, CV_RUN_SEG, CV_RUN_STOP

Description: Used to "separate" data when recording it using *Command View*.

How it is used: See the chapter titled "Using *Command View* on Dynos" for a full description.

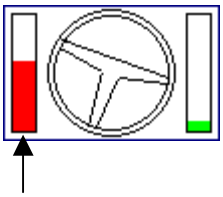
Signals In Circle Track & Road Race version

CT RR

Signal Name: BRAKING

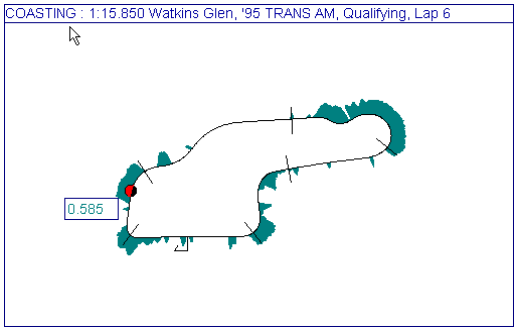
Description: Is the positive portion of the longitudinal G (LONG_G) signal.

How it is used: To create the red vertical bar graph in a *driver controls* display



Signal Name: COASTING

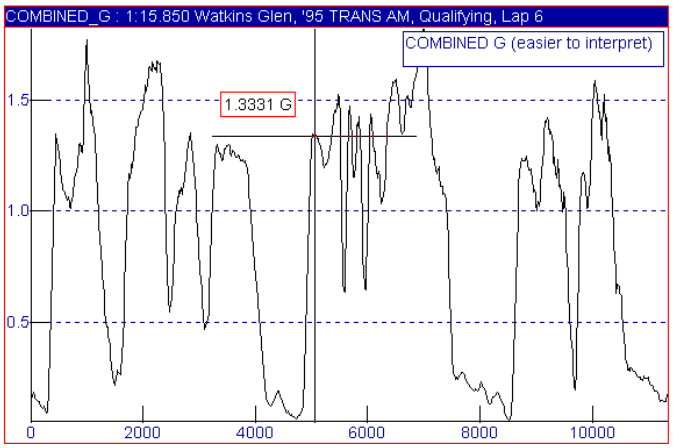
Description: Is a measure of how much the driver is "coasting" meaning not fully on the brakes nor fully on the throttle. It ranges from 0 to 1, with 1 being "lots" of coasting.

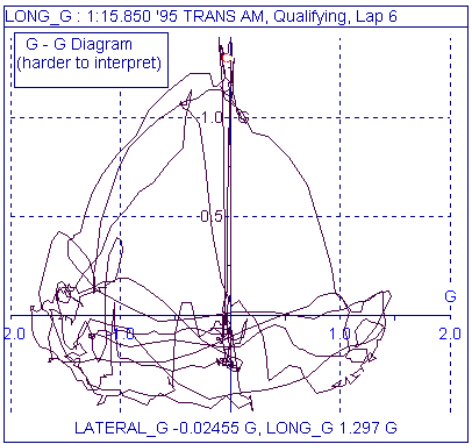


How it is used: Plotted on the map, it quickly displays where the driver needs to build confidence or simply "drive harder". Use map plots of coasting as a visual "goal seeking" exercise when leaning new tracks. Obviously, the goal is to constantly try to reduce the amounts of coasting shown.

Signal Name: COMBINED_G

Description: Is the vector sum of Lateral and Longitudinal G, and therefore equivilent to the instantaneous radius of the "friction circle" in a G-G diagram. It is easier to interpret a full lap of data using COMBINED_G plotted vs time or distance rather than LATERAL_G vs LONG_G in a signal vs signal plot.



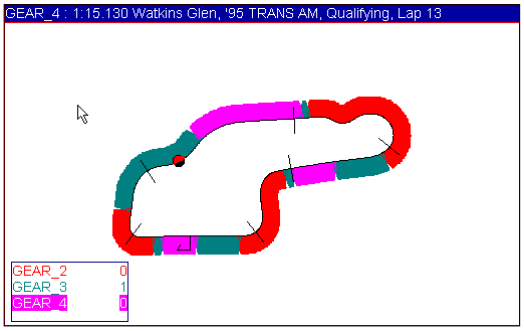


How it is used: To determine if a driver can go into a corner deeper (brake later) or get on the gas earlier (in high powered vehicles).

Signal Names: GEAR_1 thru GEAR_7

Description: Detect which gear is engaged. Equal to 1 if you are in that gear (ie, if GEAR_3 = 1 you are in 3rd gear), otherwise equal to 0.

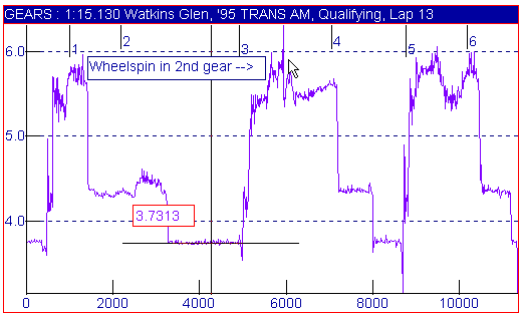
How it is used: To create map plots showing gear utilization. If you are using just 3rd, 4th, and 5th gear at a track, create a map plot, include just GEAR_3 thru GEAR_5, and you will have a picture of your gear usage.



Signal Name: GEARS

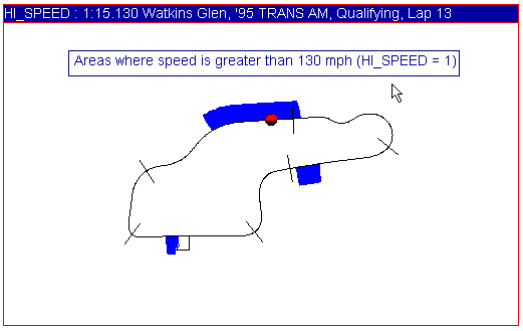
Description: Is the overall ratio of ENGINE_R to WHEEL_R. Yields a graph with a "staircase" appearance.

How it is used: In lower gears a variance from "perfect flat line" indicates wheel spin or clutch slippage *if WHEEL_R is taken from a non-driven wheel*. Can also be used to determine gear usage, but most people find it more difficult to interpret.



Signal Name: HI_SPEED, MED_SPEED, LOW_SPEED

Description: Classifies parts of the track as "low, medium, or high speed" Is computed from user-entered limits. Each of the signals are equal to 0 when you are NOT in that particular speed range, and 1 when you are. For example, If HI_SPEED = 1 then your speed must be higher than a threshold you put in your car file.



How it is used: Primarily in cars where aerodynamic effects are important, these can be used to partition the track.

Signal Name: IN_GEAR

Description: Is numerically equal to the gear that is engaged, thus if you are in 3rd gear, IN_GEAR = 3

How it is used: Another way of displaying gear usage, numerically rather than visually. Can also be used in advanced analysis formulas if you have the math option.

Signal Name: LONG_G

Description: Longitudinal G *calculated* from SPEED data rather than measured from an accelerometer. Will only be calculated if the data set DOES NOT have a recorded signal named LONG_G. In general, it is NOT as accurate as a measured LONG_G signal since it can be "fooled" by spikes in SPEED data from wheel lock, wheel spin, etc.

How it is used: In the same manner as measured LONG_G. Is included for the benefit of customers who only have single axis (LATERAL) g sensor.

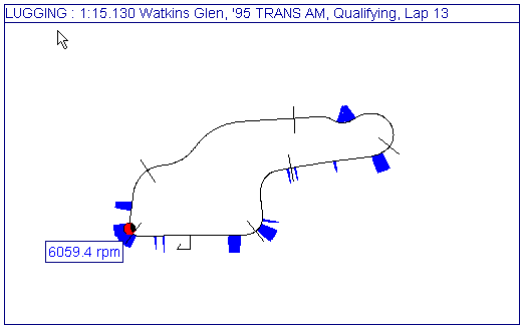
Signal Name: LUGGING

Description: Determines if you are operating the engine at RPM lower than ideal. Is equal to ENGINE_R *IF:*

- ENGINE_R is less than the minimum you define.

AND

- THROTTLE is greater than 30%

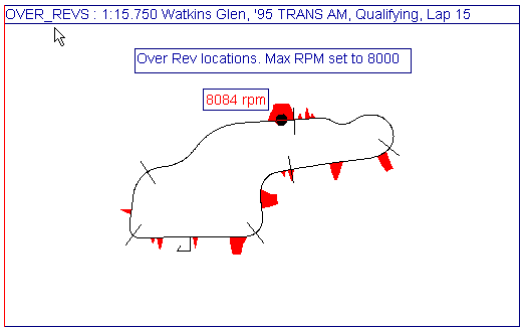


How it is used: Plotted on the map, you can instantly see where gearing may be incorrect.

You can also plot it on a signal vs time plot in the Drag racing version.

Signal Name: OVER_REVS

Description: Determines if you are operating the engine at RPM higher than ideal. Is equal to ENGINE_R if ENGINE_R is greater than the maximum you define.



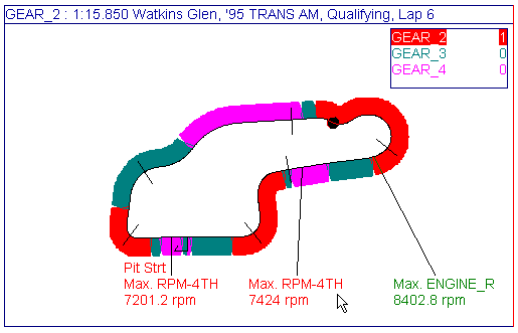
How it is used: Plotted on the map, you can instantly see where gearing may be incorrect, where the driver has to "stretch" a gear to get to a comfortable shifting place on the track etc.

You can also plot it on a signal vs time plot in the Drag racing version.

Signal Names: RPM-1ST thru RPM-7TH

Description: Equals ENGINE_R *only* when the gear in question is engaged. For example, RPM-4TH equals ENGINE_R when you are in 4th gear, and the rest of the lap is equal to 0.

How it is used: Used primarily in marker schemes when you want to find maximum RPMs in certain gears. Also used in advanced analysis formulas if you have the math option.



Signal Name: SPD_STEER

Description: "Speed corrected" steering, per the formula published by Buddy Fey in *Data Power*.

How it is used: Used for evaluating over steer vs under steer (or loose vs tight). See *Data Power* for a detailed description of how to use. For those with the *User Programmable Math* option, the HANDLING formula supplied with that option is usually a better tool for over steer/under steer analysis.

Signals In Drag Race version

DRAG

Signal Name: CLUTCH_SLIP

Description: Calculates slip, in terms of percent of ENGINE_R. Uses ENGINE_R and INPUT_R in formula.

How it is used: Fundamental parameter used in tuning your clutch in drag racing.

Signal Name: GEAR1 thru GEAR7

Description: Detects which gear is engaged. Equal to 1 if you are in that gear (ie, if GEAR3 = 1 you are in 3rd gear), otherwise equal to 0..

How it is used: Intermediate calculations that feed into GEAR1_R thru GEAR7_R

Signal Name: GEAR1_R thru GEAR7_R

Description: Calculates the "theoretical" ENGINE_R you would have in each gear based on SHAFT_R and the user-entered gearing data.

How it is used: When plotted along with actual ENGINE_R, yields the old "Racepak" style way of looking at clutch slip in terms of difference between Measured ENGINE_R and theoretical based on SHAFT_R.

Signal Name: INPUT_R

Description: Transmission input shaft RPM Only calculated if you do not have a measured signal called INPUT_R. Is calculated from SHAFT_R and all your user-entered gearing information.

How it is used: Used to calculate CLUTCH_SLIP

DYNO

Signals In Dyno version

Signal Name: BSFC

Description: Brake Specific Fuel Consumption, calculated from POWER, FUEL_FLOW, and user-entered fuel density factor.

How it is used: Widely used in engine dyno tuning

Signal Name: POWER

Description: Horsepower, calculated from TORQUE, ENGINE_R, and correction factors.

How it is used: Primarily used in dyno applications, also applicable to all on-vehicle applications

Signal Name: TORQUE

Description: calculated from measured LOAD from a load cell and the user-entered torque arm. If inertia correction is being used, the TORQUE also includes the inertia factor and ENGINE_R. (See the chapter on Dyno testing)

How it is used: Feeds into POWER formula.

Comparison signals

CT RR

The CT & RR version of TM has some additional functions known as Comparison Signals. These are all loaded from the plot's context sensitive menu or from the *Control* pull-down menu.

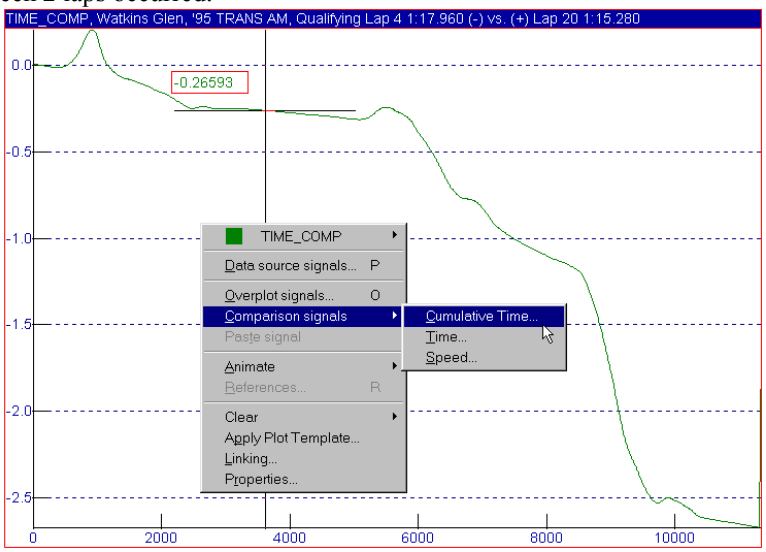
Cumulative Time Comparison (TIME_COMP signal)

The TIME_COMP signal compares one lap to another and determines how much time has been gained or lost as a function of track position or lap time. By analyzing a TIME_COMP graph you can see exactly where the difference in lap time between 2 laps occurred.

How to load

Go to the **Scratch Pad** page in your view, apply focus to the plot on that page, and clear it (press W).

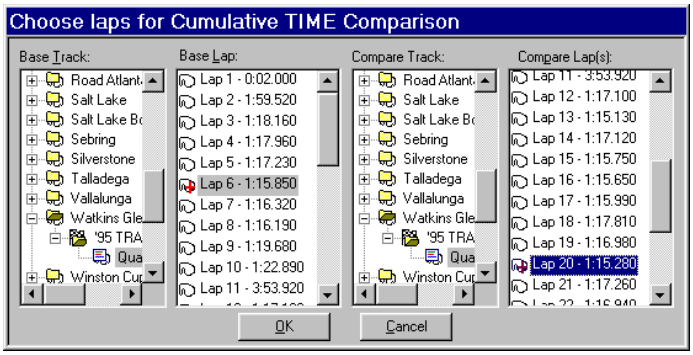
Next, *right-click* on the plot. Point at *Comparison Signals…* then left click on *Cumulative Time.*



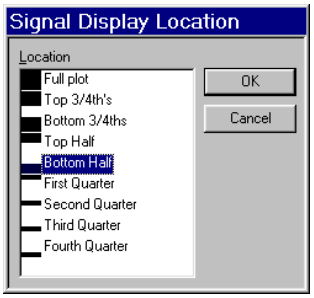
Next, Use the controls in the dialog to navigate to and select the 2 laps you wish to compare:

Click OK.

In this example we have selected Laps 6 and 20 from the sample Watkins Glen data.



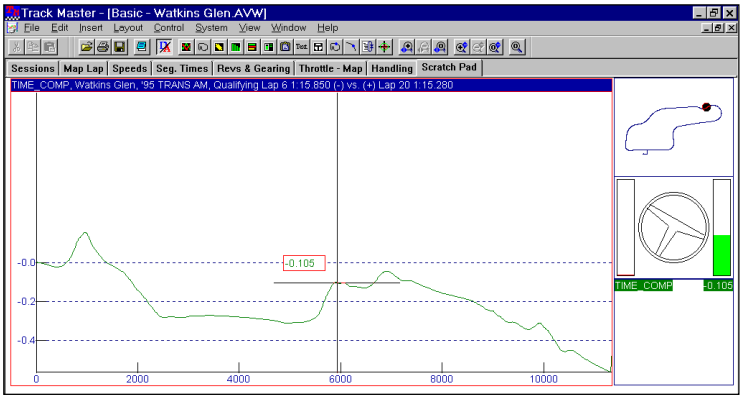
Next, select the location in the plot for the signal to appear. Use the default (Bottom Half) for now, since this will leave the top half of the plot blank (for adding other signals).



You should see this plot now:

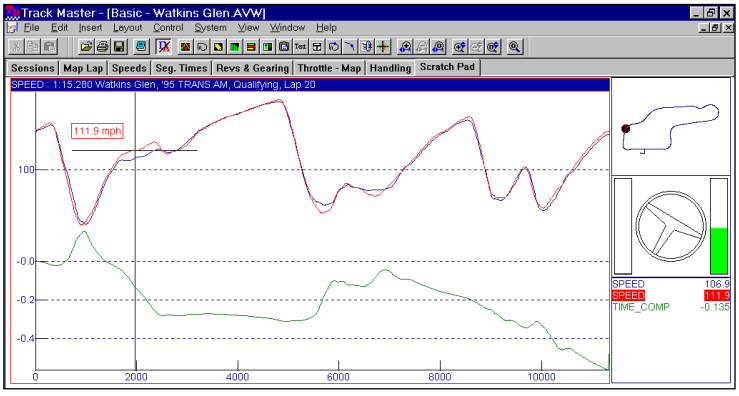
The status line for this plot shows the 2 laps you selected along with the lap times. The graph shows the time difference (in seconds) between the 2 laps. Wherever this difference is negative, the first lap (Lap 6 in this case) has lost that amount of time to the second lap (Lap 20 in this case).

At the point where the cursor is on this plot, Lap 6 is .105 seconds behind Lap 20. A quick look at this graph indicates where the big differences in lap time occur.



Next, plot Speed from Lap 6 (as the *data source)* and Speed from Lap 20 (*as an overplot*) in the top half of the graph.:

Now you can see the difference between the speeds for each lap, as well as the resultant difference in lap time.

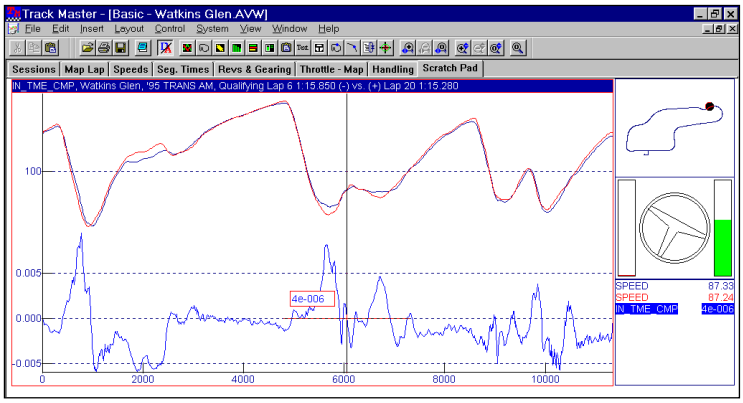


Changing the laps used to create TIME_COMP

Note: Since the TIME_COMP signal is made up from data from 2 laps, it can not be linked to other plots, however, if you hit Page Up or Page Down (with focus on the TIME_COMP signal), the first lap in the comparison will change to either the previous or next lap.

Time Comparison (IN_TIME_COMP signal)

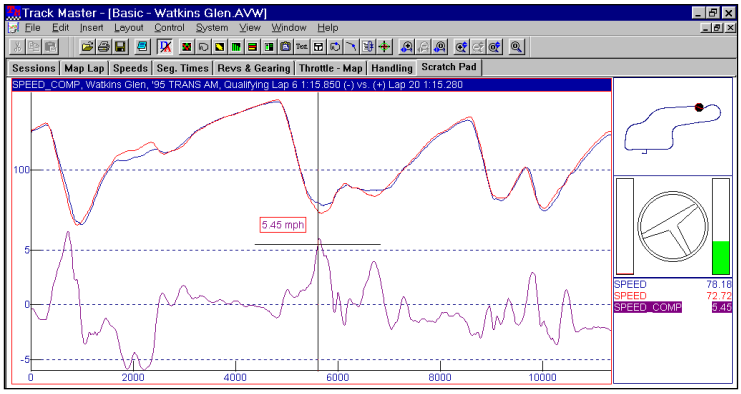
This function works exactly the same as the Cumulative Time Comparison, but displays the instantaneous time difference between the 2 laps, rather than the cumulative time difference.



If you use the *Time*… comparison signal on laps 6 and 20 (as in the above example), you get this graph. The big "bumps" in the IN_TIME_COMP signal show where the big differences in lap time exist. Most people prefer the *Cumulative Time* function over the *Time* function.

Speed Comparison (SPEED_COMP signal)

You select the laps to use for the Speed Comparison exactly the same as the previous 2 functions. If you have speeds from 2 laps plotted in the top half (as in the above example), and you do a Speed Comparison, you will get:



The SPEED_COMP signal is the **difference** in speed between the 2 laps. Wherever SPEED_COMP is positive, the first lap is faster. There is another way of plotting the difference of a any signal from 2 different laps, as we will see in the next section.

Reference Laps

You can designate or set certain laps or runs as *References*. These are usually really good (or even the best) laps of data you have at a track. They can be from any *Event* or *Session* you choose. Usually they are all from the same track as you are currently analyzing data from.

- Set References to very fast laps that you will constantly be comparing all new data to.
- References make it easy to quickly compare all the signals in a plot to the Reference Lap.

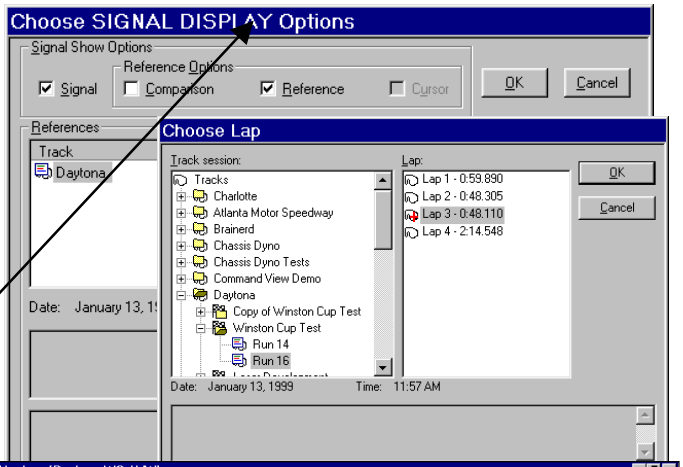
How to set and Plot a Reference

Apply focus to a plot where you want to activate a Reference. Right click, then left click on *Reference.*

You will see this dialog:

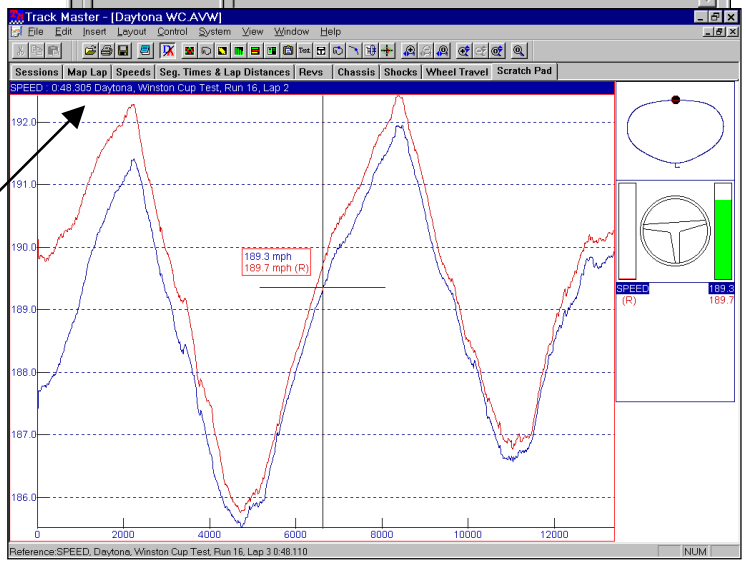
Click the *Add…* button, (it will take you to the *Choose Lap* dialog. Choose a lap to set a reference to, then click Ok.

You will now be back at the *Choose Signal Display Options* dialog. The lap you chose is now in the *References* list. Also notice that the reference box is checked in the *Show Signal Options* section of this dialog.



Your plot will now have both the original data source and the reference plotted:

- The *flying box* shows the values (at the cursor position) for both signals. The Reference is the one with the (R) after it.
- As usual, the *Title Bar* for the plot gives the specification for the signal which as focus (the one the cursor is on)
- The *Status Line* give the specification for the *Reference* which is plotted.



Additional pre-programmed Signals

Both the *Chassis Animation and Analysis* option and the *User Programmable Math* option include additional pre-programmed signals. See the chapters dedicated to those options for details.

Map Markers

Chapter 4 Starting to use Command Link

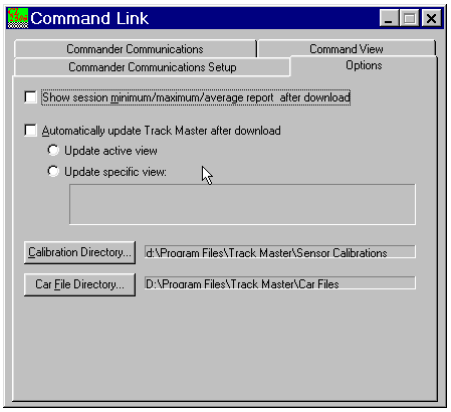
This chapter will teach you the basics of the COMMAND-LINK communication software, and prepare you for doing the "practice record" described in the next chapter.

Configuring Command Link

Start CL by double clicking on its icon on the desktop.

Setting program options

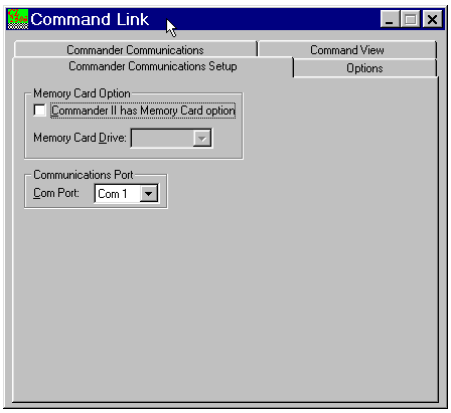
Click on the *Options* tab:



- Make sure all the check boxes on this tab are *cleared* for now. We will work with these options later.
- If you installed your software using the default locations, your *calibration directory* and *car file directory* specifications should be as they are shown here, except that your installation will most likely be on the C: drive.

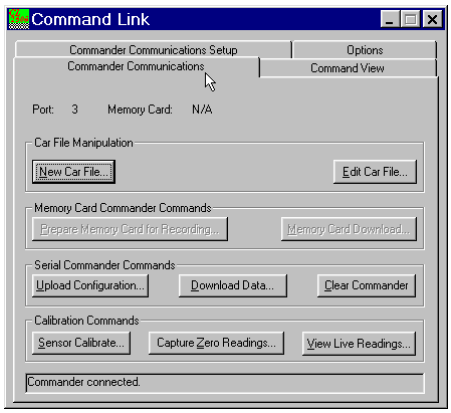
Setting communications options

Click on the *Commander Communications Setup* tab.



- If you have a memory card type Commander II, you should have configured your PC and set your memory card drive back in chapter 1. If you have not, return to chapter 1 now and do so.
- Set your communications port to the COM port you will be plugging the communications cable into on your PC. 95% of the time this will be COM1
- BE SURE that the COM port you select is NOT the port that an internal OR PCMCIA Modem is using. If you accidentally specify a port used by a modem, CL may appear to be connected to the Commander II when in fact it is not. If you are not sure which COM port your modem is using, go to the Control Panel, Modems, then click on your modem and select properties to see which port your modem is using.
- The communications cable is used for interactive viewing of live data, calibration of sensors, zeroing of sensors, and in the case of *wire transfer download* type Commander II models, it is used for data download.

The *Commander Communications* Tab



Click on the *Commander Communications* tab.

This tab is where most of the action in CL is performed. Notice that the buttons are grouped as follows:

- Car File Manipulation (used by all systems)
- Memory Card Commander Commands (used only by memory card systems)
- Serial Commander Commands (used only by wire-transfer download systems)
- Calibration Commands (used by all systems)

Notice that the memory card command buttons are all disabled in this example. This is because no memory card drive was set in the communications options tab, and therefore CL "thinks" it is to be used on a wire-transfer download system.

Also notice that the Serial Commander Commands and the Calibration Commands in the example are **enabled**. This is because we were connected to a Commander II when we made this manual. If you are not currently connected to your Commander II (with your serial communication cable), your buttons will be **disabled**.

- The action buttons in this tab are "context" sensitive.

Viewing and editing *Car Files*

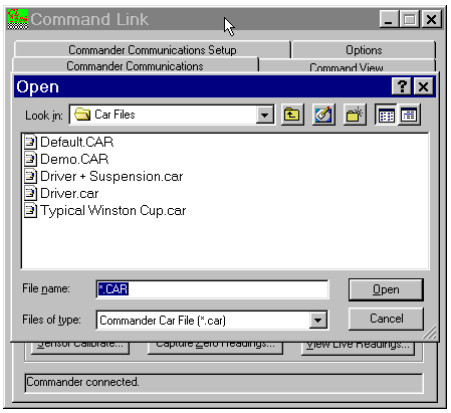
What is a car file?

A car file contains a great deal of information that controls both how your data gets recorded (by your Commander II) and how it gets displayed and analyzed (by TM). It contains information on:

- Which channels to record, what sample rate to record them at, and what their names are
- What the calibration factors are for each of your sensors
- What offsets are to be used when plotting the data (captured when you zero sensors)
- All the various parameters specific to your vehicle, such as what your gear ratios are, what range your engine should operate in, in the case of the suspension option, what all your motion ratios, etc are.
- All setup and changes type notes you want to keep with the data.

As you can imagine, the car file contains lots of key information that must be correct if your data is going to be meaningful and useful.

Selecting and editing car files

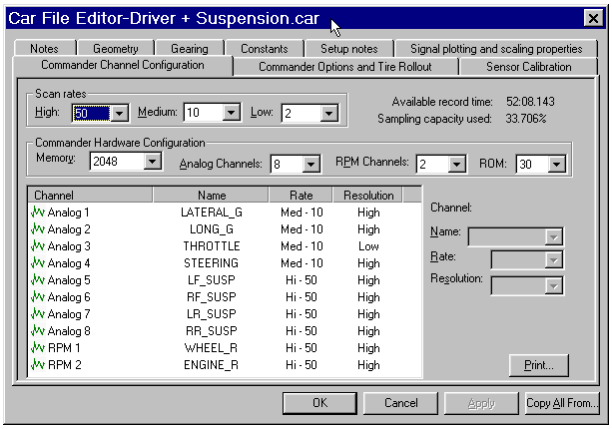


Click the *Edit Car File…* button.

There are several demo type car files included with on all CDs. They are listed here.

There should also be a car file specifically for your system. Its name will begin with a 6-digit number such as 503xxx. This number is the serial number of your Commander II.

For now, open the demo car file named *Driver + Suspension*. Do not open your car file yet.



The car file contains many tabs to organize all the data entry. Do these tabs look familiar? They should. If you completed the section in chapter 1 titled "Introduction to the *Notebook"* you should recognize many of these tabs as ***being the same tabs as are in the signal notebook in Track Master.***

Explore these tabs a little to see all the information that is or could be entered.

- The car file contains a huge amount of data
- Most of this data is the same information as is in the signal notebook in Track Master.
- To minimize tedious labor, signal notebooks are created by making copies of the car file
- Notice that there is no "Save" button in the car file editor. Changes made are saved as soon as you click OK, so be careful, and if you are not sure you want to save changes, click *cancel*

Click cancel now to exit the editor.

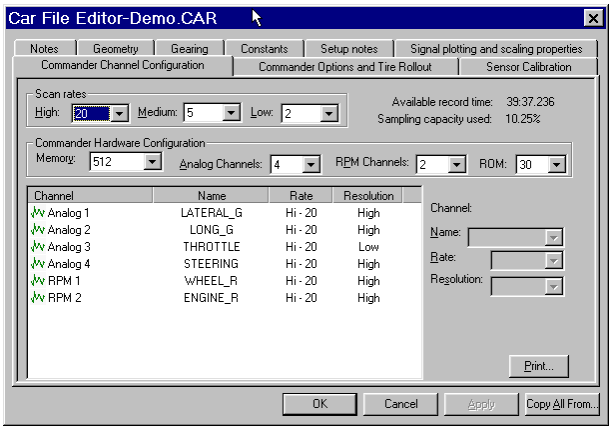
How a *car file* becomes a *session notebook*

To minimize tedious labor, signal notebooks are created by making copies of the car file. This notebook is created at the time the data is downloaded from the memory card or via wire from the Commander II.

- Each notebook in TM (remember, each and every session or run has its own notebook) is a "*snapshot" of the car file at the instant the data is downloaded.*
- The key importance of this principle may be obvious to you now, or will become apparent later in this manual.

Viewing and editing your *car file*

Click *edit car file* again and this time select your car file. You should be at the *Commander Channel Communication* tab.

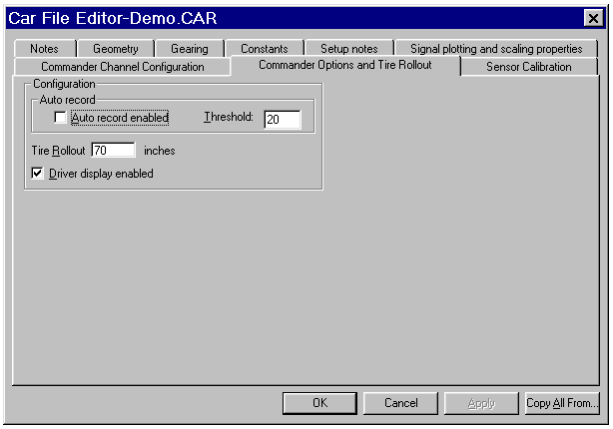


Important settings in your *car file*

If you have purchased a complete system from CDS, your car file is already configured with all your sensors assigned to the correct hardware channels, all initial calibrations entered, etc.

An initial suggested scan rate has also been set for all your channels. Leave all these settings as they are for now.

Now click on the *Commander Options and Tire Rollout*:



- Make sure the *Auto record enabled* box is NOT checked. (For Drag systems, this is called *Auto Launch Detect)*
- If you have the Driver Display with your system, make sure it is *enabled.*
- In the *Tire Rollout* box, enter the approximate circumference of the tire where the WHEEL_R sensor is installed on your vehicle. (we will do a more accurate measurement and enter it later)
- Click OK to save any changes.

Communicating with your *Commander II*

Now we will begin to "talk to" your Commander II.

VERY IMPORTANT: Some PCs are not fully compliant with RS 232 standards, particularly when they are running Windows 2000 or ME. These incompatibilities can cause communication problems. Many problems will be avoided if you **always have Command Link running** on your PC **BEFORE** you connect your *Commander II* to your PC.

Make sure the *Commander II* is ready

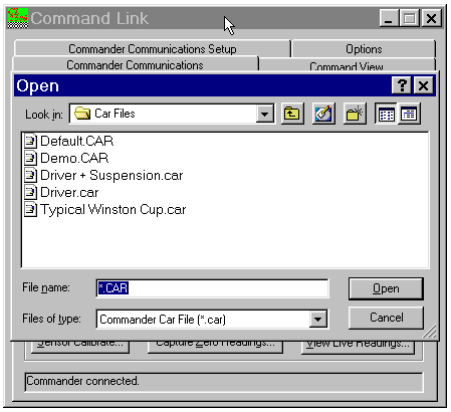
Make sure your Commander II is ready to communicate. The Power switch (on the front panel) should be ON, the trigger switch (on the cable) should be OFF.

Upload configuration (internal memory *Commander II*)

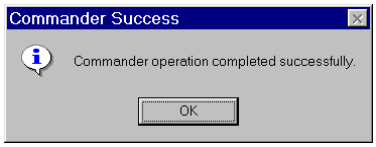
Wire Download System

Skip this section if you have a memory card Commander II.

- The green light on the front of your Commander II should be blinking slowly. If it is not, check the switch positions as described above.
- Connect the communications cable between your PC and the Commander II.
- The *Upload Configuration* button should be enabled. Click on it.
- If the button is not enabled, verify that you have selected the correct COM port. If you still cannot get the button to enable, refer to the troubleshooting appendix.
- Select *your* car file
- Click *open* (or simply double click on your car file name)



- After a few seconds, you should see:

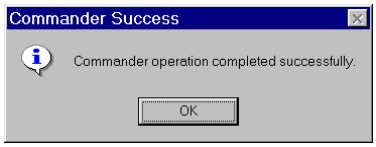


Skip the next section and go on to *Viewing Live Readings.*

Prepare memory card for recording (memory card *Commander II)*

Memory Card System

- Insert your memory card into the PC card slot you configured CL for.
- The *Prepare memory card for recording* button should be enabled. If it is not, go back to Chapter 1, to the section titled “Configuring you PC for Memory Cards” and successfully complete all the steps in that section.
- Click *Prepare memory card for recording.* You will receive a warning that all data on the card will be erased, click OK
- Select your car file in the *Open* dialog box and click *open* (or simply double click on your car file name)
- After a few seconds, you should see:



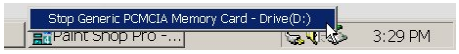
- Remove your card from the PC

Removing memory cards when running Windows 2000

When running Windows 2000, it is very important that you follow this procedure when removing your memory card. When you wish to remove the card from the PC:

- Point at the "Eject Hardware" icon on your task bar:

- Single click on it and you will see:



- Single click on the message and you will see:

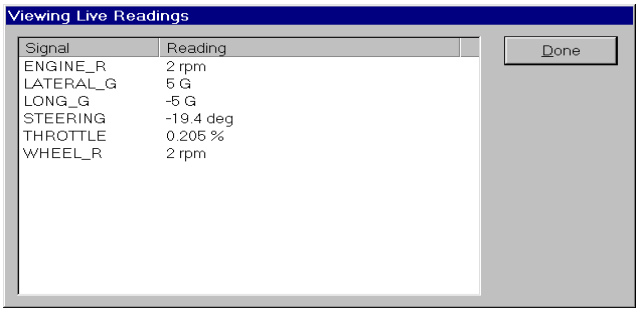
- Click OK and then remove the memory card.
- If you forget to perform this procedure, you will receive a warning from Windows 2000, and the next time you inset the card Command Link will not recognize it. If this happens, simply eject the card properly and re-insert it and then CL will recognize it.

Inserting a memory card *in Commander II*

- The green light on the front of your Commander II should be on steady. (not blinking) If it is not, check the switch positions as described above.
- Open the card door and insert your card "connector first" with the label up.
- The green light on the front of your Commander II should start blinking slowly. If it is not, or if it is "double blinking" refer to the troubleshooting appendix.
- Connect the communications cable between your PC and the Commander II.

Viewing Live Readings

Click the *View Live Readings* button. You should see a box like this:



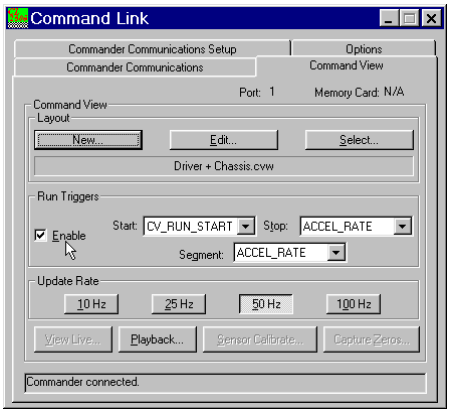
- The signals you see should be the ones your Commander II is configured for.
- Move or otherwise exercise some of the sensors. You should see the readings change on the screen.
- Note that RPM channels have a minimum reading that they will show. They will never read all the way down to 0 RPM

- Sensors that need to be zeroed or interactively calibrated (such as throttle and steering) will not being showing correct values because we have not done that step yet, but they should show changes as you move the sensors.
- Click DONE when you are done.
- IMPORTANT NOTE: notice that the green LED on the Commander II is NOT blinking while it is sending data to CL. It is "frozen" at whatever "state" (on or off) it was in when communication began.

If you DO NOT have the Command-View option, skip ahead to the next chapter on doing a "Practice Recording".

If you have the Command-View option, continue on with this chapter.

Starting to use *Command-View*



Click on the *Command View* tab in CL. This tab is the "control panel" for Command-View (CV).

The basic steps to view live data using CV are:

1. Select a Command View Layout
2. Select an Update Rate
3. Select "View Live"

Commander II "State"

In order to use CV, your Commander II must be in the same "state" as if you were viewing live, calibrating, or zeroing sensors with Command Link, i.e.:

- The Power switch (on the front panel) should be ON, the trigger switch (on the cable) should be OFF.
- You should have already "uploaded a configuration" or inserted a "prepared memory card"
- Review the previous sections of this chapter if you are not sure.

Selecting a Layout file

What is a *Layout?*

The *Command-View Layout* controls which signals are displayed, and what type of "gauge" or gauges are used for each signal.

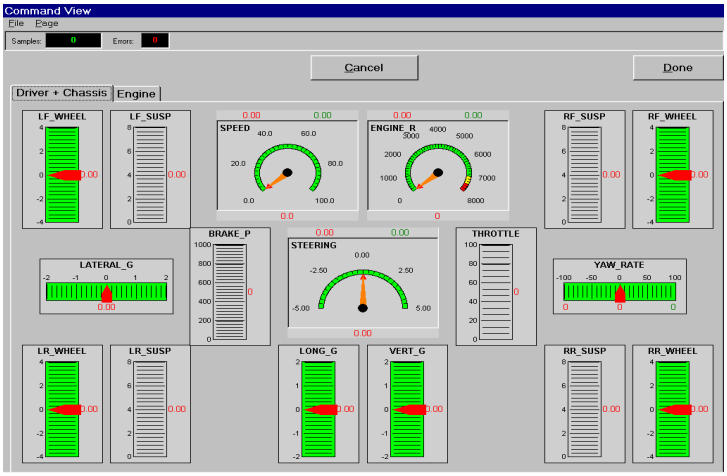
- CV Layouts are "graphical screens"
- A number of standard CV Layouts are included with the software.
- CV Layouts are easy to modify, change, and create.

- One big difference between CV and the standard *view live* in CL is that CV can display math signals both CDS-programmed and user-programmed.

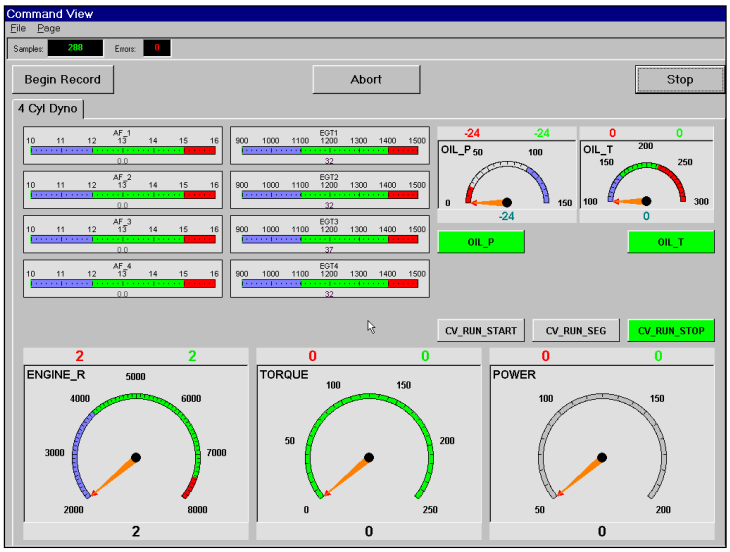
Standard layouts included

There are a number of standard CV layouts included with the software. Their names make it obvious as to what there intended usage is.

- Here is a typical layout designed for using with an on vehicle application where driver, engine, and chassis data is being logged.



- Note the "Page Tabs" in the upper left area of the layout. These work exactly as they do in TM. You can switch from page to page by clicking on them.
- Here is a typical Dyno layout.



Choosing a Layout to use

Click the *select* button and select the *command view layout* you wish to use.

- If you are not sure of the layout, select one and then click *edit* to examine or alter the layout.

- Several sample layouts are included with your program to serve as a starting point.
- Make sure that at least some of the sensors you are using with your system are displayed in the layout you select.

Update rate selection

Select an *update rate.* Generally you want to use the fastest rate possible, but the more channels you have turned on, the lower the maximum allowable update rate. 50 or 100 Hz are best for dyno work.

Set the update rate to 100. If the Commander II cannot do 100 Hz with the channels you have turned on, you will receive an error message asking you to run at the next lower rate. This will continue until you get down to a rate the Commander can handle. If you have an older Commander II with ROM 32 or earlier you will only be able to *view live* at 1 Hz, and WILL NOT be able to record data with CV.

IMPORTANT NOTE: The Commander II you are using must have ROM 33 or higher to *view live* at rates higher than 1 Hz. The label on the side of your Commander II has its ROM version printed on it. If your ROM number is 32 or below, contact CDS to arrange to have your unit updated.

Viewing Live Readings with CV

Click the *View Live ...* button. The layout you selected should appear on the screen.

- The green light on Commander II will start to flash at the rate equal to your *Update rate.*
- Move or otherwise exercise some of the sensors. You should see the readings change on the screen.
- Sensors that need to be zeroed or interactively calibrated (such as throttle and steering) will not being showing correct values because we have not done that step yet, but they should show changes as you move the sensors.

"Counters" in the CV Layout screen

- Notice there are 2 "counters" in the upper left of the layout screen.
    - The *Samples* counter increments for each complete set of readings that come in, so if your update rate is set at 50 Hz, it will increment 50 times each second.
    - The *Errors* counter increments each time there is a communication error. Command-View's communication between the *Commander II* and the PC is very robust and includes error detection and recovery.
- Click STOP or press "S" when you are done.

If you are using your Commander II strictly in a "stationary" mode (not in a vehicle), skip the next chapter and go straight to Chapter 5

Chapter 5 Doing a “practice record” (on-vehicle applications)

If your system is to be used only in stationary applications such as on-dyno, skip ahead to the next chapter.

In this chapter, you will record some data in the shop, in order to practice and learn the mechanics of operating the system and software.

Record some data

Your system should be ready to record if you are continuing on from Chapter 3. If you are not sure, return to the “Communicating with your *Commander II”* section of chapter 3 and follow the steps to prepare for recording.

In this exercise we will use the trigger switch to start and stop recording. We will record several segments. Note that the procedure is a little different for Drag systems.

Read through this procedure at least once before actually doing it.

Record several “laps”

CT RR

The green light on your Commander II should be blinking slowly. Each time you turn the Trigger ON the Commander II will start recording AND enter a time in the lap timetable, so that each lap time you get in your data file will be equal to the time that the trigger switch was ON during that segment.

1. Turn the trigger switch ON. The green light will start to flash at the rate equal to your *high speed scan rate (sample rate)* set in your car file.
   - If your high speed rate is greater than 100, you will not see the light flash, it will simply appear to ”dim”
2. Move some of the sensors to make the data interesting. Run the engine if possible to get ENGINE_R data.
3. After about 20 seconds to 1 minute, turn the trigger OFF
4. Repeat steps 1-3 twice more so that you have a total of 3 laps or segments. Be sure the trigger is OFF when you finish.

DRAG

The green light on your Commander II should be blinking slowly. The first 2 times you turn the Trigger ON the Commander II will start recording AND enter a time in the Pass times table, so that each lap time you get in your data file will be equal to the time that the trigger switch was ON during that segment.

1. Turn the trigger switch ON. The green light will start to flash at the rate equal to your *high speed scan rate (sample rate)* set in your car file.
   - If your high speed rate is greater than 100, you will not see the light flash, it will simply appear to ”dim”
2. Move some of the sensors to make the data interesting. Run the engine if possible to get ENGINE_R data.
3. After about 20 seconds turn the trigger OFF

4. Repeat steps 1-3 ONCE more so that you have a total of 2 times. Be sure the trigger is OFF when you finish.

Download your practice data

Wire Download System

The green light on the front of your Commander II should be blinking slowly. If it is not, check the switch positions as described above.

1. Connect the communications cable between your PC and the Commander II.
2. Click the *Download Data…*button

Memory Card System

The green light on the front of your Commander II should be blinking slowly. If it is not, check the switch positions as described above.

1. Remove the memory card from the Commander II
2. Insert it into your PC's card slot
3. Click the *Memory Card Download …*button

Track Master's data structure

You should recall from chapter 1, Track Master's data structure is as follows:

CT RR

Circle Track & Road Race, Drag mode

Data is organized by TRACK, EVENT, and SESSION

- The TRACK is the physical track the data is from, such as *Watkins Glen* or *Talladega*. ALL DATA FROM THE SAME PHYSICAL TRACK SHOULD BE STORED UNDER 1 TRACK FOLDER
- The EVENT is the event name when the data was recorded, such as *2000 Trans Am Race* or *April Test Day 1* etc.
- The Session name is the name you give to the recording event such as *Friday AM Practice,* or *Day 1 Run 2* or simply *Session 1, Session 2* etc.

DRAG

Drag mode

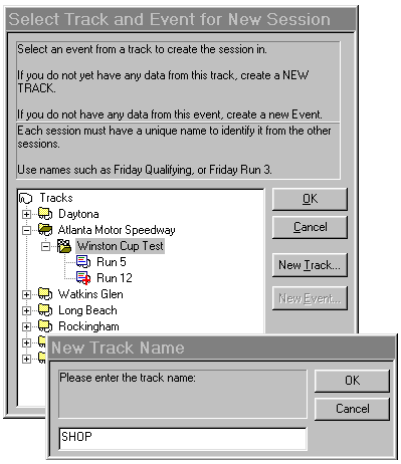
Data is organized by TRACK, EVENT, and PASS

- The TRACK is the physical track the data is from, such as *Rockingham* or *Houston*. ALL DATA FROM THE SAME PHYSICAL TRACK SHOULD BE STORED UNDER 1 TRACK FOLDER
- The EVENT is the event name when the data was recorded, such as *2000 Race* or *April Test Day 1* etc.
- The PASS is the name you give to the recording event such as *Qualifier 1, Elimination round 2* or simply *Pass 1, Pass 2,* etc.

Create a new *Track*

Click the *New Track…* button

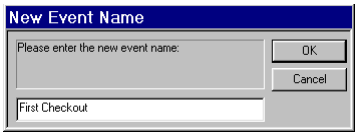
Type in ***Shop*** [enter] for the new track name



Create a new *Event*

Click the *New Event* button

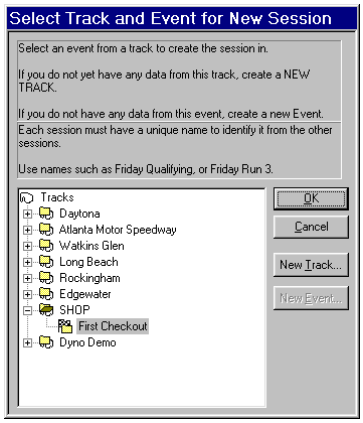
Type in ***First Checkout*** [enter] for your event name



Create a new Session or Run

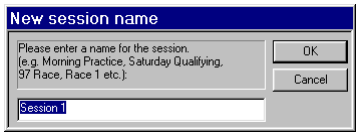
You will now be at the *select Track and event for New Session* dialog, with focus on the *First Checkout* event. This indicates that Command Link is ready to store the data:

- In the TRACK named **SHOP**
- In the Event named **First Checkout**



Now CL needs to know the name you want to use for the Session or Run. Click OK.

- CL will offer to name the session "*Session 1"*. Click OK to accept.



DRAG

Drag Racing systems will offer to name the session *Pass 1.* Click OK

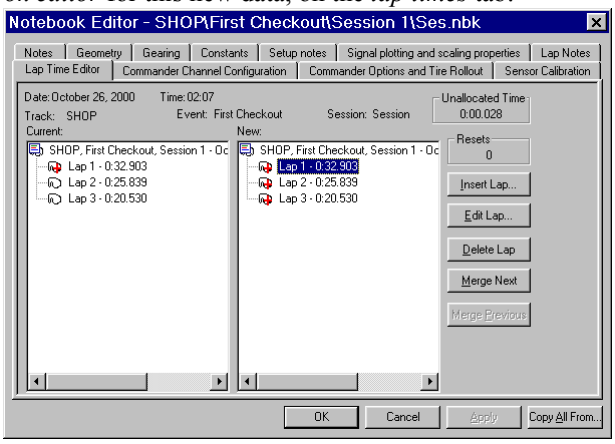
Wire Download System

Wire Transfer systems will see a progress bar during download. Download will take a little time with wire transfer. Memory card downloads are nearly instantaneous.

CT RR

Examine your Lap Times

After download is complete you will see the *notebook editor* for this new data, on the *lap times* tab.

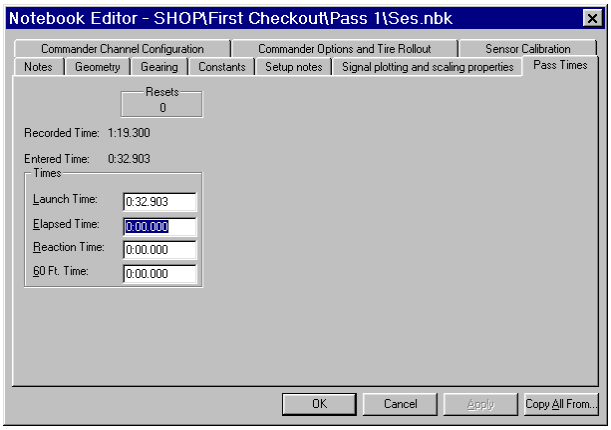


- Remember when we learned about how notebooks are created in the previous Chapter 4? It was at this instant, when the dialog appeared on the screen, that this notebook was created from your car file.
- You should have 3 lap times listed, one for each time you turned the trigger switch ON then OFF

DRAG

Examine your *Pass Times*

After download is complete you will see the *notebook editor* for this new data, on the *Pass times* tab.



- Remember when we learned about how notebooks are created in the previous Chapter 4? It was at this instant, when the dialog appeared on the screen, that this notebook was created from your car file.
- Notice that there is a time entered for *Launch Time*. This is the time from your first trigger on to trigger off. Normally, this time will be from when you or your crew turned the trigger ON to the time the car left the starting line.
- The Elapsed Time (from your time slip) is always entered manually in Drag mode. For this sample data, enter 10 seconds for your ET for now.

Load your "practice" data into *Track Master*

Start Track Master if you do not already have it running.

Load the "Shop Data" view

CT RR

If the view named *RR CT Shop View* is not in your *Select View* dialog, click *Load Other* and choose it.

Load "from last save"

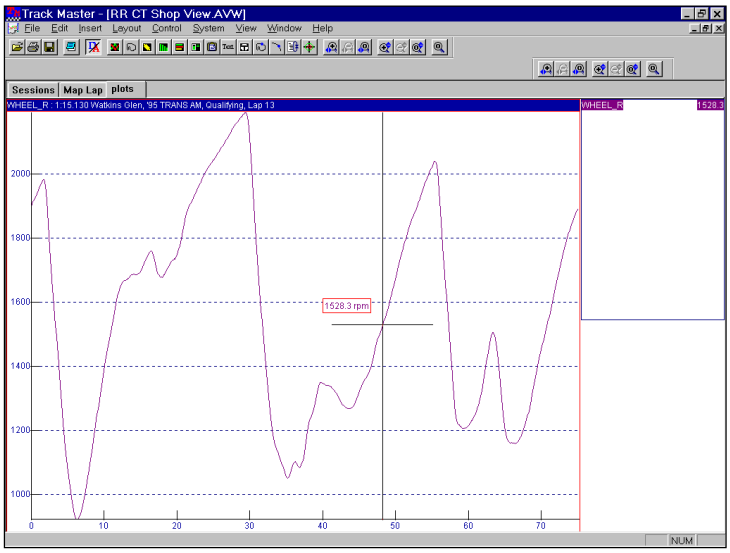
DRAG

If the view named *Drag Shop View* is not in your *Select View* dialog, click *Load Other* and choose it.

Load “from last save”

Verifying your practice data

The *Shop Views* are very simple. They consist of 1 signal vs time plot and 1 data display.



- Use all that you learned in Chapter 2 to change data source to your shop data, and load the signals for the sensors that you moved when you recorded the data.
- You may have to “fish” through the laps or segments to find the point at which you moved each sensor.
- Work with this until you are both comfortable and satisfied that the data you recorded is the data you are looking at on your screen.

Chapter 6 Doing a “practice record” with Command View (Dyno)

DYNO

This chapter is geared toward “stationary applications” such as Dynos, and introduces the use of Command View to record data. You will record some data in order to practice and learn the mechanics of operating the system and software.

Record some data

IMPORTANT NOTE: The Commander II you are using must have ROM 33 or higher for recording data with Command-View. The label on the side of your Commander II has its ROM version printed on it. If your ROM number is 32 or below, contact CDS to arrange to have your unit updated.

This chapter is geared toward using the Commander II as a Dyno instrumentation system, but is equally applicable if you are using your system for any stationary data acquisition application such as recording data from your spring checker, flow bench, etc.

In this exercise we will use Command View to record 1 segment of data. Read through this procedure at least once before actually doing it.

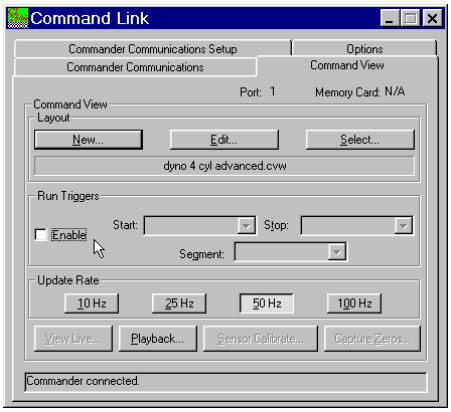
Preparation

Your system should be ready to record if you are continuing on from Chapter 3.

Your Command View settings should be as they were when you first used CV in chapter 3.

The key points are:

- Your Commander II should be turned “on” and ready to communicate
- Your configuration should be uploaded (or a “prepared” memory card should be in it)
- Your PC should be connected to your Commander II with the communication cable
- Command Link should be running, and you should be on the *Command View* tab.

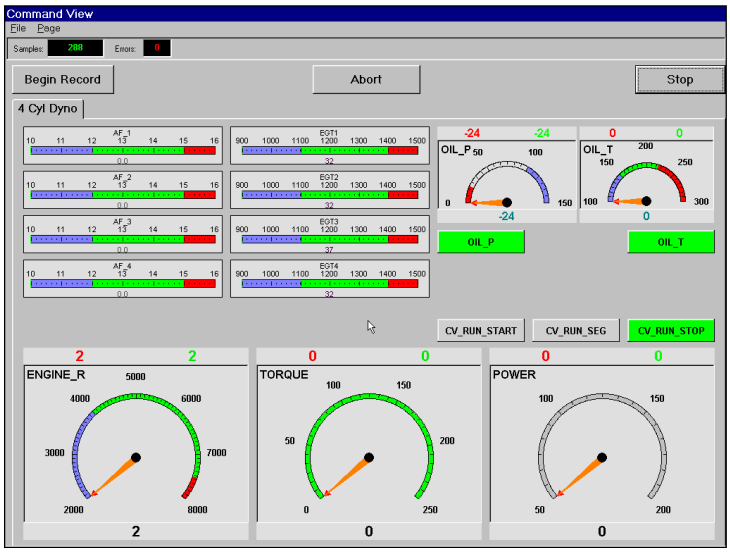


- The *Run Triggers* should NOT be enabled for this exercise. If they are, un-check the *Enable* box as shown above..
- You should have the CV layout you want to use “selected” as well as the “update rate”

If you are not sure, return to the “Communicating with your *Commander II”* section of chapter 3

Record one segment of data

1. Click the *View Live ...* button. The layout you selected should appear on the screen. For example:



   - The green light on Commander II will start to flash at the rate equal to your *Update rate.* If your update rate is 100, you will not see the light flash, it will simply appear to ”dim”

2. Click the “*Begin Record”* button in the upper left, or press “B”

   - The *Begin Record* button changes to *“recording”* and the sample counter resets to zero and begins counting recorded samples.

3. Run the engine to get some basic data, It is not necessary to do a full “pull” at this time.

4. After about 20 seconds to 1 minute, click on *Stop* or press “S”

Store the recorded data

When you record data using CV, there is no “download” step because the all the data coming into the PC through CV is being stored in a temporary buffer as you view it. All that needs to be done once you are done recording is to tell the software where you want the data to be permanently stored.

Track Master’s data structure for *Dyno* mode

As you should recall from chapter 1:

In *Dyno mode,* data is organized by TYPE, NAME or NUMBER, and RUN

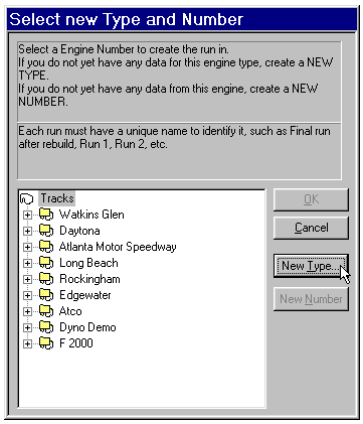
- The TYPE refers to ENGINE TYPE if you are testing engines, or VEHICLE TYPE if you are using the system on a chassis dyno. For an engine dyno, possible types might be *F2000,* or *Cup Restrictor Plate* etc.
- NAME or NUMBER is the serial number of the engine under test, or the name of the customer who owns the vehicle, etc.
- The RUN is the name you give to the recording event such as *Final test after rebuild,* or *Baseline,* or simply *Run 1, Run 2,* etc.

Note: This chapter assumes you are using the DYNO version of TM. If you are using the CT & RR or the DRAG version, some of the nomenclature used here (such as" engine type" etc) will not match your software.

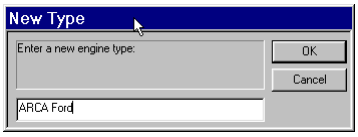
If you are NOT using the Dyno version you can refer back to the section on downloading the practice data (in the previous chapter) if you need to review the data storage process.

Specify where to store the data

Create an *Engine Type* folder

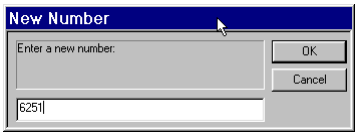


As soon as you stop the recording process, the *select new type and number* dialog will appear. If this is the first run with this *type* of engine, click *new type* and enter the type of motor (**ARCA Ford** for example).

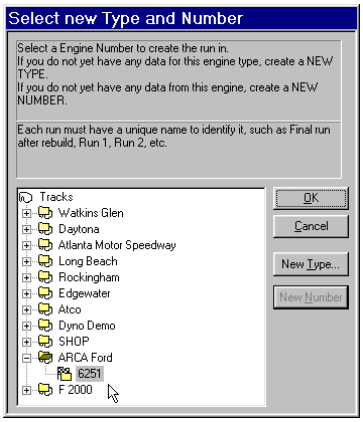


Create a new *Name or Number* folder

Click the *New Number* button and type in the engine number. Most builders use a serial numbering system for the engines, and this is what you should type in for the *Engine Name or Number*.



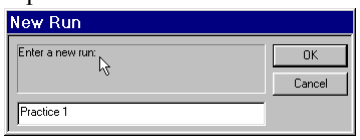
Create a new Run



You will now be at the *select Type and Number* dialog, with focus on the *Engine* you just created or selected above. This indicates that Command View is ready to store the data:

Now CV needs to know the name you want to use for the Session or Run. Click OK.

- CV will offer to name the run *"Run 1"*. Since this was just a practice run, override the default run name *(Run 1)* by typing in "*Practice 1"* Then press Enter or Click OK to accept.



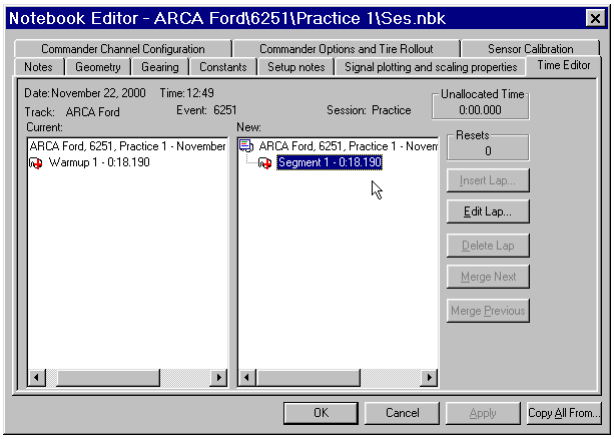
- If you allow it to, CV will continue to automatically increment the run # every time you do another run on this engine, or, you can always manually override this "automatic run

naming" feature by manually typing in a run name, like *"final run after rebuild"* for example.

Examine your times

After download is complete you will see the *notebook editor* for this new data, on the *times* tab.

- Remember when we learned about how notebooks are created in the previous chapter? It was at this instant, when the dialog appeared on the screen, that this notebook was created from your car file.
- You should have only 1 time listed, corresponding to the total time you were recording for.



Load your "practice" data into *Track Master*

Start Track Master if you do not already have it running.

Load the "Shop Data" view

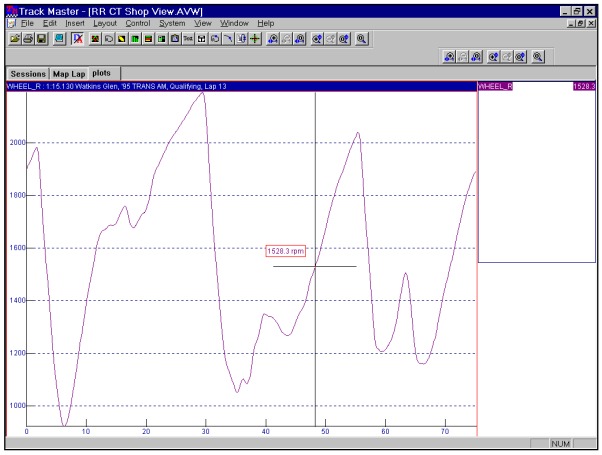
If the view named *Dyno Shop View* is not in your *Select View* dialog, click *Load Other* and choose it.

Load "From last save"

Verifying your practice data

The *Shop Views* are very simple. They consist of 1 signal vs time plot and 1 data display.

- Use all that you learned in Chapter 2 to change data source to your shop data, and load the signals for the sensors that you moved when you recorded the data.



- Work with this until you are both comfortable and satisfied that the data you recorded is the data you are looking at on your screen.
- Note that in the *Dyno Shop View* your data is plotted vs. *Time (in seconds)*. This is to aid you in visualizing the sensor movements that you recorded in this practice run. When we get to recording actual pulls on the dyno, we will be plotting all data vs. Engine RPM instead of time.

Chapter 7 Gather and enter information about YOUR vehicle

In this chapter you will gather and enter all the specific information about your vehicle which Track Master needs so it can perform analysis on your data.

If you are using your system strictly for Dyno data acquisition, you can skip this chapter

Importance of accurate information

Track Master has many built in functions or formulas that calculate results based on data the Commander II records AND based on information you provide and enter into the program.

For example, SPEED (in MPH or KPH) is calculated from WHEEL_R data (recorded) AND the tire circumference (determined and entered by you). Obviously, if either element of information is inaccurate, the result is inaccurate. If you overestimate (instead of measure) your wheel circumference, your SPEED signals will also be ESTIMATES instead of MEASUREMENTS.

In computer work, we call this GIGO, which stands for Garbage In, Garbage Out. Computers are very good at calculating garbage information if they are fed garbage to begin with.

If you carefully measure all the parameters required by TM for your application, you will get very accurate data out. If you do not, you will get Garbage data out

Which functions use the data I enter?

Throughout this chapter See Appendix A for a listing of which functions utilize the information you enter in this chapter.

Entering The Data in your Car File

Start Command Link and click E*dit Car File.* Select your car file and begin reviewing the information you need to enter as described in the next few sections.

Circle Track/Road Race

CT RR

Commander Options and Tire Rollout

You have 3 choices to make in this section. 1) Do I want **AutoRecord** enabled? 2) What is the circumference of the tire monitoring wheelspeed? 3) Do I want my Driver Display enabled?

Enable **AutoRecord** once you become familiar with the use of the Commander II. This feature saves memory space and is often used for the driver who tends to forget to flip the trigger switch on. **AutoRecord** is a feature in the Commander II that will prohibit the Commander II from recording data until its Threshold speed is met. Threshold is in MPH or KPH. When AutoRecord is enabled, the green light on the front of the Commander II will go OUT and will not start to blink (indicating data is being recorded) until the threshold is met. The Trigger Switch must be ON prior to leaving the pits or starting area.

Tire Rollout is the circumference (in inches or centimeters) of the tire monitoring wheelspeed.

If you have a digital driver display and you want to see both your laptime and MPH, check and enable the display. If you have a digital driver display, but you only want to see your laptime, DO NOT enable the display. If you do not have a digital driver display, there is no reason to check this box.

Gearing

The Gearing sheet is used for record keeping and for entering values that TrackMaster uses in some of its analysis functions.

Gears: Select the appropriate number of gears in your engine.

Engine Revolutions Minimum & Maximum values: Enter the ***Minimum RPM*** you desire your engine to be operated at. (This setting is used by TrackMaster to calculate ***Lugging***). Enter the ***Maximum RPM*** you desire your engine to be operated at. (This setting is used by TrackMaster to calculate ***Overrevs***).

Gear/Gear Ratios: Click on the ***Gear Number*** in the list to enter the ratio for that gear. You can enter the ratio as a number or enter the input and output tooth count. Input all the gear and final drive ratios.

Constants

Session Constants are used primarily in math channel formulas. This feature allows you to write generic math channel formulas and custom tailor them to a specific car or setup by embedding these session constants into the formulas. Use this feature for items that change from session to session, such as ride heights, spring rates, etc.

Fetch System Defaults allows you to use the system default constants in TrackMaster 2000. (You can view them by loading TrackMaster, hit Cancel when asked to Select a View, go to System, go to Options, go the Constants).

Copy Page From… allows you to copy constants from another session notebook.

Drag Race

DRAG

Commander Options and tire rollout

You have two choices to make in this section. 1) Should I enable Auto Launch Detect and at what speed Threshold? 2) What is the tire circumference of the driven wheel?

Auto Launch Detect **should always be used in drag racing applications**. Enable Auto Launch Detect to mark the start of the RUN when the speed threshold is reached. The purpose of Auto Launch Detect is to separate the data into *Stage, Pass,* and *Cooldown* segments. Set the ***Threshold*** (in MPH or KPH) to a desired value (usually 10 or less).

Put your Driven wheel (usually the rear wheel) circumference in the *Tire Rollout* box. Since RPM1 on most drag racing Commander II systems is set for driveshaft RPM, make sure you enter your **Final Drive Ratio** on the **Gearing** page of the car file.

Gearing

The Gearing sheet is used for record keeping and for entering values that TrackMaster uses in some of its analysis functions. The individual Gear Ratios and the Final Drive ratio (along with the ENGINE_R and SHAFT_R signals) are used to calculate the **CLUTCH_SLIP** signal.

Gears: Select the appropriate number of gears in your engine.

Engine Revolutions Minimum & Maximum values: Enter the ***Minimum RPM*** you desire your engine to be operated at. (This setting is used by TrackMaster to calculate ***Lugging***). Enter the ***Maximum RPM*** you desire your engine to be operated at. (This setting is used by TrackMaster to calculate ***Overrevs***).

Gear/Gear Ratios: Click on the ***Gear Number*** in the list to enter the ratio for that gear. You can enter the ratio as a number or enter the input and output tooth count. **Input all the gear and final drive ratios**. The Final Drive ratio is used by the Auto Launch Detect function.

Constants

Session Constants are used primarily in math channel formulas. This feature allows you to write generic math channel formulas and custom tailor them to a specific car or setup by embedding these session constants into the formulas. Use this feature for items that change from session to session, such as ride heights, spring rates, etc.

Fetch System Defaults allows you to use the system default constants in TrackMaster 2000. (You can view them by loading TrackMaster, hit Cancel when asked to Select a View, go to System, go to Options, go the Constants).

Copy Page From… allows you to copy constants from another session notebook

Chassis Animation & Analysis option

CT RR

Geometry

Geometry information is used to generate the Chassis Animation and suspension signals, such as ride heights and shock speeds. It is only available if you have the Suspension Analysis option enabled on your software key.

All motion ratios are in distance (in inches or centimeters) of travel per distance (in inches or centimeters) of wheel travel. The ***Shock Motion Ratio*** is how much the shock moves when you move the wheel 1 inch (or centimeter). The ***Sensor Motion Ratio*** is how much the sensor moves when you move the wheel 1 inch (or centimeter). Input whether the sensor *Extends* or *Compresses.*

The ***Static Ride Heights*** are measured from the ground to the plane of the floor of the car (the chassis plane). These numbers are used to draw the reference plane in the suspension animation. Have either the driver or equivalent weight sit in the driver's seat. The chassis plane you measure should be parallel to the floor or bottom of the chassis.

Measure the ***Track Width*** from tire center to tire center. Measure the ***Wheel Base*** from axle to axle.

Animation Scale controls the amount of exaggeration when showing the suspension animation plane. (1 = no exaggeration, very hard to see the movement, 5 to 9 typical settings).

Constants

Session Constants are used primarily in math channel formulas. This feature allows you to write generic math channel formulas and custom tailor them to a specific car or setup by embedding these session constants into the formulas. Use this feature for items that change from session to session, such as ride heights, spring rates, etc.

Fetch System Defaults allows you to use the system default constants in TrackMaster 2000. (You can view them by loading TrackMaster, hit Cancel when asked to Select a View, go to System, go to Options, go the Constants).

Copy Page From… allows you to copy constants from another session notebook

Data for additional formulas supplied with user math option

Constants

Chapter 8 Recording data at the track

In this chapter you will learn all the key points for successful operation of your system at the race track. These are the steps you should follow each and every time you run your system.

If you are using your system strictly for Dyno data acquisition, you can skip this chapter

Preparation – key to success

Setting up your beacon & receiver

CT RR

It is important that you properly align your in-car receiver with the trackside beacon so that the Commander II can divide your recorded data into laps. Both the beacon and receiver have a 16 position rotary switch to select a channel number. Select a channel that is currently not in use by others and set both the beacon and receiver to that channel.

We recommend you install the beacon on a standard camera-type tripod. A threaded bushing is located on the bottom of the beacon for that purpose.

- Locate the beacon between 20-120 feet away from the vehicle path
- Locate the beacon at least 15 feet away from other beacons (of ANY manufacturer)
- Set up the beacon at the same height above ground as the receiver in the vehicle
- Aim the beacon to that it is parallel to the track surface
- Connect the beacon to a freshly charged 12V battery with at least 20 amp-hrs rating. There is an LED on the side of the beacon which indicates the battery status. A slow blink indicates the battery voltage dropping, a fast blink indicates the battery is low and the range is reduced.
- Locate the beacon at approximately the same location on the track from day to day and event to event. You want to keep the "start" reference as close to the same as possible.

The in-car receiver receives a modulated light beam signal from the trackside beacon. Each time the receiver "sees" the beacon, a lap time is recorded.

- Mount the receiver to the car so that it is not sensing the beam through glass or Plexiglas.
- Mount the receiver so that it is aimed parallel to the racing surface.
- Mount the receiver so that it is shielded from direct sunlight.

If you experience erroneous photo trips or are missing lap times, check your Commander II Hardware manual for guidance.

REMEMBER TO RETRIEVE YOUR BEACON FROM THE TRACK BEFORE THE END OF EACH DAY.

Edit your *Car File*

CT RR

DRAG

Prior to arriving at the track, you should have reviewed your car file (see Chapter 4). Since the contents of the *Car File* get copied to the *Signal Notebook* when you download, it makes sense to put as much information as possible into the *Car File*, rather than making changes to individual *Signal Notebooks* afterwards.

Changes made to a *Car* File will have absolutely no effect on data WHICH HAS ALREADY BEEN DOWNLOADED, ONLY TO DATA THAT IS YET TO BE RECORDED.

DO NOT change the working *Car File* prior to downloading any data. This will cause an TrackMaster error of …….

If you have the ***Suspension Analysis option***, make sure that you have entered the proper springs rates (on the *Constants* tab) and Motion Ratios (on the *Geometry* tab).

On the *Gearing* tab, select the proper number of gears the vehicle has. Click on the Gear number in the list to enter the ratio for that gear. You can enter the ratio as a number or enter the input and output tooth count. It is important that you enter a *Final Drive* ratio.

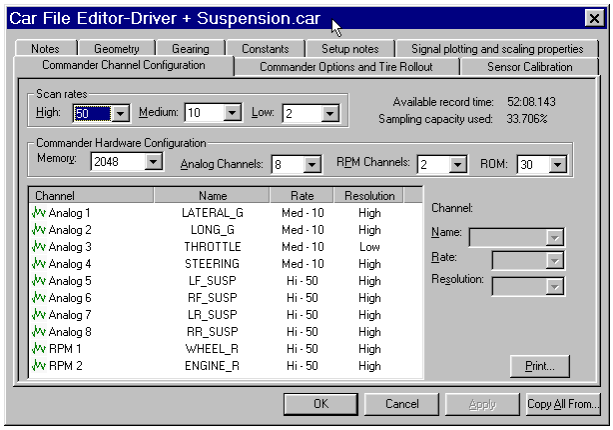
Each time you change springs or gears, you must change the appropriate values in the *Car File*.

Scan rate

Select your ***High, Medium, Low,*** and ***OFF*** scan rates from the list. *OFF* will disable the channel and no data will be recorded on that channel only.

It is not necessary to use a *Medium* or *Low* scan rate in your setup. The purpose of having them is to conserve memory and maximize ***Available Record Time***.

Enabled channels



The enabled channels in your car file are the listed channels that have designated scan rates.

You may have many more channels available in your Commander II that you are not using. Simply disable those channels by turning the scan rates *OFF*.

If you add a sensor to your system and need to add that information to your car file, click on the down arrow at the Analog Channels in Commander Hardware Configuration, select the next highest number of analog channels, select the designated analog channel, and give it a name, scan rate and resolution. (Note: CDS provides sensor calibration sheets for each new sensor added to a system). Turn OFF any channels that you are not using or do not have available to you.

Available record time

Available Record Time is the maximum length of time you can record based on the *COMMANDER II* memory and the recording configuration (enabled channels, scan rates and resolution) you have set.

If the *Available Record Time* is not adequate for your needs, you must either adjust the scan rates or contact Competition Data Systems to change the memory size of the Commander II or obtain a new memory card.

Sampling Capacity Used

Sampling capacity used tells you what fraction of the total recording speed capability of the *COMMANDER II* you are using with this recording configuration.

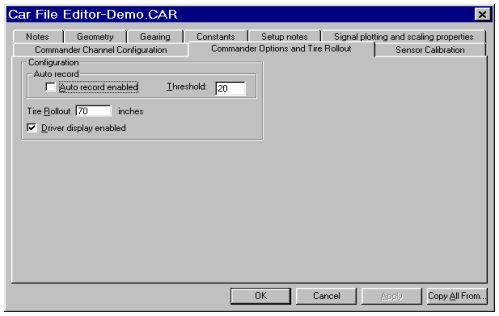
If the *Sampling capacity used* exceeds 100%, the recording configuration cannot be used.

To reduce the *Sampling capacity used*, try any of the following:

- If you are using 3 *Scan Rates*, try to combine the *Low* and *Medium* channels to just ONE *Scan Rate.*
- If you are using 2 *Scan Rates*, try to combine them into the *High Scan Rate.*
- Sample all RPM channels at 1 common *Scan Rate.*
- Reduce the total number of enabled channels.
- Reduce the *High Speed Scan Rate.*

Auto Record Option (Circle Track & Road Race)

CT RR



The ***Auto Record*** feature causes the *COMMANDER II* to start recording AFTER a speed *Threshold* is reached. The purpose of this is to conserve memory. To activate this feature, go to the *Commander Options and Tire Rollout* tab of your *Car File* and check the box.

Set the speed *Threshold* in MPH or KPH to the desired value.

When using the *Auto Record* feature, you still have to turn on the *COMMANDER II* trigger at the start of the session. The green light on the *COMMANDER II* go out and will not start to flash UNTIL the speed *Threshold* is exceeded.

If there is a problem with the **WHEEL_R** signal (RPM 1 channel), the speed *Threshold* will never be EXCEEDED and no data will be recorded. Make sure the WHEEL_R signal is working.

Auto launch detect (Drag Racing)

DRAG

The ***Auto Launch detect*** feature causes the *COMMANDER II* to mark the start of the **RUN** when the speed *Threshold* is reached. The purpose of this feature is to separate the data into *Stage*, *Pass*, and *Cooldown* segments. To activate this feature, go to the *Commander Options and Tire Rollout* tab of your *Car File* and check the box.

Set the speed *Threshold* in MPH or KPH to the desired value. This *Threshold* speed is determined by the signal into RPM 1 of the COMMANDER II.

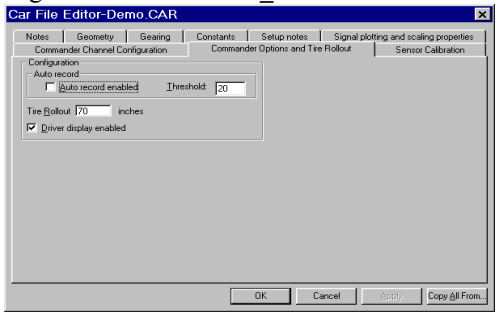
If you are not getting a signal on RPM 1, then the speed *Threshold* will never be exceeded and no start of run mark will be placed in the data. If this happens, you still have data, but you will need to manually determine the start of the run. This will be discussed later in this chapter.

Tire rollout

CT RR

DRAG

Tire Rollout is the circumference of the tire corresponding to the **WHEEL_R** signal. IT IS VERY IMPORTANT THAT THIS VALUE IS CORRECT. The circumference is measured in inches or centimeters. This value is used by *TrackMaster* to convert the signal named **WHEEL_R** to **SPEED** and to calculate live SPEED for the driver display. The value is also used by *TrackMaster* to determine DISTANCE.



Driver display

CT RR

If you purchased a Digital Driver Display for the *COMMANDER II*, you must enable its use by checking the box for ***Driver display enabled***. The display will show LIVE speed while on the track, EXCEPT when you pass the BEACON. When you pass the beacon, the laptime will be shown on the Display for about 8 seconds.

If you ***disable*** the Display (un-check the box), the Display will show laptimes only.

CT RR
DRAG

Keeping track of changes with the *Car File*

As was mentioned before, the contents of the *Car File* get copied to the *Signal Notebook* when you download, therefore, it makes sense to put as much information as possible into the *Car File*.

Entering Notes in the *Car File*

There are two different Note tabs available in the *Car File* – the *Notes* tab and the *Setup notes* tab. The usage of all notes in the notebook is optional. If you get in the habit of using them, you will be better organized. Usage of the notes tabs has the advantage of keeping your records attached to the data they apply to.

The *Notes* tab is for general notes and should be brief. If you have multiple drivers, you will want to make sure the driver information is correct. You may want to record the weather conditions, tire compound, engine serial number, or any applicable information.

The *Setup notes* tab is for more explicit notes concerning the vehicle's setup, such as tire pressures, corner weights, setup changes or other related information.

Upload configuration (internal memory *Commander II*)

Upload Configuration means send the Car File to the internal memory COMMANDER II using the serial communication cable (aka, download cable). You should have previewed the *Car File* and made all the necessary changes prior to this step.

The procedure is:

- Turn the COMMANDER II power ON and the TRIGGER switch if OFF.
- Connect the PC to the COMMANDER II using the serial communication cable provided with the system. The serial communication cable is specially manufactured to communicate with the COMMANDER II and cannot be purchased from a computer supply store.
- Open Command Link and select *Upload Configuration*.
- Select and *Open* your *Car File*.
- "Commander II operation successfully completed" will indicate the transfer is done.

Prepare memory card for recording (memory card *Commander II)*

Prepare memory card for recording means send the *Car File* to a formatted memory card. This also erases any old data currently on the memory card. You should have your memory card slot designated per instructions in Chapter

The procedure is:

- Insert a formatted SRAM memory card into the PC's PCMCIA card slot.

- Open Command Link and select *Prepare memory card for recording*.
- Select and *Open* your *Car File*.
- "This will permanently erase all data on the memory card", select *OK*.
- "Commander operation successfully completed" will indicate the transfer is done.
- Turn the COMMANDER II power ON and insert the memory card – NEVER insert the memory card into the COMMANDER II if the COMMANDER II power is off.

Calibrate your sensors

*Sensor Calibrate…*allows you to change the relationship between the electrical output of the sensor and its corresponding engineering units. For most CDS supplied sensors, it is unnecessary to run the interactive calibration. Simply enter the electrical and engineering values that come with the sensors into the *Sensor Calibration* tab in the *Car File*.

Which sensors to calibrate interactively

The throttle and steering sensors are two sensors that must be interactively calibrated. If you have a brake displacement sensor should also be calibrated. Do the following procedure for each sensor to be calibrated:

- Click on *Sensor calibrate…*
- Click on the name of the sensor to calibrate
- Click on *Begin Calibrate*. The reading will fluctuate – this is the voltage reading.
- Position the sensor for the first reading and click on Take Reading. Input the engineering value for that reading. Proceed with as many readings as necessary. Most CDS sensors are linear and require only two readings.
- When done, click on *End Calibrate.* If you made a mistake during the calibration, click on *Abort Calibration*.
- If you have more than one sensor to calibrate, click on the second sensor to calibrate and follow the above.
- When you are done calibrating all the sensors needing calibration, click on *Done*.

Zero your sensors

Capture Zero Readings allows you to apply an offset to a signal(s) that you select to cause them to read zero at a particular point. To Capture Zero Readings:

- Click on *Capture Zero Readings*
- Click on the signal name or names of the sensors to be zeroed.
- Click on *Zero*. If you made a mistake, click on *Un-Zero*. When finished, click *Done.*

Which sensors to zero

Use this feature to zero your steering, G, aero pressure, and suspension sensors when the car is sitting at static ride height with the steering wheel straight ahead and no one is touching any of the controls.

NEVER use this feature on signals whose source is a thermocouple or on RPM sensors. Both of these sensors have fixed offsets and zeroing them will cause them to give erroneous readings.

Verify operation of key sensors

View Live Readings... allows you to see live sensor readings, in engineering units. Calibration and zero offsets are applied to the readings so that you can verify that all your sensors are set up as you want them to be. Depress the throttle, move the steering wheel, and shake the car so that you can see that all the channels are working properly. If any signal does not respond properly, check that each sensor is connected to its cable and that the channel has a scan rate on.

Send the car out

You have successfully sent the Car File to the Commander II via Upload Configuration or Prepare Memory Card for Recording, you have calibrated and zeroed the necessary sensors, you have verified that the photo receiver is properly aligned and the beacon is setup properly and with a fully charged battery (for road racing and circle track users), you are ready to send the vehicle out on the track.

Start your stopwatch and turn the trigger switch ON before the car leaves the pits. (Position the beacon at the point on the track where you want the laps of data to start. The driver can also turn the trigger on when you want to start recording. Use the AutoRecord feature of the Commander II if you wish). REMEMBER: If you do NOT have Auto Record enabled, the green light on the front of the Commander II will blink at the rate equal to your high speed scan rate. If you have Auto Record Enabled, the green light on the front of the Commander II will go out when you turn on the trigger until you surpass the MPH threshold.

Manually record each lap time.

Make sure to turn the trigger switch off after the vehicle returns to the pits.

For Drag Racing, turn the trigger switch ON after the last burnout (so that you do not “trip” the Auto Launch Detect feature while doing burnouts.

Make sure to turn the trigger switch off after the vehicle returns to the pits.

Download your track data

The green light on the front of your Commander II should be blinking slowly. If it is not, check the trigger switch position and make sure that it is OFF. If the green light is out, you may have a problem with your Commander II (check the Troubleshooting Guide in the Commander II manual) and you need to contact Competition Data Systems or a CDS representative.

1. Connect the download/communications cable from your PC to the Commander II.
2. Open Command Link and click *Download Data.*.

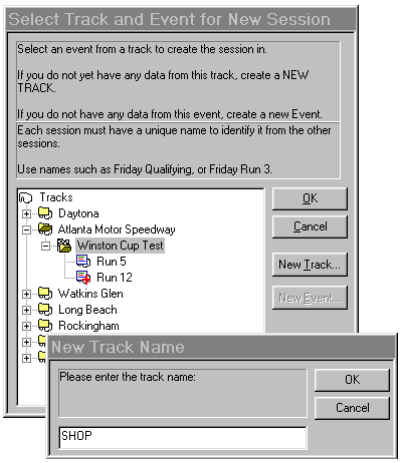
1. Make sure the Commander II POWER is still on and remove the memory card from the Commander II.
2. Insert the memory card into your PC card slot.
3. Open Command Link and click *Memory Card Download.*.

You should recall from Chapter 1 TrackMaster’s data structure

Create a new *Track*

The ***Track*** is the physical track the data is from (ie, Watkins Glen or Daytona). All the data from the same physical track should be stored under ONE track folder.

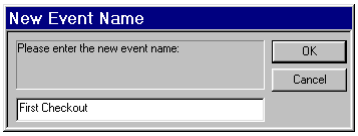
Click the *New Track…*button , enter a track name and click *OK*.



Create a new *Event*

The ***Event*** is the event name when the data was recorded (January 14 2002 Test or 2001 Trans Am Race). Do not include any slashes (/) or commas (,).

Click the *New Event* button and enter an Event Name and click *OK*. Click *OK* again to get to the ***Session*** Name or ***Pass*** Name and enter an appropriate name to distinguish the session/pass from all others for the event (ie, Session 1, Pass 1 or morning practice).



Verify Important information after download

CT RR

After you have successfully downloaded the data, you will see the *Notebook Editor* for the new data on the Lap Times Editor tab. Review the laptimes and check for resets.

If the lap times are correct and you have no resets, click *OK* and continue on.

If the lap times are correct but you have resets, click *OK* and continue on but review your data carefully. If you have 1 reset, it can be caused by starting the vehicle when the Commander II is powered up. If you have many resets, you need to examine your cabling and look for nicks/cuts or distance to ignition wires. You need to examine your sensors to see if any are damaged. You may see dropouts in your data. You need to replace or repair the damaged sensors or cables before taking more data.

If the lap times are NOT correct, you will need to edit them. DO NOT select the ***DELETE LAP*** button. Deleting laps will also delete data – you don't want to do that. You should review the laptimes taken with the stopwatch and compare them to the listed times. Very short lap times recorded, such as times of less than 8 seconds, mostly likely are attributed to a faulty trigger switch. Long lap times are caused by the beacon not tripping the receiver and often attributed to misalignment of the beacon and receiver or the signal "washed out" from another encoded beacon too close to yours. Go to the Commander II Hardware Manual troubleshooting guide for possible solutions.

DRAG

For Drag Racing, after downloading is complete, you will see the *Notebook Editor* for the new data on the Pass Times tab. The *Entered Time* is the sum of the Launch Time plus the Elapsed Time. The *Launch Time* is the time when you or a crew member first turned the Commander II trigger ON to the time the vehicle left the starting line.

- Type in the *Elapsed Time* from your time slip. This is very important because it is used by TrackMaster to determine how much data to plot for the Pass.
- Enter the *Reaction Time* from your time slip. This is only for record keeping and not used by TrackMaster.

- Enter the *60 ft. Time* from your time slip. This is used for record keeping and for placing the 60 ft. marker on X-Y plots.

Lap times

CT RR

You have 5 options in the Lap Time Editor.

Insert Lap – insert a lap **following** the highlighted lap

Edit Lap – edit the lap time (___minutes) : (___seconds)

Delete Lap – delete the lap data

Merge Next – merge the time and data from the highlighted lap to the lap **following**

Merge Previous – merge the time and data from the highlighted lap with the lap **previous**

If the lap time editor shows only one lap time for the session, click **Insert Lap** for each recorded lap and input a lap time.

If it appears that the beacon "missed" triggering the receiver for some lap(s), you need to **Edit** the lap time and **Insert** the time for the "missed" lap.

If you have many short laps, it is easier to **Merge Next** or **Merge Previous** all the laps and **Insert** lap times.

DRAG

Drag Racing – Manually Determining the Start of the Run

If you did not have Auto Launch Detect enabled when you recorded data, or if you had a problem with the RPM 1 signal such that the Auto Launch Detect threshold was not exceeded, then you need to follow these steps:

1. After downloading the data, you will notice that the Launch Time will be equal to the Recorded Time.
2. Enter your ET as you normally would and click OK
3. Open TrackMaster and plot Engine RPM and/or Shaft RPM from the STAGE segment of the run. It will show STAGE and PASS data all in one plot.
4. Move the cursor to the point on the plot that looks like the start of the run, based on your previous experience of analyzing data.
5. Refer to the upper left corner of the info Window and note the time at this cursor position.
6. Go back to the Notebook editor in TrackMaster (either through the File Menu or through the plot's Speed Menu) and select the Pass Times tab. Type in the time noted in Step 5 and click OK.

Now when you plot the Stage data from this pass, it should only display Stage data, and when you plot Pass data, it will show you Pass data.

System resets

Resets are an indication that there is a low battery power or an electrical interference problem. You may get a reset if you start your vehicle while the Commander II is on or if your battery voltage falls below 11 volts. You may get a reset(s) if you have run your sensor cables too close to ignition wires and are picking up noise. You may get a reset if the Commander II is resting or rubbing against the metal frame

of your vehicle. You may get resets if a sensor is shorting out. You want to find the source and eliminate all system resets sources.

Unallocated time (data)

Using the Min/Max report generator in Command Link

You must check the *Show session minimum/maximum/average report after download* box in the Command Link *Options* tab in order to display immediately following download a text report.

Using the *Auto Update* option in Command Link

If you enable Auto Update in Command Link, you must have TrackMaster running prior to initiating the download. TrackMaster will automatically display new data as soon as download is completed.

Verify key signals and have a track map generated first

Enable after your first session of the day

Chapter 9 Using *Command View* on Dynos

DYNO

This chapter is specifically for people who are using their Commander II system with Track Master, Command Link and Command View as a complete data system on a dyno.

Overview

The Commander II along with Track Master, Command Link and Command View, make up an excellent high accuracy, cost effective dyno instrumentation system. The big difference between the dyno and other Commander II applications is:

- Rather than the Commander II recording and storing data, it simply reads the sensors and sends the readings via serial cable to the PC
- *Command View* records the data direct to the hard drive of the PC, at the same time it is being displayed.
- Consequently, there is no "download" step in the process after recording takes place and before analysis can begin.

Engine Dynos

Most engine dynos, both manually and automatically controlled, can be fitted with a Commander II based acquisition system. Older style dynos which use a hydraulic pressure type load sensing device are retrofitted with a more accurate electronic load cell.

Chassis Dynos

Commander II based systems are used on both inertia only type chassis dynos and the eddy current load controlled type dynos. There are several classes of application:

- Load controlled dynos such as the Mustang Dyno use the Commander II along with CDS software (TM & CV) to add both channels and capability. Most notably, the superior math facility and multi page capability of TM enables advanced users to do the analysis they need to do, and could not otherwise do with the standard instrumentation and software supplied with the dyno. The Mustang has an analog output for the torque signal, so no load cell or inertia calculations are needed on the CDS part of the system.
- The Dynojet inertia dyno has a direct link to CDS systems. In this case all data analysis is done in the Dynojet software. Use of this type of CDS system is covered in a separate manual.
- In the future, users will be able to utilize a Commander II and CDS software as a stand-alone system on inertial dynos such as the Dynojet.

Default formulas

The following describes how torque and power are measured and corrected in dyno applications. These are the "stock" or preprogrammed formulas that the software uses as default.

- These formulas and even the underlying strategy of how things operate can be modified by you if you have the *programmable math* option in Track Master.

How Torque, Power and BSFC are calculated

- The Commander II records a reading from a load cell. Its default signal name is LOAD
- Torque is calculated from the LOAD signal and from a constant called TORQUE_ARM
- Torque is inertia-corrected using a calculation involving the rate of change of ENGINE_R and a constant inertia factor called INERTIA. This correction is completely optional and is disabled by setting INERTIA equal to 0.
- POWER is calculated from TORQUE, ENGINE_R, and a weather correction factor called CORR_FACTOR. You can disable this correction by setting CORR_FACTOR equal to 1.
- BSFC is calculated from corrected POWER, FUEL FLOW (from a flow meter or a math channel)) and a constant named FUEL_DENSITY (Lb/Gallon)

Entering the important constants

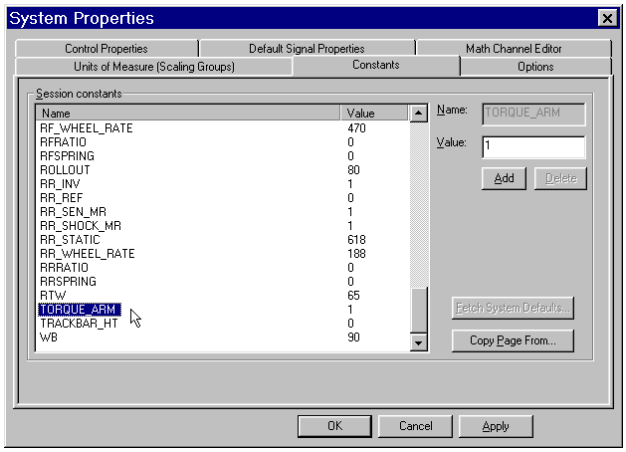
From the above, we see that there are 4 key constants or factors that your data depends on, namely:

- TORQUE_ARM
- INERTIA
- CORR_FACTOR
- FUEL_DENSITY

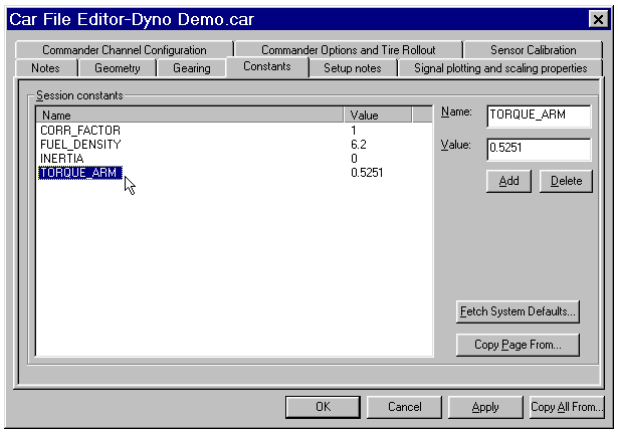
You can enter these constants in several different places in the software, depending on your needs as follows:

TORQUE__ARM

- If your TORQUE_ARM (the distance from the centerline of your drive shaft to the axis of your load cell) never changes, i.e. you do not need to reconfigure your dyno for different engines, then enter your toque arm as a g*lobal* c*onstant* in *Track Master*…*System* menu…*Track Master Options* item.
    - As default, your software is delivered with TORQUE _ARM set to 1
    - TORQUE ARM is in *feet* (when using english units)



- If your TORQUE_ARM will change when you run different motors, then enter it as a *local constant* in your car file
    - Set up separate car files for each of your dyno configurations so that you do not need to constantly edit the value for TORQUE_ARM



INERTIA

- The INERTIA factor depends on the rotating mass of the engine and dyno. If you always test the same types of motors this will not change. If you test motors whose rotating masses may be significantly different, then it will change.
    - In most cases the INERTIA factor will change with changes in the components you use in the engines, so enter it as a *local constant* in your car file.
    - Set up separate car files for each of your engine configurations so that you do not need to constantly edit the value for INERTIA
    - INERTIA is determined from test data as described later in this chapter
    - Disable inertia correction by setting INERTIA equal to 0.

CORR_FACTOR (weather)

- Here is a factor that changes frequently. Keep track of this factor in your car file or in your session notebook.
    - If you do your weather correction before a run, enter the factor in your car file (via *command link*)
    - If you do your weather correction after a run, enter the factor in your *signal* notebook (via *Track Master*)

FUEL_DENSITY

- Generally you know the fuel density before dyno runs, and it stays the same for many runs, so enter it in your car file

Automatic weather correction using electronic sensors

Automatic weather correction using electronic sensors connected to the Commander II is implemented by the user entering the correction formula of his/her choice. This feature requires the *programmable math* option in Track Master.

Run triggers on Dynos

Run triggers are used to "separate" data into "interesting" and "not so interesting" segments. For example, when you do a run with an engine, you warm up the engine, you do the run, and then you bring the engine back down to idle or shut it off. The run triggers will separate this data into the 3 segments.

3 Run triggers are used. Typically, run triggers are math channels set up to return a value of 1 (TRUE) or 0 (FALSE).

After pushing the ***BEGIN RECORD*** button in CV, the program begins looking for the ***START*** run trigger channel to become TRUE (non-zero). When this occurs, CV inserts a time, AND then begins looking for the ***SEGMENT*** run trigger channel to become TRUE (non-zero). When this occurs, CV inserts a time, AND then begins looking for the ***STOP*** run trigger channel to become TRUE (non-zero).

Enabling and defining run triggers

The run triggers can be based on any signal name, but in most cases it is best to simply use the stock or default names and formulas. To enable, go to the *Command View* tab in CL:

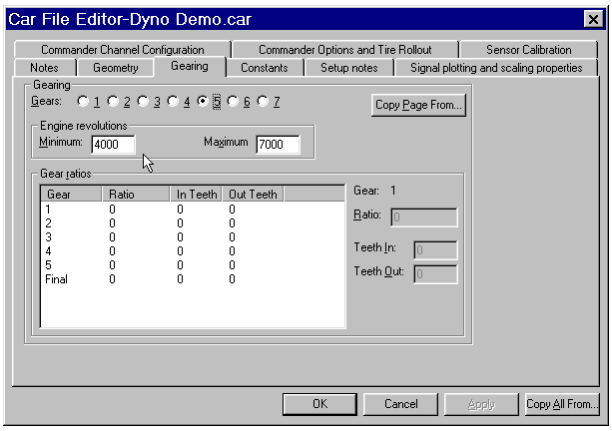
- In the *Run Triggers* section of this dialog, check *Enable*
- Set the *Start, Seg, and Stop* signals as shown above.
- If you wish to use different run trigger signals, create the formulas in the math editor (in TM), then assign them in this dialog

How the default run triggers work

The default run triggers "key" off:

- 1 data signal, ENGINE_R

- 2 Constants, Minimum Engine Revs (MIN_REVS), and Maximum Engine Revs (MAX_REVS). These constants are entered in your car file in the *gearing* tab.



The standard run trigger formulas work as follows:

- The **first** segment of data, named *WARMUP*, begins when you click *Begin Record* in CV and ends when ENGINE_R becomes greater than MIN_REVS
- The **second** segment of data, named *RUN,* begins at the end of the first segment and ends when ENGINE_R becomes greater than MAX_REVS Obviously, this second segment is the one you are usually interested in.
- The **third** segment of data, named *COOLDOWN,* begins at the end of the second segment and ends when ENGINE_R becomes less than ½ of MIN_REVS.

1 run per session

The Dyno version of TM restricts you to 1 engine run per recording event.

Multiple "runs" per session

CT RR

If you have the CT & RR version of TM, you can have as many segments of data per recording event as you like. In that case, the segments will all be called "laps". This is because once the ***STOP*** run trigger has become TRUE, CV cycles back to evaluating the ***START*** channel again. This process continues until the ***STOP*** button is pushed.

Proper use of the run triggers enables the user to make as many runs as they like without interruption, and still separate the interesting data from the non-interesting, in a exact, repeatable fashion.

Preparation for doing a run

Now we will go through all the items that must be correct to successfully record data. Many of these items do not need to be checked or changed every run, but we will go through them here to familiarize you.

Once you have done a few runs you will be able to skip many of these steps, since many items will not change from run to run.

Car file settings

Go to the *Commander Communications* tab of CL. Click *Edit Car File*. Select the car file you have set up.

- If you have just purchased your system, you will have a car file pre made for you which will begin with a 6 digit number of the form 503xxx.

Min and max revs

Click the *gearing* tab and enter the values you want to use for minimum and maximum revs.

- Set your minimum to 100 RPM below where you want your Torque and power graphs to start. Set your maximum to about 100 RPM above where you want your graphs to end.
- NOTE: when you do your run, it must start below the minimum rpm you set and end above the maximum you set.

Weather correction factor

Go to the *Constants* tab

If you do your correction manually before the run, calculate the number and enter it in the *constants* tab.

Inertia correction factor

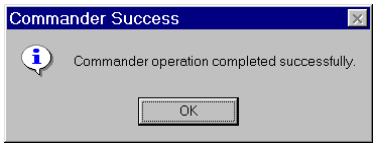
Enter the INERTIA constant. Normally this will not change from run to run, and in fact will not change unless the rotating mass of your engine and dyno changes. If you do not want to use inertia correction, enter 0.

Torque arm

Make sure the TORQUE_ARM value is correct for the dyno configuration you are running.

Complete the Edit

Once you have made all your entries, click OK. Make sure your Commander II is on, and click the *upload configuration* button. You should see:



Calibrating your load cell

Set up a fixture to apply a known torque to your dyno. Calculate what your LOAD value should be at this torque. For example, lets say:

- You have a dead weight torque of 200 Ft-lb applied.
- Your TORQUE_ARM, which acts on your load cell is 6” or .5 foot.
- Your LOAD reading at this condition should be:

LOAD x TORQUE_ARM = 200

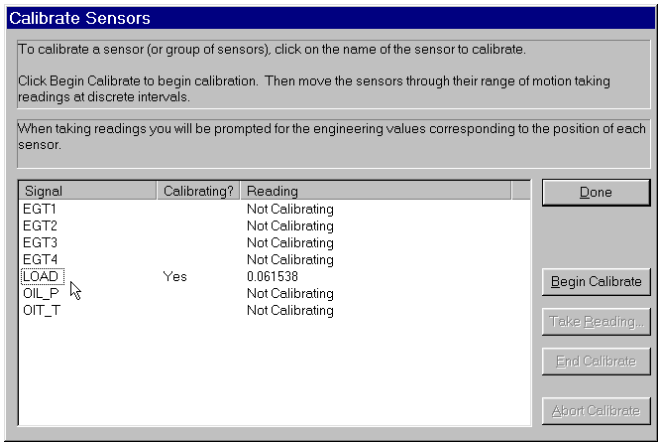
-or-

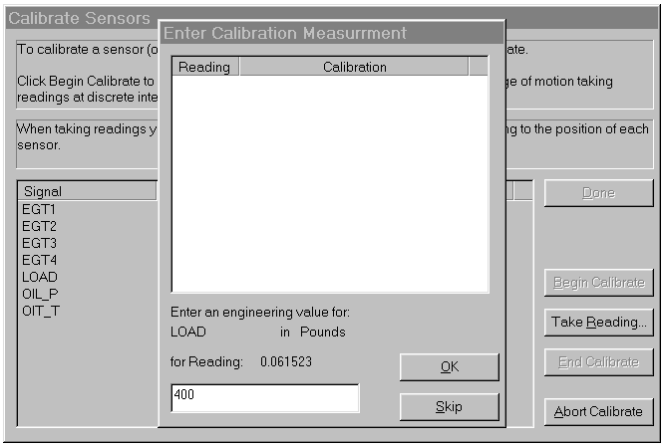
LOAD x .5 = 200

LOAD = 200/.5

LOAD = 400

1. In the *commander communications* tab of CL click *sensor calibrate.* Click on LOAD:

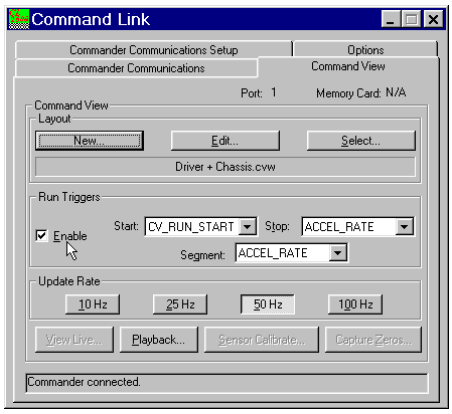




2. Click B*egin calibrate*
3. Click Take reading
4. Enter the engineering value of 400 (pounds) for the point.
5. Click OK
6. Now take the dead weight fixture off the dyno and make sure the brake is free.
7. Click *Take reading*
8. Enter the engineering value of 0 (pounds)for the point.
9. Click OK
10. Click *End calibrate*
11. Click *Done*

- Your load cell is now calibrated. To verify, hang the dead weight again, go into *view live readings*, and your LOAD should show 400 lb. Take the dead weight off and it should show 0 lb.

Command View Settings



Click on the *Command View* tab in CL.

- Verify your run triggers are set as shown:

Update rate selection

Select an *update rate.* Generally you want to use the fastest rate possible, but the more channels you have turned on, the lower the maximum allowable update rate. 50 or 100 Hz are best for dyno work.

- Set the update rate to 100. If the Commander II cannot do 100 Hz with the channels you have turned on, you will receive an error message asking you to run at the next lower rate. This will continue until you get down to a rate the Commander can handle.

Command View layout selection

Click the S*elect* button and select the *Command View Layout* you wish to use.

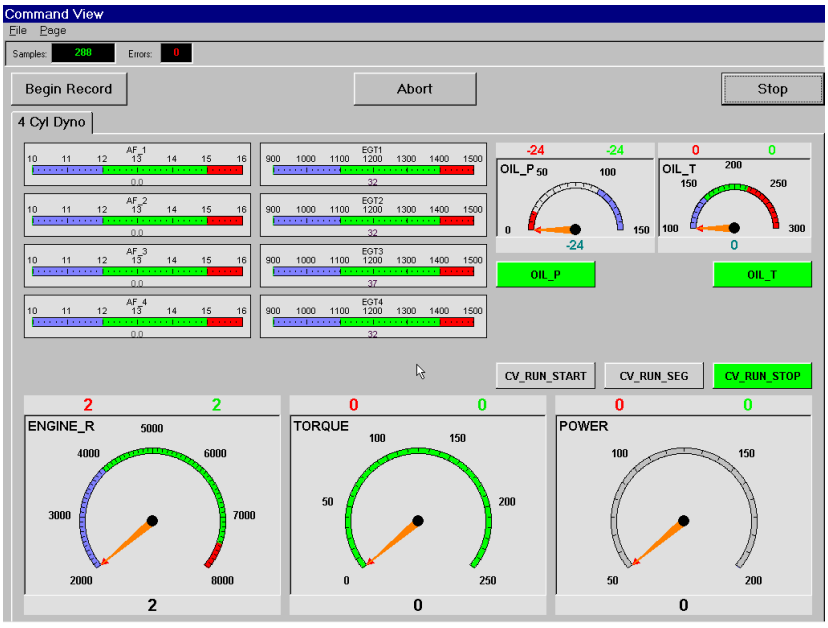
- If you are not sure of the layout, select one and then click *edit* to examine or alter the layout.
- Several sample layouts are included with your program to serve as a starting point.

You now are ready to do your first run

Doing a run

Start the *view live* screen

Click *view live.* You should see a screen with all the gauges "live":



Warm up the motor

Start the motor and warm it up. Observe the gauges on the screen to verify that everything is functioning properly.

Begin recording

Once the motor is warm and all temperatures and pressures are ok, bring the RPM *BELOW* the MIN REVS you set in your car file, and click *Begin Recording* or press **"B"**

IMPORTANT NOTE: The Torque and Power displayed during a run are *indicated* Torque and Power, not *Corrected.* They do not have any inertia correction applied since that correction can not be calculated until after the run.

Let the run triggers do their job

1. Run the engine up through the test, making sure you exceed the MAX RPM you set in your car file.
2. Unload the engine and bring it back to idle.
3. Stop recording by clicking *Stop* or pressing **"S"**

Specify where to store the data

How Track Master organizes data in Dyno mode

Lets review TM's data structure one more time, since it is very important to understand:

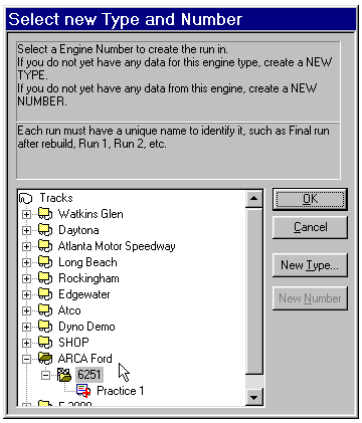
Data is organized by TYPE, NAME or NUMBER, and RUN

- The TYPE refers to ENGINE TYPE if you are testing engines, or VEHICLE TYPE if you are using the system on a chassis dyno. For an engine dyno, possible types might be *F 2000,* or *Cup Restrictor Plate* etc.
- NAME or NUMBER is the serial number of the engine under test, or the name of the customer who owns the vehicle, etc.
- The RUN is the name you give to the recording event such as *Final test after rebuild,* or *Baseline,* or simply *Run 1, Run 2*..etc.

Select or create a *Type* folder

As soon as you stop the recording process, the *select type* dialog will appear. If this is the first run with this *type* of engine, click *new type* and enter the type of motor.

If this is not the first run for this *engine type*, and therefore a folder for this engine type already exists, simply click on it to select it.



Select a *Number* or create a new one

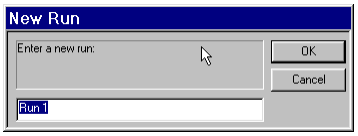
Select the *Engine,* or, if this is the first recording with this engine, click the *New Number* button and type in the engine name or number. Most builders use a serial numbering system for their engines, and this is what you should type in.

Create a new Run

You will now be at the *select new Type and Number for New Run* dialog, with focus on the *Engine* you just created or selected above. This indicates that Command View is ready to store the data:

Now CV needs to know the name you want to use for the Session or Run. Click OK.

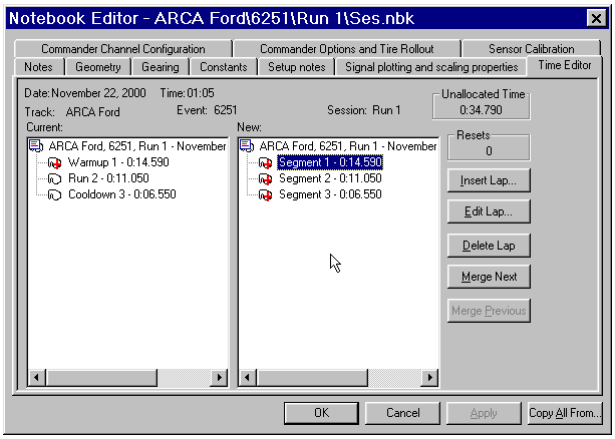
- CV will offer to name the session "*Run 1"*. Click OK to accept.



- If you allow it to, CV will continue to automatically increment the run # every time you do another run on this engine, or, you can always manually override this "automatic run naming" feature by manually typing in a run name, like *"final run after rebuild"* for example.

Examine your Times

After you click OK to store the data, you will see the *notebook editor* for this new data, on the *times* tab.



- Remember when we learned about how notebooks are created in back in chapter 3? It was at this instant, when the dialog appeared on the screen, that this notebook was created from your car file.
- You should have 3 times listed, one each for *warmup, run, and cooldown*.
- If you do not have 3 times listed, something went wrong with your setup or use of the *run triggers*. Review the steps (above) and check your work.

Analyzing the data with *Track Master*

Switch to Track Master, or, if it is not running yet, start it and load your dyno view *from last save.*

- If you are not sure which Dyno view to use as a starting point, Load them one at a time and look through them to see which one most closely matches your needs and use it as a starting point.
- ***NOTE:*** Those users who are used to a DOS environment are in the habit of constantly closing an application when they are done with it. TM and CL are pure Windows

applications, so leave both of them running all the time when you are working on the dyno. Constantly closing and reopening them is nothing more than extra work that will only distract you from the real job at hand.

- Change the *data source* for the *plot* on the first plot page in the *view* to your new data. If you have gone through the tutorial of chapters 1,2,3, and 5 you should be able to do this without further instruction. If you cannot, you need to go back through those chapters BEFORE attempting to continue.
- Proceed to the next chapter, *Starting to analyze your data*

Determining the inertia correction factor

If you wish to use inertia correction you must determine the correction factor by doing a simple experiment.

- You will need a different inertia correction factor for each engine/drive shaft/dyno configuration you run.
- Any time you change the rotational inertia of any portion of the entire rotating mass you will need to re-determine this factor.

The inertia correction concept

The concept used in inertial correction is that as you accelerate the engine, some of the torque produced is used up accelerating the rotating mass, and the rest of the torque is measured by the absorber. When you decelerate the opposite is true, the torque that the absorber measures is equal to the torque produced *plus* the torque it takes to decelerate the rotating mass.

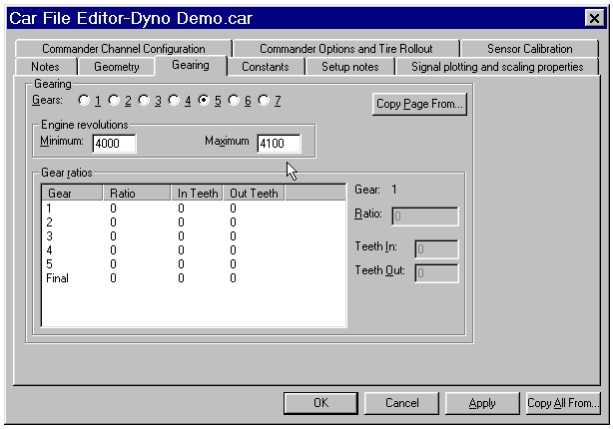
- Consequently, without inertial correction, tests run with the engine accelerating will always produce numbers *LOWER* than numbers produced by steady state tests.
- Without inertial correction tests run with the engine decelerating will always produce numbers *HIGHER* than numbers produced by steady state tests.
- Proper inertial correction results in torque and power numbers that are nearly the same for both acceleration, deceleration, and steady state tests.
- Proper inertial correction will yield results with reasonably good agreement for runs with moderately different acceleration rates. This makes the system usable by those dyno operators who do sweep tests manually (without an automatic rate controller)
- Inertia correction along with good (automatic) control of acceleration rate will yield very good repeatability.
- There are other, higher order (less important), factors that will also affect the agreement of readings for acceleration and deceleration. Those are not accounted for in the standard CDS supplied formulas, but of course with Track Master programmable math option, the user is free to explore and implement schemes and formulas to take these other factors into account.

Do a special type of run

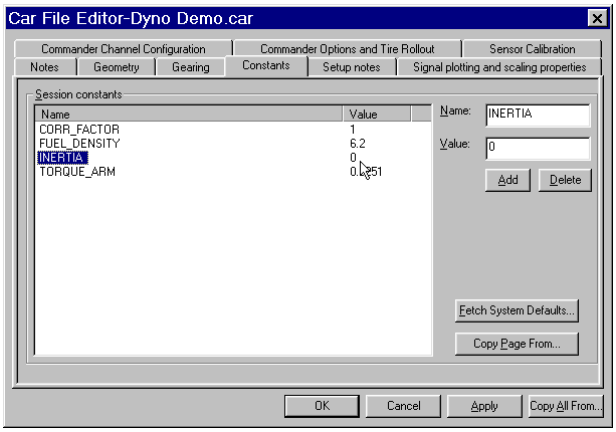
To get the data you need to figure the inertia correction factor (INERTIA), you must get a run of data both accelerating and decelerating *AT THE SAME ACCELERATION RATE!.* Here is how to do get this data:

Manually controlled dynos

1. Edit your car file, go to the *Gearing* tab and change your Maximum RPM to 100 rpm greater than your minimum RPM, then click APPLY.



2. In the CONSTANTS tab, enter 0 for your INERTIA constant, then click OK.



3. Make sure your run triggers are enabled, with the standard Dyno run triggers set. See the previous section in this chapter titled **Enabling and defining run triggers** if you are not sure.
4. Start the motor, warm it up, and do a run where you let the engine accelerate up past your normal maximum and then using the load control valve, bring the rpm back down below your starting point.
5. Let the engine return to idle, click STOP in CV (or press “S”), store your data.

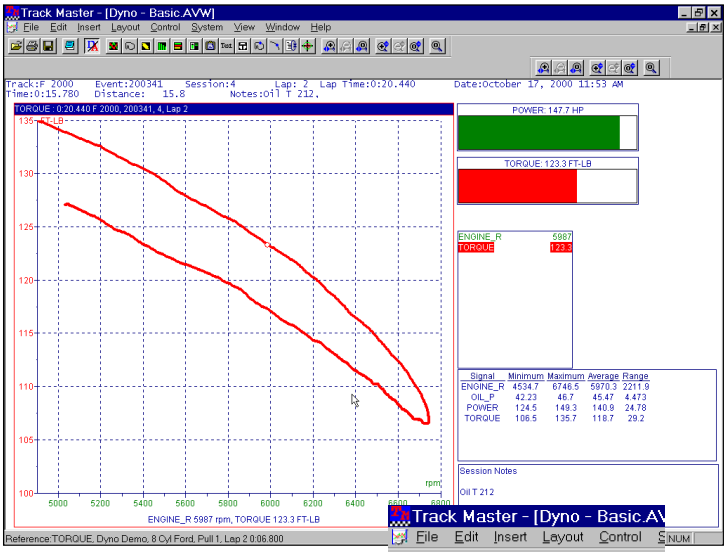
Dynos with rate controllers

You will most likely need to do 2 runs, one accelerating and one decelerating.

Plot the data

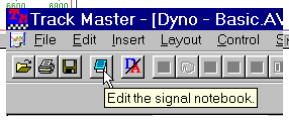
NOTE: When you examine your *Times* after storing your data, you will see a very short time for the *Run,* and a long time for the *Cooldown.* This is because of the way we set the run triggers to capture data going up and going down. All of your actual run data will be in the *Cooldown* segment.

In Track Master, in a Signal vs Signal plot, put ENGINE_R on the X axis and TORQUE on the Y axis. Make sure you plot the data from the *COOLDOWN* segment. You should see a loop of Torque:

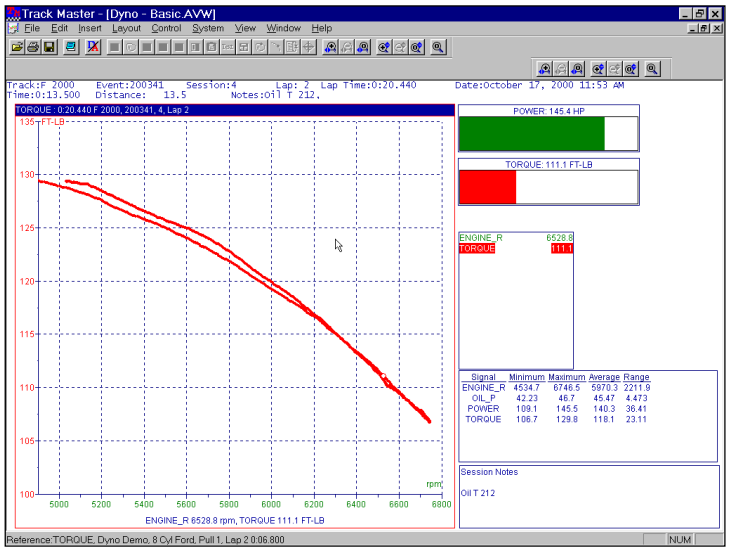


Determine the factor

Now we will determine the correction factor by trial and error.



1. Have focus on the Torque plot. Click the *Edit Signal Notebook* tool:
2. In the Constants tab, type in a value for INERTIA. Start with a value between .005 and .02 Click OK. The plot will automatically update.
3. The goal is to get the Torque “loop” to lay over itself essentially becoming 1 line.
4. Repeat the above process, increasing and decreasing the INERTIA factor until you get as close as possible to 1 line:



5. It will be nearly impossible to get the loop to exactly lay over itself at all RPM values, particulairly if your dyno is manually controlled. Try to get the best possible agreement *at the RPM where your engine produces maximum power*
6. Once you have determined the INERTIA constant for this engine configuration, enter it in your car file so that all future data will use it.

7. Repeat the above process to determine INERTIA for any other engine types you need to test.
8. VERY IMPORTANT: Once you are done determining the INERTIA constant, re-set the Maximum RPM setting in the *gearing* tab of your Car file.

Chapter 10 Starting to analyze your data

In this chapter you will begin to analyze your actual track data using one of the Views supplied with Track Master It is assumed at this point that you have good familiarity with all the material presented in the previous chapters. Refer back to earlier chapters if you need help with the mechanics of plotting and manipulating the data.

Load your data into *Track Master*

CT RR
DRAG

You can create your own View or select an existing View, but you want to select the most appropriate view to display the data obtained from the sensors that are on the vehicle. When you open TrackMaster, you will be prompted to Select View and the list will be the four most recently loaded views ordered from the most recent one at the top of the list. You can select one of those views, load another view not on that list, create a new view, or cancel.

Load an existing view

Select one of the four listed Views or one from the *Load Other* list.

Choosing which *View* to load

- If you previously created and saved a view with data from the track you are at, select that view.
- If you have not previously saved a view but use one of the preprogrammed views from CDS, select the best view for the data acquisition's system configuration. Basic views (including Circle Track and Road Racing Templates) display the G, throttle, steering, RPM and speed information. The Advanced views (including Daytona, Atlanta, Watkins Glen, and Long Beach) display data with the basic channels plus the suspension channels. The Drag racing views (including AHDRA, Pro Mod Car, and Alcohol Funny car) display the EGT, clutch slip, and other drag racing related information.
- If you load a view and you do not have the associated data recorded (ie, you don't have those sensors on the vehicle), you will get some blank areas in the view when you load it.

Load "*From Last Save*"

Once you have loaded a view, you will see the *Start Analyzing* dialog that enables you to choose which data to load into the view you selected. ***For drag racing, it is easier to simply select From Last Save*** and then change the Data Source to your downloaded data. ***For circle track and road racing, if you have previously been to a track, select From Last Save. If you are new to a track, select New Data.***

Using ***From Last Save***

1. Load a View and select ***From Last Save***.
2. Data from the last time the view was saved will be displayed. Simply right-click on the mouse on the current plot page, select ***Data Source signals…***and select the current session data. Read the title bars on the plots to make sure that the data source has changed. You need to check each plot because some may not be data source linked.
3. If you selected From Last Save for a totally different track that is displayed in the View, you will be asked if you would like to update the map lap to the selected data source,

select ***Yes***. You then must change the data source for each plot not data source linked to the original. Realistically, if you are at Rockingham and you load the Daytona view (with Daytona data), it is best to select ***New View*** instead of ***From Last Save***. You will most likely not make any mistakes this way

Load "*New Data*"

If you load a view and the track is NOT the track associated with the view, you should select *New Data.* Follow these steps to import the data properly:

1. Load a View and Select ***New Data***.
2. The *Edit REFERENCES for View* will appear. Select ***Replace Reference*** and select a lap from the newly recorded data from the Track/Event/Session list options. Click ***OK***.
3. The *Edit REFERENCES for View* will reappear. Check that the proper Track/Event/Session/Lap you selected previously is displayed and click ***OK***.
4. a) For Road Racing and Circle Track users, *Choose new MAP LAP* will appear. Select a good lap to use as a map lap and click ***OK***.

b) For Drag Racing, *Choose Pass* will appear. Select the pass and click ***OK***.

5. *Choose new DATA SOURCE* will appear at least once and sometimes many times. Make sure the data source is correct and click ***OK*** until the blinking screens stop blinking.
6. Your view should be loaded with the current data.

Setting up the map

CT RR

If it is the first time you have recorded data at a track, TrackMaster 2000 will automatically select a lap of data to construct a map. It will assume that the type of map is *Normal* and its direction is *Counterclockwise.*

If you load a view using data "*from Last Save*", you will get a previous session's Map Lap. This is okay to use if the *Starting Line* is approximately the same for both sessions.

If your map does not look correct, the most common reasons are:

- The *Direction* or *Type* is incorrect
- The data does not represent a full lap of valid information
- The wheel rollout, calibration, offset or multiplier in the notebook is incorrect
- The Lateral G calibration, offset, or multiplier in the notebook is incorrect or there is a problem with the signal sent to the Commander II (check the cable and sensor for problems)

Choosing the *map lap*

Always set the *Map Lap* to a representative lap from the Track you are analyzing. This does not have to be the fastest lap, simply a good lap. To change a Map Lap, click on *Select Map Lap…* and select the appropriate lap of data.

Setting the *Track Type* and *Direction*

There are four different Track Types:

1. Normal is a closed circuit with a total of 360 degrees of recorded rotation
2. Bridge is a closed circuit with a total of 0 degrees of recorded rotation
3. Loop is a closed circuit with a total of 720 degrees of recorded rotation
4. Open is an open or straight circuit

In North America, most Road Racing and Circle Track circuits are Normal type. To change the *Track Type*, simply click on the down arrow and select the appropriate track type as described above.

There are two *Directions*, Clockwise and Counterclockwise. Most Road Racing circuits in North America are in the clockwise direction. Most Circle Track circuits are in the counterclockwise direction. To change the direction, simply click on the down arrow and select the proper direction.

The Segment toolbar

The Segment Toolbar has four buttons.

1. Add 1 Segment. Simply click on the Add 1 Segment button and click on the map where you want to add the segment but you must see an arrow and flag symbol before clicking. 
2. Delete 1 Segment. Simply click on the Delete 1 Segment button and click on the segment you want removed when you will see an arrow and a flag that is X'd. If you do not see this symbol before you click, the segment will not be removed and you need to do it again. 
3. Auto-Segment the track. Simply click on the Auto-Segment button and the map will generate many segments based on the data from the Lateral G sensing a straight and a turn. 
4. Clear All Segments. Simply click on the Clear All Segments button and the map remove all segments. 

Segmenting the map

Segmenting the map is a personal preference. TrackMaster will automatically segment the track into straights and turns by selecting the Auto Segment key, however, TrackMaster may create many more segments than you want or need. Your options are to then delete the segments that you DON'T want or to clear all segments and manually add segments to the areas of the track that are most important to you. REMEMBER: you must attach a *Marker Scheme* to each segment if you are interested in looking at that particular data in a report.

Map *adjustments*

Map adjustments are available to adjust and rotate the track map. There are two buttons to adjust the straights, two buttons to adjust the turns, and two buttons to rotate the map.

Changing the *Data Sources* for each plot

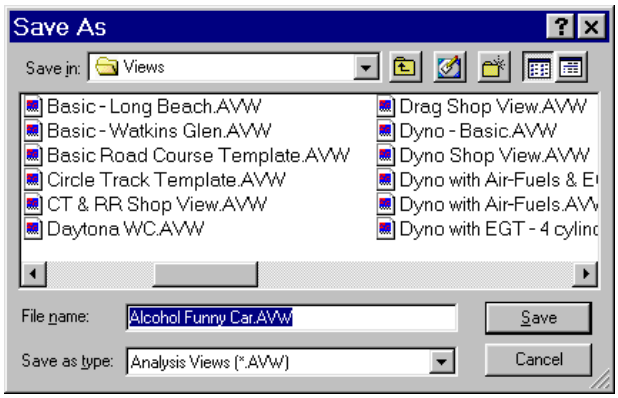
CT RR

ight click on ANY plot and a contact sensitive menu (CSM) will appear. Select *Data Source signals…* change its data source. The title bar above each plot will identify the track, the event, the session, and the lap or pass. It is best to look at the title bars when reviewing data.

Saving the view with a new name

When you go to a new track and record data, you should always save that view you displayed the data on using the track name you are at (ie, Watkins Glen Long Course, Rockingham, Edgewater). To do this,

1. Go to **File**
2. Select **Save View as…**
3. Type in a descriptive name at the **File Name:** prompt.
4. Make sure that you are saving it in the ***Views*** folder and the **Save as Type** is Analysis Views (*.AVW)
5. Click the ***Save*** button.



Exploiting saved views as "shortcuts"

Using a Saved View will save you time. By

Comparing 2 laps at once

Using the *Reference*

Setting a *reference lap*

To set a reference lap, you can

Activating the *reference*

Using the *Quick Compare*

Clearing the *quick compare* signal

Time Compare

Cumulative time compare

Comparing more than 2 laps at once

Using *over plots*

Clearing *over plots*

Changing the signals which are plotted

Using the *scratchpad* page

Chapter 11 Using the *Car File & Session Notebook*

In this chapter you will learn all the details of how the Session Notebook affects and controls how data gets used and plotted in Track Master.

Introduction

First, review key concepts introduced in previous chapters:

- Each time you download a Commander II (either by wire transfer or memory card) a *session* is created.
- There is 1 notebook for each session

Notebook tabs already covered in Chapter x

Record keeping

Good record keeping is an important key to always having good data. You should always note the weather condition. You should note the tire condition, corner weights

Should I enter my notes in my *Car File* or *Session notebook?*

Notes entered in a car file are downloaded each time data is downloaded. Notes

Notes tab

The Notes tab is the area to driver information and to keep daily notes, such as the weather condition.

Setup Notes tab

The Setup Notes tab is the area to keep specific setup information such as corner weights, pressures, shock information and much more.

Lap Notes tab

The Lap Notes tab is the area where the lap times or run times will be kept. The lap time editor will also store the lap times, but the editor is the area where you can make changes to the times.

Signal Plotting & Scaling Properties tab

Offset

An offset is a value that is used to compensate for the installation of a sensor to create a true ZERO value. For example, suspension sensors have a calibration of 0 volts correspond to 0 inches and 5 volts correspond to the maximum extended value. However, you need to install the sensor so that is can compress and extend. The zero or static ride height reading needs to be recorded and by zeroing the sensor, you will have a voltage reading for the zero position that is not 0 volts. An offset is created any time you ZERO a sensor or manually input an offset in your Signal Plotting and Scaling Properties tab in your Car File.

Multiplier

Auto Scales

Minimum & Maximum

Lap Time Editor tab

Unallocated time

Resets

Merge Next and Merge Previous buttons

Commander Channel Configuration tab

Changing *signal name*

The *Copy Page From* button

The *Copy All From* button

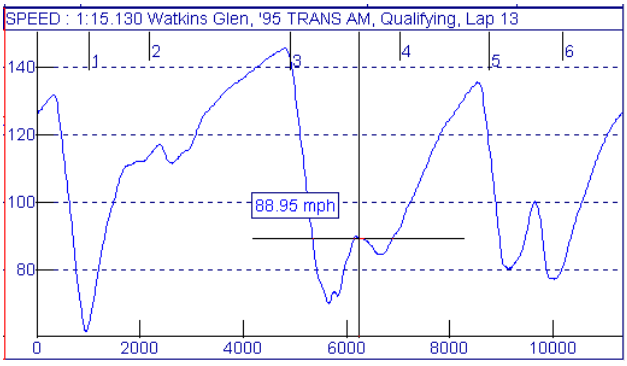
Chapter 12 Understanding all the *objects*

In this chapter you will learn all the details and some of the application of all the possible objects (plots and displays) available in Track Master

Time or Distance plot

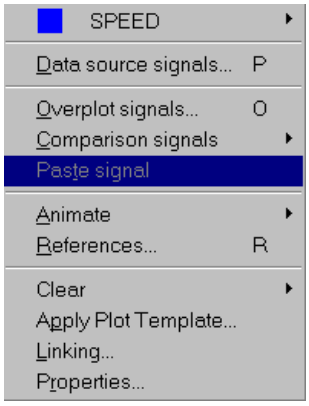
Time or distance plots (also known as X-Y plots) are used for plotting ANY signal vs. time or distance. TrackMaster for circle track and road racing is setup with the default being "vs. distance" mode. However, if you suspect problems with any sensor, you should plot that signal data on a graph "vs. time" instead of "vs. distance."

In drag racing, the default is "vs. time" mode although the 60ft. distance is indicated on the graph.



X-Y plots can be Data Source, Zoom, or Cursor linked.

Right click on an X-Y plot, you will see a menu like this:



Lists – the signals displayed on the plot

Data – source signals – change the Data Source or signals that are plotted

Overplot Signals – change the overplot signals that are plotted

Comparison Signals – compare times, speed and cumulative times

Paste – signal – paste signal from the clipboard onto a plot

Animate – start/stop the animation running

References – go the reference dialog box, add, delete or replace reference data

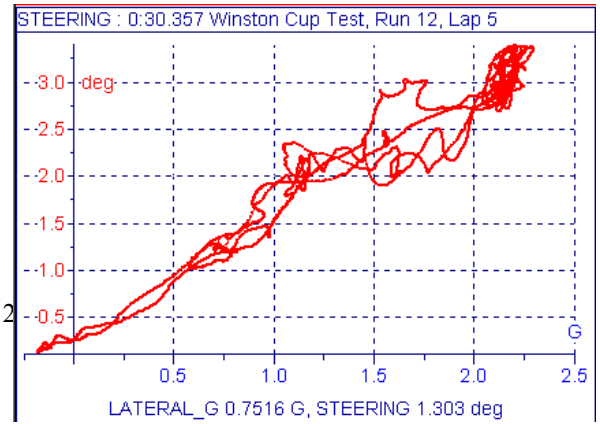
Clear – clear plot or overplots

Apply Plot Template – lists available plot templates

Linking – go to the linking dialog box; select the type of linking

Properties – choose between time/distance for X axis, show/hide the flying numeric box (attached to the cursor), show the segment marks on the plot, list information on smoothing and session notes

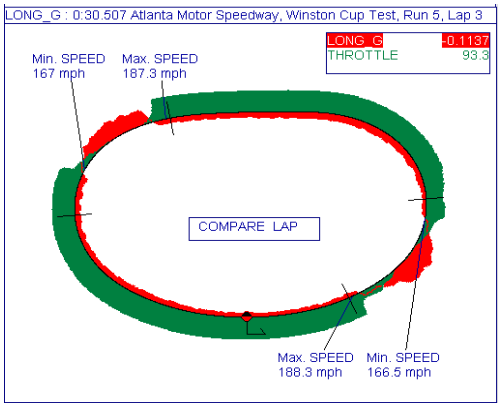
Signal vs Signal plot



A Signal vs. Signal plot enables you to plot one signal against another. These signals can be recorded data signals OR math signals. The signal vs. signal plot is used to discover and investigate how one signal changes with another, rather than how they change simply with time.

Right click on the plot to change data sources, signals and linking properties.

Track plot



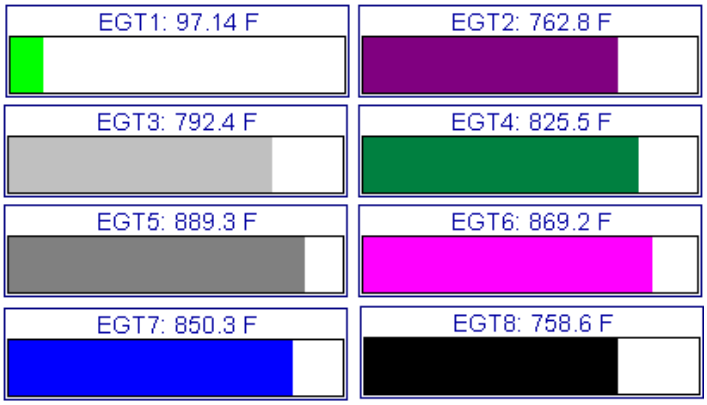
A Track Plot (also known as a Map Plot) is used to show data as a function of track position. This is a very visual type of plot that many data acquisition novices find extremely easy to interpret.

Track plots can be Data Source, Zoom and Cursor linked to other plots. Track plots can also be saved as templates.

Right click on a track plot to add a signal or signals on the plot (such as throttle position or gears), change data sources, make overplots, make compare plots, display linking properties and more.

Bar display

A Bar Display shows 1 data point at a time in bar format and coordinated with the cursor movement in the plot. Bar graphs are very useful for things like all EGTs because you instantly see which cylinders are hot or cold as you scroll through the data.



Right click on the bar display to change the display color, the signal displayed, linking properties, vertical or horizontal graph, and display properties.

Data display

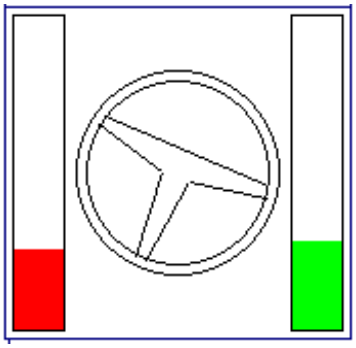
Data Displays are used to show numeric data corresponding to the cursor in its source plot. It must be Data and Cursor linked to a plot. When linked to a plot, it automatically includes all signals in the plot.

Right click on the data display to add a signal to the list, display the linking properties and turns the information bar in the data display on/off.

Driver controls display

Driver Controls Displays are used for showing driver inputs (ie, steering, throttle, brake) pictorially. These MUST be Data and Cursor linked to a plot.

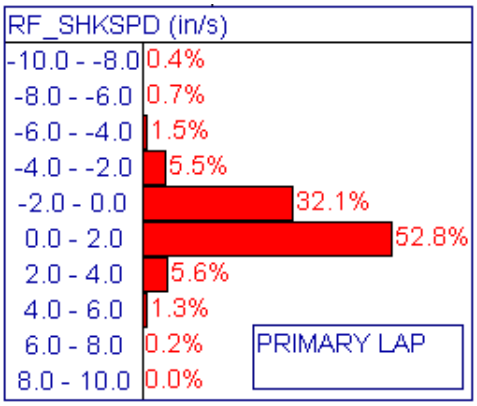
Right click on the display to show the linking properties and display colors.



Histogram display

Histograms are used to sort and classify data into bins or ranges. Histograms are very useful in summarizing complex data, such as shock speeds. Engine RPM histograms are useful to engine builders. Speed histograms are useful in aerodynamic analyses.

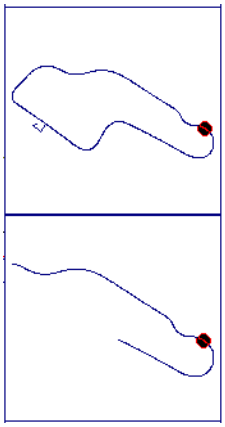
Right click on the display to show the signal displayed, change the signal, references, and display properties such as the number of bins and horizontal/vertical layout.



Map and turn locator display

Map and turn locator displays are used for visually showing cursor position on the map. Position of the cursor in the source plot is coordinated with the cursor on the track. It MUST be CURSOR linked to a plot.

Right click on a map or turn locator display to show the linking properties and to change the shape of the locator (circle, dot, plus or cross)



Notes display

Notes displays are used to show notes from the session notebook on an actual plot page, rather than having to get into the notebook editor to see the notes). The notes display can be Data Source linked to a plot so that when you change lap or session in the plot, the notes are updated as well.

Right clicking on the notes display will enable you to set options including which notes (either session or lap notes) from the notebook are displayed

Report display

Report displays are used for listing valuable data, such as segment times, lap times, lap distances. The report can also display session summary data, signal summary data of a whole session, and signal summary data of 1 lap. The report display must be data source or zoom linked to a plot.

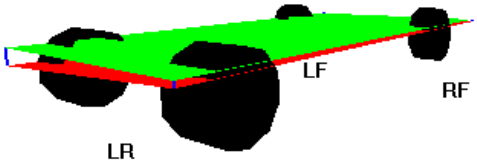
Right clicking on the display will allow you to change the linking properties and change the data displayed.

0:30.357 Atlanta Motor Speedway, Winston Cup Test, Run 12, Lap 5

Lap	Lap Time	Segment 1	Segment 2	Segment 3	Segment 4
1	0:39.019	0:15.592	0:10.939	0:05.194	0:07.294
2	0:30.436	0:07.766	0:10.043	0:05.134	0:07.494
3	0:30.357	0:07.809	0:09.988	0:05.157	0:07.403
4	0:30.318	0:07.784	0:09.986	0:05.137	0:07.411
5	0:30.357	0:07.795	0:10.019	0:05.162	0:07.381
6	0:30.516	0:07.799	0:10.104	0:05.179	0:07.434
7	1:28.000	0:08.603	0:12.114	0:07.393	0:59.890
Theoretical	0:30.267	0:07.766	0:09.986	0:05.134	0:07.381
Rolling	0:30.310	0:07.784	0:09.986	0:05.137	0:07.403

Suspension display

Suspension displays are used for showing chassis plane movement pictorially. Note that the display includes a separate toolbar for animating, zooming/shrinking, and rotating the display. A suspension display must be data and cursor linked to a plot.



Right click on a suspension display to view the following:

Planes – choose between outline or solid frame rendering the chassis of the plane
Tires – choose between outline or solid tires

Linking – choose how to link the chassis display to a plot
Properties – select display properties and suspension control colors.

Text display

Text display or text boxes allow the user to add notes on the screen used primarily for attaching notes to printouts, such as primary lap or compare lap. This is not intended for use in extensive record keeping. (You should use lap notes, setup notes, or session notes from the session notebook for record keeping).

PRIMARY LAP

Chapter 13 Creating & Using *Marker Schemes*

What are *Marker Schemes?*

A ***Marker Scheme*** is a process in which you partition the track in order to have data selectively displayed on a graph or listed in a report. The Marker Schemes are created and managed on the ***Map Lap*** page.

Using Marker Schemes

All tracks automatically have a ***Marker Scheme*** named ***Segment Times***. The user must create a marker for each segment time he wants to set on the track map. All ***Marker Schemes*** are associated with a particular TRACK and are available for use with all data stored under that Track Name. This is one reason why all data from a particular track should be saved under ONE track name.

It is up to the user to create additional marker schemes, such as Min & Max Revs, Speeds, etc. See the sample data included with the program for examples.

Types of *markers*

There are five types of markers: Absolute, Segment Minimum, Segment Maximum, Segment Average and Segment Time.

Absolute – lists the actual value of the signal for the point on the track you connected to

Segment Minimum – lists the minimum value of the signal for the given segment

Segment Maximum – lists the maximum value of the signal for the given segment

Segment Average – lists the average value of the signal for the given segment

Segment Time - lists the actual segment time between markers.

The Marker toolbar

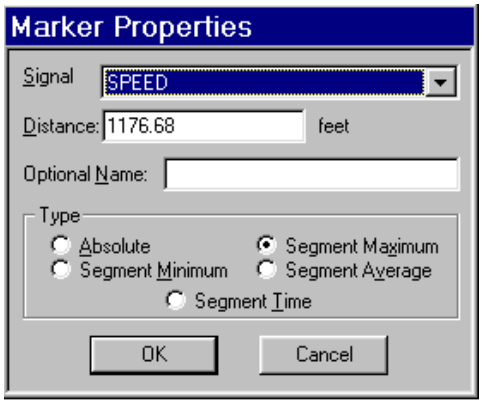
The Marker Toolbar consists of 3 buttons:

1. Add Marker 
2. Delete Marker 
3. Delete ALL Markers 

Adding a marker to an existing scheme

1. Click on the Add Marker button in the Marker Toolbar
2. Left click on the map in the segment where you want the marker to be and drag the mouse pointer to where you want the marker box to appear (**NOTE:** Do not hold down the left mouse button while dragging).
3. Left click again and the Marker Properties dialog box will appear.

4. Select the type of Marker (ie, Absolute, Segment Minimum, Segment Maximum, Segment Average or Segment Time).
5. If you select a Marker type other than Segment Time, you must select a signal by pulling down the signal list and picking a signal.
6. Click *OK* and repeat these steps for all the markers in the scheme. Your scheme is automatically saved when you exit the Map Lap page.



Deleting a marker

1. Click on the Delete Marker button
2. Click on the Marker box you wish to delete (cross hairs will appear on the box) and the marker segment will disappear.

Editing a marker

Creating a new *Marker Scheme*

1. Click on the ***New*** button under ***Marker Schemes.***
2. Type in the name you wish to use for the scheme.
3. Click on the Add Marker button in the Marker Toolbar.

4. Left click on the map in the segment where you want the marker to be and drag the mouse pointer to where you want the marker box to appear (**NOTE:** Do not hold down the left mouse button while dragging).
5. Left click again and the Marker Properties dialog box will appear.
6. If you want the Marker type to be a Segment Time, click that button and then click OK.
7. If you want the marker to act on any signal, pull down the signal list and pick a signal, then select the *Type* (either Absolute, Segment Minimum, Segment Maximum or Segment Average).
8. Click *OK* and repeat steps 3 through 7 for all the markers in the scheme. Your scheme is automatically saved when you exit the Map Lap page.

The special case of the *Segment Times* marker scheme

The *Segment Times* report display

Chapter 14 Modifying YOUR V*iew*

The *Lite* option

The LITE option is a limited functioning version of TrackMaster 2000. You input data all in the same way as the full version of TrackMaster, however, you are permanently in the Analyze mode. You cannot add, remove or move any plots, and you cannot add, remove or move any displays. You CAN view recorded data and you can add or remove signals on plots from recorded data.

Have 1 view which "evolves"

Do you want to simplify your life? Are you always too busy at the track and miss some important details? Using "one view" to analyze your data will save you time and frustration. Take a look at all the pre-programmed views that come on the CD and find one that suits your style of analyzing data the best. You can make modifications to that view and save it with that same name, OR you can use that view as a template and save it with the track name as the view name. Start with a simple view and you make the changes to suit your needs (evolve the view).

Have one view which is constantly used for analysis

Once you have created or become accustomed to a view to optimize your data analysis, use this view each and every time you analyze data. Road racing and oval track views should be setup to maximize the information. Drag views should be setup to

Save *copies* of this view for different tracks etc

You will want to use the "Save View As…" command each time you go to a NEW track. This will properly file your data into track views (ie, Daytona, Rockingham, Long Beach, Leicester, etc). Generally, you will use the same sensors as you previously used and the view will be set up for those sensors.

Start with a supplied view

To save yourself time and frustration, use a supplied view. One of the most difficult concepts users understand is the linking function in TrackMaster. The supplied view plots are already properly linked, so you should have little to no difficulty in working with a view.

Make additions and deletions to suit your needs

In a typical supplied view, there are many different plots, some which are unnecessary to you and some you would like displayed in a different manner. Make the changes to suit your style of analyzing data. If you have the LITE version of TrackMaster, you are unable to make these changes.

Changing the layout of a *plot page*

Be in *design* mode

In order to make any changes (other than adding a signal graphs on plot), you must be in Design Mode. To do this you need to click on the D/A button in TrackMaster. When the D is bold, the design mode is enabled.

Selecting an object

Like in most Windows applications, you must double click on an object to select it.

Moving and resizing an object

To move or resize an object, you first need to select the object. To move the object, you need to click on the outline of the object and direct its movement to the new location. To resize an object, you must click on the small squares on the corners and/or sides of the selected object and drag the corner/side to the size you desire.

The *arrange* tool

Creating new *Plot Pages*

Warning: Creating new plot pages is easy to do, but you must remember to LINK the new plots on the pages to another plot in your view in order for the plotted data to change data sources when you expect it to.

To create a new Plot Page, go to the Insert command. If all the commands are grayed out, then you are in Analyze Mode and you must switch to Design Mode as previously discussed. Once in Design Mode, go to the Insert command

Inserting plots

To create a new Plot, go to the Insert command. If all the commands are grayed out, then you are in Analyze Mode and you must switch to Design Mode as previously discussed. Once in Design Mode, go to the Insert command,

Deciding on linking options

Inserting displays

Deciding on linking options

Arranging the page

Making several objects the same size

Selecting and resizing multiple objects

Aligning several objects

The page arrangement dialog box

Give the page a meaningful name

End result – consistency in analysis of data

Chapter 15 Miscellaneous Topics

Activating and adjusting toolbars

Multi Mode users

TrackMaster 2000 is a powerful software program with many options all controlled through the software key. An engineer or technical person involved in many different applications can use one software program. TrackMaster 2000 has a road /oval racing mode, a drag mode, and a dyno mode. The TrackMaster software key can be programmed to enable any of these or all three modes.

Switching modes

Toggling between modes is simple. Select the TrackMaster mode based on the type of racing the Commander II is being used. From within TrackMaster perform the following steps:

1. Go to the **System** Menu
2. Go to **TrackMaster Options**
3. Go to **Options**
4. Select the **System Type** button
5. Make your choice of Road/Oval Racing, Drag Racing, Dyno, or Cancel.
6. If you change modes, TrackMaster will close all open views.
7. Go to **File** and **Open View** for the mode of data you are analyzing.

If you know prior to loading a view that you want to switch modes, when prompted to Select a View, choose Cancel. Then follow steps 1 through 6 from above.

Importance of keeping your views separate

Loading views in the incorrect mode causes problems that are not always apparent to the user if they have a multi-mode software key. Loading a road racing/oval track view with drag racing data will not allow the user to properly distinguish the data into Stage, Pass and Cooldown – you will get Lap 1, Lap 2 and Lap 3 instead. You will also get a Map Lap page that is blank. Loading map based views in dyno mode causes lots of error messages… put notes in manual (in *multi user* chapter).

Importance of Making backups

If you have ever worked with any software program with any type of PC, you should know that saving your work is imperative. With the multitude of viruses roaming the internet and software world and with the wear and tear you subject your PC to, your hard drive is not the only place to keep your data. Hard drives become corrupted or crash – that is a fact of life for PCs and you, the user, should be prepared for it.

What to make frequent backups of

As with any software program, making backups of data and files is a must. You must backup the entire Session Folder of the data that is of concern to you. You need the Session.bin file, Ses.nbk file, the iic file, and the map.str file.

Chapter 16 Tricks and Shortcuts and Pitfalls

Tricks and Shortcuts

Using plot templates

Using hot keys

Pitfalls

View saved with empty plots

Math channels

Chapter 17 Command-View details

In this chapter you will learn all the details of Command-View, including modifying and creating Layouts in Command-View. If you DO NOT have the Command-View option, skip this chapter.

Introduction

Command View (CV) is a new program option in Command Link that enables:

- Graphical viewing, zeroing, and calibration of sensors using "virtual gauges", useful in all applications
- Simultaneous recording and viewing of live data at rates up to 100 Hz (requires a Commander II with ROM 33 or higher)

Command view has many useful applications including in-car system checkout and calibration as well as stand-alone dyno instrumentation.

Recommended PC settings for *Command-View*

For best viewing of the supplied CV layouts we recommend the following display options on your PC:

In your Windows *Control Panel, Display Properties:*

- Set the *screen area* or *resolution* to 1024 x 768
- Set the *colors* to 16 bit (or higher)
- Set the S*ettings…advanced…* to ***Small Fonts***
- Set the *Appearance.. scheme.. to Windows standard (large)*

Overview of operation

When recording data or viewing live readings with CV:

- The *Car File* that you have sent (or put on the memory card) determines which channels the *Commander II* transmits to CV.
- The *Command-View Layout* controls which data is displayed. Even though a channel may be turned on in the car file, it will not be displayed unless a gauge for it exists in the CV layout file.
- All channels are sent to CV at the same rate, regardless of whether they are set to high, medium, or low scan rate in the car file. They are sent at the *Update Rate* selected in the Command View tab. (NOT at the "scan rate" set in the car file).
- Most Math Signals that can be calculated from the active channels will also be available for live display in CV.
    - An important exception is that CV cannot display math signals that depend on "several data points in time". Math signals that contain the DERIV and INTEG functions are 2 examples of this.
- ONLY Raw Data signals (as defined as channels in your car file) can be interactively zeroed or calibrated in CV. For example, LF_SUSP *CAN* be zeroed and calibrated since it

generally is a recorded signal. LF_WHEEL *CAN NOT* be zeroed and calibrated since it generally is a math signal.

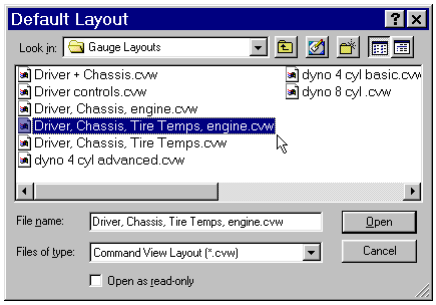
Becoming familiar with *gauges*

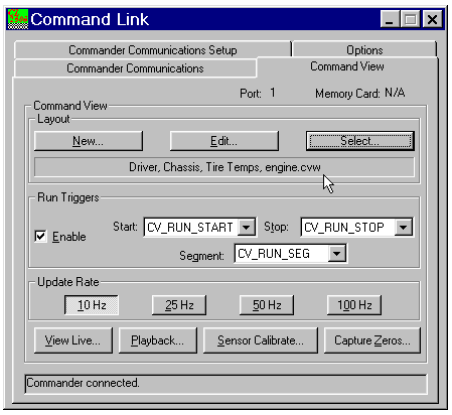
CV layouts are made up of *gauges*. There are a number of different *types* of gauges in CV, as well as an extensive set of *properties* for each gauge. Lets become familiar with them:

Select a layout

To edit or use a *layout,* it first must be *selected.* In CV, click on the *Select* button.

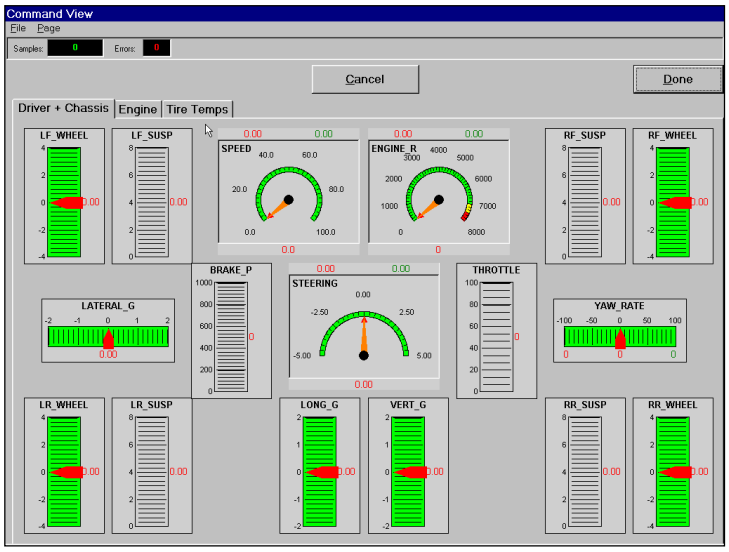
You will see a list of the standard layouts supplied. Select the one that most closely describes the configuration of your system. Click Open:





In this example we have selected the *Driver, Chassis, Tire Temps, engine* layout.

Now click *Edit…* you will see:



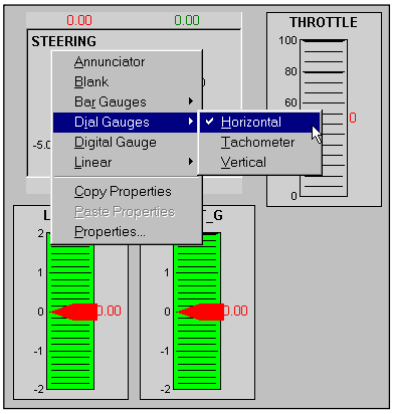
Notice the tabs near the top of the screen:

- CV is a multi page program similar to Track Master. A layout file can have 1 or more pages.
- The pages can be given friendly names to indicate their content

Context-Sensitive menus

Now right-click on one of the gauges:

- CV has context-sensitive menus just as TM does.

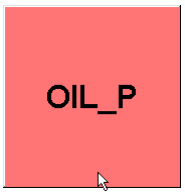


The *Types* of gauges in CV

There are many different types of gauges available in CV. Lets learn to identify them. As we introduce each type of gauge below, browse from page to page in the layout you have selected and see how many of the gauge types you can find. Feel free to *select* another layout and edit it if you like in order to get a feel for all the possible gauges in CV.

Annunciator

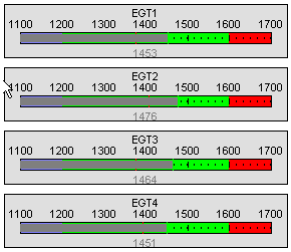
An Annunciator is like a big warning light. It tells you that a signal meets some condition such as oil pressure being too low, or too high, or "just right"



- Annunciators can have up to 3 "color ranges"

Bar Gauges

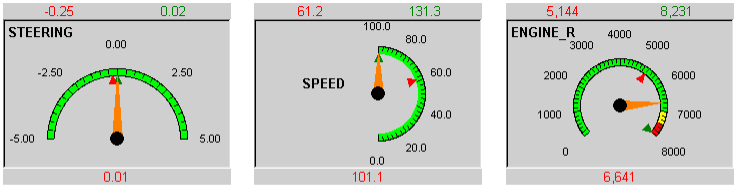
Bar gauges are useful for showing the relative position of several channels, such as the 4 EGTs shown here.



- Bar gauges can be either horizontal (as shown) or vertical

Dial Gauges

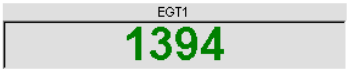
Dial gauges are the classic "moving needle" style. They can be shown in 3 different styles as shown below.



Horizontal ***Vertical*** ***Tachometer***

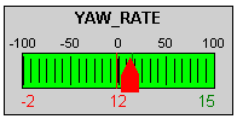
Digital Gauges

Digital gauges show "big numbers". They can be set to change color when their signals reach your defined thresholds. The font typeface is completely user-selectable.



Linear gauges

Linear gauges are very similar to bar gauges except that they have "moving pointers" rather than the gauge "filling in" as the bar gauge does.

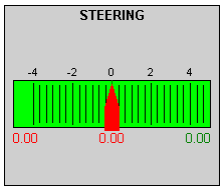


- Linear gauges can be vertical or horizontal

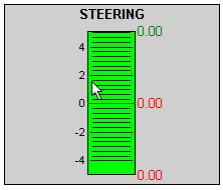
Changing the *gauge type*

The type of gauge can be changed by right clicking on it and selecting the type of gauge you want to change it to. For example, *select* and then *edit* the *Driver, Chassis, Tire Temps, engine* layout.:

- Right click on the *steering* gauge in the center.
- Point at *Linear*. then click on *horizontal.* You will see the *properties* dialog for the gauge, just click OK for now. The gauge will now look like:



- Right click on it again and select *bar gauge…vertical.* Click OK. You will see:



Notice that all of the properties of the gauge, such as its scales, the signal it displays (steering), its colors etc all remained intact as we changed from one gauge type to another.

- Once a gauge has been created and its properties set, its *type* can be changed without having to re-set all other properties. All properties of a gauge are retained when you switch its *type.*

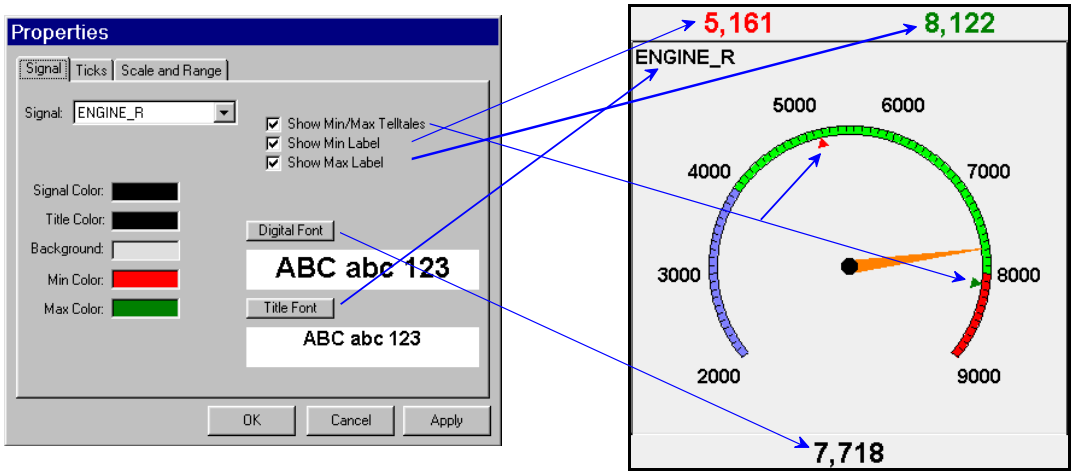
Gauge properties

Lets go over what the different gauge properties do. First lets make a copy of the layout you will most likely be using:

1. In CV, Click *select* and choose the layout that most closely describes the configuration of your system. Click *open.*
2. Click the *file* pull down menu (in the upper left) and click *save as…* Type in a name for this copy of the layout such as "temp" or "scratchpad"
3. You now are editing this layout under the new name you just gave it, thus you do not have to worry about damaging the original copy as we experiment with *gauge properties.*
4. As we go through the different *properties,* change some of them to see their effect.

Rather than try to explain in words what each property item is, we will show a series of pictures to explain the less obvious properties. (Some properties, such as *background color,* need no further explanation).

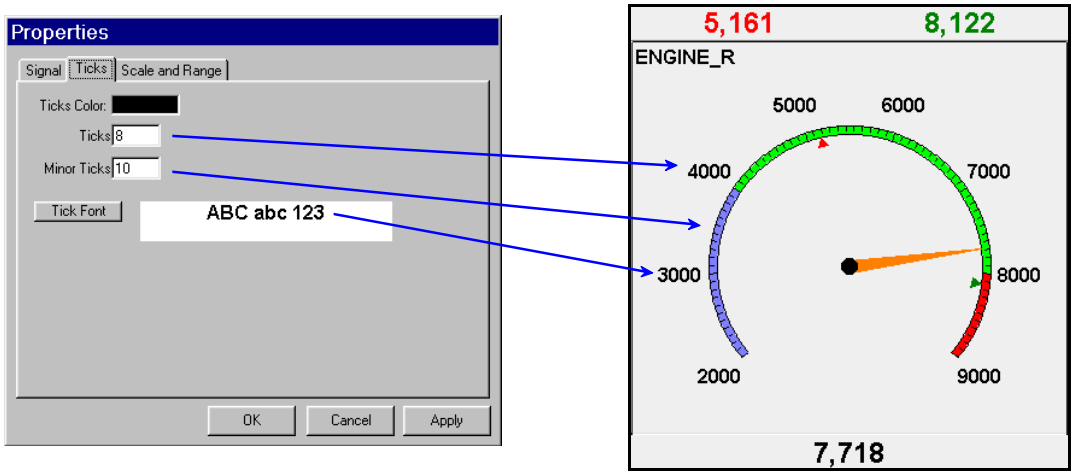
The *signal* tab



Notes:

- The *Digital Font* is used for the *min and max labels* as well.
- The *min and max labels* "capture" min and max readings while you run CV.

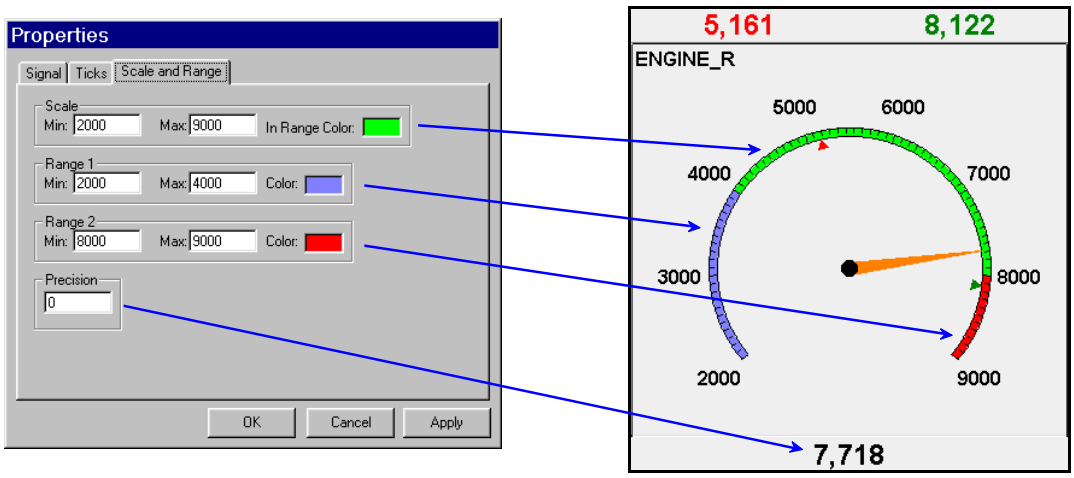
The *Ticks* tab



Notes:

- CV will try to use the number of *Ticks* you set to create scales, but will always try to make the scales with nice even boundaries, in which case the number of labeled ticks it displays might not exactly equal the number you set. In this example, if you change the ticks from 8 to 9, no change will appear on the gauge, because 9 ticks over the 2000 to 9000 range would result in labels of 875, 1750 etc. rather than the nice 2000, 3000, etc. labels we have.
- The *Minor Ticks* are simply the number of lines drawn between *Ticks.*

Scale and *Range* tab



Notes:

- The settings you use for *Scale* determine the overall scale of the gauge.
- The *In Range Color* will be used for the entire gauge unless you also specify the (optional) *Range1 and Range 2*
- *Range 1 and Range 2* are completely optional and should be set to 0 if not used. They are also completely arbitrary in that they can be set to any part of the gauge. For example, you could set *Range 1* to a min of 5000 and a max of 6000, in which case that part of the gauge would have a blue "band" in this example.
    - The *Range 1* and *Range 2* colors always "override" the *"In Range"* color
    - *Digital gauges* use these range colors to determine what color to display the digits in and thus the digits can change colors depending on the value of the signal it is displaying.
    - *Annunciators* use these range colors to determine what color it is and thus the annunciator changes colors depending on the value of the signal it is displaying.
- *Precision* determines how many digits are displayed to the right of the decimal point. For example, 99.33 uses a *precision* of 2.

Creating and modifying layout pages

Now that we are familiar with all the types of gauges and their properties, lets learn how they are put together in layouts.

First, select and edit the layout you were working on in the previous section.

Modifying a layout page

First we will learn to modify existing pages.

Deleting a gauge

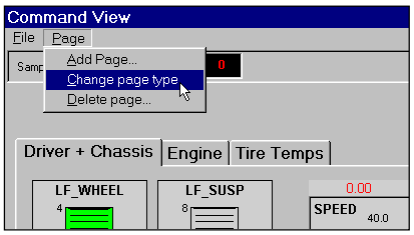
To completely delete a gauge, right click on it, then click *blank* in its CSM:

- This changes the gauge's *type* to "blank"
- Notice that you are now left with a blank cell in the layout.

Changing the *page name and type*

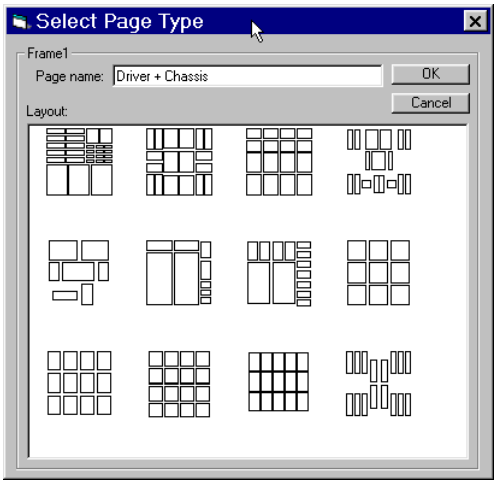
Unlike Track Master, you do not have complete freedom to re-size and add gauge elements in Command View. Pages are made fixed combinations of "cells". These combinations are referred to as "*page types*".

- To re-arrange a page you must change its *type*
- Click on the *Page* pull down menu, then click *Change page type…*



You will see the *Select page type* dialog.

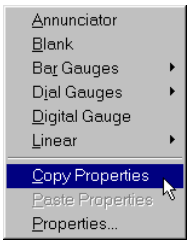
- You can change the *name* of the page (which appears on its tab)
- You can also select a different *type* from the choices shown. Notice that some of the *types* use *cells* that are only suitable for certain types of gauges. For example, some of



the smaller and narrower cells are only suitable for bar gauges, digital gauges, and Annunciators. Experiment with this to see the effect of changing the *page type.*

Moving gauges on a layout page

Lets say you have a page that is close to the way you want it, but you want to move some of the gauges around. You can do this by using the copy and paste properties feature:



1. Make the "target cell" (where you want the gauge "moved to") the correct *type* by right clicking on it and setting its *type.*
2. Right click on the "source" cell, then left click on *copy properties*
3. Right click on the "target" cell, then left click on *paste properties*

Add a new page to a layout

Click on *Page* pull down menu, then click *Add Page…* You will see the *Select page type* dialog.

- Type in the name you want to use for the page.
- Select the layout type you want to use. Click OK

- You will have a page with all blank cells, inserted AFTER the page you were on. Start by setting the gauge type for a cell, then setting its properties.

Tips for creating new pages

You can significantly reduce the amount of work to set all the properties of gauges in a new page by exploiting the copy and "copy and paste properties"

- If there is a gauge in the layout (perhaps on another page) that is similar to the new gauge you are trying to add, copy its properties
    - Then paste them on the new gauge,
    - Then edit the new gauge's properties and only change the properties that are different in the new gauge.
- When creating a group of gauges that display similar data (air fuel ratio for all cylinders for example) do the following:
    - Set the *type* (bar gauge for example) for all the gauges.
    - Set ONE of the gauges up exactly as you want them all to appear.
    - Copy this gauge's properties to all the other gauges
    - Go into each individual gauge and just set the signal name

Deleting pages

Delete a page from the *Page* pull down menu.

Saving the layout

As you make changes to a layout you should periodically save the layout (from the *File* pull down menu). If you have an extensive layout you will have a significant amount of labor invested to get it "just right", so it is good to save it frequently and to make backups of it.

- If you forget to save the layout while you are editing it, you will be prompted to save it when you exit the editor

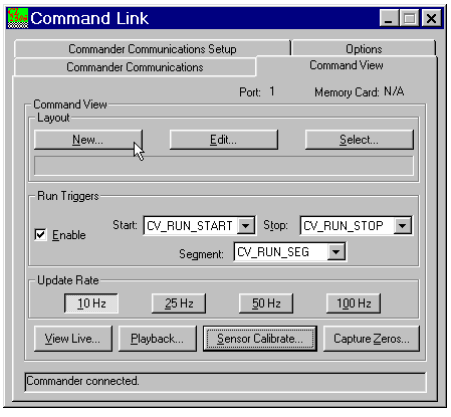
Saving with a new name

An easy way to make and maintain backups of your layout is to use the *Save as…* feature in the file pull down menu.

Creating a new layout

To create a new layout from scratch, click the *New…* button in the Command View tab:

- A layout with 1 page will be created.
- Go into the *page* menu and set the page name and type.
- Create your gauges
- Save the layout, giving it the name you want to use.



Playback of data

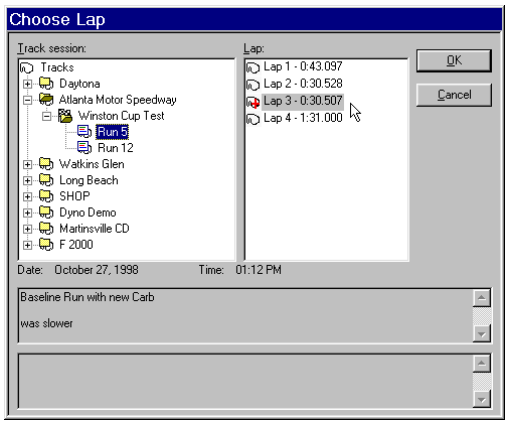
You can "test" your layout by playing back data previously recorded.

- Any Track Master data can be "played back", including data recorded with a Commander II (and downloaded) or data recorded through Command View

To playback data:

- Select the layout to be used by CV
- Click the *Playback…* button. You will see the *Choose Lap* dialog
- Choose the data you wish to play back
- Click OK

The data starts playing back in CV. When CV gets to the end of the lap, it will loop back to the beginning and continue until you click *Stop.*



Viewing Live readings with *Command-View*

The mechanics of viewing live readings has already been covered in chapter 3. When viewing live, remember these important points:

- The *Car File* that you have sent (or put on the memory card) determines which channels the *Commander II* transmits to CV.
- The *Command-View Layout* controls which data is displayed. Even though a channel may be turned on in the car file, it will not be displayed unless a gauge for it exists in the CV layout file.
- All Math Signals which can be calculated from the active channels AND that are **not** dependent upon multi-data-point functions will also be available for live display in CV.
    - Multi-data-point functions are those that use more than 1 point in time to determine their value. The DERV (Derivative) is one example of this type of function, since derivatives are based on the current, previous, and next data point.
    - Other multi-data-point functions are INTEG, NEXT, and all embedded smoothing functions such as SML, SMM, etc.

Using *View Live* to validate all your calibrations and math formulas

The ability of CV to calculate math signals "on the fly" makes it very useful for validating your math formulas and calibrations. Here are 2 examples:

- You can view your ride height math signals "live" with the vehicle sitting in the garage at static ride height. The displayed values should agree with your settings. If they do not, there is something wrong with your formulas or car file settings
- If you have created a gauge for a math channel and it does not update when you *view live* (it is "frozen" at zero) then there is something wrong with your formulas or your car file

because CV can not calculate the signal from the data it is getting and the formulas defined in TM.

- An important exception is that CV can not display math signals that depend on "several data points in time". Math signals that contain the DERIV and INTEG functions are 2 examples of this.

Min and Max capture on gauges

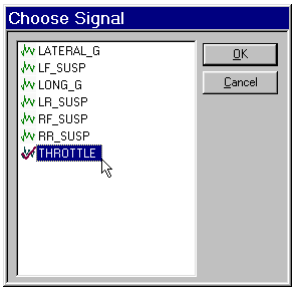
The min and max labels on gauges will "capture" values as you view live. If you are also recording, you may discover that the values "captured" when viewing live do not exactly agree with the recorded data. There are several reasons for this:

- When you examine the recorded data in Track Master, you may be looking at a plot where local smoothing has been applied to override the default smoothing. The captured values in CV are always based on the default smoothing values.
- The captured values in CV are based on the data being set to the "Screen update", which only occurs 20 times per second in CV and is fixed (it does not change when you select a different *update rate* in CV) IF you are simultaneously recording at a higher rate (which IS determined by the CV update rate), you may be recording "peaks and valleys" that the screen "misses" due to its slower update rate.
- One other source of discrepancies is if your gauge is displaying a math signal whose formula depends on multiple data points. See the previous section in this chapter titled "**Viewing Live readings with *Command-View*"**
- In general, the recorded data is the correct data. The slight discrepancies you may see between the captured live min and max values and those in the recorded data are usually quite minor.

Calibrating & Zeroing Sensors

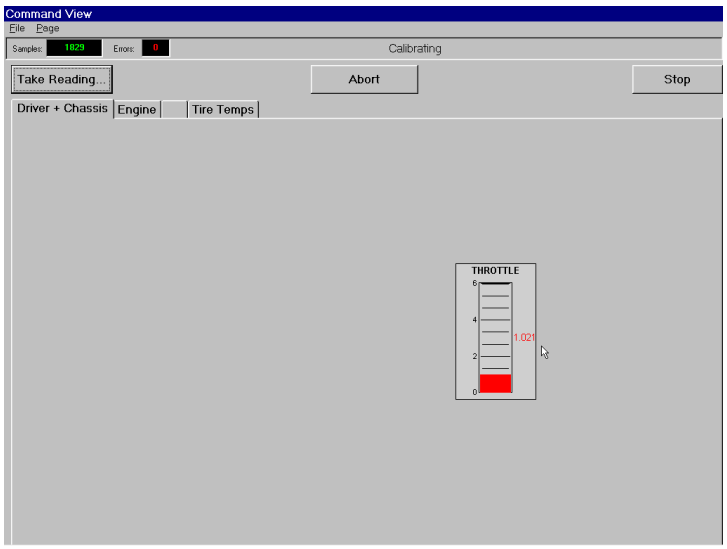
CV enables you to graphically calibrate and zero sensors. Only recorded signals can be zeroed and calibrated (not math signals).

To calibrate a sensor, click *Sensor Calibrate…* in CV. You will see the *Choose signals* dialog:



- Click the signal(s) you wish to calibrate
- Click OK

You will see your layout with only the gauge(s) for the selected signals shown:



- Have the sensor at the first calibration position, and click *Take Reading.* Enter the engineering value for the first point. For example, if you are calibrating *Throttle,* have the throttle closed, take the reading, and enter 0 for the engineering value.
- Move the sensor to the next position, and click *Take Reading.* Enter the engineering value for this point. For example, if you are calibrating *Throttle,* have the throttle wide open, take the reading, and enter 100 for the engineering value.
- Continue until you have captured readings at all the desired points, then click *Stop.*
- NOTE: you must take at least 2 data points when calibrating. If you accidentally click *Stop* after taking only 1 data point, all data recorded with that sensor will be reported as 1 constant value, equal to the one data point you took.
    - For example, lets say you only took the 0 reading for throttle. If you fail to realize this, all the recorded data (all the points) for throttle will be 0%, which might lead you on a goose chase thinking you have a sensor problem.
    - If you are not sure you have calibrated properly, then after you are done, validate your calibration by *viewing live* with CV.

Recording data with *Command-View*

See the chapter titled “Using *Command View* on Dynos” for in-depth instructions on recording data with CV, including a detailed description of the *Run Triggers”*.

Chapter 18 The *Chassis Animation & Analysis* option

Introduction & assumptions

The Chassis Animation & Analysis option gives the user the ability to view and analyze the performance of the chassis setup. The option takes the recorded data from the four suspension sensors (labeled LF_SUSP, RF_SUSP, LR_SUSP, and RR_SUSP) and uses the geometry information you enter about your car to translate the raw data into useful information such as Shock Speeds, Ride, Roll and Pitch change.

Pre-programmed signals included

Sign conventions

See appendix x for detailed listing of formulas

The *Suspension Animation* Display

The Toolbar

Changing the Perspective

The Rates Available for Animation

Properties

Solid vs Wire Frame

Chapter 19 The User Programmable Math Option

What is the Math Channels Option?

The Math Channels option is the ability to create or change math formulas for specific signals not included in the basic TrackMaster software or Suspension Analysis Options. The Math Channels option can only be accessed only if your hardware key is authorized for the option. Once entered in the Math Channel Editor, a math signal is listed in the signal list for any data session that contains all the source signals required by the formula.

How Math Channels Work in Track Master 2000

When a math signal is calculated, all source signals used in the formula are loaded WITHOUT smoothing applied regardless of what level of smoothing is specified in the Signal Attributes table. Once a calculation is complete, any smoothing specified for the new math signal is applied. Offsets and multipliers specified in the Signal Notebook for the math signal are also applied.

Priority of Resolving Signals

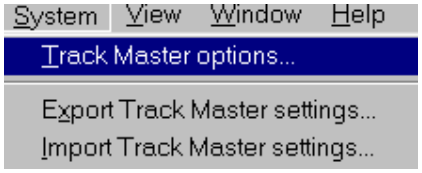
Recursion

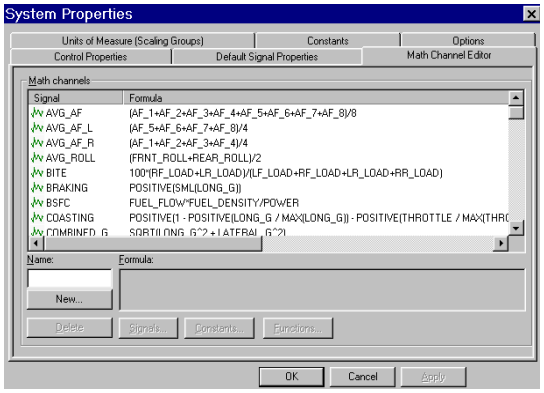
Once entered in the math channels, a math signal is listed in the signal list. Math formulas may use other previously defined math signals with up to 3 levels of recursion.

Circular References

The *Math Channel Editor*

The Math Channel Editor is found in the System menu. To locate the Math Channel Editor, click on **System**, click on **TrackMaster Options**, and click on **Math Channel Editor**.





Editing an Existing Formula

To edit a math formula, simply highlight the signal name (by clicking on the name) and the equation will appear in the Formula box. You can enter the corrections or modifications by simply typing in the correct formula or you can use the Signals, Constants or Functions menus. If you have more than one formula to edit, simply click Apply when done with a formula and proceed on with the next by clicking on that signal name. When done with all the modifications, click OK.

Entering a New Formula

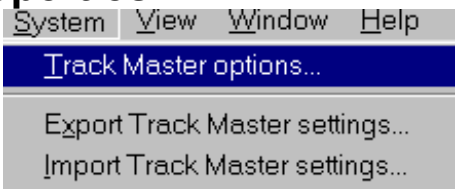
The Signals, Constants, and Functions Buttons

Typing vs. Picking from the Lists

Math Editor Syntax and Special Functions

Chapter 20 Changing Program Settings with the *System* Menu

Track Master Options - System Properties



Control Properties

Default Signal Properties

Units of Measure

Constants (global)

Options

Changing program *modes*

Chapter 21 Transferring settings and data to another PC

In this chapter you will learn how to move all software settings and data from 1 computer to another

Introduction

In order to transfer your complete Track Master, Command Link and Command View environment from 1 PC to another, several items must be moved. They are:

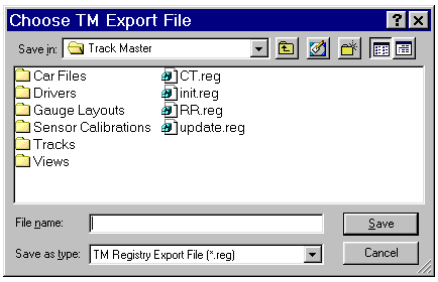
- Track Master program settings such as default signal properties etc.
- Recorded data files
- Track Master *View* files
- Command Link *Car* files
- Command View *Layout* files

Moving Track Master Program Settings

Exporting Track Master Settings

Start Track Master on the first (source) PC. Go to the *System* menu, and select *Export Track Master Settings*.

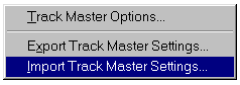
As default, all of your program settings will be checked. If for some reason you do not want certain settings transferred to the new machine, uncheck those boxes now. Click OK.



Next you will see this dialog box. Pull down the *save in* list and navigate to your floppy disk drive. Give the settings file a name and Click OK. Your program settings are now exported and saved.

Importing Track Master settings

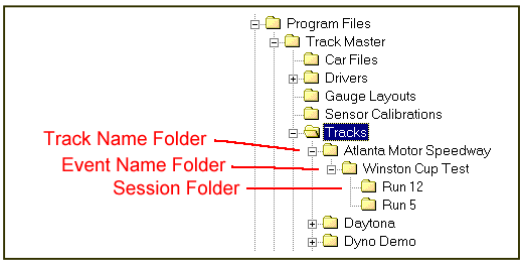
Start Track Master on your new PC. Go to the *System* menu, select *Import Track Master Settings*.



Navigate to your floppy disk drive. The file you created in the previous step should be listed. Open it. Your program settings are now installed on your new machine. You must close Track Master and restart for the settings to take effect.

Copying *Data Files*

Data files for each session or run are stored in a separate folder for each session or run. These session folders are stored in a data structure of folders that includes the *track name* folder, the *event name* folder, and the *session* folder. This structure must be maintained when moving data from 1 pc to another.



Maintain data structure

The easiest way to move the data is to connect the 2 PCs on a network, and use Windows Explorer to move each entire *track name* folder from 1 PC to the other. In some cases you can use your floppy disk drive to move the folders and files, but in many cases the standard 1.44 megabyte floppy will be too small to move even a single session of data.

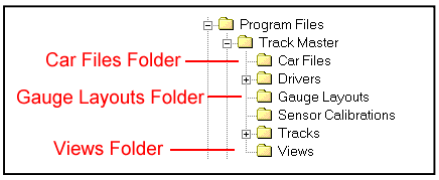
In these 2 cases, you would simply copy each entire TRACK folder from 1 machine to another, and all the EVENT and SESSION folders (under the TRACK folder) would be copied too.

Another way to move the data is to first compress it using a program such as *Winzip.* IF you use *Winzip,* make sure that Winzip is set to both RE-CURSE FOLDERS and SAVE FOLDER NAME INFORMATION. This method is a little more complicated and requires good working knowledge of Winzip.

One more method of moving the data is to use programs that enable connection of 2 computers via serial or parallel cable, such as *Laplink.*

(Please note that CDS does not provide technical support or training in the use of Windows Explorer, Laplink, Winzip, or other 3rd party programs)

Copying *View* and *Template F*iles



View files contain all the information Track Master needs to create all the plot pages in the view, AND the information on which data was last saved with the *view.* THE VIEW FILES DO NOT CONTAIN THE ACTUAL DATA. This is why if you simply copy view files from 1 machine to another and try to load the view, you will get many error messages telling you that Track Master can not find certain data.

View and *template* files are saved in the *Views* folder. Copy all the files from the *Views* folder on the first PC to the same folder on the second PC. These files are fairly small and can usually all fit on 1 floppy disk.

Copying *Car Files*

Car Files contain all the information a Commander II needs to record data, including all sensor calibrations etc. *Car Files* are saved in the *Car Files* folder. Copy all the files from the C*ar Files* folder on the first PC to the same folder on the second PC. These files are fairly small and can usually all fit on 1 floppy disk.

Copying Command View *Layout Files*

The Command View *Layout* files contain all the information the *Command View* program needs to duplicate screen layouts you may have created or modified. They are saved in the *Gauge Layouts* folder. Copy all the files from the *Gauge Layouts* folder on the first PC to the same folder on the second PC. These files are fairly small and can usually all fit on 1 floppy disk.

Summary

If after moving all items per the above steps you get error messages saying Track Master can not find certain data, the most likely cause is you did not EXACTLY duplicate the folder structure when moving the data. Note which data the program says it cannot find, and use *Windows Explorer* to examine and verify the folder structure.

Important Note Regarding Write-able CDs

If you use a writ-able CD to move data, all the files will have their READ ONLY attribute set when you write them to the CD, and this attribute must be cleared before TM can use the files.

If you do not zip up the data files prior to storing on CD, then you must manually clear this attribute on each individual file. Therefore, if using a CD, we HIGHLY recommend zipping the data first, and copying the ZIP file to the CD. Then, when you un-zip the data on the new PC, all the original file attributes will be preserved.

Appendix A – Math Technical Reference

Introduction

Sign Conventions

Syntax

Preprogrammed Formulas

Circle Track & Road Race

Drag Race

Dyno

Chassis Analysis option

Additional Supplied formulas

Appendix B – Recovering from problems in data

“Shifting” data in time

Circle Track & Road Race

Drag Race

Dyno

Fixing calibration or setup problems

Using data with faulty signals

Data with no valid speed signal

Data with no valid Lateral_G signal

Using data with no lap times

Estimating lap times

Entering lap times manually

Appendix C – Software Troubleshooting

Operating System Compatibility Statement

CDS Software is designed to operate on the Windows operating system, version 98 SE and higher.

For maximum compatibility with operating systems other than Win 98 SE we recommend F35 or higher ROM and TM and CL 5.4 or higher.

CDS does not guarantee compatibility with any operating system.

PROBLEM	CAUSE and/or SOLUTION

ISSUE # CL-1

Command Link or Command View "***View Live Readings"*** fails. Problem occurs intermittently.

Applies to:

- Windows 95, 98 on certain PCs particularly Dell Notebook computers
- Windows 2000 Professional (may apply to NT 4.0)
- ALL Commander II ROM versions
- **Command Link versions 5.2 and lower**

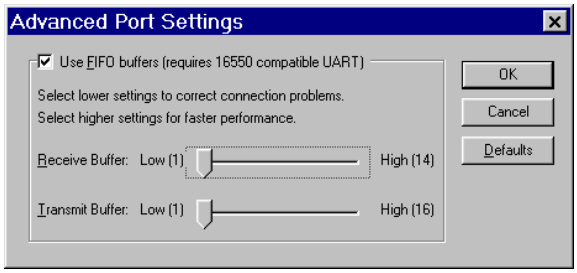
Recommended Action:

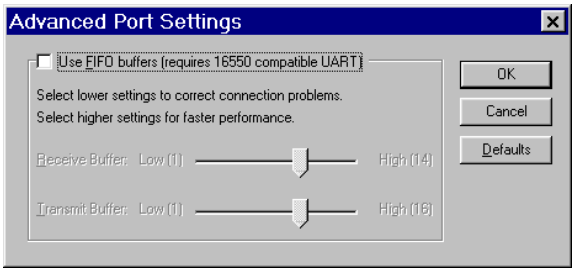
1. Upgrade to TM and CL version 5.4 or higher
2. Upgrade your Commander II ROM to version F35 or higher

Alternate Action: (may or may not work)

Adjust COM port settings in windows as follows:

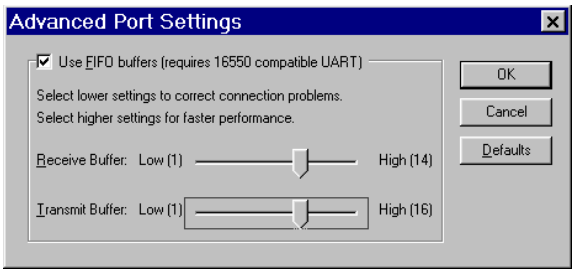
- Right Click on **"My Computer"**
- Select **Properties**
- (Click **Hardware** in Win 2000)
- Click **Device Manager**
- Double click on **Ports**
- **Double Click** on the **COM Port** you are using with Commander
- Click **Properties**
- Click **Port Settings**
- Click **Advanced**
- **Try each of the following setting combinations**, starting with the first one shown. **You MUST re-boot your PC after each setting change** for it to take affect.
    - After each change, press the reset button on the Commander II and then try to View Live Readings.

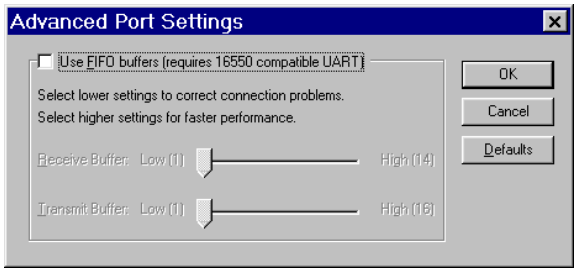




PROBLEM	CAUSE and/or SOLUTION

ISSUE # CL-1 (Continued)





- Click ok to get out
- **IMPORTANT**: you MUST Re-Boot your PC for changes to take effect.

NOTE*:* You may have to try to "***view live´*** repeatedly, some of the time you will get "Unable to send command" message. If you get an error message in CL, press the **Reset** button on the front of the Commander II just before you click the *View Live* button in CL again.

NOTE: If you still can not *view live*, try pressing the **Reset** button on the front of the Commander II just before you click the *View Live* button in CL.

Make sure green light on front of Commander II is flashing slowly before you attempt a communication command (such as ***View Live Readings*** etc.). If it is not, press the **Reset** button on the front of the Commander II.

ISSUE # CL-2

Command Link ***Upload Configuration*** fails

Applies to:

- Commander II ROM versions ALL
- Command Link versions 5.2 and lower.

Recommended Action:

1. Upgrade to TM and CL version 5.4 or higher
2. Upgrade your Commander II ROM to version F35 or higher

Alternate Action: (may or may not work)

SOLUTION #1

- Perform the steps listed in issue #CL–1 (above)
- If all of the above fail to solve your problem, try pressing the reset button on the Commander II right before you send it a command

NOTE: Make sure green light on front of Commander II is flashing slowly before you attempt a communication command (such as ***View Live Readings*** etc.) If it is not, press the **Reset** button on the front of

PROBLEM	CAUSE and/or SOLUTION
	the Commander II. **SOLUTION #2** • If you already are running TM and CL version 5.2, update to Command Link version 5.2.86.139 (5.21 Beta, dated 1/10/01) or newer. Go to http://www.competitiondata.com/downloads and follow the link to the updates page or check the readme.txt file installed in your ***\program files\track master\documents*** folder. • If you are running TM and CL version 5.1 or lower, you must purchase an upgrade to 5.2
ISSUE # CL-3 Command View View Live Readings works the first time you do it, but then fails on subsequent attempts. **Applies to:** • Windows 2000 Professional (may apply to NT 4.0) • Commander II ROM versions **33 and lower ONLY** Command Link with Command View option	**Recommended Action:** 3. Upgrade to TM and CL version 5.4 or higher 4. Upgrade your Commander II ROM to version F35 or higher **Alternate Action: (may or may not work)** **First,** try the items listed in ISSUE # CL-1 (above) If you still have the problem, you must press the reset button on the Commander II just prior to doing a ***View Live*** in Command View. • This problem is due to a quirk in Windows 2000 which we are hoping Microsoft fixes in their next release. Check their web site for the availability of a service pack for the version of Win 2000 you have. • Commander II ROM 34 and higher eliminates this problem
ISSUE # CL-4 Command View ***View Live Readings*** does not work at all with Commander II ROM 30 and lower **Applies to:** • Windows 2000 Professional (may apply to NT 4.0) • Commander II ROM versions 30 and lower • Command Link with Command View option	Contact CDS to arrange for a ROM upgrade to your Commander II

PROBLEM	CAUSE and/or SOLUTION
ISSUE # CL-5 Can not communicate at all with Commander II. **Symptoms:** • Green light on Commander II flashes erratically or freezes when communication cable is connected**. This will occur even if CL is not running on the PC** • *Calibration Command* buttons in CL become disabled intermittently when communication cable is connected. • **Applies to:** • Windows ME, 2000 Professional, XP • All Commander II ROM versions. • Command Link all versions	**Cause:** The combination of your PC Hardware and Windows version result in an RS 232 (COM) port which does not behave per the RS 232 specification. The COM port is constantly sending "garbage" characters. **Possible Solution #1**: Version 5.4 of CL has been found to "fix" this problem on some PCs. If you have CL and TM version 5.2 and have this problem you will receive CL 5.4 free of charge. Contact CDS for availability. Possible Solution #2**: Re-installation of the Operating system (windows) may be required.**

PROBLEM	CAUSE and/or SOLUTION
ISSUE # CL-5a Can not download data from Commander II. (wire-transfer models only) **Symptoms:** • The *Retries* number on the CL download screen counts up, but no records are received. **Applies to:** • Windows ME, 2000 Professional, XP • Commander II ROM versions 34 and lower. All Command Link versions.	**Recommended Action:** Upgrade to TM and CL version 5.4 or higher Upgrade your Commander II ROM to version F35 or higher
ISSUE # CL-6 Command View ***View Live Readings*** give error message "*out of memory"* when trying to view live readings. **Applies to:** • All operating systems • All Commander II ROM versions • Command Link version 5.3	**Cause:** You have signal names included in your *car file* which are not in the *Default Signal Attributes* table. **Solution**: • Start Track Master an verify that you are running version 5.3 by clicking *help* then *About Track Master.* The revision number should be 5.3.168.184 or higher • Next, click *System* then *Track Master Options* then *Default Signal Properties* • Check each signal used in your car file against the list of signals in the *Default Signal Properties.* Find the signals which AREIN you car file but NOT LISTED in the Default signal properties. Click the Add… button and type each one of them in. • Close Track Master and Command Link • Re-start Command Link. • If you continue to get this error you have not included or possibly miss- typed one of the signals. • When creating new signal names, always create in TM first • **FIXED IN VERSION 5.3.99.190**

PROBLEM	CAUSE and/or SOLUTION
ISSUE # CL-7 Command View ***View Live Readings*** give error message "*cds error"* when trying to view live readings. **Applies to:** • All operating systems • All Commander II ROM versions • All versions of Command Link	**Cause:** The PC you are using to try to *view live readings* with does not have an exact copy of the car file which was either uploaded to the Commander II (if you have internal memory Commander II) or used to prepare the memory card. **Solution**: • Upload the setup to the Commander II or prepare the memory card using the same PC as you are using for communication purposes. • If your team uses multiple PC's, copy the car file from the main PC to all the other PCs which you wish to use for communication
ISSUE # TM-3 After copying data from 1 PC to another, you are unable to access (plot) the copied data. **Applies to:** • Track Master version 5.2	**SOLUTION** • Upgrade to TM version 5.4 Contact CDS by phone or check our web site, www.competitiondata.com
ISSUE # CL-8 Command Link will not run. When starting CL, you get a issues warning "failed to load drivers, please re-install software before contacting CDS" **Applies to:** • Command Link 5.3 • Windows XP	**SOLUTION** • Do not use "compatiability settings on XP. Run software in "native" XP mode. • Right click on the shortcut to CL on your desktop • Left click on *Properties* • Click the *Compatibility* Tab • Make sure the "*Run this program in compatibility mode"* is **NOT** checked.

PROBLEM	CAUSE and/or SOLUTION
ISSUE # TM-3, CL-9 Either program behaves sluggishly or locks up from time to time. **Applies to:** • All versions of CL lower than 5.4 • Windows XP & 2000 professional	**SOLUTION** • Compatibility problem. Do not run both applications at the same time. Close CL when you want to run TM, and visa versa. • Fixed in CL and TM version 5.4 Upgrade to TM and CL 5.4
ISSUE # CL-10 Communication problems when viewing live or wire transfer download. • Lots of retries when downloading. • Lots of errors when viewing live with Command View • Erratic or non-sensible values when viewing live with Command Link **Applies to:** • All versions of CL lower than 5.4 Windows XP & 2000 professional	**SOLUTION** • Compatibility problem. Do not run both TM and CL applications at the same time. Close TM when you want to run CL. • Resolved in CL version 5.4 Upgrade to TM and CL 5.4
ISSUE # CL-11 Command Link will not run. When starting CL, you see the "splash" screen, then nothing. **Applies to:** • Command Link 5.3 • All versions of Windows	**Cause:** CL 5.3 requires that you have a COM 1 serial port installed on your PC. You do not necessarily need to use COM 1 with CL, but it must be installed on the PC. **SOLUTION** • In the windows device manager, assign your COM port to be COM 1. • Note that if you are using a USB to serial converter for COM 1, it must be plugged in to the PC for CL to start.. **- OR -** • Contact CDS for update to CL 5.4 or higher • **FIXED IN VERSION 5.4**

PROBLEM	CAUSE and/or SOLUTION
10-28-2002 **Release of CL and TM 5.4**	All known TM and CL issues with Windows XP are now resolved with release 5.4 Note that Memory card configuration issues (which are operating system issues, not TM or CL issues) still exist..
ISSUE # PC-1 PC does not recognize memory card. **Applies to:** Windows 2000 and XP (all versions)	**SOLUTION** • First, see the item in the Microsoft knowledge base located at : http://support.microsoft.com/search/preview.aspx?scid=kb;en-us;Q310772 • This article is reprinted in appendix B of this document. • The essence of this article is that you must install Windows XP service pack #1 on your machine. This can be done at this link: http://support.microsoft.com/default.aspx?scid=kb;en-us;Q322389 • If after installing service pack 1 your PC still does not recognize your memory card, follow the instructions memory card driver installation in the next section.
ISSUE # C2-1 When using multiple sample rates in your CAR file configuration (HIGH and MEDIUM rate for example) Only the channels set to HIGH rate get recorded. The Signal List in TM offers the medium speed channels, but when you plot them there is no data in them. **Applies to:** All Commander II with ROM versions 41	**CAUSE:** This bug is triggered by "viewing live" data, zeroing sensors, or calibrating sensors **and then** immediately recording data. Some of the program variables were not being properly reset in the Commander II firmware after doing the "*View Live"* tasks. **TEMPORARY WORKAROUND:** Whenever you view live readings, zero sensors, or calibrate sensors, after you are done then re-prepare the memory card (or upload the configuration if you have an internal memory Commander II) **BEFORE** you attempt to record data. **PERMANENT SOLUTION:** Have your Commander II upgraded to ROM version 43. If you have ROM 41 This will be done at no charge.

PROBLEM	CAUSE and/or SOLUTION
ISSUE # USB-1 Command Link issues message **"Commander must be connected"** when attempting to *view live, clear, calibrate, etc.*. **Applies to:** • Command Link 5.4 & lower • Windows XP & 2000 • Edgeport USB to Serial adapter	**NOTE: CL** issues this message even though you do have the Commander II connected and have the correct COM port set in the *Communications Setup* of CL. Not all PC's running XP or 2000 experience this problem. **CAUSE:** This is a bug in the edgeport software when running XP. **TEMPORARY WORK AROUND** Make a "trip" through the *Communications setup* tab in CL (click its tab then click back to *Commander Communications)* before trying to communicate through the edgeport. This activates the edgeport so that it works properly when you actually try to communicate. **NOTE:** You only have to make this "trip" once after booting CL. If you close CL you will need to do it again before communicating.
ISSUE # USB-2 Command Link may get stuck in a loop when wire transfer downloading a Commander II through an edgeport USB-COM adapter. "Retries" count up endlessly and download is "stuck" **Applies to:** • Command Link 5.4 & lower • Windows XP & 2000 • Edgeport USB to Serial adapter • Internal memory (wire transfer download) Commander II	**CAUSE:** This is a bug in the edgeport software when running XP. **NOTE**: Not all PC's running XP or 2000 experience this problem. This problem seems to only occur infrequently so the usual cure is to: • Unplug download cable • Hit reset button on Commander II • Close then re-open CL and try again. If the problem reoccurs frequently then change the settings for the edgeport. Follow the instructions for issue #CL 1 at the beginning of this guide.

Memory Card Driver installation for Windows 2000 & XP

If your memory card is not working (no removable drive shown in “my computer” when the card is inserted), then follow these instructions.

VERY IMPORTANT! Verify that you are using a CDS supplied memory card. There are many SRAM memory cards on the market that simply do not work **and can not be made to work** under Windows 2000 and XP.

NOTE FOR XP USERS ONLY: First verify that you have XP service pack 1 or higher installed on your PC. See issue# PC-1 (Above).

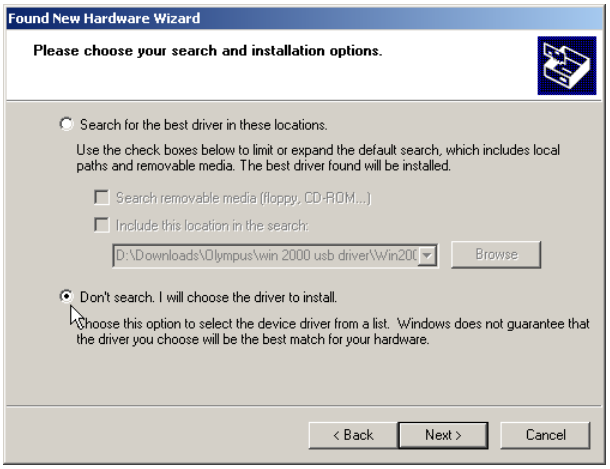
Driver installation Procedure

Insert Card in PC

1) When you first insert a memory card in the PC the Windows 2000 hardware setup process begins when the “Found New Hardware Wizard” starts. If the wizard does not start, go to the instructions below to **Update Driver for Card**.

2) In the first screen of the Wizard, click the button to *Install from a list or specific location.*

   Then click *Next.*

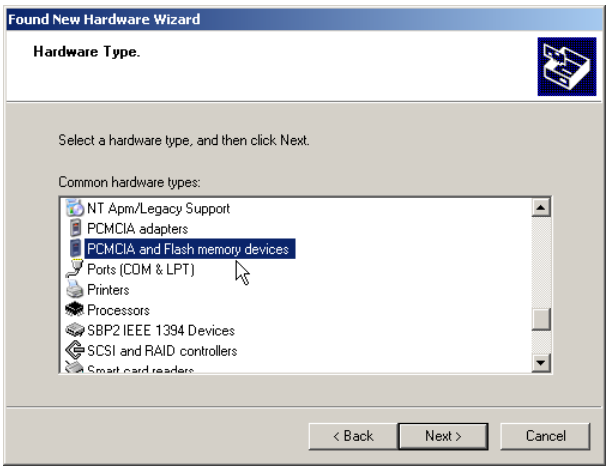


3) Now you should see the *Search Options* dialog box. Click the *Don’t search, I will choose driver to install* button.

   Then click *Next.*

4) Now you should see the *Hardware type* dialog box. Click on *PCMCIA and Flash memory devices.*

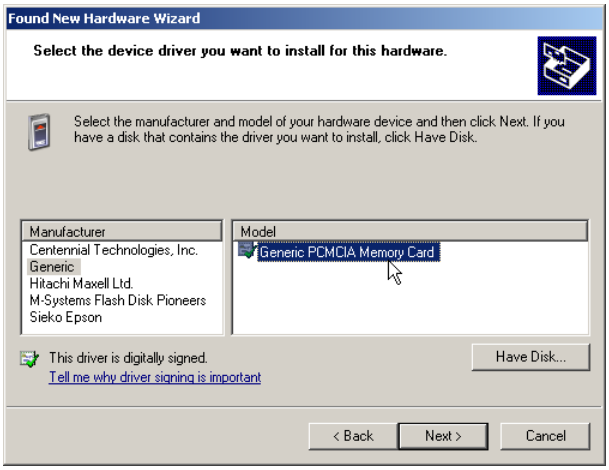
   Then click *Next.*



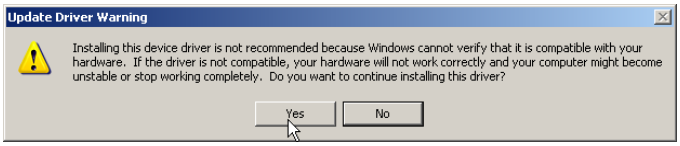
5) Now you should see the *Select Device driver* dialog box. On the left side click *Generic*, then on the right side click *Generic PCMCIA Memory Card.*

   NOTE: if there is a *Show Compatible hardware* check box in the dialog. Un-check the option.

   Then click *Next.*



NOTE: You might receive a *Update Driver warning.* If you do, click *Yes.*



6) Click *Finish* to complete the installation. Click *YES* when you are asked to re-start windows. After windows re-starts your PC should recognize the memory card as a removable drive. (see Verifying That Your PC Recognizes the Cards Properly in chapter 1 of this manual.) If your PC still does not recognize the card, refer to the **Update Driver** section below**.**

If you still have problems, verify that you are using a CDS supplied memory card. There are many SRAM memory cards on the market that simply do not work and can not be made to work under Windows 2000 and XP. If you have an old card or one not supplied by CDS, contact CDS to purchase a compatible card.

VERY IMPORTANT NOTE: in windows XP and 2000 you must "Stop" the memory card before removing it from the machine. See the section "Removing Memory Cards When Running Windows 2000 & XP" in chapter 1.

Update Driver for Card

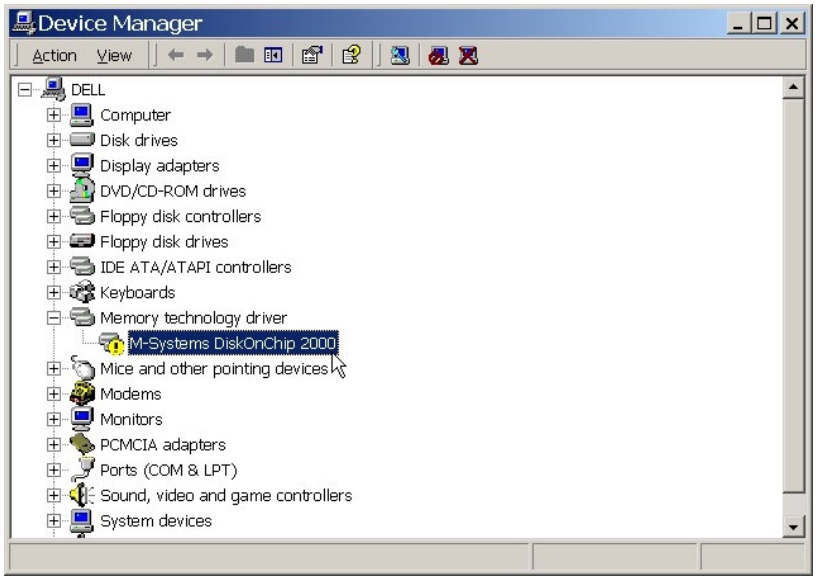
if you have already inserted a memory card (before reading these instructions) and another driver has been installed for it you will not see the Wizard when you insert the card in your PC, but you probably will see a message that the card is not working properly.

Update the driver for the card as follows:

Insert Card in PC

1) Right-click on the *My Computer* icon on your desktop. Then left click on *Properties.*

2) Click the *Hardware* tab, then click *Device Manager.* You will see a list of devices installed on your computer.



3) Find the device in the list that is not working, as indicated by the yellow " ! " next to it. It will usually be listed under *Memory Technology driver* or under *PCMCIA and Flash memory devices*.

4) Left-click on the device then click the *Action* menu at the top and select *Update Driver.*

Now go to step 2 in the Driver Installation Procedure section (above)

Microsoft Knowledgebase article: PCMCIA Device May Not Work in Windows XP

The information in this article applies to:

- Microsoft Windows XP Home Edition
- Microsoft Windows XP Professional

SYMPTOMS

A Personal Computer Memory Card International Association (PCMCIA) device that works correctly in Microsoft Windows 98, Microsoft Windows 98 Second Edition, Microsoft Windows Millennium Edition, and Microsoft Windows 2000, may not work correctly in Windows XP. If this problem occurs, a black exclamation point (!) on a yellow field is displayed on the device in Device Manager. Additionally, no resources will be allocated to the device.

CAUSE

This problem can occur if the PCMCIA device has its configuration information in common (working) memory instead of attribute memory (where the Card information structure (CIS) and configuration registers are mapped). The Pcmcia.sys driver in Windows XP does not recognize such devices, and because of this, does not allocate resources to the device.

RESOLUTION

To resolve this problem, obtain the latest service pack for Windows XP. For additional information, click the following article number to view the article in the Microsoft Knowledge Base:

Q322389 How to Obtain the Latest Windows XP Service Pack

The English version of this fix should have the following file attributes or later:

Date	Time	Version	Size	File name	Platform
25-Oct-2001	08:07	5.1.2600.17	116,352	Pcmcia.sys	Intel
25-Oct-2001	08:07	5.1.2600.17	310,784	Pcmcia.sys	ia64

STATUS

Microsoft has confirmed that this is a problem in the Microsoft products that are listed at the beginning of this article. This problem was first corrected in Windows XP Service Pack 1.

First Published: Oct 17 2001 9:18AM

Keywords: kbenv kbhw kbtool kbOSWin2000fix kbWinXPpreSP1fix kbWinXPsp1fix kbbug pc card

Appendix D – Troubleshooting Upgrade from TM 97

Users of TM-97 may experience problems updating from TM 97 to TM 2000. If the install of TM 2000 fails or if you have problems accessing your data after update, please review the following:

PROBLEM #1: Install cannot successfully complete. Error message issued by install:

Rename of Folder Failed

SOLUTION #1: Using Windows Explorer, do the following:

1. Verify that there is no folder named TRACK MASTER in the C: \PROGRAM FILES folder. If there is, delete it.
2. Verify that the C:\PROGRAM FILES folder attribute is NOT set to READ ONLY. If it is READ ONLY, change it.
3. Verify that the C:\PROGRAM FILES\TRACK MASTER 97 folder attribute is NOT set to read only. If it is READ ONLY, change it.

Try to install TM 2000 again. If you still get the same error message, then using Windows Explorer:

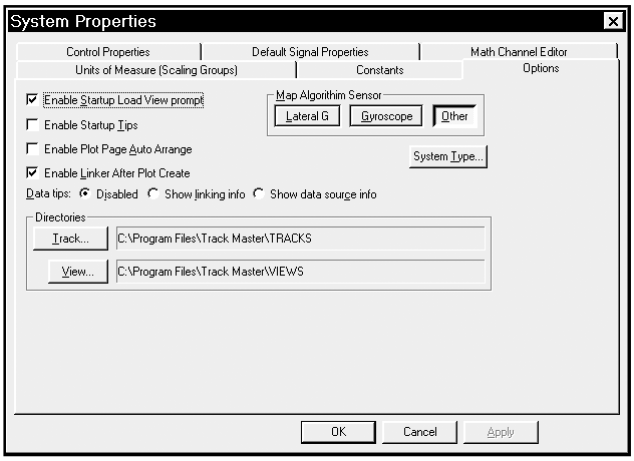
3. Navigate to C:\PROGRAM FILES\TRACK MASTER 97 and delete the TRACK MASTER 97.EXE and COMMAND LINK 97.EXE files
4. Install TM 2000
5. Using Windows Explorer, copy the contents of the C:\PROGRAM FILES\TRACK MASTER 97\TRACKS\ folder to the C:\PROGRAM FILES\TRACK MASTER\TRACKS\ folder.
6. Using Windows Explorer, copy the contents of the C:\PROGRAM FILES\TRACK MASTER 97\VIEWS\ folder to the C:\PROGRAM FILES\TRACK MASTER\VIEWS\ folder.
7. Using Windows Explorer, copy the contents of the C:\PROGRAM FILES\TRACK MASTER 97\CAR FILES\ folder to the C:\PROGRAM FILES\TRACK MASTER\CAR FILES\ folder.
8. Check & verify the items listed in SOLUTION #2 (below).

IF YOU DO NOT KNOW HOW TO USE WINDOWS EXPLORER TO NAVIGATE YOUR FOLDERS OR TO COPY AND DELETE FILES, REFER TO THE ONLINE WINDOWS HELP OR CONTACT YOUR PC SUPPLIER FOR SUPPORT. CDS DOES NOT SUPPLY SUPPORT FOR WINDOWS EXPLORER.

PROBLEM #2: Difficulty accessing data or views after update

SOLUTION #2: Verify all TRACK MASTER and COMMAND LINK file path settings as follows:

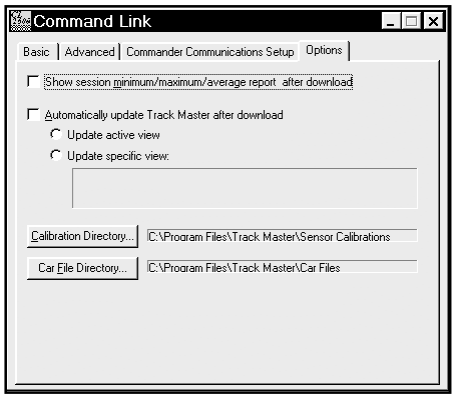
1. Start TRACK MASTER 2000, click CANCEL when you get to the SELECT VIEW Dialog Box.
2. Click SYSTEM, then TRACK MASTER OPTIONS, and then OPTIONS.



3. Verify that your TRACK file path is as shown here. If it is not, click on TRACK, and navigate to your C:\PROGRAM FILES\TRACK MASTER\TRACKS folder and select it.
4. Verify that your VIEW file path is as shown here. If it is not, click on VIEW, and navigate to your C:\PROGRAM FILES\TRACK MASTER\VIEWS folder and select it.

Now verify your COMMAND LINK settings:

1. Start COMMAND LINK 2000, click on OPTIONS



2. Verify that your CALIBRATION DIRECTORY file path is as shown here. If it is not, click on CALIBRATION DIRECTORY, and navigate to your C:\PROGRAM FILES\TRACK MASTER\SENSOR CALIBRATIONS folder and select it.

3. Verify that your CAR FILE DIRECTORY file path is as shown here. If it is not, click on CAR FILE DIRECTORY... and navigate to your C:\PROGRAM FILES\TRACK MASTER\CAR FILES folder and select it.

Appendix E – Hot Keys

These hot keys are active when an ***X-Y plot*** has ***Focus***, and their effect or action is taken on that ***Plot***.

KEY	ACTION
P	Displays the Data Source Dialog for the Plot
O	Displays the Overplots Dialog for the Plot
C	Displays the Change Color Dialog for the signal the cursor is on
Z	Displays the Zero Signal Dialog, to "zero or un-zero" the signal at the cursor's position
S	Displays the Change Smoothing Dialog for the signal the cursor is on
D	Deletes the signal the cursor is on
Q	Display the Choose Session Dialog for doing a Quick Compare
L	Displays the Location Dialog for moving a signal's vertical position within an X-Y Plot
W	Clears the plot that has Focus (deletes all signals in the plot)
R	Displays the Change Reference Signal
H	Displays Choose New Lap
M	Brings up the Menu Box (just as if you right-clicked on the mouse)
F	Applies Full Zoom or Un-Zoom on the plot that has Focus
Ctrl+P	Print
Ctrl+O	Open View
Ctrl+N	New View
CtrlF4	Close View
AltF4	Exit
Ctrl+S	Save View
Alt+S	Save View As…
Ctrl+C	Copies the Plot that you have Focus on (you must be in the Design Mode)
Ctrl+X	Cuts the Plot that has Focus (you must be in the Design Mode)
Ctrl+V	Pastes the Copy of the Plot from the Ctrl+C or Copy Command (you must be in the Design Mode)