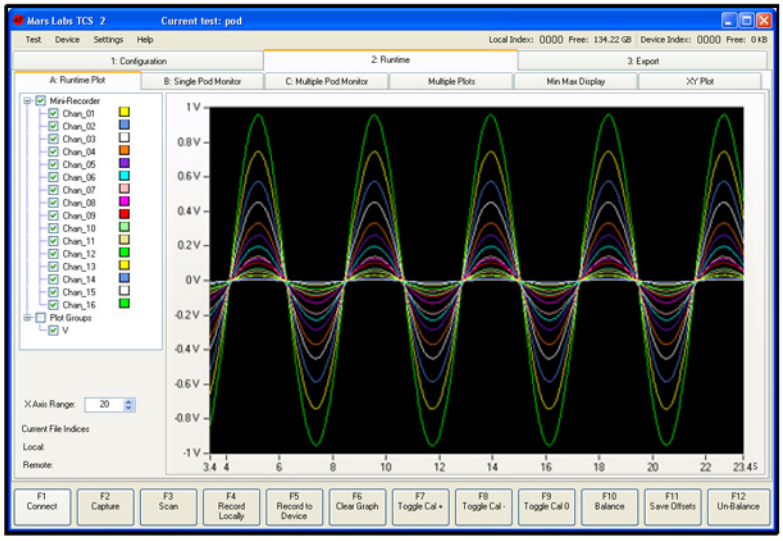
Titan Control Software (TCS)

User Manual



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Titan Control Software User Manual v8.8
MNL 1001
February 2013
(covers TCS version 2.7.4.3)

Bookmarks and hyperlinks added for PDF viewing

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Advanced Settings

NOTE: *The PDF version of this User Manual contains hyperlinks that permit quick access to referenced sections. Hyperlinks are indicated by a blue rectangle around referenced text:*

See Voltage Sensor configurations (pg 116)

Clicking on the link will take you to the referenced page.

Hyperlink rectangles only appear in the PDF version of the Manual and not in the printed version.

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Introduction

Titan Control Software (TCS) is a software application that provides for the configuration, acquisition, display and storage of sensor data from Titan data acquisition devices. TCS allows you to easily configure and control up to 16 channels of sensor data from a Titan Pod or Mini-Recorder, and up to 128 channels from an 8-port Titan CPU Channel Multiplexer. Acquired data can be displayed graphically or in numerical form in real-time, and can be exported in a variety of common file formats.

This manual is intended to provide an overview of TCS with complete feature descriptions, specifications, installation and setup procedures, and operational information.

Overview

This User Guide will take you through the steps to configure TCS to work with your Titan device. The *Starting Up* section should be followed first to install TCS and get the Titan hardware properly connected and running with the TCS application. Detailed information about TCS windows and features appears in the *Advanced Settings* section that follows.

Requirements

TCS is a standalone application designed to run on Windows XP with SP3 and Microsoft .NET Framework installed. The Microsoft .NET Framework installer is supplied on the TCS installation disc.

The TCS application requires:

- 100 MB Hard Drive space
- 512 MB RAM (min.)
- 1024 x 768 minimum screen resolution
- Two (2) USB 2.0 ports

A 2.4G Pentium 4 or faster PC is recommended for the best performance.

Support

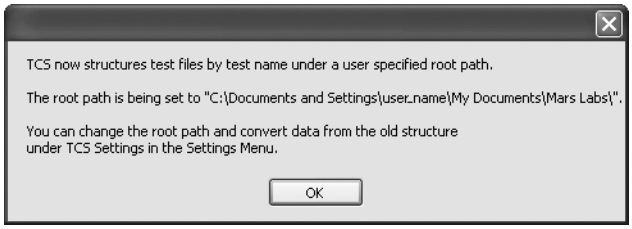
Support for this product is available by contacting the factory during normal business hours (9am – 6pm EST) at 301-470-3278. Additional information can be found on our web site: http://www.marslabs.com

Starting Up

This chapter describes the steps to install, connect and configure the TCS application with the Titan Pod, Mini-Recorder or the Titan CPU.

Pod/Mini-Recorder Installation

1. Install the Microsoft .NET Framework, found on the TCS installation disc (filename: “dotnetfx35.exe”).
2. Install the TCS application (filename: “TCS2_setup_X.X.X.exe”). The filename will include the current version number of TCS. Once installation is complete, the TCS application can be found in the Mars Labs file in the directory. The installation will also add a ‘TCS2’ shortcut icon on the desktop.
3. Connect the Titan device to the PC using the supplied dual USB Y cable. This special cable allows the connected device to draw the necessary power from the PC, while still utilizing the convenience of a USB power source.
4. The PC may prompt that a new hardware device has been found; proceed with the on-screen instructions and install the Titan USB driver if needed. **For assistance with the USB driver installation, see the Troubleshooting section at the end of this document**.
5. Launch the TCS application. The first time TCS is run, the following message window will appear:



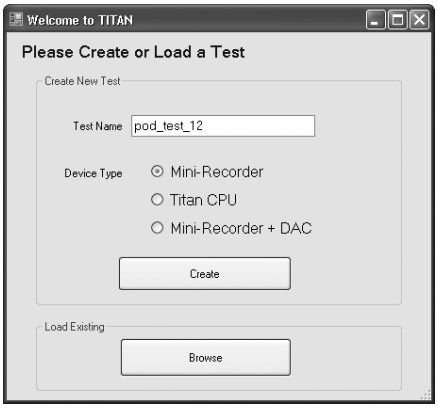
The message informs that TCS data files are exported under the specified test name to the displayed root path. You can change the root path, as well as convert data taken in previous versions of TCS to the new structure, under the ‘Settings’ menu.

NOTES:
1. ***The root path is also displayed in the TCS window title bar.***
2. ***For more information on Root Path, Export Path, and Data Conversion, see the TCS Menus section.***

Click ‘OK’ to dismiss the message window and continue with the installation.

Pod/Mini-Recorder Installation (con't)

6. You will be prompted to create a new test or load an existing test:



For a Mini-Recorder or Pod device, click on the 'Mini-Recorder' radio button under 'Device Type'.

TCS assigns a default test name that is based on the selected device and the current date. To change the name, click inside the Test Name field and enter a new name. All data taken during this session will be exported using the assigned test name.

After selecting the device type and test name, click 'Create' to begin configuring the test.

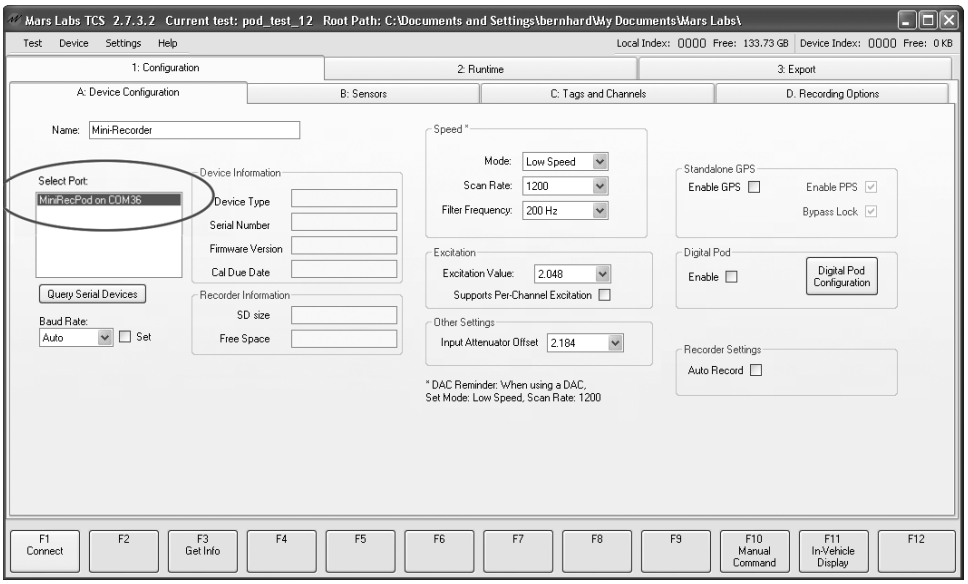
NOTES:

1. Test names cannot contain spaces

2. In this window, you also have the option of loading an existing test. Click on the 'Browse' button and navigate to the location of the test (test files use a '.tcf' extension). After selecting the desired test, clicking 'Open' (or simply double-clicking on the file) will load the file into TCS.

Pod/Mini-Recorder Device Configuration

After creating a test, TCS will display a 'Device Configuration' window which shows the test name and root path in the title bar. The next step is to select a device from the 'Select Port' list and then click the 'Connect' button (F1). If no ports appear in the list, click on the 'Query Serial Devices' button to check for connected hardware.



Once connected, the 'Device Information' and 'Recorder Information' panels will be filled with information about the connected Titan hardware. To complete the basic device configuration, select the speed of the device (High/Low), the desired scan rate, and the filter frequency. For complete information on all Device Configuration screen options, see Advanced Settings (pg 38). After completing the basic setup, continue to the *Sensors* configuration section.

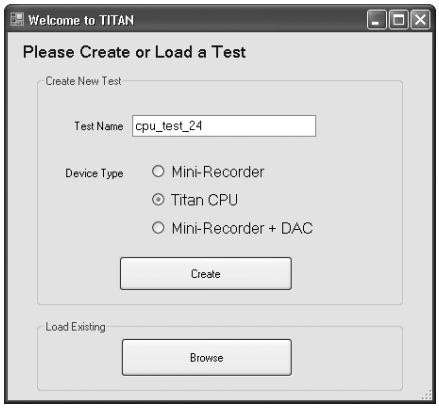
Titan CPU Installation

1. Install the Microsoft .NET Framework, found on the TCS installation disc (filename: “dotnetfx35.exe”).
2. Install the TCS application (filename: “TCS2_X.X.X.X_setup.exe”). The filename will include the current version number of TCS. Once installation is complete, the TCS application can be found in the Mars Labs file in the directory. The installation will also add a ‘TCS2’ shortcut icon on the desktop.
3. Connect the Titan CPU your Ethernet network, but do not apply power to the Titan CPU.
4. Using standard ‘straight-through’ Ethernet cabling, connect the Titan Pods/ Mini-Recorders to the Titan CPU, starting with the lowest numbered ports first. Continue until all devices are connected.
5. Apply power to the Titan CPU. The Titan CPU will initialize and auto-detect all connected devices. The initialization period is about 90 seconds.
6. Launch the TCS application. The first time TCS is run, the following message window will appear:

The message informs that TCS data files are exported under the specified test name to the root path shown. You can change the root path, as well as convert data taken in previous versions of TCS to the new structure, under the ‘Settings’ menu.

Click ‘OK’ to dismiss the message window and continue with the installation.

7. You will be prompted to create a new test or load an existing test:



Click on the ‘CPU’ radio button under ‘Device Type’.

TCS assigns a default test name that is based on the selected device and the current date. To change the name, click inside the Test Name field and enter a new name. All data taken during this session will be exported using the assigned test name.

After selecting the device type and test name, click ‘Create’ to begin configuring the test.

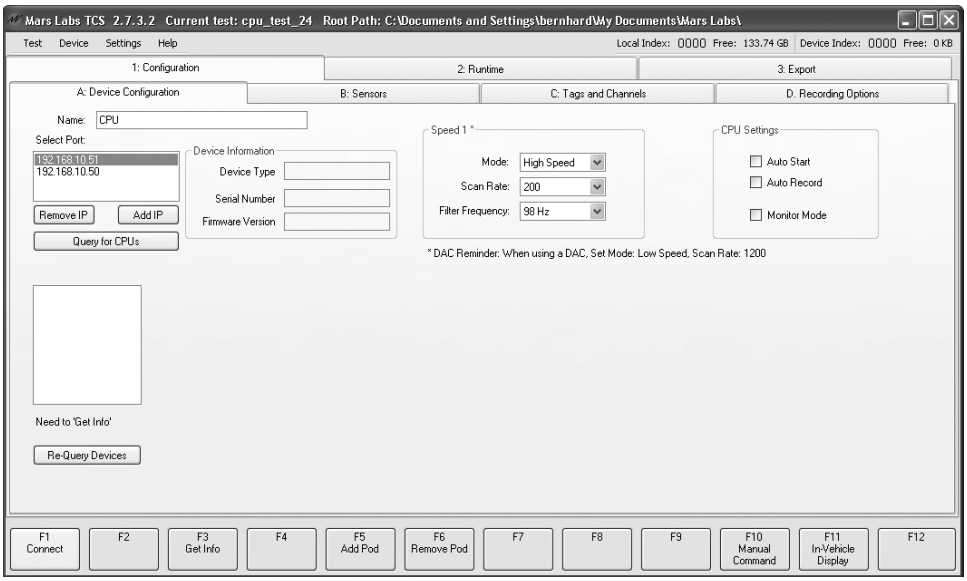
NOTES:

1. Test names cannot contain spaces

2. In this window, you also have the option of loading an existing test. Click on the ‘Browse’ button and navigate to the location of the desired test (test files use a ‘.tcf’ extension). After selecting the test, clicking ‘Open’ (or simply double-clicking on the file) will load the file into TCS.

Titan CPU Device Configuration

After creating a test, TCS will launch and display a ‘Device Configuration’ window which shows the test name and root path in the title bar. The first step is to select the network address of the connected Titan CPU device. This address is posted on the CPU hardware; it should appear in the ‘Select Port’ field in TCS. If the address does not appear, click on ‘Query for CPU’. After the ‘Select Port’ field updates, select the correct address and then click ‘Connect’ (F1) to connect to the Titan CPU:



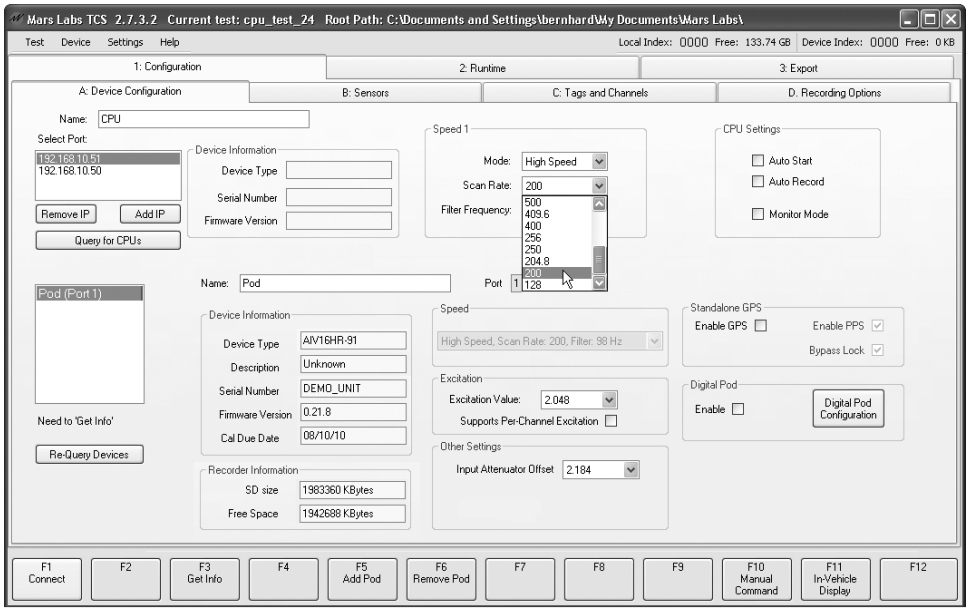
After connections are established, the ‘Device Information’ fields will display information about the connected Titan hardware, as shown below. To complete the Titan CPU device configuration, select the desired scan rate and the filter frequency of the Titan CPU from the drop-down menus. The selected speed, scan rate and filter frequency for the Titan CPU will be applied to all connected Titan devices.

NOTE:

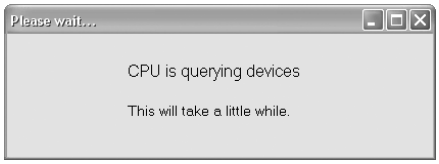
1. If the Titan CPU is configured for High Speed operation when Low Speed Titan Pods or Mini-Recorders are connected, an error will result.

2. If a Titan DAC is part of the system configuration, select Low Speed mode with a 1200 Hz Scan Rate.

3. For complete information on all CPU Device Configuration screen options, see Advanced Settings (pg 42).



The Titan CPU supports up to 8 Titan Pods and/or Mini-Recorders. Titan devices can be added or removed from the Titan CPU as needed, but any new devices are not automatically detected. If you wish to add additional Titan Pods or Mini-Recorders after the initial configuration (the Titan CPU auto-detects devices only upon power-up), make the connections and then click on the 'Re-Query Devices' button. The Titan CPU will scan all ports for new devices, and TCS will display a status message during the process:



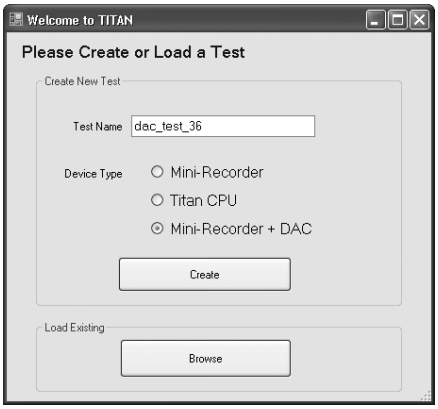
All connected Titan devices will be detected and appear in the device list in TCS.

For complete information on all Device Configuration screen options, see Advanced Settings (pg 38).

After completing the basic setup, continue to the *Sensors* configuration section.

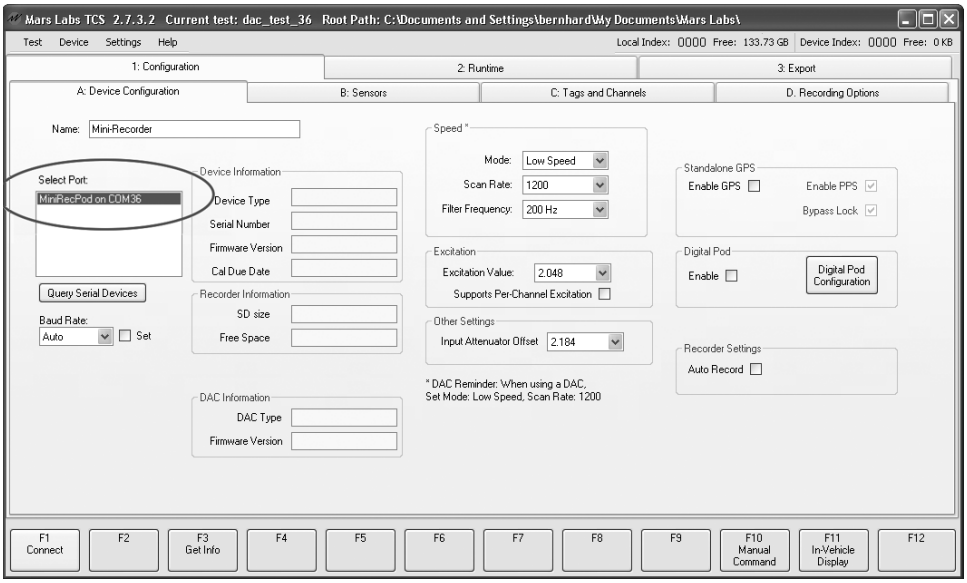
DAC Installation

The DAC Installation follows the Pod/Mini-Recorder installation for TCS as described on page 7. When you get to step 6 in the procedure, click on the ‘Mini-Recorder + DAC’ radio button under ‘Device Type’. TCS assigns a default test name that is based on the selected device and the current date. To change the name, click inside the Test Name field and enter a new name (test names cannot contain spaces). All data taken during this session will be exported using the assigned test name.

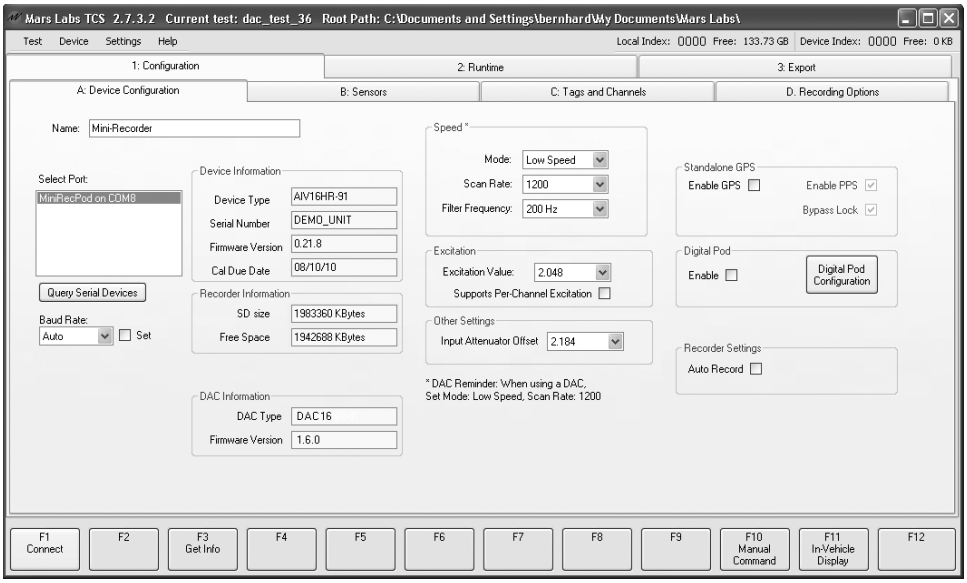


DAC Device Configuration

After creating a test as described above, TCS will display a ‘Device Configuration’ screen which shows the test name and root path in the title bar. Select a device from the ‘Select Port’list and click the ‘Connect’ button. If no ports appear in the list, click on the ‘Query Serial Devices’ button to check for connected hardware.



Once connected, the ‘Device Information’, ‘Recorder Information’ and “DAC Information’ panes will display information about the connected Titan hardware. For the DAC Test, the Mode, Scan Rate and Filter Frequency are optimally configured for the DAC:

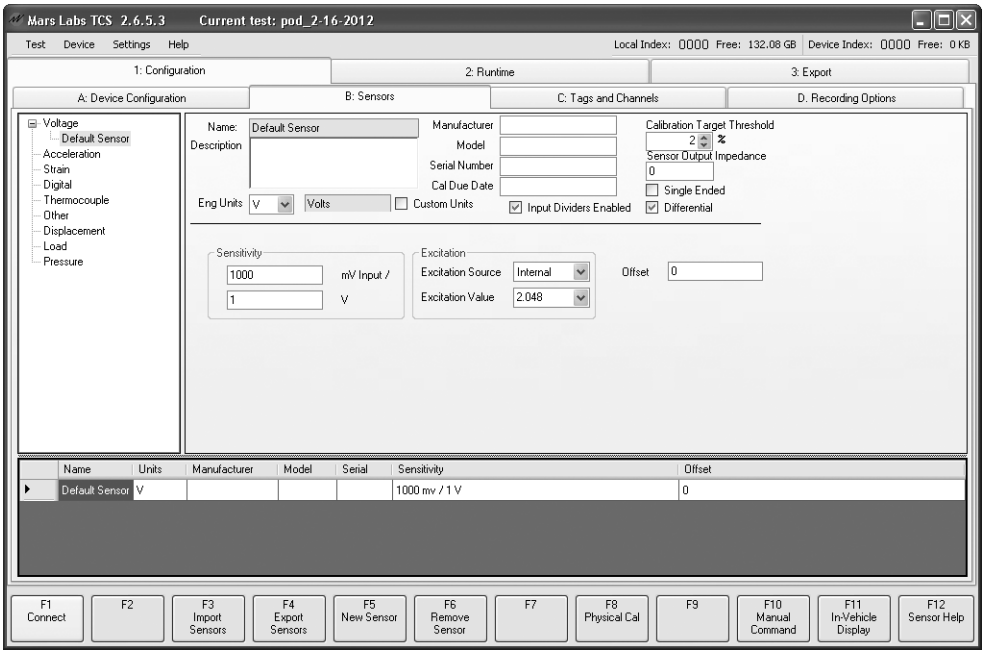


Save the test by selecting ‘SAVE’ from the TEST menu before advancing to the *Sensors* configuration section.

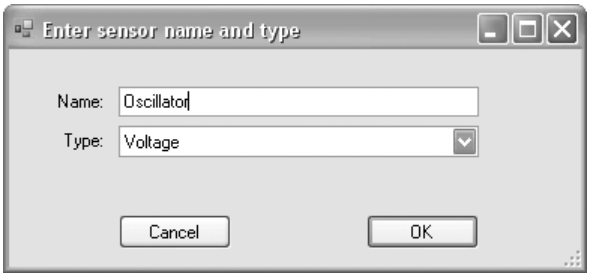
NOTE: *The Titan DAC runs in Low Speed mode at a 1200 Hz scan rate*.

Configuration: The Sensors Tab

Configure the Sensors by clicking on the ‘Sensors’ tab. The Sensors tab window is where you select and configure the types of sensors that will be connected to the Titan device (Accelerometers, Strain Gauges, etc).



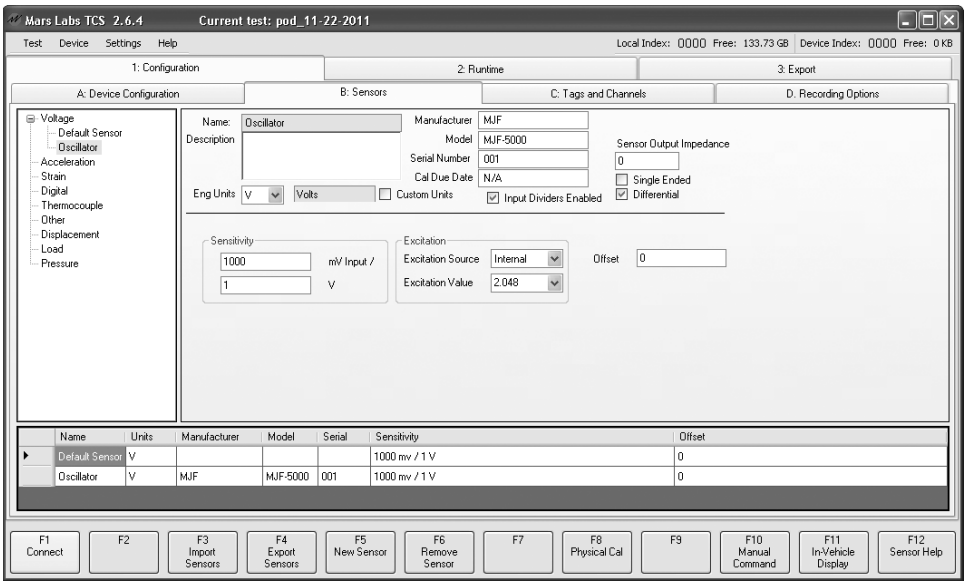
To add a sensor, click on the ‘New Sensor’ button (F5). In the prompt that appears, type in the name of the sensor. Select the type of sensor from the ‘Type’ drop-down menu, and then click ‘OK’. Note that once you click ‘OK’ the sensor name cannot be changed.



NOTE: *You can also create a new sensor simply by double-clicking on the desired sensor type in the Sensor Tree. Any sensors created in this manner will be named automatically, however, you will not be able to specify a sensor name.*

As sensors are added, each name will appear in the Sensor Tree on the left side of the window. You can enter additional information about each new sensor (description, manufacturer, model, etc.) in the editable fields. A table at the bottom of the window provides an overview of all added sensors.

NOTE: *The Overview Table is for display only; it cannot be used for editing*

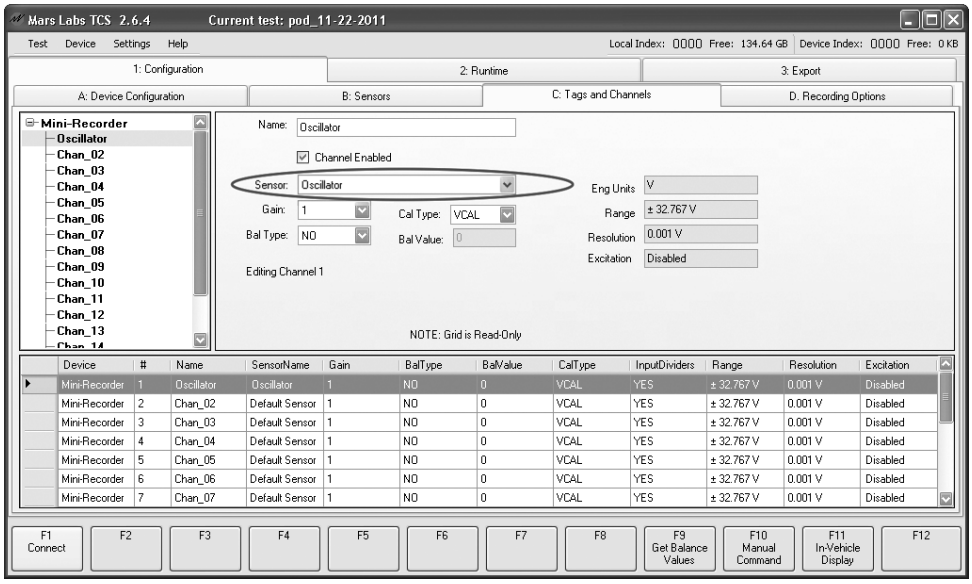


Continue adding sensors in this manner until all sensors have been defined.

Configuration: The Tags and Channels Tab

To configure the input channels of the Titan device, click on the ‘Tags and Channels’ tab. Note that in this window, all channels are initially assigned to a default voltage sensor type.

To assign a sensor to a channel, highlight the desired channel in the Channel Tree on the left and then select the sensor from the Sensor drop-down box as shown. As each sensor is assigned to a channel, the assignment will appear in the table at the bottom of the window. This table provides a detailed overview of all channel assignments and is intended for display only; it should not be used for editing.

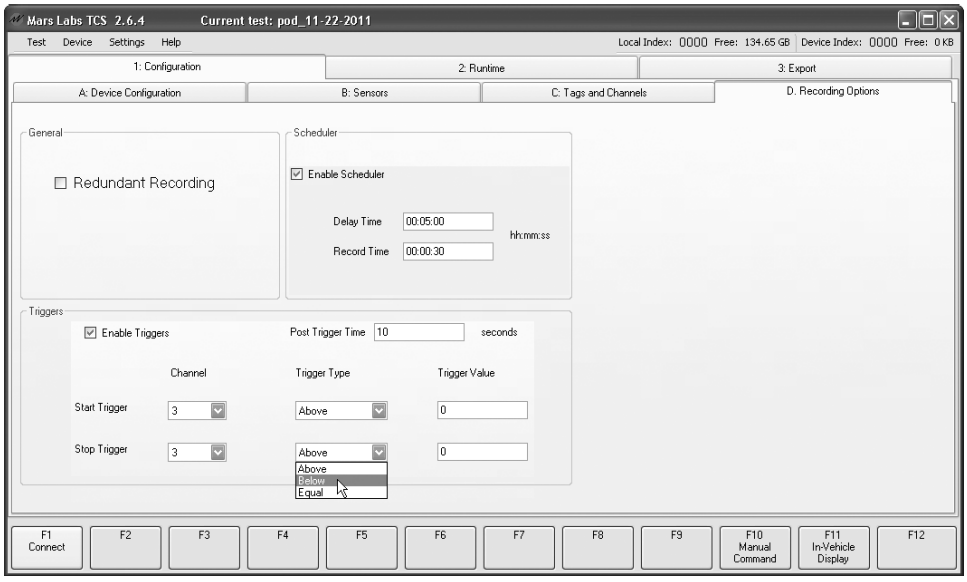


Continue assigning sensors to channels until all sensors have been assigned for the channels of all connected devices, then select ‘SAVE’ in the TEST menu to save your test configuration. TCS is now configured for basic testing. Additional recording options (shown on the following page) can be specified if event triggering or routine start/stop recording is desired.

Configuration: The Recording Options Tab

To enable and configure triggers, click on the ‘Recording Options’ tab. The ‘Recording Options’ window allows you to specify the parameters that will start and stop remote recording on the connected Titan device.

Independent ‘Start Trigger’ and ‘Stop Trigger’ channels can be specified here, along with independent trigger types and thresholds. The ‘Post Trigger Time’ field allows you to specify the amount recording time that will continue after a ‘Stop Trigger’ event is received.



The Recording Options window also allows you to schedule recordings in short, non-continuous segments. This ‘Scheduling’ function is only available for recording locally to TCS; it is not implemented for recording remotely.

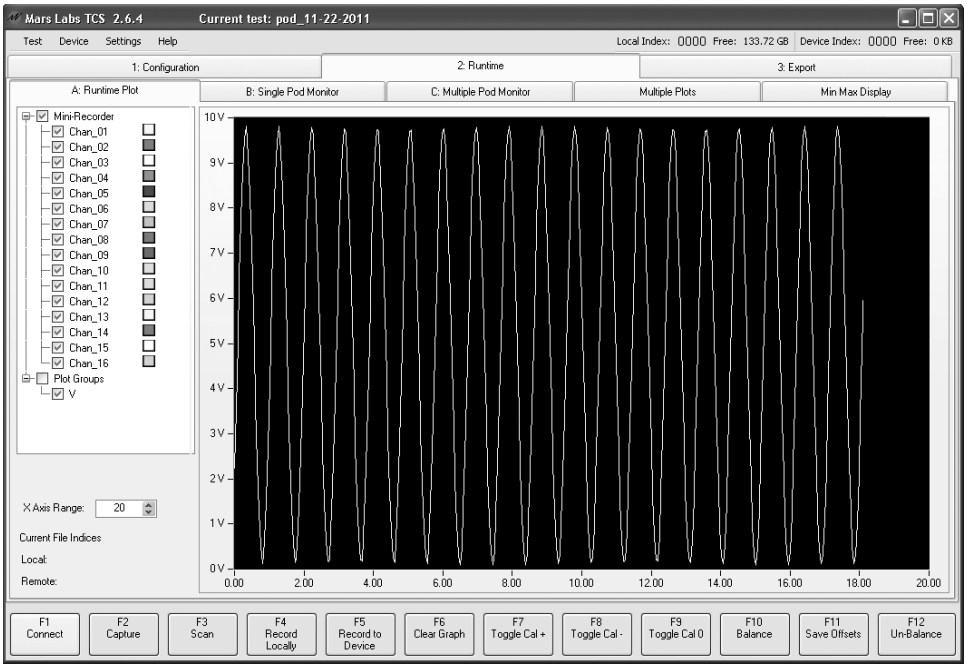
When the Scheduling function is enabled, recordings will occur according to the ‘Delay Time’ and ‘Record Time’ parameters. ‘Delay Time’ sets the frequency of the recording, while ‘Record Time’ sets the duration. For the example shown above, once scanning is initiated in TCS, a 30-second recording would be made every 5 minutes until scanning is stopped.

The Recording Options window also allows you to enable Redundant Recording, which automatically engages both recording modes (Local and Remote) when recording is initiated. Redundant Recording works with both Scheduling and Trigger Modes.

NOTE: *Redundant recording is not supported with Titan DACs*

The Runtime Tab

To view and record incoming data, click on the ‘Runtime’ tab at the top of the screen. A Runtime plot window will appear:

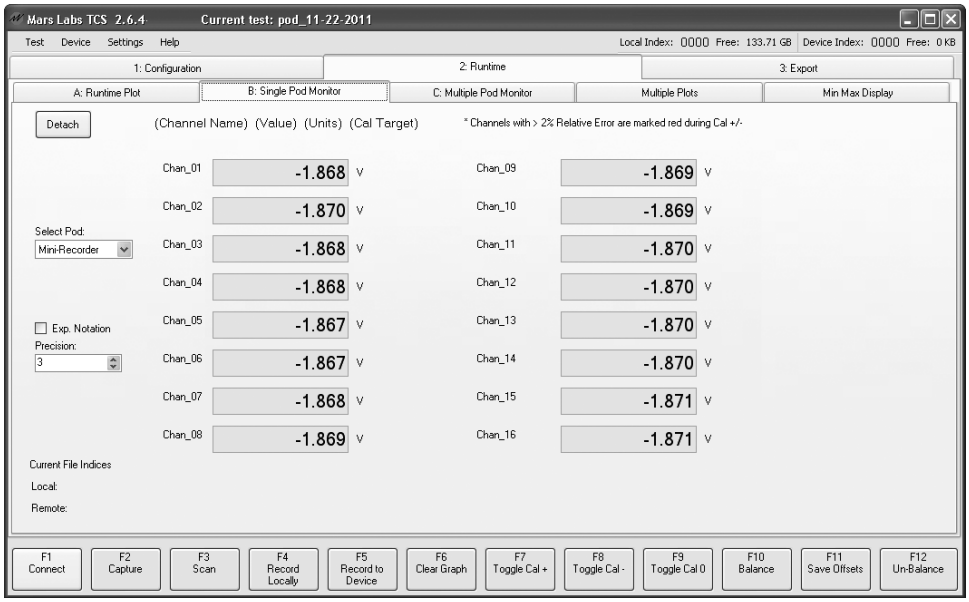


To begin monitoring incoming data, press the ‘Scan’ button (F3). The Scan button will briefly glow yellow indicating that the TCS application is transmitting the sensor configuration to the connected Titan device. After a few seconds, the Scan button will glow green indicating that TCS is now monitoring the incoming data.

You can display any channel, any group of channels or all channels from all connected devices in the Runtime window by clicking on the related checkboxes in the Channel Tree display. The colors used for plotting can be changed by right-clicking on the channel(s) you wish to change. To quickly view all channels simultaneously, select the Device checkbox at the top of the channel tree. To refresh the plot at any time, click ‘Clear Graph’ (F6).

You can view the data in a numerical format by clicking on the ‘Single Pod Monitor’ tab at top of the screen. Both the plotted and numerical monitors can be viewed simultaneously by opening a separate window for the numerical monitor using the ‘Detach’ button located in the lower right corner.

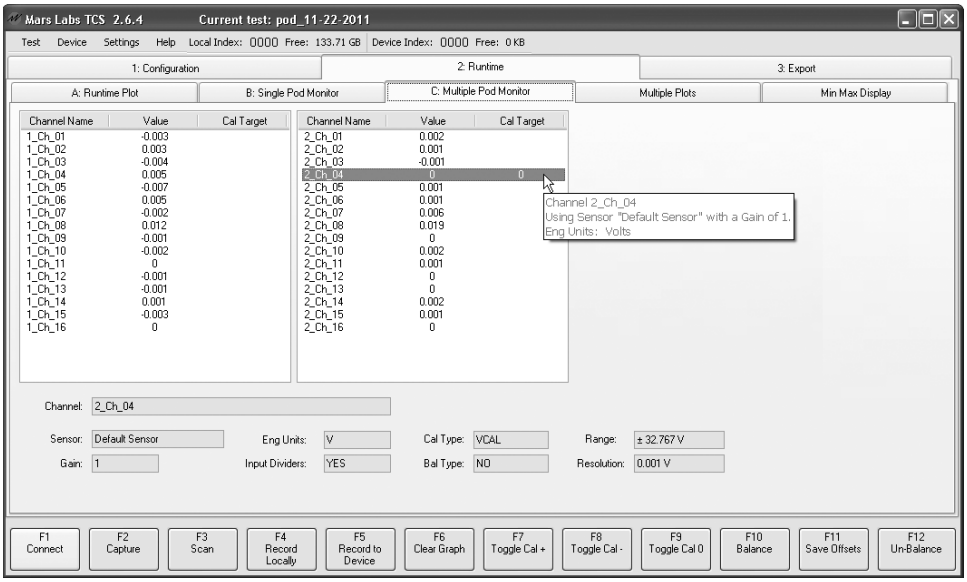
> ***NOTE:*** *When you click on the ‘Detach’ button, it opens a separate Digital Monitors window, and the button label changes to ‘Reattach’. When you click on ‘Reattach’, the Digital Monitors window closes and the data in that window reappears under the ‘Single Pod Monitor’ tab.*



Incoming data can be recorded either locally to the PC hard drive, or remotely to the SD card in the Mini-Recorder, or to the built-in memory of the Titan CPU. To start recording, TCS must first be monitoring the incoming data (F3 will be highlighted in green). Click on ‘Record Locally’ (F4) or ‘Record to Device’ (F5) to begin recording. While recording, the ‘Record’ button(s) will appear highlighted in red. Both local and remote recording can be run simultaneously. Pressing the ‘Record’ button a second time will stop recording, but continue monitoring. Clicking the ‘Scan’ (F3) button will stop both the recording and monitoring functions.

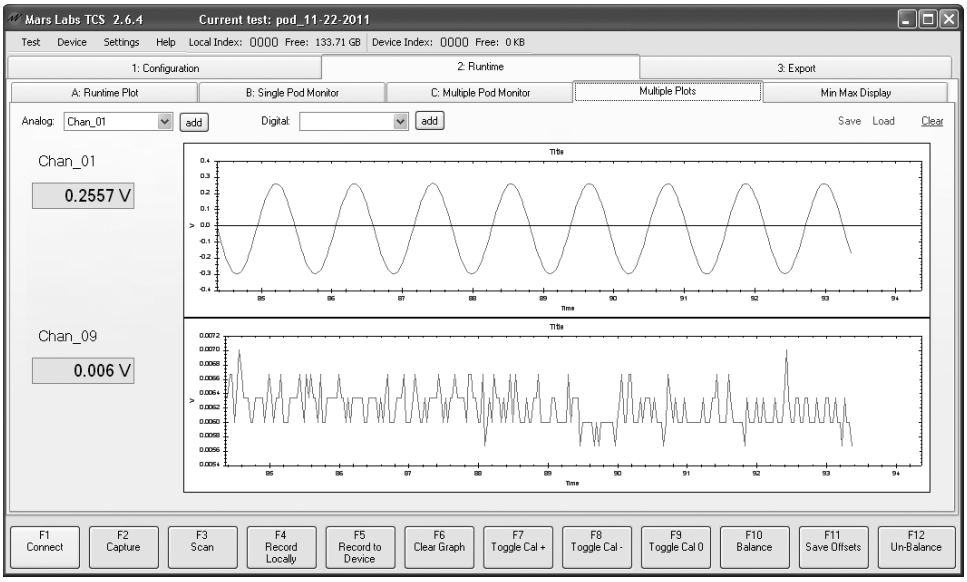
> ***NOTE:*** *Do not physically disconnect the Titan device while scanning or recording. Stop the scanning/recording operation and press ‘F1’ to disconnect the device from the TCS application prior to removing the USB connection.*

If you are using a Titan CPU with multiple Titan devices, you can view the data for all devices by clicking on the 'Multiple Pod Monitor' tab at the top of the screen:



To view information about a specific channel in a given Titan device, simply select the channel of interest. The fields at the bottom of the window will display the configuration information of the selected channel.

To view plots of individual channels, select the 'Multiple Plots' tab and then select the desired channel(s) to display:

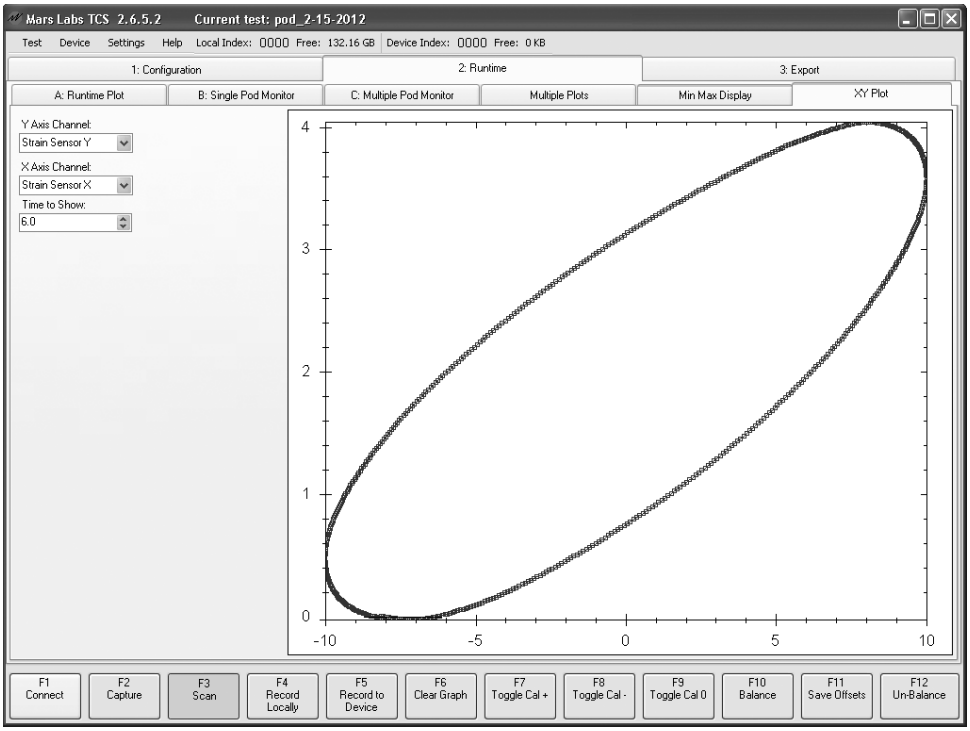


To get an overview of the minimum and maximum channel values, select the ‘Min Max’ tab:

To begin tracking minimum and maximum values, click on the ‘Track Min Max’ checkbox. To reset all values, click on the ‘Reset All’ button. To reset individual channels, click on the associated ‘Reset’ channel label.

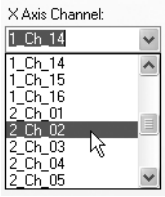
> ***NOTE:*** *The MinMax display will only show the first 16 enabled channels. When using a CPU with multiple Pods connected, only the first 16 enabled channels will be displayed, starting with the Pod at Port 1, then Port 2, etc.*

To view a display of two channels plotted against each other, select the 'XY Plots' tab:



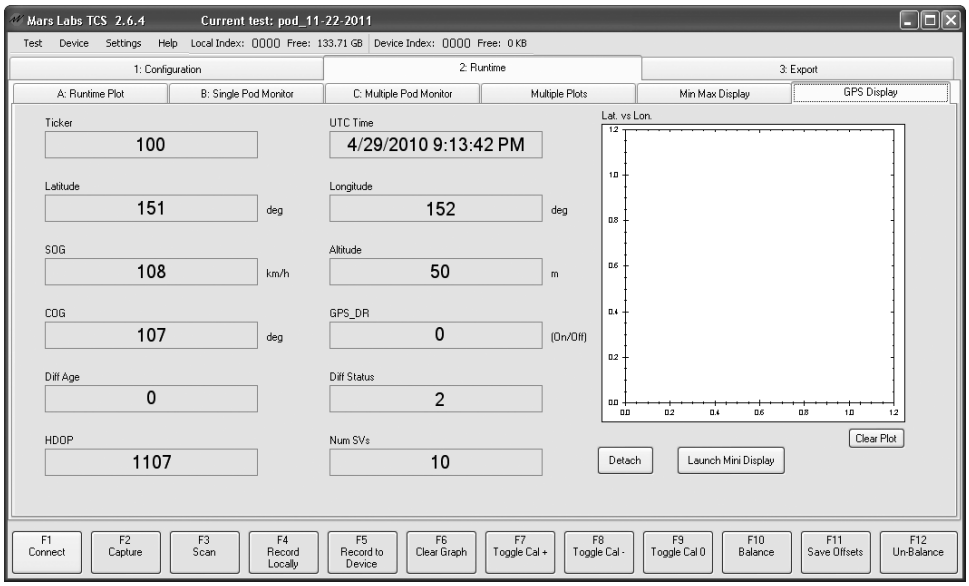
The XY Plot screen provides a continuously updated 'X versus Y' display of data points from any two channels. The two channels are selected using the 'X-Axis' and 'Y- Axis' dropdown menus. The 'Time to Show' parameter determines the number of data points that will be displayed based on the current Scan Rate. For example, if the Scan Rate is 100 Hz and the 'Time to Show' parameter is set for 6 seconds, then the X-Y Plot will be continuously updated with the most recent 600 data points.

NOTE: *When using a CPU, the X-Axis and Y-Axis dropdowns include the port numbers of the connected Titan devices:*

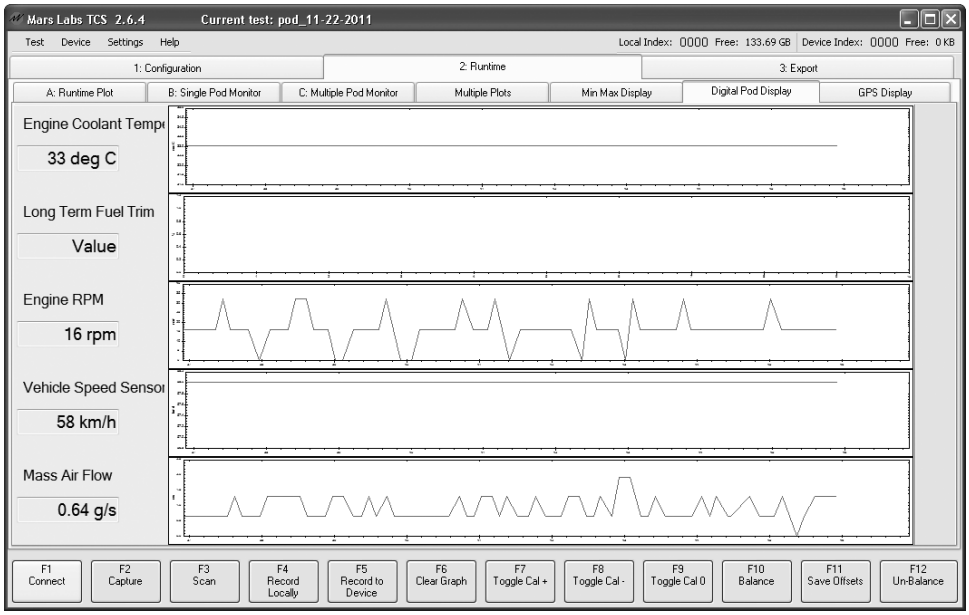


NOTE: *XY Plotting is a CPU-intensive function. On general-purpose PC's, performance can become sluggish at high scan rates. For best performance when XY Plotting is desired, the recommended scan rate should not exceed 600 Hz.*

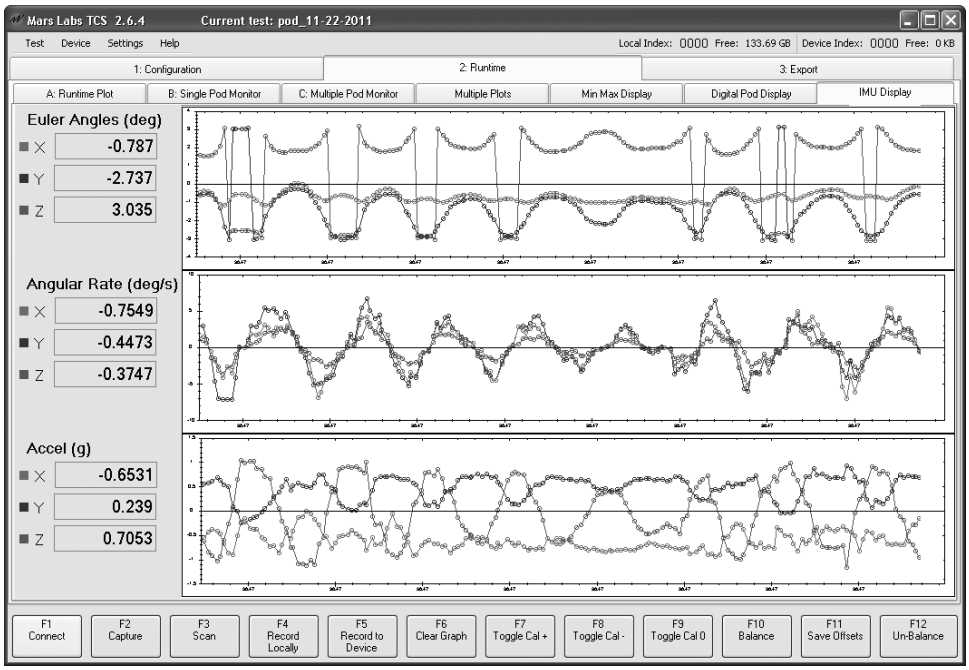
If ‘Standalone GPS’ is enabled, a ‘GPS Display’ tab is added to the Runtime screen that allows you to view the parameters associated with the GPS sensor:



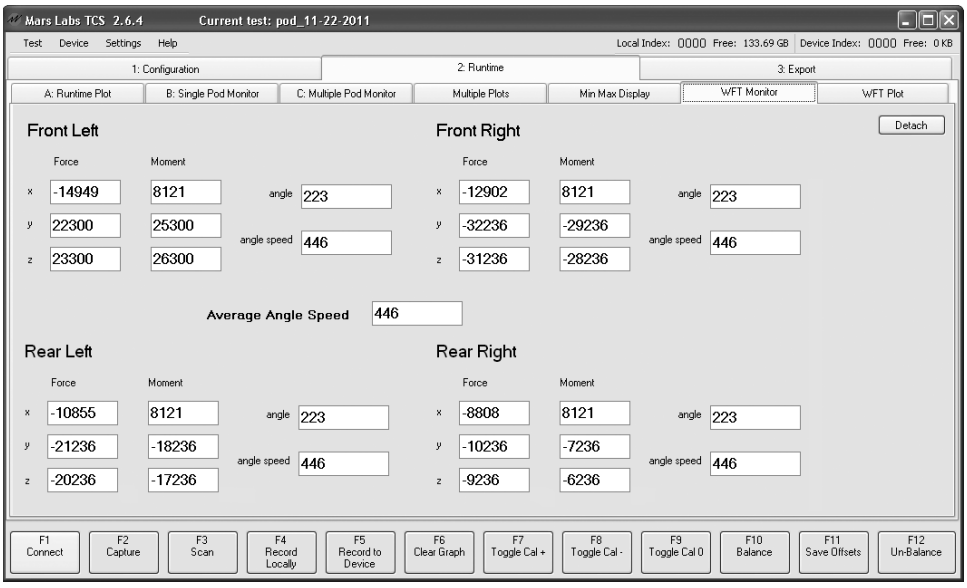
If the Digital Pod is enabled and configured, a dedicated ‘Digital Pod Display’ tab is added to the Runtime screen The display provides a real-time plot of the data for each digital sensor along with a readout of the instantaneous values:



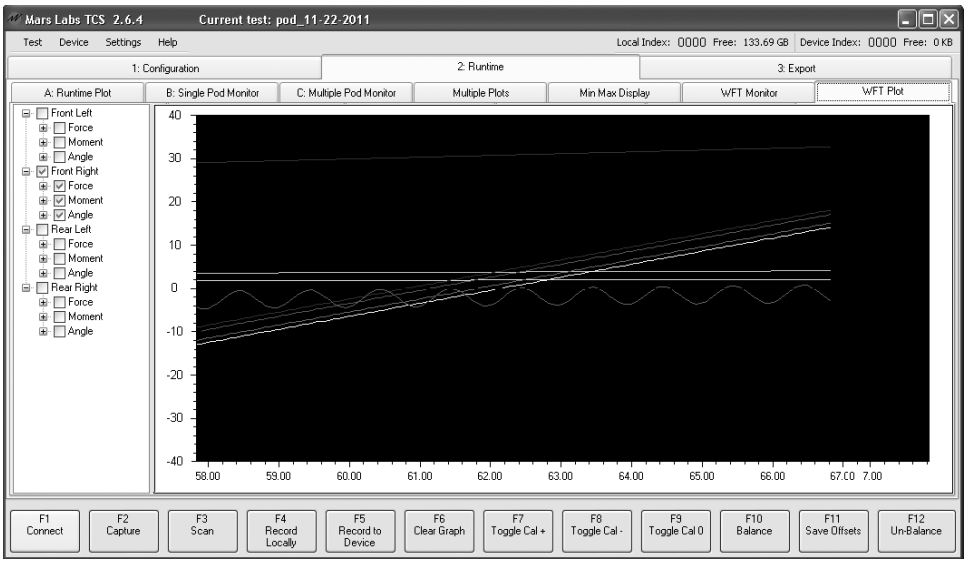
When the Digital Pod Serial Port is configured for the 3DM-GX3 Inertial Measurement Unit (IMU), an 'IMU Display' tab is added to the Runtime screen. The display provides a real-time plot of the sensor data along with a readout of the instantaneous values:



When the Digital Pod is configured for a Wheel Force Transducer (WFT), two additional display tabs are added to the Runtime screen: 'WFT Monitor' and 'WFT Plot'. The WFT Monitor screen provides a realtime display of the data from each wheel sensor group:

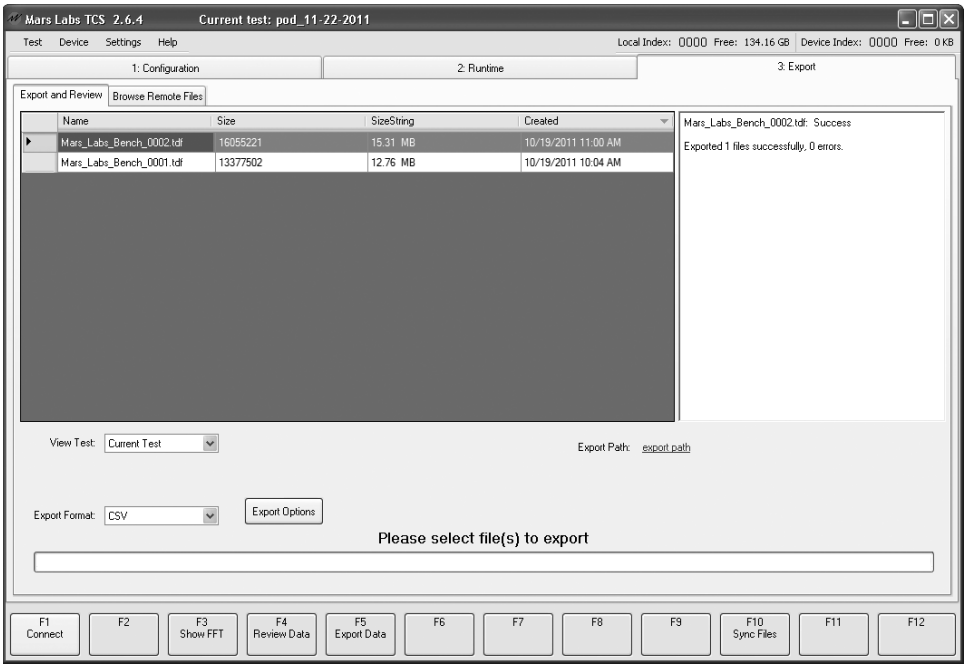


The WFT Plot screen provides a selectable realtime plot of the individual Force, Moment and Angle parameters from each wheel. Checkboxes in the left menu panel are used to select the desired parameters to plot:



The Export Tab

To export recorded data sets, access the exporter function by clicking on the ‘Export’ tab.



The Export window displays all of the locally recorded files created under the current test name. To view files that were recorded remotely on the connected Titan device, click the ‘Browse Remote Files’ tab at the top, then click the **Browse Device** button to view the files stored on the device. Data test files stored in alternate locations can be accessed by clicking the **Browse SD** button.

To transfer remote files, select the desired files from the list and then click **Transfer Files**. To view newly transferred files, switch back to the ‘Export and Review’ tab and select any of the standard viewing options. Note that you may have to change the test selected under the ‘View Test’ drop down in order to see the transferred files.

NOTES:

1. *Test files that are recorded remotely will always have a ‘-r’ appended to the file name:*

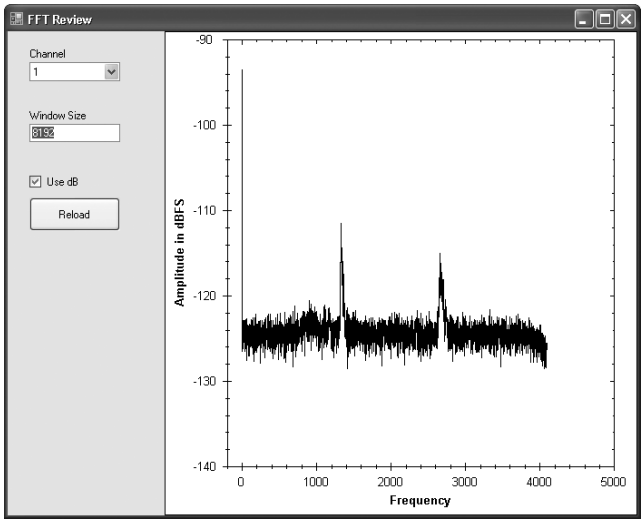
   Sample_Test_0002-r.tdf

2. *Test files that are imported from alternate locations will have an ‘- i’ appended to the file name:*

   Imported_Test_003-i.tdf

FFT Review

To view an FFT of a single channel from a data set, select the data set and click on the 'Show FFT' button (F3). An FFT Review window will be displayed. The window defaults to displaying an FFT of channel 1 with a window size of 8192 points. To view a different channel, select the channel from the Channel drop-down. To adjust the window size, enter the desired value in the Window Size field. The Window Size can be adjusted from 8 to 32767 points. After making the selections, click the 'Reload' button to view the plot.



In the FFT Review window, holding down the CTRL key while dragging the mouse allows you to pan the plot left or right, and up or down. The mouse scroll wheel will zoom in or zoom out of the plot. To access additional image manipulation options, right-click anywhere inside the window to bring up a contextual menu of selections:

Here's a brief description of each menu item:

Copy - Copies the current FFT plot to the clipboard

Save Image As... - Allows you to save the current FFT plot in one of six different formats:

.emf (Windows Extended Metafile Format)
.png (Portable Network Graphics)
.gif (Graphical Interchange Format)
.jpg (Joint Photographic Experts Group)
.tif (Tagged Image File Format)
.bmp (Bitmap)

Page Setup - Produces the standard 'Page Setup' window

Print - Produces the standard 'Print' window

Show Point Values - Displays the closest X and Y data coordinates associated with the placement of the cursor.

Un-zoom / Unpan - Allows you to undo the last zoom or pan operation. Repeatedly selecting this will step back through all zoom or pan operations until the original display is restored.

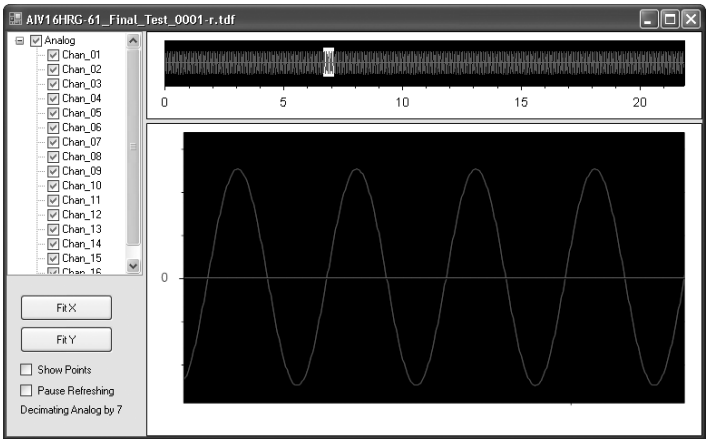
Undo All Zoom/Pan - Restores the display to the original state, undoing all zoom and pan operations.

Set Scale to Default - Restores the X and Y axis to the original default values.

When finished reviewing the FFT plot, click on the CLOSE box to dismiss the window and return to the Export window.

Reviewing Data

Any test file can be reviewed prior to export using the 'Review Data' button (F4) or by double-clicking on the data file. This brings up a separate window that displays two views of the data: a thumbnail display of the entire test file (at the top) and a larger display that offers zoom and pan capability (at the bottom). In either display, you can drag across a portion of the data to get a magnified view of that section. Holding down the CTRL key in a magnified view allows you to pan left or right, or up and down. The 'Toggle Points' button will toggle the sample points on and off, while the 'Fit X' and 'Fit Y' buttons will fit the data into the respective axis.



When finished reviewing the data, click on the CLOSE box to dismiss the window and return to the Export window.

NOTE: *Only one Review window can be open at a time. Attempting to review another test while the Review window is open will result in an error.*

Exporting Data Files

Test data can be exported in seven file formats:

WAV - PC sound file format. Permits viewing the data graphically using standard PC sound applications.

CSV - ‘Comma Separated Value’, a plain text data file with fields separated by commas.

TSV - ‘Tab Separated Value’, a plain text data file with fields separated by tabs.

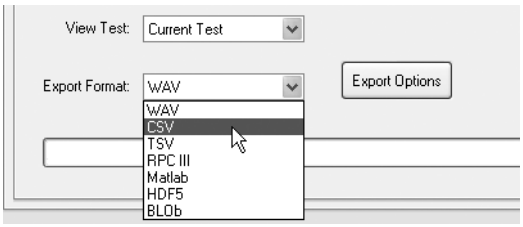
RPCIII - Standard data format used in noise and vibration measurement/analysis systems.

MATLAB - Data format compatible with MATLAB

HDF5 - Portable data format for managing very large data collections

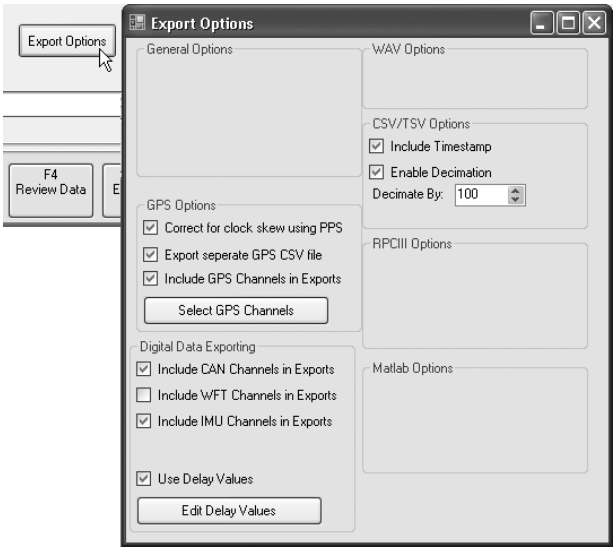
BLOb - ‘Binary Large Object’, DBMS files in a binary format

Use the ‘Export Format’ drop-down to select the desired file format:



Several of the file formats offer additional exporting options that are accessed by selecting the ‘Export Options’ button.

Clicking on the ‘Export Options’ button produces a window where you can select the various options available for each export format:



Export Options

CSV / TSV Options:

Include Timestamp - When checked, the Timestamp will be included with the exported CSV or TSV data. An example is shown below.

	A	B	C	D	E	F	G	H	I	J	K
1	**Time**	**Chan_01**	**Chan_02**	**Chan_03**	**Chan_04**	**Chan_05**	**Chan_06**	**Chan_07**	**Chan_08**	**Chan_09**	**Cha**
2	**Seconds**	**V**	**V**	**V**	**V**	**V**	**V**	**V**	**V**	**V**	**V**
3	0	1.707625	1.487	0.427	1.056	0.839	0.632	0.412	0.212	-0.002	0.0
4	0.000244	1.708313	1.488	0.427	1.055	0.84	0.632	0.412	0.211	-0.002	0.0
5	0.000488	1.7085	1.487	0.427	1.056	0.838	0.632	0.412	0.21	-0.003	0.0
6	0.000732	1.709688	1.488	0.428	1.058	0.841	0.633	0.412	0.211	-0.001	0.0
7	0.000977	1.711375	1.49	0.429	1.058	0.841	0.634	0.413	0.212	-0.002	0.0
8	0.001221	1.712625	1.49	0.428	1.058	0.84	0.633	0.412	0.211	-0.003	0.0
9	0.001465	1.713813	1.492	0.428	1.059	0.841	0.634	0.412	0.212	-0.002	0.0
10	0.001709	1.715563	1.494	0.429	1.061	0.842	0.635	0.413	0.213	-0.002	0.0

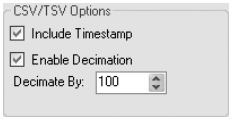
Exported ‘CSV’ data file with timestamp
(viewed in Microsoft Excel)

An example of an exported ‘CSV’ file might look like this:

Sample_test_0002.csv

where: ‘Sample_test’ is the test name
‘0002’ indicates the second recorded dataset (indices)
‘.csv’ is the file format

CSV / TSV Options (Con't):



Enable Decimation - When this is checked, exported data will decimated by the value in the 'Decimate By' field.

Decimation values are in the range of 1 - 1000. Entries can be made by using the increment/decrement button, or by manually entering a value in this field.

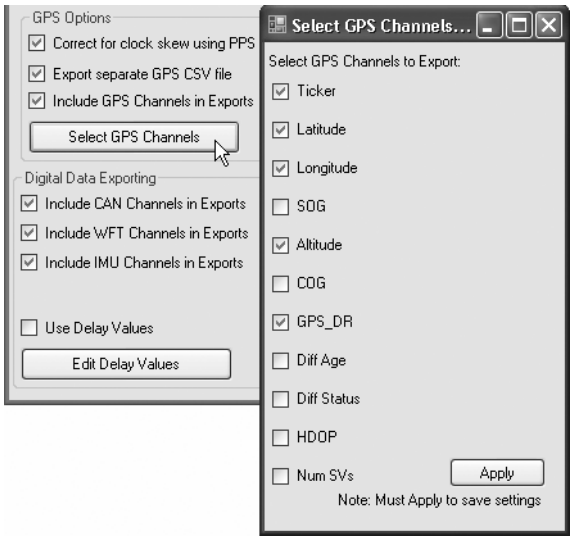
GPS Options:

Correct for clock skew using PPS – When checked, analog scans will be adjusted using the PPS signal from the GPS unit. The exporter will report the clock skew adjusted in ppm after exporting.

Export separate GPS CSV file – When checked, GPS data will be exported to a separate CSV file with a column for each GPS field. It will also include a column that maps the analog scan time of each packet.

Include GPS channels in Exports – When checked, the GPS data will be included with the analog export, padded to the analog rate.

Select GPS Channels – Produces a window to select specific GPS fields to include with analog data exports:



When ‘Export separate GPS CSV file’ is selected, the exported data file will have the same name and indices as the test file, but include ‘gps’ in the filename:

Sample_test_0002-gps.csv

An example of an exported GPS file:

	A	B	C	D	E	F	G	H	I	J
1	**Scan Count**	**UTC Time**	**Latitude**	**Longitude**	**Altitude**	**COG**	**SOG**	**DR**	**Num SVs**	**HDOP**
2	342	2010:04:30:18:16:50.8	39.1058133	-76.845717	0	11519	16	0	3	260
3	738	2010:04:30:18:16:51.0	39.1058133	-76.845717	0	11519	11	0	3	260
4	1134	2010:04:30:18:16:51.2	39.1058133	-76.845717	0	11519	3	0	3	260
5	1536	2010:04:30:18:16:51.4	39.1058133	-76.845717	0	11519	11	0	3	260
6	1938	2010:04:30:18:16:51.6	39.1058133	-76.845717	0	11519	0	0	3	260
7	2334	2010:04:30:18:16:51.8	39.1058133	-76.845717	0	11519	7	0	3	260
8	2736	2010:04:30:18:16:52.0	39.1058133	-76.845717	0	11519	11	0	3	260
9	3132	2010:04:30:18:16:52.2	39.1058133	-76.845717	0	11519	7	0	3	260
10	3534	2010:04:30:18:16:52.4	39.1058133	-76.845717	0	11519	16	0	3	260

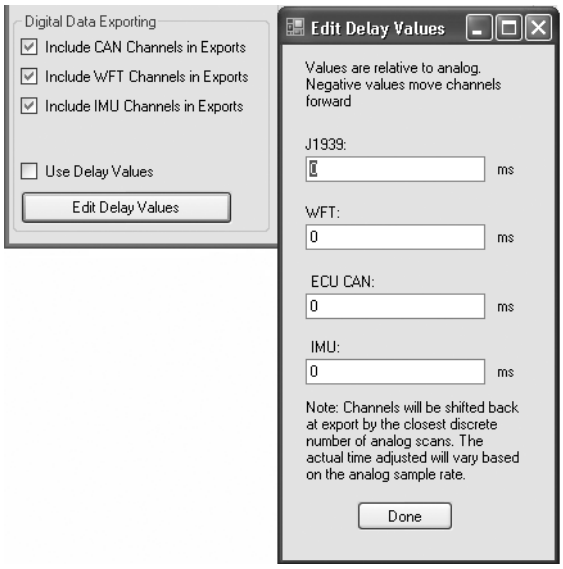
Exported GPS data file
(viewed in Microsoft Excel)

Digital Data Exporting Options:

'Include' checkboxes – When checked, the selected digital channels will be included with the analog export, padded to the analog rate.

Use Delay Values – When checked, delay values will be applied to the digital data during export. This function is used to compensate for any fixed delays in the digital stream, ensuring synchronization between the analog and digital data.

Edit Delay Values - Produces a window for entering delay values for each digital source:



NOTE: *When delay values are applied, the corresponding digital data will be shifted back by this amount during export.*

Export File Path

After selecting all export options, return to the Export screen and press ‘F5’ to export the data. The default Export path is ‘My Documents\MarsLabs\<test_name>’.

NOTE: To change the export path, select the ‘TCS Settings’ option in the SETTINGS menu and enter the new path.

After the data has exported successfully, a status message will appear in the upper right of the window. Sample message:

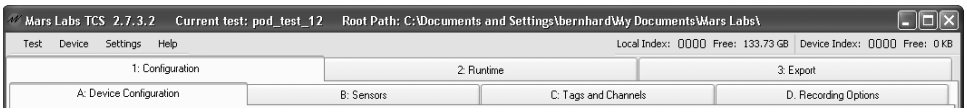
“Exported 1 files successfully, 0 errors”

Advanced Settings

A description of the TCS windows and features appears below.

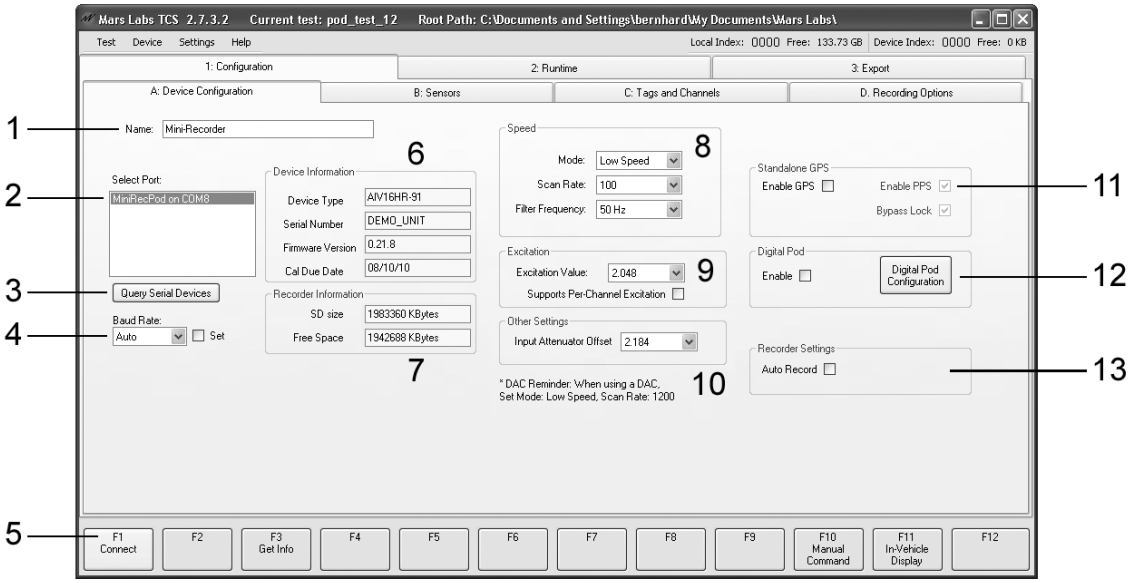
Configuration Tab

The ‘Configuration’ tab provides a series of related screens to configure the connected Titan Device(s), configure Sensors, and select Tag and Channel assignments for the TCS application. Individually tabbed windows are provided for each of these functions:



Device Configuration - Mini-Recorder

The Mini-Recorder *Device Configuration* screen allows you to connect to and configure the function of the connected Titan Mini-Recorder/Pod by selecting the device speed, scan rate and filter frequency. This window displays specific information about the connected device (device type, description, firmware version), and information about the SD memory card (if using a Mini-Recorder). It allows you to enable GPS, Digital Pod and Auto-Record functions. The example below shows a Mini-Recorder configuration.



The components of the Device Configuration screen:

1. Name field – Allows you to specify a unique name for the device. This name is displayed in the channel list in the 'Tags and Channels' window.
2. 'Select Port' list – This list displays all connected Titan modules.
3. 'Query Serial Device' button – Use this button to check for connected hardware
4. Baud Rate dropdown - Selects the baud rate that TCS will use to connect to the Titan hardware. An 'Auto' setting means that TCS determines the baud rate based on the rate that is sent by Titan Device. Any other setting will force TCS to communicate at the selected rate. When the SET box is checked, TCS commands the Titan device to set the baud rate to the chosen setting after connecting.

   NOTE: *If the baud rate is too low to support the scan rate, the connected Titan device will not output data over the serial port.*

5. Function keys – In the Device Configuration window, the Function keys are assigned the following functions:

   F1 - Connects/disconnects to the device on the selected port
   F3 - Refreshes the Device Information display
   F10 - For issuing Manual Commands to the connected device
   F11 - Invokes the In-Vehicle Display

6. Device Information pane – Displays information of the connected device, including the device type*, unit description, firmware version, and information about the Mini-Recorder SD memory card (capacity and free space).

   * In the Device Type field, the device nomenclature is as follows:
   The first three letters indicate the general device type
   The following number indicates the number of channels
   The following letter indicates High or Low Speed capability
   The letter 'R' indicates recording capability
   Following the 'R', an 'A' or 'D' indicates that the device has an internal expansion card installed:
   'A' = Internal DAC
   'D' = Internal Digital Pod
   The letter 'G' indicates GPS support
   Numbers that appear after the dash are codes that specify the connector type and the operating voltage

Device Configuration screen components (con't):

7. Recorder Information pane – Displays information about the Titan device SD memory card (capacity and free space).

8. Speed pane – The drop-down menus in this panel allow you to configure the device speed, scan rate and filter frequency of the connected hardware:
   Mode - Selects High Speed or Low Speed operation.

   Scan Rate - Sets the scan rate. The available scan rates are:

   High Speed: 128 - 10,000 samples per second per channel
   Low Speed: 10 - 1200 samples per second per channel

   Filter Frequency - Sets the frequency of the anti-aliasing filter. This filter is automatically set when High Speed is selected. For Low Speed operation, the available filter frequencies are:

   Bypassed, 5, 10, 20, 40, 50, 80, 100Hz

9. Excitation pane – Allows you to enable Per-Channel Excitation if the connected Titan device supports this feature.

10. Other Settings panel –
    a. Input Attenuator Offset – Allows you select the amount of attentuator offset (2.048V or 2.184V)

11. Standalone GPS pane – Allows you to enable the GPS function if the connected Titan device supports GPS. If the connected device does not support GPS, checking the 'GPS Enable' checkbox does nothing.

    When GPS is enabled, checking the 'Bypass Lock' box allows the GPS to operate without locking to GPS satellites. This permits you to check the basic operation of the GPS function in areas where satellite reception is not available.

    Checking the 'Enable PPS' box enables the Pulse Per Second function.

Device Configuration screen components (con't):

12. Digital Pod pane – Allows you to enable and configure the Digital Pod function. For details on configuring the Digital Pod, see page 44.

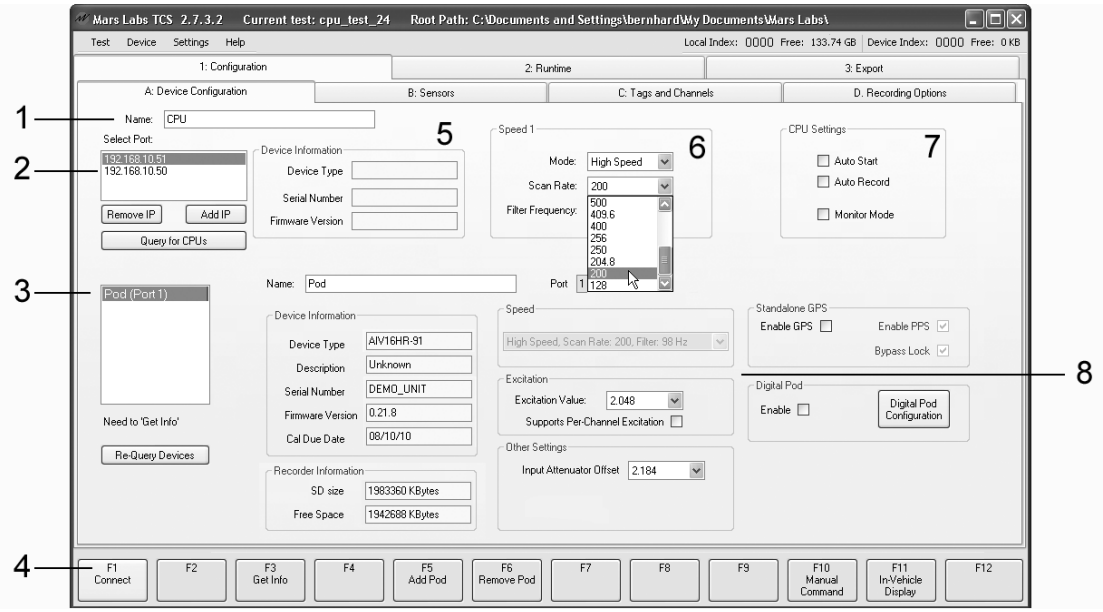
13. Recorder Settings pane – Allows you to select Auto-Record mode. In Auto Record mode, the Titan Mini-Recorder automatically begins remote recording upon power-up.

    To enable Auto-Recording, click on the checkbox. The Auto Recording function will be enabled when you configure and run a new test. Once Auto-Recording is enabled, it will remain enabled until a new test is configured and run without Auto-Recording.

    NOTE: *If Auto Recording is enabled but an SD memory card is not installed when the Mini-Recorder is powered on, recording will not initiate. Auto Recording remains enabled, however; the Mini-Recorder will record when power is applied with an SD memory card present.*

Device Configuration - Titan CPU

The Titan CPU *Device Configuration* screen allows you to connect to and configure the function of the Titan CPU. This window also displays specific information about the CPU device (device type, serial number, and firmware version), and information about all connected Titan Pod/Mini-Recorder hardware.



The components of the CPU Device Configuration screen:

1. Name field – Allows you to specify a unique name for the device. This name appears in the channel list in the 'Tags and Channels' window.

2. 'Select Port' list – This list displays all connected Titan CPUs. Devices can be added or removed from the list using the associated buttons, and new hardware can be queried.

3. A list of connected Titan Devices. The list can be refreshed by clicking on the 'ReQuery Devices' button.

4. Function keys – In the CPU Device Configuration window, the Function keys are assigned the following functions:

F1 - Connects/disconnects to the selected Titan CPU
F3 - Refreshes the CPU Device Information display
F5 - Adds a Pod/Mini-Recorder
F6 - Removes a Pod/MiniRecorder
F10 - For issuing Manual Commands to connected devices
F11 - Invokes the In-Vehicle Display

CPU Device Configuration screen components (con't):

5. Device Information pane – Displays the information of the connected CPU, including device type, serial number and firmware version.

6. Speed pane – The drop-down menus in this panel allow you to configure the device speed, scan rate and filter frequency of the connected hardware:

    Mode - Selects High Speed or Low Speed operation.

    Scan Rate - Sets the scan rate. The available scan rates are:

        High Speed: 128 - 2500 samples per second per channel
        Low Speed: 10 - 1200 samples per second per channel

    Filter Frequency - Sets the frequency of the anti-aliasing filter. This filter is automatically set when High Speed is selected. For Low Speed operation, the available filter frequencies are:

        Bypassed, 5, 10, 20, 40, 50, 80, 100, 150, 200 Hz

7. CPU Settings - Checkboxes to set the Power-On condition of the CPU:

    Auto Start: When checked, enables CPU Auto Start. Auto Start commands all connected Titan hardware to begin scanning when the CPU powers up.

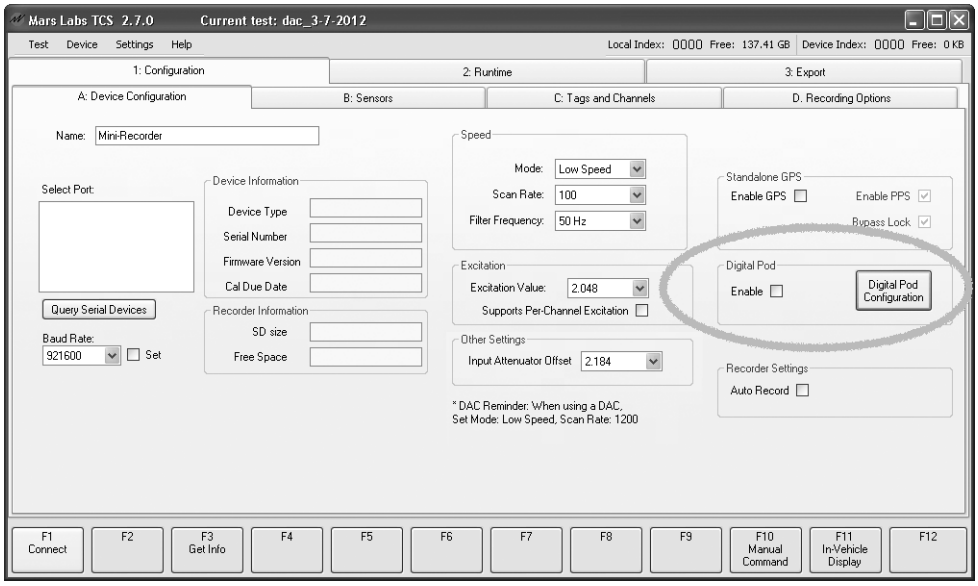
    Auto Record: When checked, enables CPU Auto Record. When Auto Record is enabled, the CPU will begin recording a dataset upon power-up.

    Monitor Mode: When checked, Monitor Mode is enabled. Monitor Mode prevents the CPU from altering device configurations on power-up. When Monitor Mode is enabled, the CPU will not query devices and will not send any commands to connected devices. Instead, it will load the configuration it used at the previous run and assume it is connecting to the same devices already running.

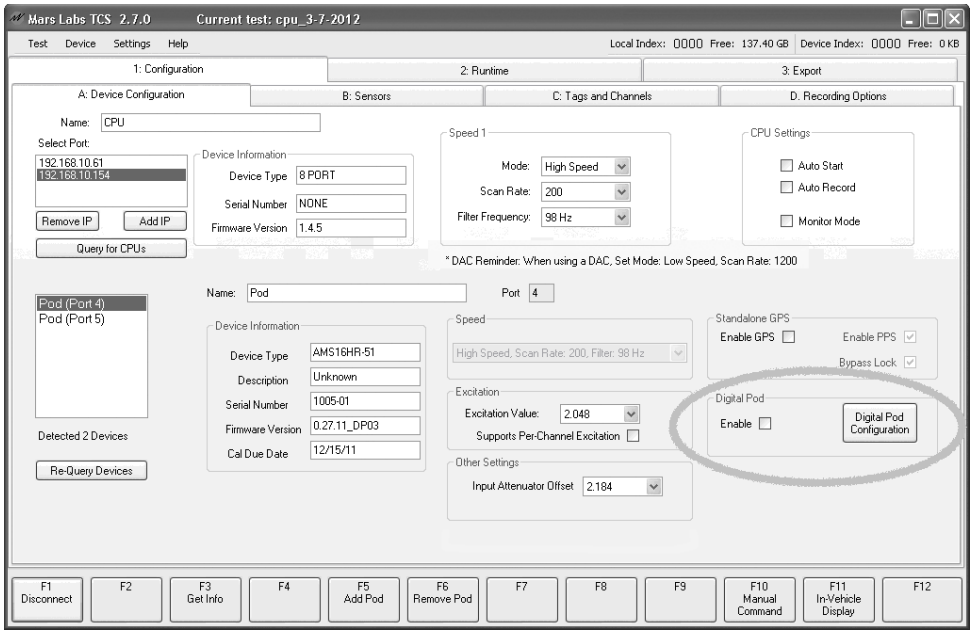
8. Pod/Mini-Recorder device information. Information reported here corresponds to the device that is selected in the Device List (item 3 above). For specific information about Pod/Mini-Recorder configurations, see the Mini-Recorder Device Configuration section (pg 38).

Digital Pod Configuration

The Digital Pod is configured on the *Device Configuration* screen as shown:

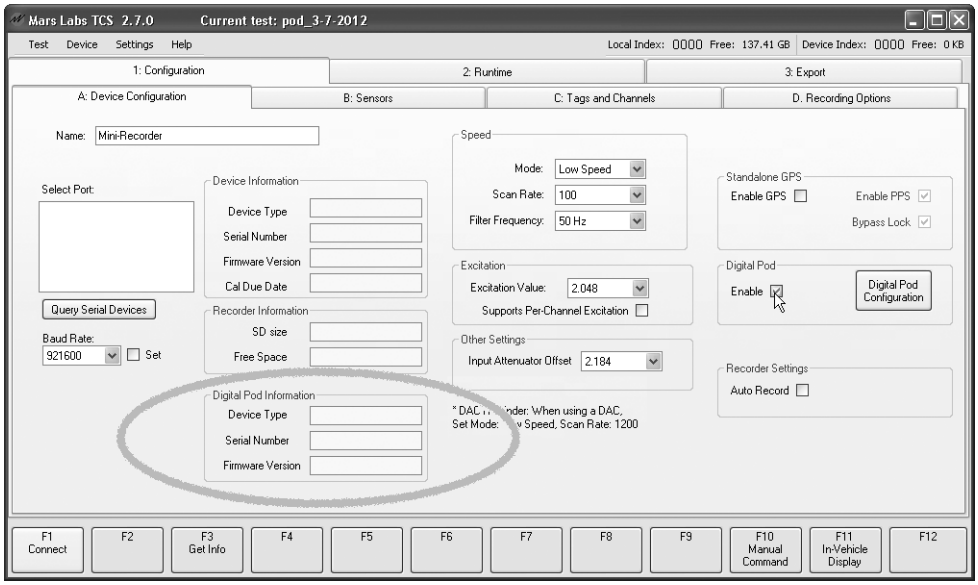


Mini-Recorder screen (similar for DAC screen)



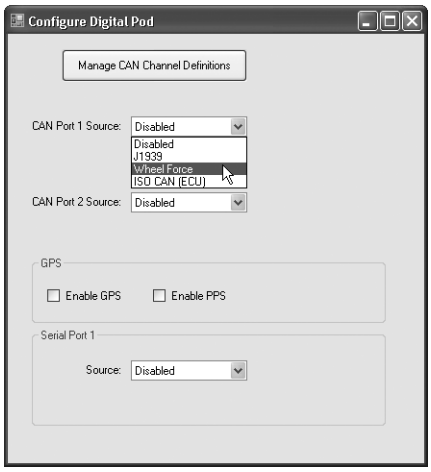
Titan CPU screen

When the Digital Pod 'Enable' box is checked, TCS sets up the communication parameters for the Digital Pod and adds information fields to the *Device Configuration* screen as shown:



Mini-Recorder screen

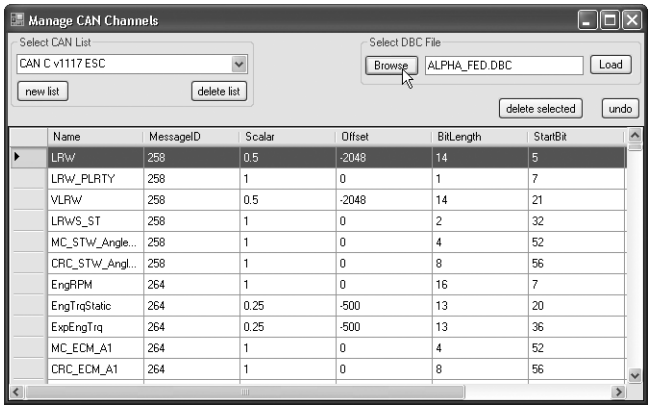
Clicking on the 'Digital Pod Configuration' button produces a configuration window that allows you to select setups for both CAN ports, the GPS and Serial inputs, as well as access a CAN channel definition management function:



Descriptions of each configuration option follows.

Managing CAN Channel Definitions

The ‘Manage CAN Channels Definitions’ button produces a configuration window that allows you to select and manage channel definitions in DBC files:



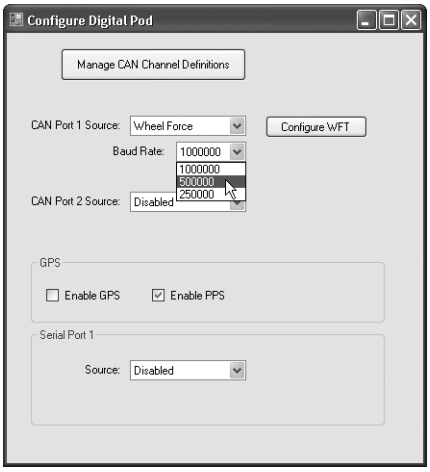
CAN Channel Management Window controls:

Browse – Selects the DBC file
Load – Loads the selected DBC file into TCS
Select CAN List – A dropdown that displays the DBC files that have been loaded
New List, Delete List, Delete Selected and Undo – Functions not yet implemented

NOTE: *When configuring the Digital Pod for Wheel Force Transducers, you will need to load the associated DBC file into the CAN Management window prior to configuring the WFT.*

Configuring CAN Port Sources

CAN Port Sources are selected from a dropdown menu as shown. After a selection is made, a Baud Rate selection dropdown will appear along with a button to access the configuration options for the selected source (‘Configure ISO CAN’, ‘Configure WFT’ or ‘Configure J1939’):



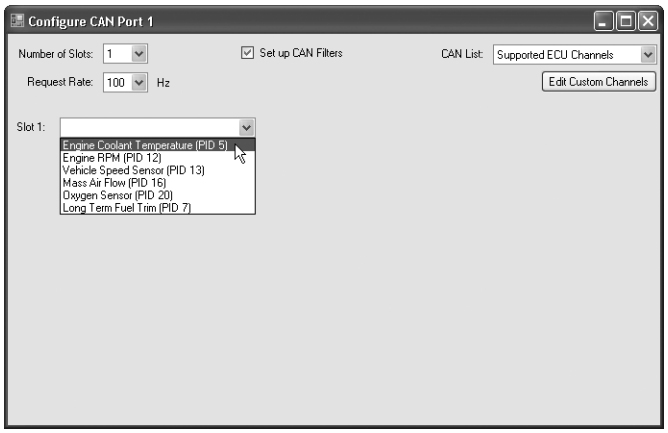
The proper Baud Rate setting for each port is dependent on the chosen CAN source:

For ISO CAN: 500,000 or 250,000
For J1939: 250,000
For WFT: 500,000

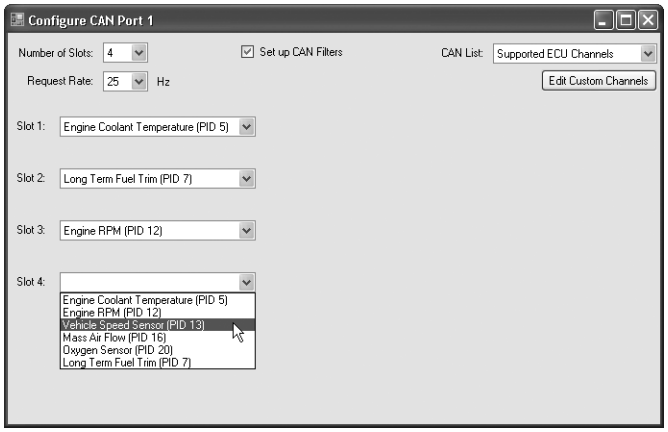
The specific configuration options for each CAN Port Source, as well as the GPS and Serial Port, are described below.

ISO CAN

The ‘Configure ISO CAN’ button produces a configuration window that allows you to assign ECU channels as shown. Up to ten ECU channels can be assigned. Currently, selections are only available from supported ECU channels (custom channel support is not yet implemented).



When assigning channels in channel slots, observe that the number of slots will affect the request rate, and vise versa. For example, if four channel slots are selected, the request rate for each channel will automatically be decreased to 25 Hz per channel:



When the maximum number of channel slots is selected (10 slots), the request rate is reduced to 10Hz/channel. After completing the channel assignments on this screen, clicking on the close box enters the assignments into TCS.

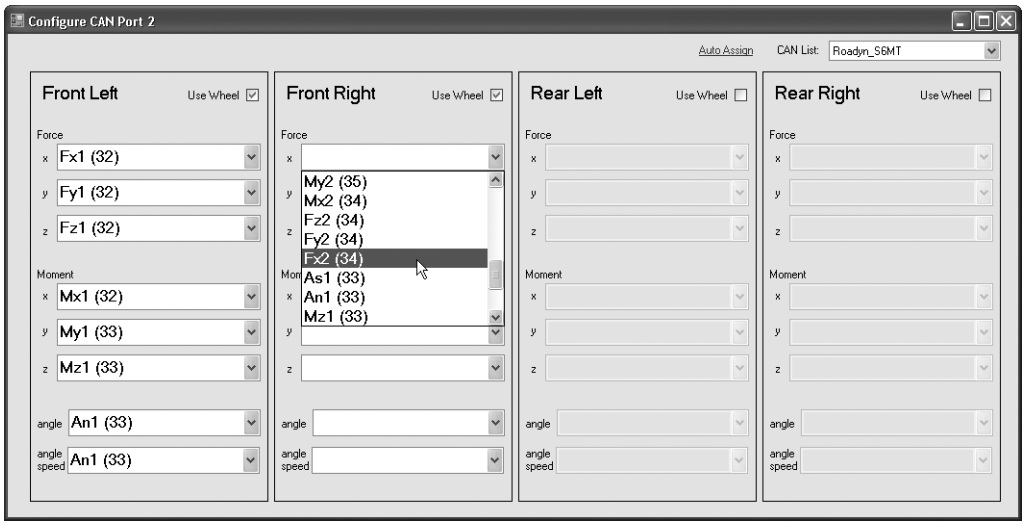
ISO CAN Configuration Window Controls:

CAN List – A dropdown to select DBC files (currently limited to supported ECU channels only).
Edit Custom Channels – Function not yet implemented
Request Rate – A dropdown to select the data request rate
Number of Slots – A dropdown to select the number of slots
Set up CAN Filters – This checkbox sets up filters based on the message ID for each configured ECU channel
Slot 1-10 – A drop down to assign channels

After completing the channel assignments on this screen, clicking on the close box enters the assignments into TCS. Channel assignments/changes are stored when the test is saved.

Wheel Force Transducer

The ‘Configure WFT’ button produces a configuration window where you assign channels to individual wheel force elements:



The parameters that appear in the dropdowns are derived from the ‘CAN List’ DBC selection in the upper right corner.

NOTE: *Listings that appear in the ‘CAN List’ dropdown are loaded into TCS from the ‘Manage CAN Channel Definitions’ window*

If the channel names in the selected DBC file match the field labels in TCS, clicking on the ‘Auto Assign Channels’ button will automatically map the proper channels to all wheels, eliminating the need for individual assignments.

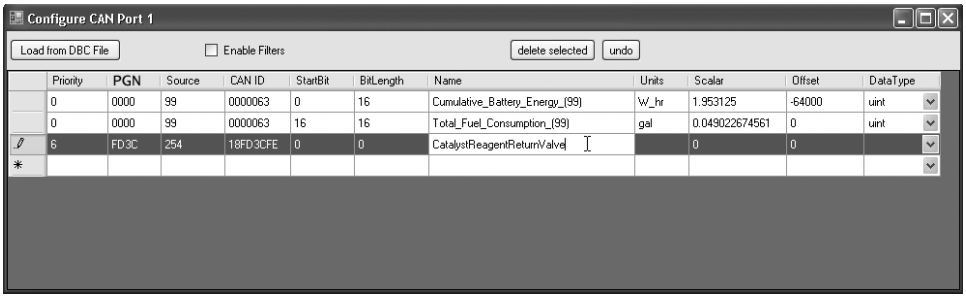
After all channel assignments are complete, clicking on the close box enters the assignments into TCS. Channel assignments are stored when the test is saved.

WFT Configuration Window Controls:

CAN List – A dropdown to select DBC files
Auto Assign Channels – A button that automatically assigns the proper channels when the channel names in the DBC file match TCS field labels
‘Use Wheel’ – Checkboxes to enable/disable selected wheel tables

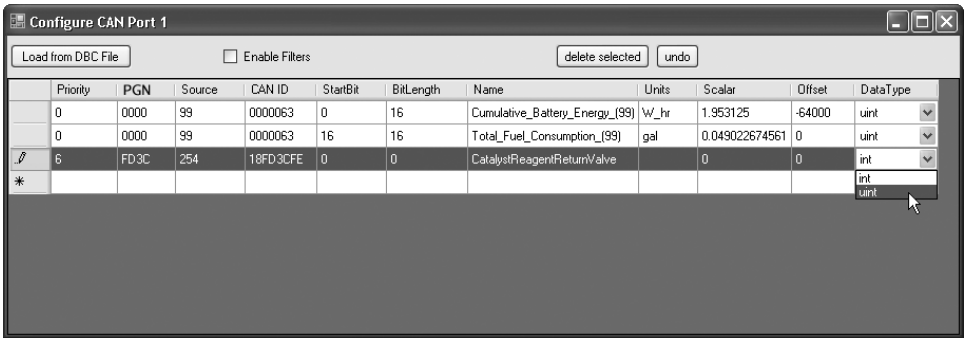
J1939

The ‘Configure J1939’ button produces a configuration window that allows you to load an existing DBC file, edit field values, or define additional channels by manually entering the data (an example of manual entry from a data sheet appears on the following page):



NOTE: *The CAN ID value comprises the Priority, Parameter Group Number (PGN) and Source values. The Can ID value is displayed in Hex. The PDU is formatted as two bytes in Hex and represents the PDU Format and PDU Specific values.*

The ‘Data Type’ drop-down menu on the far right selects signed integer (‘int’) or unsigned integer (‘uint’) values:



After all new channel assignments are complete, clicking on the close box enters the assignments into TCS. Channel assignments are stored when the test is saved.

J1939 Configuration Window Controls:

Load from DBC File – Allows you to select and load a DBC file
Enable Filters – When checked, this sets up filters based on the message ID for each configured J1939 channel.
Delete selected – Deletes the selected channel definition
Undo – Undo the last action

An example of manual entry of several J1939 channels from a data sheet is shown below:

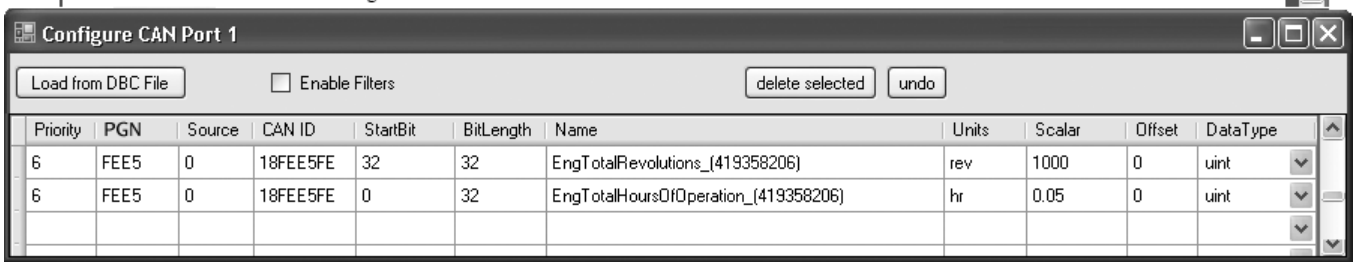
PGN 65253 Engine Hours, Revolutions

Transmission Repetition Rate :on request
Data Length : 8
Reserve Bit : 0
Data Page : 0
PDU Format : 254
PDU Specific : 229
Default Priority : 6
Parameter Group Number : 65253 (0xFEE5)

Start Position	Length	Parameter Name	SPN
1-4	4 bytes	Total engine hours	247
5-8	4 bytes	Total engine revolutions	249

With ECU simulated parameter value

Total engine hours: 0 to 210554060.75h 0.05h/bit. We give the value according to actual running time.
Total engine revolutions: 0 to 4211081215000r 1000r/bit. We give the value according to engine speed and actual running time.



Note that the TCS Start Bit is the bit position of the channel message. If the data sheet lists the Start Position instead of the Start Bit (as shown above), the Start Bit is computed as:

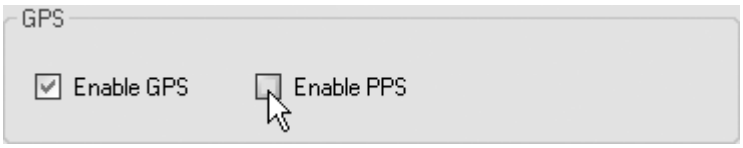
(Start Position -1) * 8

For example, a Start Position of ‘5’ translates to a Start Bit value of ‘32’:

(5-1) * 8 = 32

Note also that the Bit Length parameter in TCS is specified in bits, not bytes.

GPS



Checking the 'Enable GPS' box enables the Digital Pod's GPS port to accept data from a Garmin LX18X 5 Hz sensor.

Checking the 'Enable PPS' box enables the Digital Pod's GPS port to accept Pulse Per Second data from the Garmin LX18X 5Hz sensor.

NOTE: *Whenever the GPS/PPS option is enabled in the Digital Pod, PPS must also be enabled on the Device Configuration page. If the PPS option is not selected, PPS data exports will not increment as expected.*

Serial Port

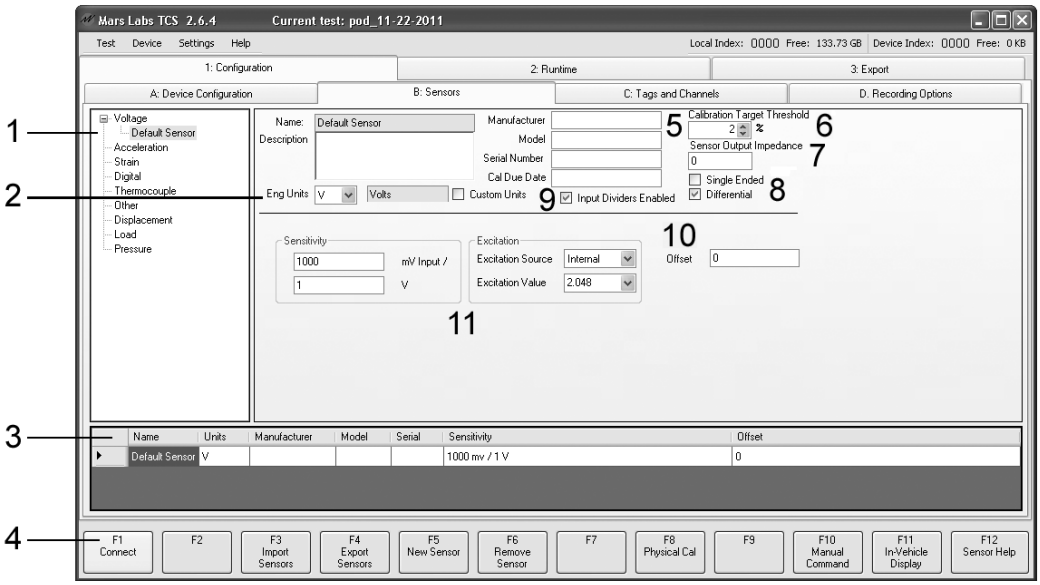
Serial port sources are selected from a dropdown menu in the Serial Port pane. Currently, the only available selection is '3DM-GX3 IMU', which provides support for the model 3DM-GX3-25 IMU device. The baud rate setting for this device is fixed at 115,200, which means that you will need to configure your IMU device to stream data at the same rate.

The '3DM-GX3 IMU' option is pre-configured to parse the C8 message (Acceleration, Angular Rate and Orientation matrix). Future support is planned for expanded configuration of the IMU device.

NOTE: *Because the Digital Pod configuration screen is much smaller than the TCS window, it's possible for the Digital Pod configuration screen to fall behind the TCS window, appearing to be closed. Since changes to the Digital Pod configuration do not take place in TCS until the configuration screen is closed, it's possible to make changes without the changes actually taking effect. For this reason, always be sure to close the Digital Pod configuration screen after making assignments or changes.*

Sensors

The *Sensors* screen is where you configure the analog sensors that are connected to the Titan device. Sensors can be individually named, cataloged and configured.



The main components of the *Sensors* screen are:

1. Sensor Tree – The Sensor Tree displays all defined sensors in TCS according to the sensor type (voltage, acceleration, strain, etc).

2. 'Eng Units' – The engineering units for the output data. A drop-down menu provides an extensive list of engineering units for each sensor type. Custom units can also be defined if needed.

3. Table of sensors. The table provides a non-editable overview of all defined sensors for a given sensor type (voltage, acceleration, strain, etc).

4. Function keys – In the Sensor window, Function keys are assigned as follows:

   F1 - Connects/disconnects to the Titan device
   F3 - Import Sensor
   F4 - Export Sensor
   (see Sensor Import/Export, pg 76)
   F5 - Adds a new sensor to the sensor list
   F6 - Deletes a sensor from the sensor list
   F8 - Physical Calibration (applies to all sensors except Strain, Frequency, Thermocouple and 'Other' sensor types)
   F10 - For issuing Manual Commands to the Titan device
   F11 - Switches to the In-Vehicle display
   F12 - Sensor Help - Context-sensitive sensor help

5. Text fields in the upper part of the pane allow you to enter basic information about the sensor (manufacturer, model, serial number & cal due date) plus additional information (sensor position, notes, etc.).
6. Calibration Target Threshold – Sets the Sensor Calibration Target tolerance, from 1% to 100%. The default for all sensors is 2%.
7. Sensor Output Impedance – When Input Dividers are enabled, this field allows you to enter the output impedance of the sensor (applies to ICP Acceleration, Displacement, Sensitivity, Polynomial, Pressure, Strain and Voltage sensors).
8. 'Single Ended/Differential' checkboxes – When Input Dividers are enabled, these checkboxes allow you to select either single ended or differential sensor types (applies to ICP acceleration, displacement, sensitivity, polynomial, pressure, strain and voltage sensors).
9. 'Input Dividers Enabled' checkbox – Where applicable, this function physically enables the resistive divider network when using the sensor. Checking this box will divide the voltage across any channel using the sensor by a factor of 16.
10. Offset – This field allows you to enter an offset value in whatever engineering units are specified. The offset value is applied to the data after the transform. Offset values can be positive or negative.
11. Fields in the lower part of the pane for sensor configuration. The fields and other information presented here will vary according to the type of sensor being configured, and may or may not include excitation (see Sensor Types below).

Sensor Types

TCS supports ten types of sensors. In alphabetical order, they are:

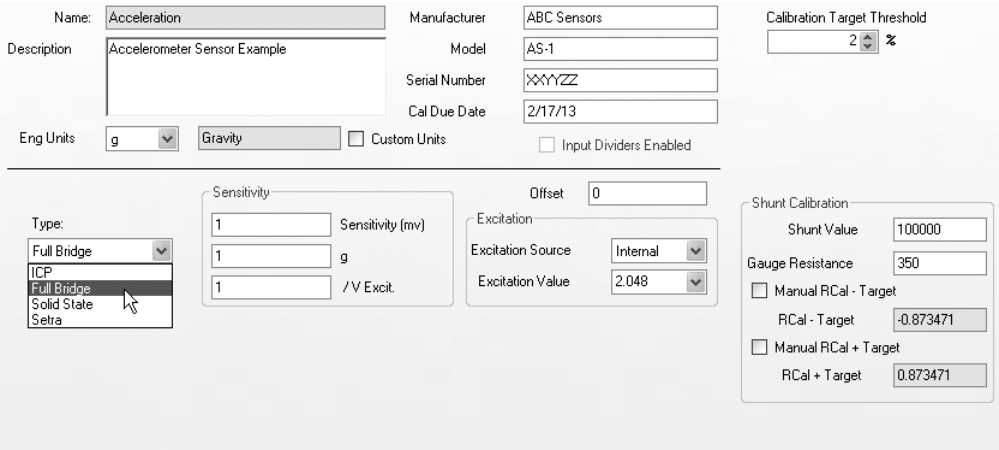
Acceleration, Digital, Displacement
Load, Other - Sensitivity, Other- Polynomial
Pressure, Strain, Thermocouple & Voltage

Each sensor type has unique setup page in the Sensors Tab window. When you add a new sensor (by clicking on the 'New Sensor' button, or pressing F5), you will be prompted to select the type of sensor that you wish to add. Once the sensor type has been specified, the sensor setup page appears.

A description of each sensor setup pane follows.

Sensor Types - Acceleration

Titan devices support four types of acceleration sensors: ICP, Full Bridge, Solid State and Setra.



Field Definitions

Input Dividers Enabled: Enabled by default for ICP sensor types, and optionally available for Solid State and Setra sensor types, this function physically enables a resistive divider network that divides the voltage across any channel using the sensor by a factor of 16.

Type: Selects the type of acceleration sensor. This selection determines the configuration options that are presented in the lower part of the pane.

Sensitivity: Sensor translation from millivolts into engineering units. If excitation is specified the sensitivity equation is updated to include a value for the excitation.

Excitation Source: The excitation source for the sensor (Internal/External). This field is available for Full Bridge, Solid State and Setra sensor types. For ICP sensors, the excitation source is set for a constant current.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected.

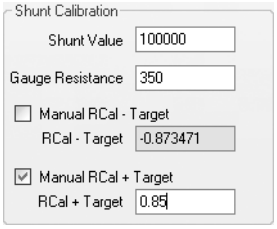
Shunt Value: The value in ohms for the calibration resistor used to check the calibration of the sensor.

Gauge Resistance: The resistance of a single bridge of the strain gauge.

NOTE: *The 'Excitation' and 'Shunt Calibration' panes only appear when Full Bridge, Solid State or Setra sensor types are selected*

Sensor Types - Acceleration (con't)

RCAL Target: The computed value (in engineering units) of the calibration target of the sensor. Enabling 'Manual RCAL' allows you to manually enter target values for CAL+ and/or CAL-. :



Acceleration Sensor Transforms

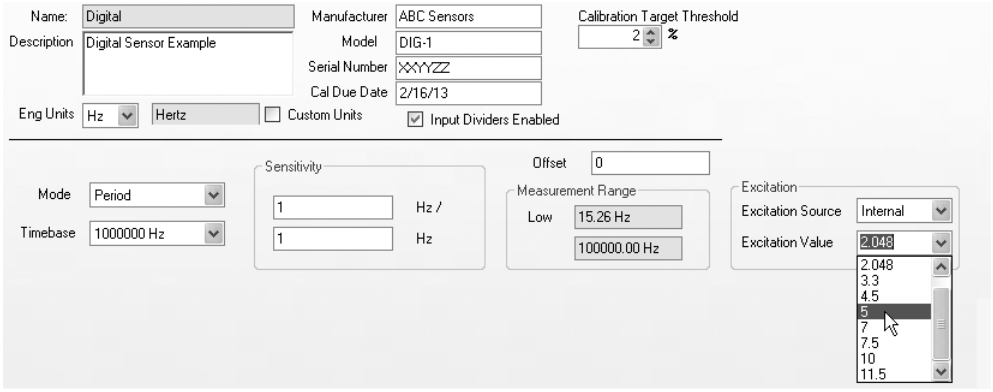
$$ICP \text{ and } Solid\ State: \quad f(x) = \frac{x * Units}{Sensitivity} + Offset$$

$$Full\ Bridge: \quad f(x) = \frac{x * Units * (PerVolts / Excitation)}{Sensitivty} + Offset$$

See related hardware connection diagrams (pg 117)

Sensor Types - Digital

Titan devices support two types of digital sensors: Period and Totalizer.



Field Definitions

Mode: Selects Period or Totalizer modes. The selection determines the configuration options that are presented in the lower part of the pane.

Timebase: Available only when Period mode is selected, this is the frequency range to be measured. Four ranges are available: 50 KHz, 100KHz, 500KHz, 1MHz.

Sensitivity: Sensor translation from millivolts into engineering units. For Period mode, the engineering units default is 'Hz'. For Totalizer mode, the engineering units default is 'cnts' (counts).

Measurement Range: Present only when Period mode is selected. The values displayed in these non-editable fields are dependent on the Timebase selection.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu.

Digital Sensor Transform

$$Period\ Mode: \quad f(x) = \frac{Timebase * Units}{x * Sensitivity}$$

$$Totalizer\ Mode: \quad f(x) = \frac{x * Units}{Sensitivity}$$

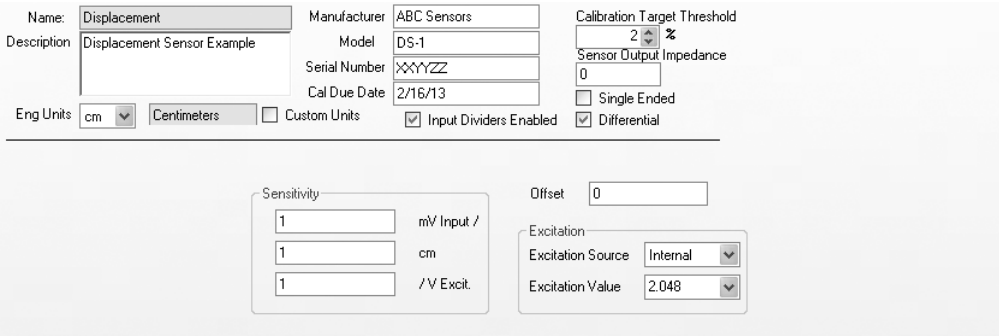
See Frequency Sensor connection diagrams (pg 123)

NOTES:

1. *Digital sensors can only be assigned to channels 1, 8 or 16, and only one digital sensor can be assigned at a time.*
2. *When a Digital Sensor is selected, the GPS Pulse Per Second (PPS) option must be disabled in both the Device Configuration and the Digital Pod configuration screens.*
3. *Period measurements are valid to approximately 7K Hz.*
4. *In Totalizer mode, the maximum number of counts = 65535.*

Sensor Types - Displacement

Titan devices support a variety of displacement sensors, all classified as Displacement.



Field Definitions

Sensitivity: Sensor translation from millivolts into engineering units. If excitation is specified the sensitivity equation is updated to include a value for the excitation.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu.

Displacement Sensor Transform

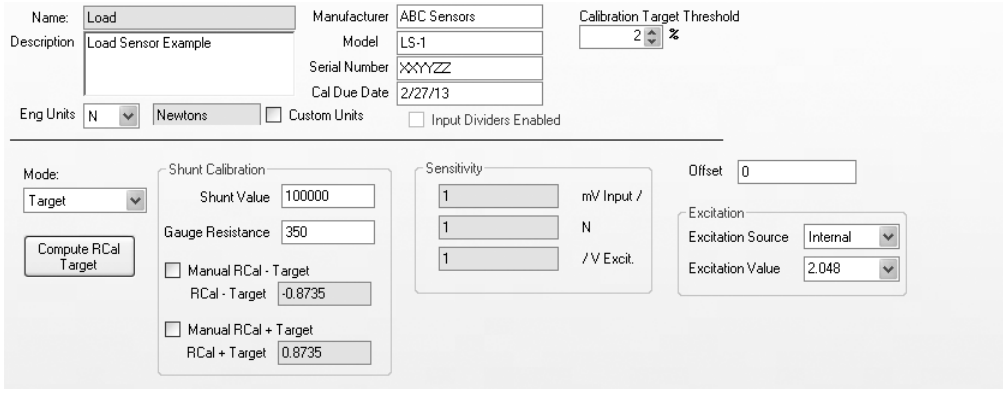
$$With\ Excitation\ set\ \text{to None}: \quad f(x) = \frac{x * Units}{Sensitivity} + Offset$$

$$With\ Excitation\ On: \quad f(x) = \frac{x * Units * (PerVolts/Excitation)}{Sensitivity} + Offset$$

See Displacement Sensor connection diagrams (pg 121)

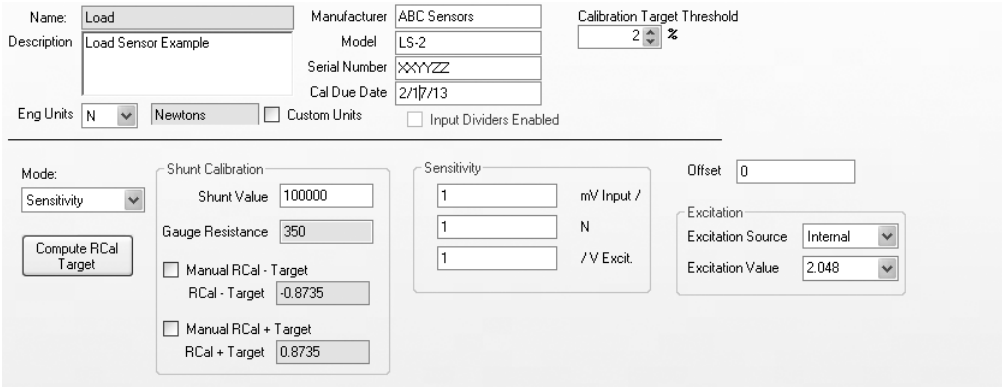
Sensor Types - Load

Titan devices support many types of load sensors, all classified as Load.



Field Definitions

Mode: Selects Target or Sensitivity modes. The selection determines the configuration options that are presented in the lower part of the pane. When Target mode is selected (shown above), the Sensitivity fields are greyed out and cannot be changed. When Sensitivity mode is selected (shown below), the Gauge Resistance and Manual RCAL fields are greyed out and cannot be changed.



Shunt Value: The value (in Ohms) for the calibration resistor used to check the calibration of the sensor.

Gauge Resistance: The resistance (in Ohms) of a single bridge of the load sensor.

Sensor Types - Load (con't)

RCal Target: The computed value for RCAL when the 'Compute RCal Target' button is pressed. The computed value is based on the values entered into the 'Shunt Calibration' and 'Sensitivity' fields. Enabling 'Manual RCAL' allows you to manually enter target values for CAL+ and/or CAL-. When a manual target value is specified, the 'Compute RCal Target' button is ignored for that target.

Sensitivity: Sensor translation from millivolts into engineering units. If excitation is specified the sensitivity equation is updated to include a value for the excitation.

Excitation Source: The excitation source for the sensor: None, Internal, or External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop-down menu.

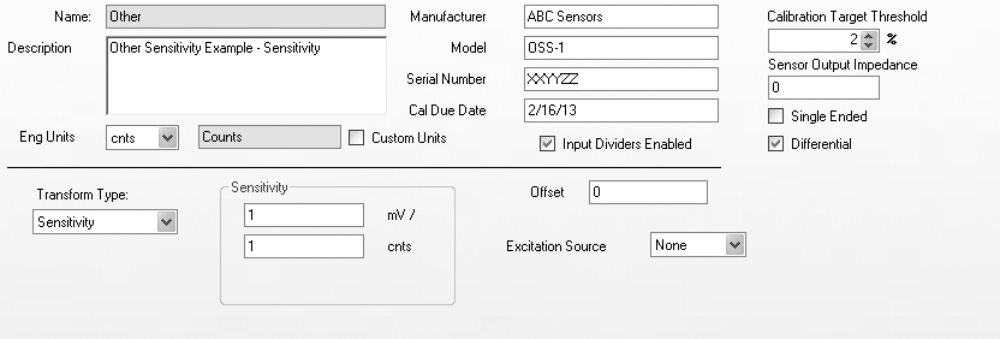
Load Sensor Transform

$$f(x) = \frac{x * Units * (PerVolts / Excitation)}{Sensitivity} + Offset$$

See Load Sensor connection diagrams (pg 117)

Sensor Types - Other - Sensitivity

Titan devices support two methods of defining additional (Other) sensor types: Sensitivity and Polynomial. The Sensitivity configuration is shown below. The Polynomial configuration is shown on the next page.



Field Definitions

Transform Type: Selects either the Sensitivity or Polynomial transform.

Sensitivity: Sensor translation from millivolts into engineering units. If excitation is specified the sensitivity equation is updated to include the value for the excitation.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu..

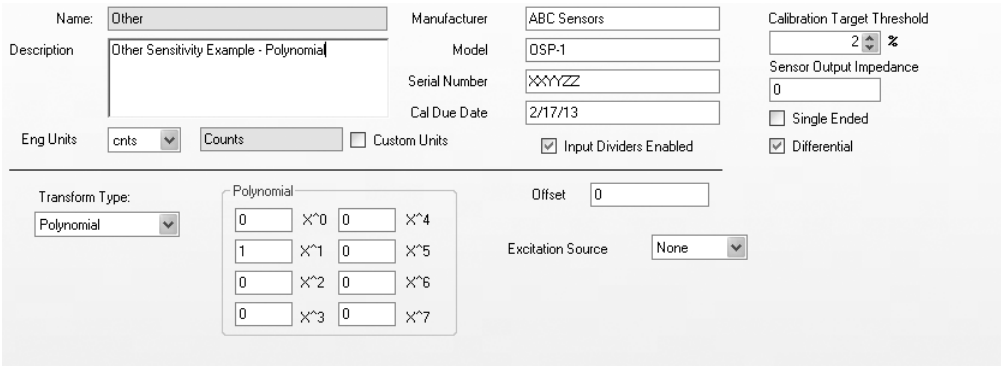
Sensor Transform

$$\textit{Sensitivity Mode with Excitation Enabled}: \quad f(x) = \frac{x * Units * (PerVolts/Excitation)}{Sensitivity}$$

$$\textit{Sensitivity Mode with Excitation set to None}: \quad f(x) = \frac{x * Units}{Sensitivity}$$

Sensor Types - Other - Polynomial

The Polynomial configuration is shown below.



Field Definitions

Transform Type: Selects either the Sensitivity or Polynomial transform.

Polynomial Coefficients: Enter a coefficient value for each Polynomial order. This will be used to translate sensor millivolts to engineering units. Up to an eighth order polynomial may be entered.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu.

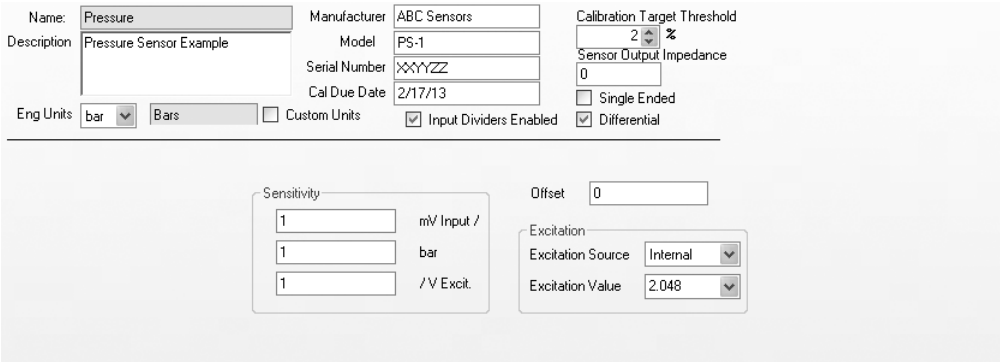
Sensor Transform

Applies the given polynomial.

NOTE: *For Polynomials, the specified polynomial is applied to the raw reading in mV. Excitation is not accounted for.*

Sensor Types - Pressure

Titan devices support many types of pressure sensors, all classified as Pressure.



Field Definitions

Sensitivity: Sensor translation from millivolts into engineering units. If excitation is specified the sensitivity equation is updated to include a value for the excitation.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu.

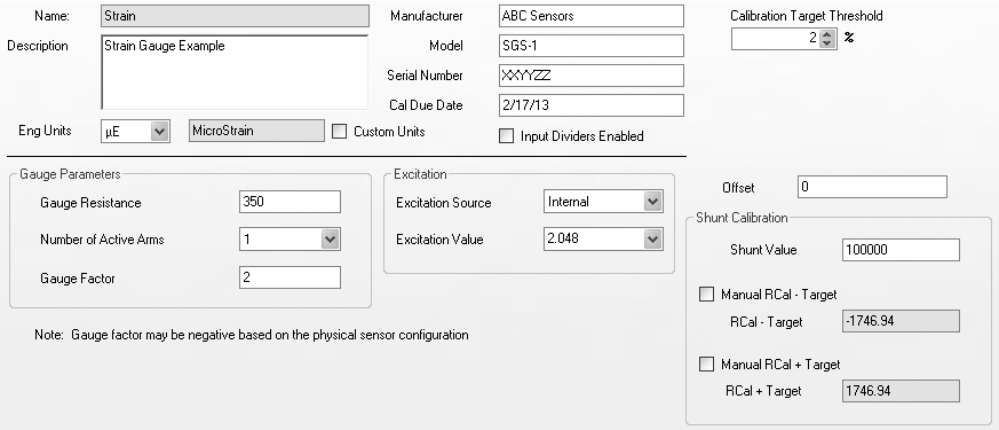
Pressure Sensor Transform

$$With\ Excitation\ set\ \text{to None}: \quad f(x) = \frac{x * Units}{Sensitivity} + Offset$$

$$With\ Excitation\ On: \quad f(x) = \frac{x * Units * (PerVolts/Excitation)}{Sensitivity} + Offset$$

Sensor Types - Strain

Titan devices support many types of strain gauge sensors, all classified as Strain.



Field Definitions

Gauge Resistance: The resistance (in Ohms) of a single bridge of the strain gauge.

Number of Active Arms: The number of active arms the strain gauge is using:

1 arm = Quarter bridge
2 arms = Half bridge
4 arms = Full bridge

Gauge Factor: The gauge factor of the strain gauge. The gauge factor may be negative based on the physical sensor configuration.

Excitation Source: The excitation source for the sensor: Internal or External.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop-down menu.

Shunt Value: The value (in Ohms) for the calibration resistor used to check the calibration of the sensor.

RCAL Target: The computed value (in engineering units) of the calibration target of the sensor. The computed value is based on the values entered for the 'Shunt Value' and 'Gauge Parameter' fields. Enabling 'Manual RCAL' allows you to manually enter target values for CAL+ and/or CAL-.

Strain Sensor Transform

$$One\ Active\ Arm: \quad f(x) = \frac{4x}{Excitation} + Offset$$

$$Two\ Active\ Arms: \quad f(x) = \frac{-2x}{Excitation} + Offset$$

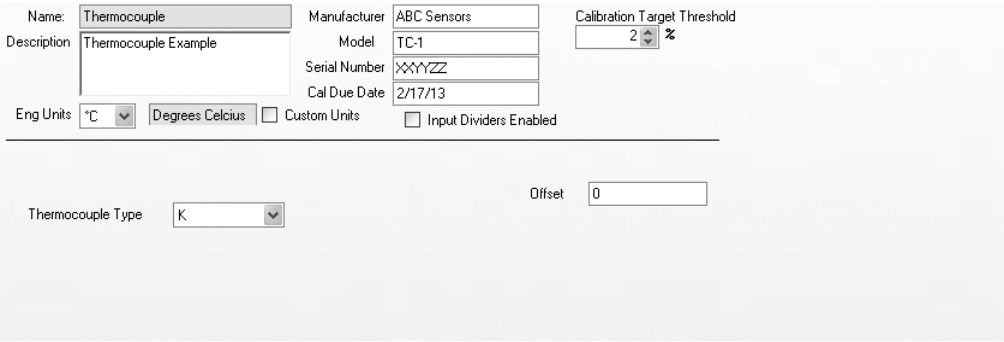
$$Four\ Active\ Arms: \quad f(x) = \frac{-x}{Excitation} + Offset$$

Note : The strain sensor also adjusts for units mE and *E.*

See Strain Sensor connection diagrams (pg 117)

Sensor Types - Thermocouple

Titan devices support three types of thermocouples: J, K and T.



Field Definitions

Thermocouple Type: Selects J, K, or T type thermocouples. Titan devices support the full range of each Thermocouple type:

J: -210 to 1200 degrees C
K: -200 to 1372 degrees C
T: -200 to 400 degrees C

Sensor Transform

Thermocouple transforms are pre-defined eight-order polynomials that are defined for each thermocouple type. The transforms are shown on the following pages.

See Thermocouple Sensor connection diagram (pg 125)

Sensor Types - Thermocouple (con't)

Type K Transforms

```
*************************************************************
* This section contains coefficients of approximate inverse
* functions for type K thermocouples for the subranges of
* temperature and voltage listed below. The range of errors of
* the approximate inverse function for each subrange is also given.
* The coefficients are in units of °C and mV and are listed in
* the order of constant term up to the highest order.
* The equation is of the form t_90 = d_0 + d_1*E + d_2*E^2 + ...
*     + d_n*E^n,
* where E is in mV and t_90 is in °C.
*
*    Temperature        Voltage            Error
*      range              range            range
*      (°C)               (mV)             (° C)
*    -200. to 0.      -5.891 to 0.000    -0.02 to 0.04
*     0. to 500.      0.000 to 20.644    -0.05 to 0.04
*     500. to 1372.   20.644 to 54.886   -0.05 to 0.06
*************************************************************
Inverse coefficients for type K:

Temperature  -200.             0.           500.
  Range:        0.           500.          1372.

  Voltage   -5.891          0.000         20.644
  Range:     0.000         20.644         54.886

        0.0000000E+00  0.000000E+00 -1.318058E+02
        2.5173462E+01  2.508355E+01  4.830222E+01
       -1.1662878E+00  7.860106E-02 -1.646031E+00
       -1.0833638E+00 -2.503131E-01  5.464731E-02
       -8.9773540E-01  8.315270E-02 -9.650715E-04
       -3.7342377E-01 -1.228034E-02  8.802193E-06
       -8.6632643E-02  9.804036E-04 -3.110810E-08
       -1.0450598E-02 -4.413030E-05  0.000000E+00
       -5.1920577E-04  1.057734E-06  0.000000E+00
        0.0000000E+00 -1.052755E-08  0.000000E+00

  Error      -0.02          -0.05          -0.05
  Range:      0.04           0.04           0.06
```

NOTE: *Transform information shown on this page and following pages was obtained from the NIST Thermocouple database at http://srdata.nist.gov.*

Sensor Types - Thermocouple (con't)

Type T Transforms

```
*****************************************************************
* This section contains coefficients of approximate inverse
* functions for type T thermocouples for the subranges of
* temperature and voltage listed below. The range of errors of
* the approximate inverse function for each subrange is also given.
* The coefficients are in units of °C and mV and are listed in
* the order of constant term up to the highest order.
* The equation is of the form t_90 = d_0 + d_1*E + d_2*E^2 + ...
*     + d_n*E^n,
* where E is in mV and t_90 is in °C.
*
*    Temperature        Voltage            Error
*      range              range            range
*      (°C)               (mV)             (° C)
*    -200. to 0.     -5.603 to 0.000    -0.02 to 0.04
*     .0 to 400.     0.000 to 20.872    -0.03 to 0.03
*****************************************************************
Inverse coefficients for type T:

Temperature  -200.             0.
  Range:        0.           400.

  Voltage   -5.603          0.000
  Range:     0.000         20.872

         0.0000000E+00  0.000000E+00
         2.5949192E+01  2.592800E+01
        -2.1316967E-01 -7.602961E-01
         7.9018692E-01  4.637791E-02
         4.2527777E-01 -2.165394E-03
         1.3304473E-01  6.048144E-05
         2.0241446E-02 -7.293422E-07
         1.2668171E-03  0.000000E+00

  Error      -0.02          -0.03
  Range:      0.04           0.03
```

Sensor Types - Thermocouple (con't)

Type J Transforms

```
*************************************************************************
* This section contains coefficients for type J thermocouples for
* the two subranges of temperature listed below.  The coefficients
* are in units of °C and mV and are listed in the order of constant
* term up to the highest order.  The equation is of the form
* E = sum(i=0 to n) c _ i t^i.
*
*     Temperature Range (°C)
*        -210.000 to 760.000
*         760.000 to 1200.000
*************************************************************************
Name: reference function on ITS-90
Type: J
Temperature units: °C
EMF units: mV

Temperature
Range:         -210.0 to 760.0

              0.000000000000E+00
              0.503811878150E-01
              0.304758369300E-04
             -0.856810657200E-07
              0.132281952950E-09
             -0.170529583370E-12
              0.209480906970E-15
             -0.125383953360E-18
              0.156317256970E-22

Temperature
Range:         760 to 1200.0

              0.296456256810E+03
             -0.149761277860E+01
              0.317871039240E-02
             -0.318476867010E-05
              0.157208190040E-08
             -0.306913690560E-12
```

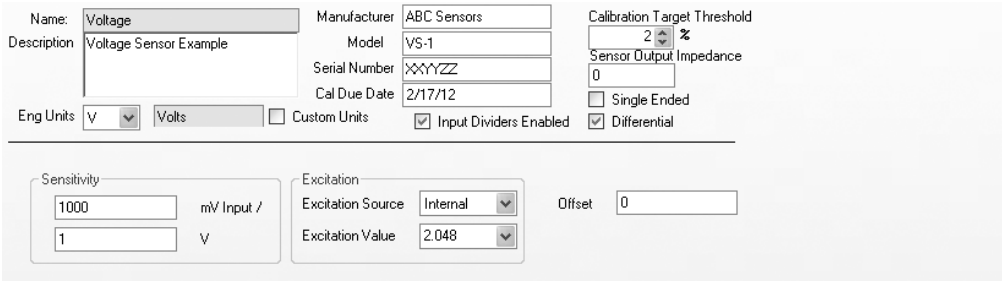
Sensor Types - Thermocouple (con't)

Type J Transforms

```
*************************************************************************
* This section contains coefficients of approximate inverse
* functions for type J thermocouples for the subranges of
* temperature and voltage listed below. The range of errors of
* the approximate inverse function for each subrange is also given.
* The coefficients are in units of °C and mV and are listed in
* the order of constant term up to the highest order.
* The equation is of the form t _ 90 = d _ 0 + d _ 1*E + d _ 2*E^2 + ...
*     + d _ n*E^n,
* where E is in mV and t _ 90 is in °C.
*
*    Temperature         Voltage             Error
*      range               range              range
*      (°C)                (mV)               (° C)
*    -210. to 0.       -8.095 to 0.000     -0.05 to 0.03
*     0. to 760.        0.000 to 42.919    -0.04 to 0.04
*     760. to 1200      42.919 to 69.553   -0.04 to 0.03
*************************************************************************
Inverse coefficients for type J:

Temperature  -210.              0.            760.
  Range:        0.            760.           1200.

  Voltage   -8.095           0.000          42.919
  Range:     0.000          42.919          69.553

         0.0000000E+00  0.000000E+00 -3.11358187E+03
         1.9528268E+01  1.978425E+01  3.00543684E+02
        -1.2286185E+00 -2.001204E-01 -9.94773230E+00
        -1.0752178E+00  1.036969E-02  1.70276630E-01
        -5.9086933E-01 -2.549687E-04 -1.43033468E-03
        -1.7256713E-01  3.585153E-06  4.73886084E-06
        -2.8131513E-02 -5.344285E-08  0.00000000E+00
        -2.3963370E-03  5.099890E-10  0.00000000E+00
        -8.3823321E-05  0.000000E+00  0.00000000E+00

  Error      -0.05           -0.04           -0.04

  Range:      0.03            0.04            0.03
```

Sensor Types - Voltage

Titan devices support many types of voltage sensors, all classified as Voltage.



Field Definitions

Input Dividers Enabled: Enabled by default when Voltage sensors are specified, this function physically enables a resistive divider network that divides the voltage across any channel using the sensor by a factor of 16.

Sensitivity: Sensor translation from millivolts into engineering units.

Excitation Source: The excitation source for the sensor: None, Internal, External. When 'None' is selected, the Excitation Value field is hidden.

Excitation Value: The value in volts for the sensor excitation. When 'Per-Channel Excitation' is enabled, an excitation voltage from 2 to 11.5V can be selected in the drop down menu.

Voltage Sensor Transform

$$f(x) = \frac{x * Units}{Sensitivity} + Offset$$

See Voltage Sensor connection diagram (pg 120)

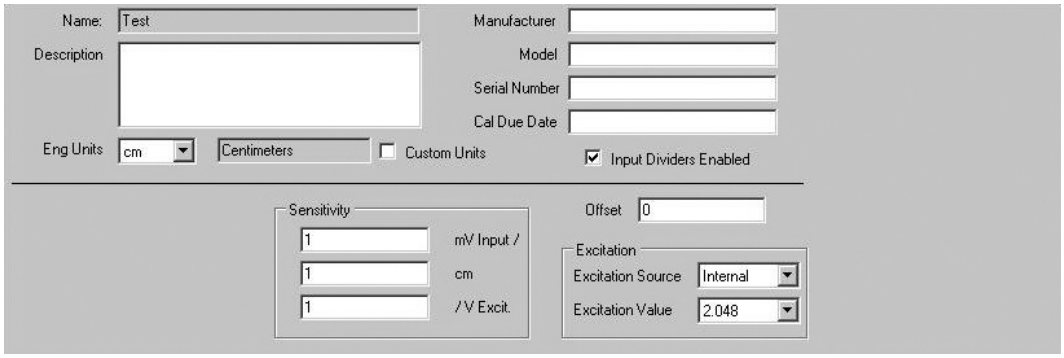
Physical Calibration (F8)

Physical calibration (PCAL) allows you to establish sensor calibration parameters through the use of a known physical force or property. In effect, PCAL allows you to specify the relationship of a sensor output for a given input. This is desirable in those cases where the sensor calibration is unspecified or unknown, such as the output of a Load Cell for a given input load.

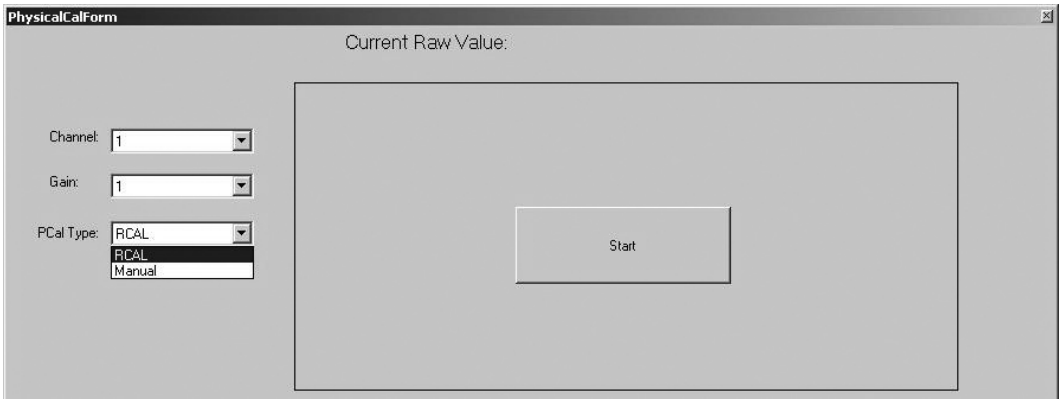
In TCS, physical calibration can be performed on all sensors except for Strain, Frequency, Thermocouple and 'Other' sensor types. The following examples illustrate how to perform a physical calibration using a Displacement sensor.

PCAL example

Let's begin by defining a new Displacement sensor. The default 'Sensitivity' values for a Displacement sensor are 1mV/1cm:



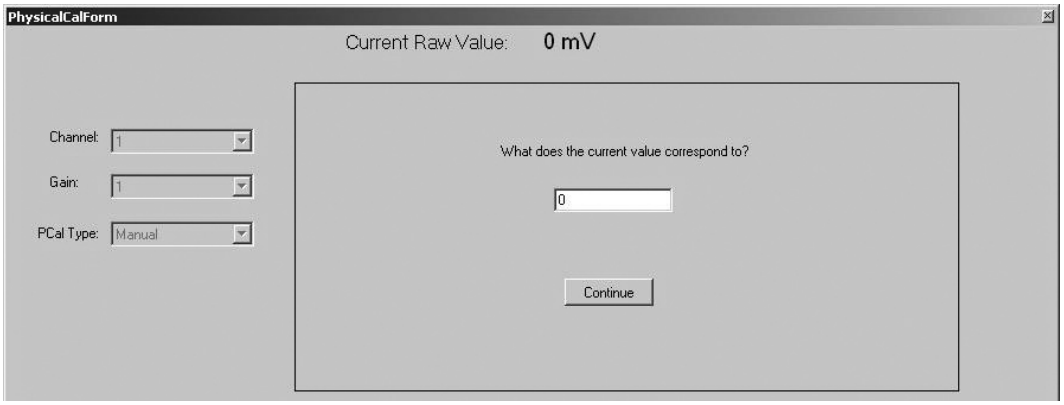
Select the PCAL function (F8), then select the Channel the sensor is assigned to, select the Gain, and the method of physical calibration (RCAL or Manual) for the desired sensor:



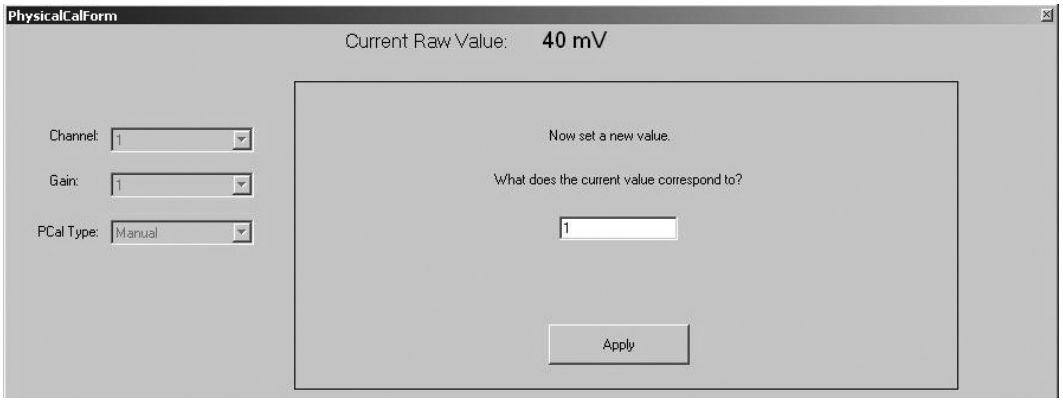
NOTE: *Although the example above shows Gain = 1, the actual Gain setting used for PCAL should be the same gain as configured in the Tags and Channels screen.*

For Manual PCAL:

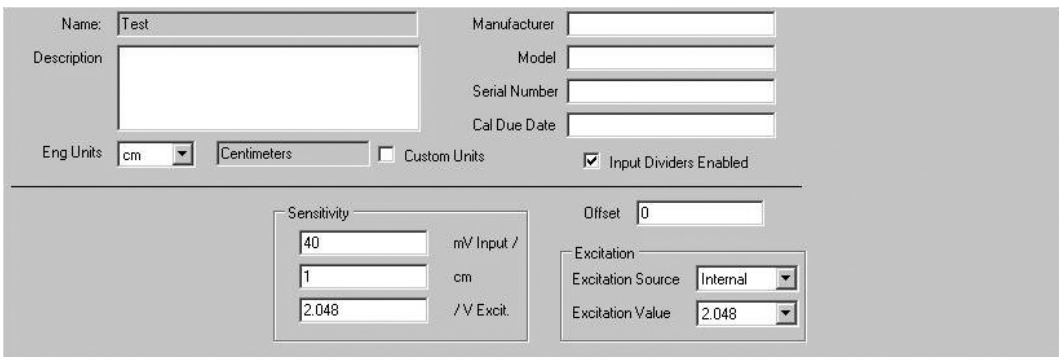
Select ‘START’. TCS will now read and display the raw input value from the sensor, and allow you to enter the value that the input corresponds to:



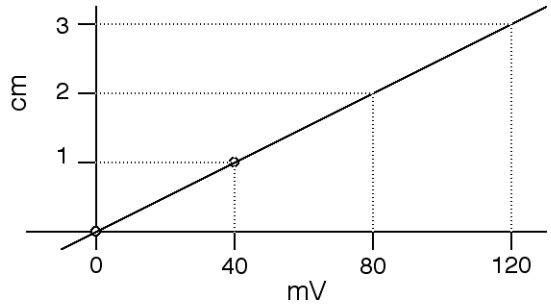
Select ‘CONTINUE’. Now apply a known input to the sensor. This will result in a new raw value being displayed. Enter the value that this input corresponds to, and then select ‘APPLY’:



The ‘Sensitivity’ values for the Displacement sensor now reflect the values resulting from the physical calibration process. In this example, a 40mV input corresponds to a displacement of 1cm:

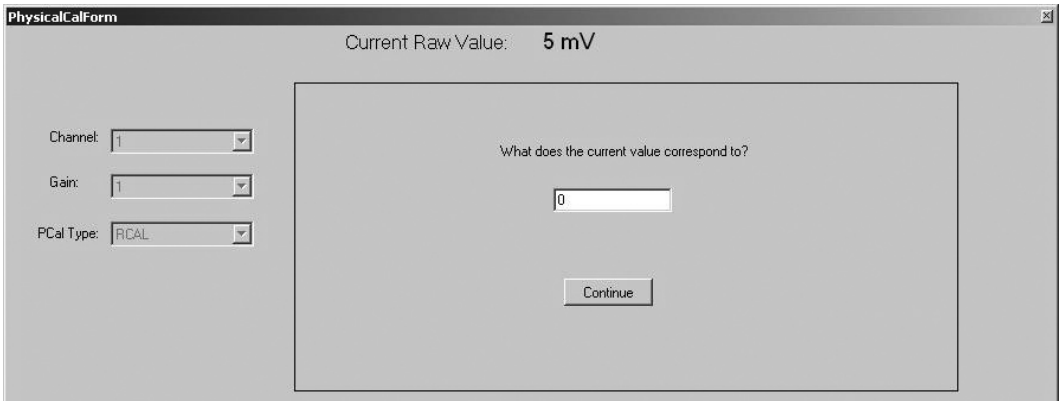


Based on the values chosen for this example, the Displacement sensor exhibits no offset:



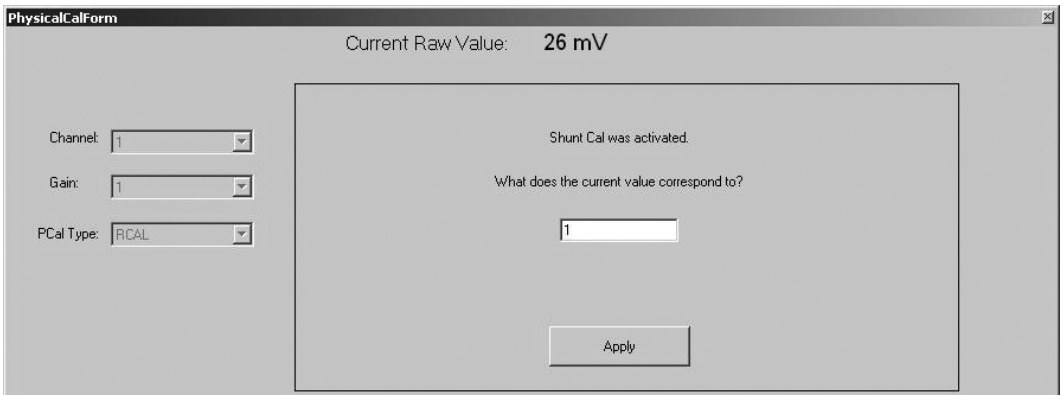
For RCAL:

Select ‘START’. TCS will now read and display the raw input value from the sensor, and allow you to enter the value that the input corresponds to:

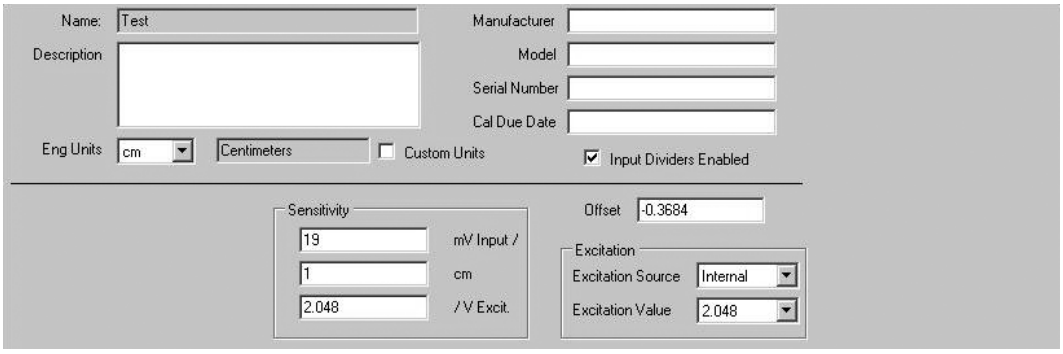


NOTE: *RCAL is only valid for 2.048V excitation. Different excitation values will result in an invalid RCAL result.*

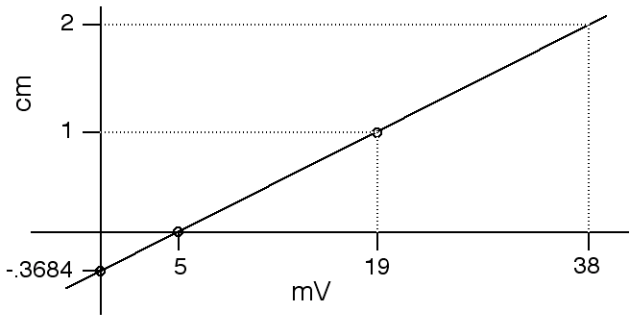
Select ‘CONTINUE’. For RCAL, shunt calibration is activated. Now apply a known input to the sensor. This will result in a new raw value being displayed. Enter the value that this input corresponds to, and then select ‘APPLY’:



The ‘Sensitivity’ values for the Displacement sensor now reflect the values resulting from the physical calibration process. Note also that the PCAL values used in this example produce a computed offset of -.3684 cm:

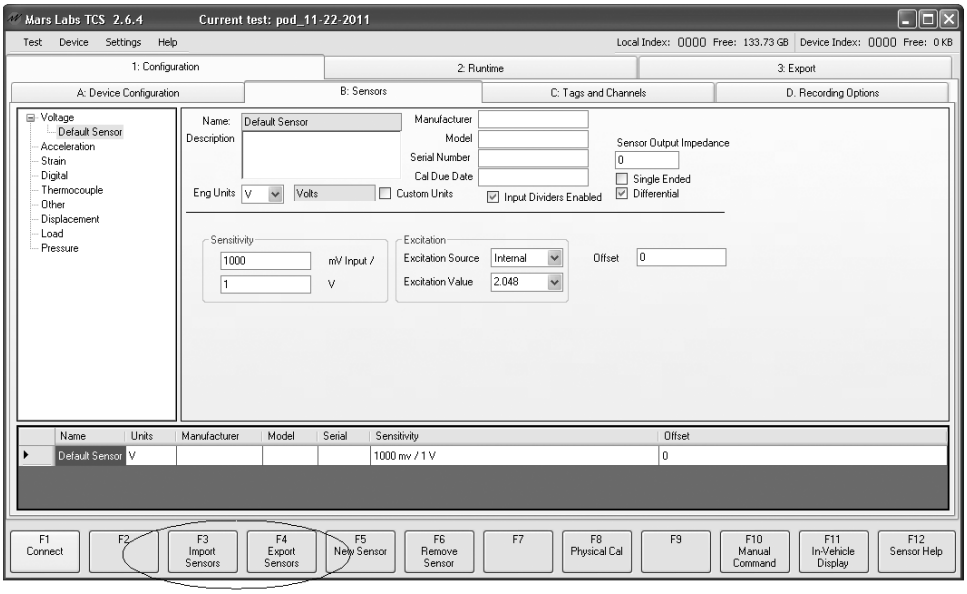


Viewed graphically:



Sensor Import/Export

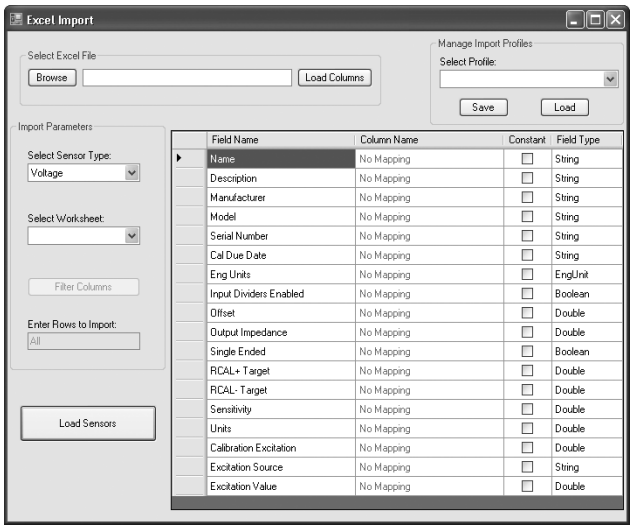
Sensor Import and Export functions appear on the button bar on the *Sensors* screen:



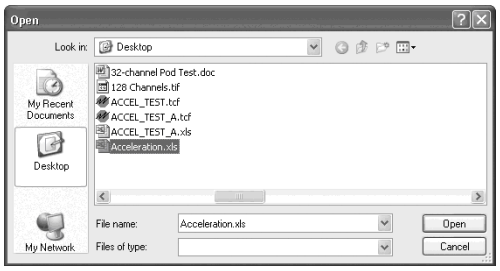
Clicking on the ‘Import Sensors’ button (F3) invokes the Import screen, while clicking on the ‘Export Sensors’ button (F4) invokes the Export screen. Only one screen can be accessed at a time.

Sensor Import

Selecting ‘Import Sensors’ brings up an Import window that allows you to select the files to be imported:



The first step in the Import process is to load the desired sensor database file. Click on the ‘Browse’ button (upper left) and navigate to the location of the source files. Select the file and click ‘Open’:



NOTES:

1. Sensor database files must be in the MSExcel file (.xls) format on a single worksheet. MSExcel files with multiple worksheets will produce an ‘Index out of range error’ when loaded.

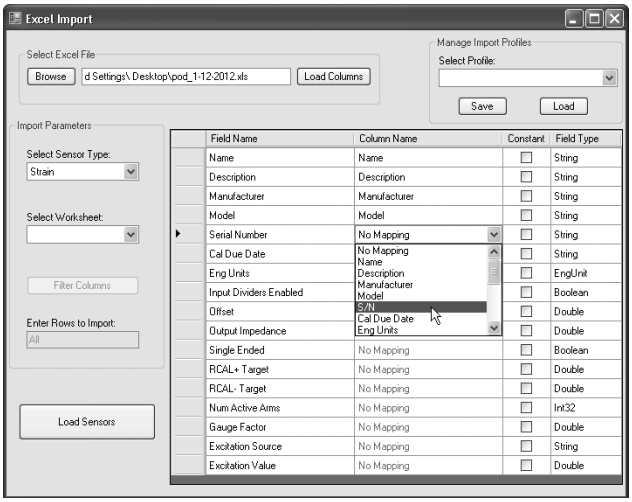
2. Sensor database files should contain descriptive names for each column on the topmost row. These names will be used to map the information in each column with the fields in TCS:

	A	B	C	D	E
1	**Name**	**Description**	**Manufacturer**	**Model**	**S/N**
2	Strain Gage	Bi-axial Tee	ML Industries	MLSG-12	12345
3	Strain Gage	Bi-axial Tee	ML Industries	MLSG-23A	12346
4					

In the ‘Import Parameters’ section, select the desired sensor from the ‘Select Sensor Type’ dropdown. This will display the TCS fields that are appropriate for the selected sensor type.

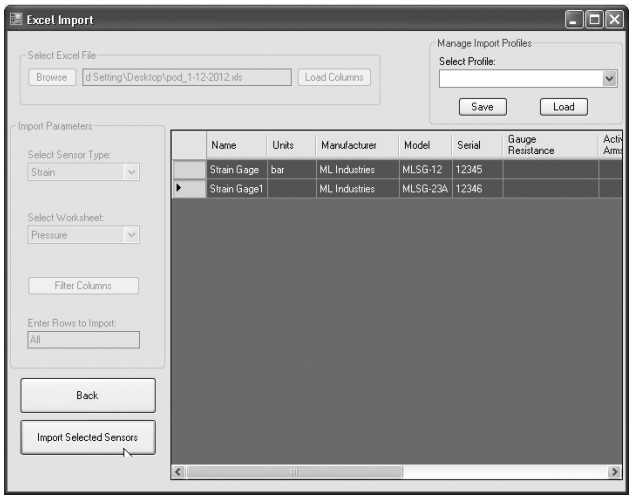
Click on the ‘Load Columns’ button. This will load the column names from the sensor database that was just loaded.

The next step is to map the TCS field names to the names in the database file using the dropdown menus. If the sensor information you are importing was previously exported from TCS, the mapping will already be correct:

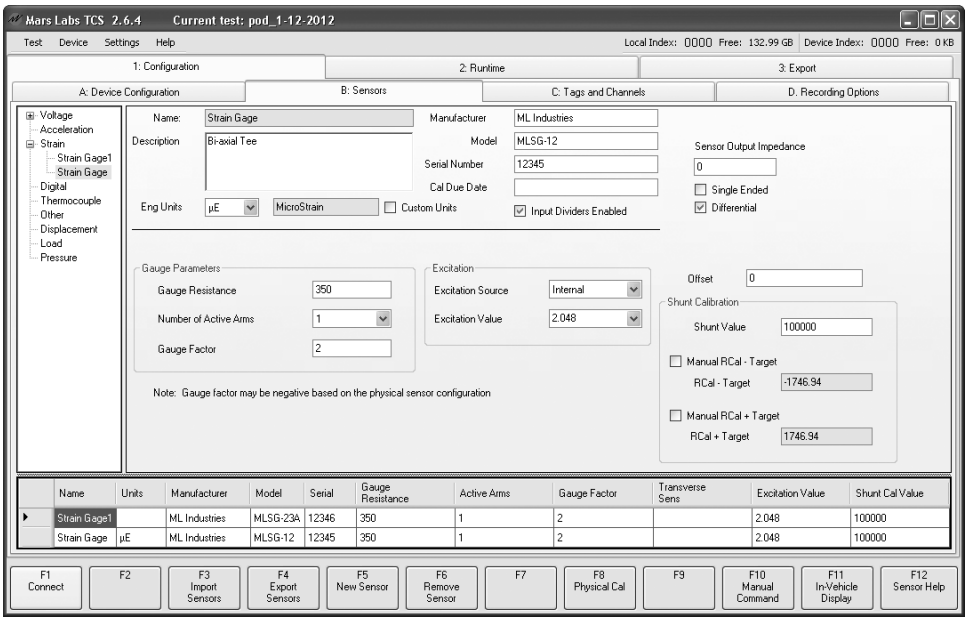


NOTE: *For large sensor databases, the number of items that appear in the dropdowns can become considerable. To reduce the number of items that are displayed, it is suggested that you pre-sort your sensors into individual single worksheets organized by sensor type.*

After the mapping operation is complete, click on ‘Load Sensors’ to get the list of available sensors. CRTL-Click to select the desired sensors for import, and then click on ‘Import Selected Sensors’:



The selected sensors will be imported into TCS:



The table below shows the assignable field types in TCS, organized by sensor:

Assignable fields in TCS		Sensor Types									
		Accelerometer	Digital	Displacement	Load	Other - Sensitivity	Other - Polynomial	Pressure	Strain	Thermocouple	Voltage
Basic Sensor Information [1]		X									
Engineering Units [2]		X									
Offset [3]		X									
Input Dividers [4]		X	X	X		X	X	X	X	X	X
Sensor Output Impedance (Ohms) [5]		X		X		X	X	X	X	X	X
Single Ended/Differential Input		X		X		X			X	X	X
Sensitivity (Sensor Output per Engineering Unit)	Sensitivity Value	X		X	X	X	X	X	X		X
	Eng. Unit Value ('Units')	X		X	X	X	X	X	X		X
	Calibration (per V Excitation)	X		X	X	X	X	X	X		X
Type or Mode [6]		X	X		X	X	X			X	
Excitation	Source (None/Int/Ext)	X		X	X	X	X	X	X		X
	Value (volts)	X		X	X	X	X	X	X		X
Gauge Resistance					X				X		
Active Arms (1/2/4)									X		
Gauge Factor									X		
RCAL+ Target (manual entry or computed value)		X			X				X		
RCAL- Target (manual entry or computed value)		X			X				X		

Notes:

1. *Basic Sensor Information* is information common to all sensor types, including Name, Description, Model, Manufacturer, Serial Number, and Cal Due Date.

2. *Engineering Units* supported in TCS include Amps (µA, mA, A), metric units (µm, mm, cm,m, km), Volts (µV, mV, V), Atmospheres (atm), Pressure (bar), Flow (cc/s), Counts (cnt), Acceleration (g), and Degrees per second.

3. The *Offset* value is always specified in *Engineering Units.*

4. *Input Dividers* is specified as a TRUE/FALSE condition that determines whether or not the Input Dividers are enabled in TCS for the selected sensor. When TRUE, Input Dividers are enabled; when FALSE, Input Dividers are disabled.

5. When *Input Dividers* are enabled, *Sensor Output Impedance* and *Single Ended/Differential Input* options can be specified. *Sensor Output Impedance* is specified in Ohms. The *Single Ended* option is a TRUE/FALSE selection. When TRUE, a Single-Ended input is specified; when FALSE, a Differential input is specified.

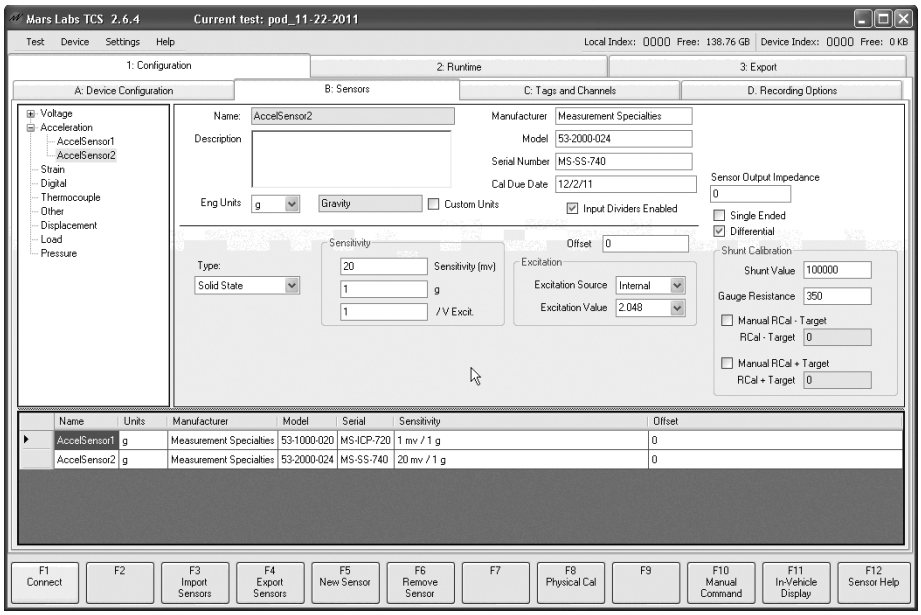
6. *Type or Mode* - This field specifies a selection of two or more options for a given sensor type within TCS. This field can be left blank for database imports.

7. During import, empty database fields will result in default value assignments in TCS.

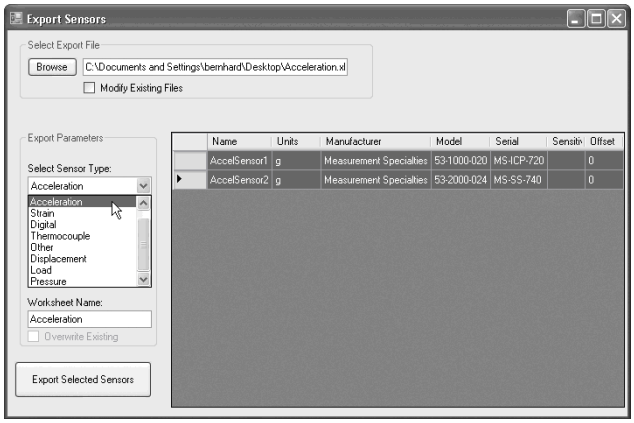
Sensor Export

Any sensor or group of sensors configured in TCS can be exported and saved for later recall.

Consider the example below, where several accelerometer sensors have been configured:

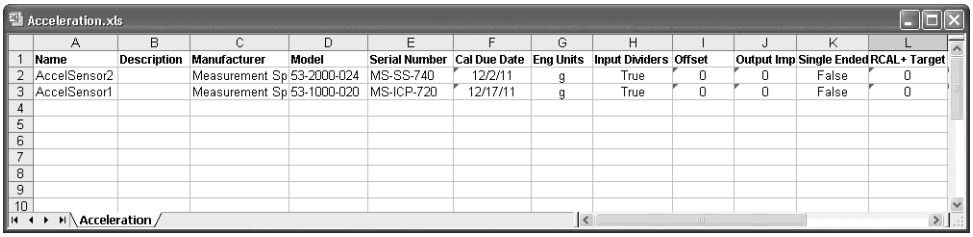


Clicking on the ‘Export Sensors’ button brings up a window that allows you to export the sensor information for an individual sensor or group of sensors configured in the current test:



On the Export Sensor screen, sensors are grouped by type using the 'Select Sensor Type' dropdown menu. In the example above, selecting 'Acceleration' displays the two accelerometers in the sensor list. To export the sensors, CTRL-Click to select both sensors and then click on the 'Export Selected Sensors' button. The file will be exported with the file name (and location) shown in the 'Select Export File' field.

The exported file can be opened using MS Excel or a comparable spreadsheet application. Viewing the file reveals the sensor information and configuration that was exported:


Acceleration.xls

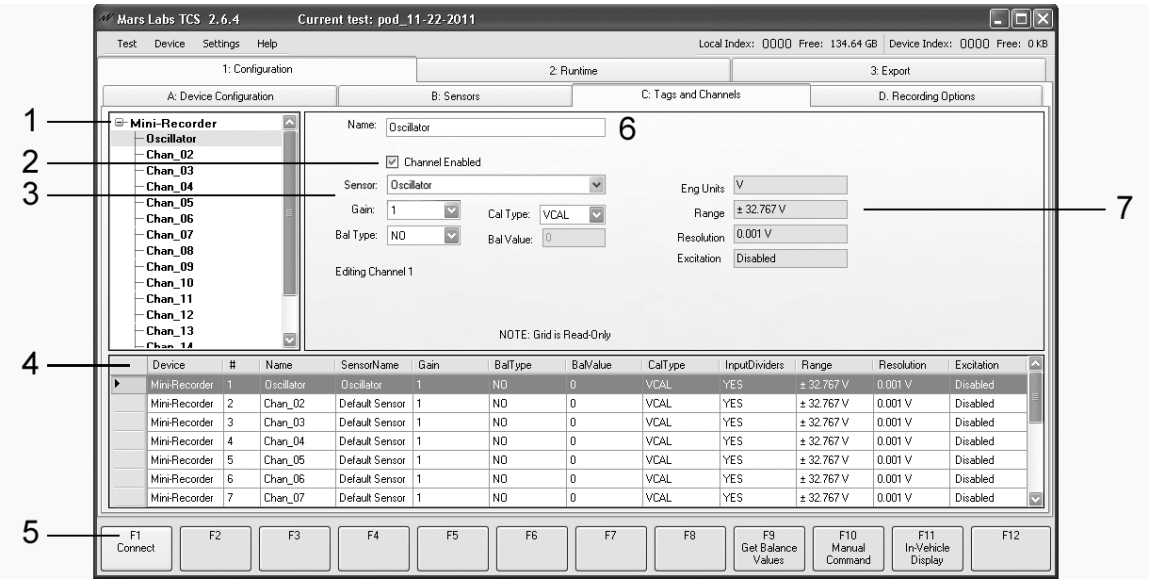
	A	B	C	D	E	F	G	H	I	J	K	L
1	Name	Description	Manufacturer	Model	Serial Number	Cal Due Date	Eng Units	Input Dividers	Offset	Output Imp	Single Ended	RCAL+ Target
2	AccelSensor2		Measurement Sp	53-2000-024	MS-SS-740	12/2/11	g	True	0	0	False	0
3	AccelSensor1		Measurement Sp	53-1000-020	MS-ICP-720	12/17/11	g	True	0	0	False	0
4												
5												
6												
7												
8												
9												
10												

Acceleration

NOTE: *When multiple sensor types are being exported with the same file name, each sensor type is saved on a separate worksheet, i.e. Voltage sensors will appear on a Voltage worksheet, Accelerometers will appear on an Accelerometer worksheet, etc. Worksheet names always default to the sensor type, but can freely be renamed. To export sensors to individual files (not worksheets), change the name in the 'Select Export File' field for each sensor type.*

Tags and Channels

The *Tags and Channels* screen is where you configure the input channels of the connected Titan device by assigning each channel to a sensor.



The main components of the *Tags and Channels* screen are:

1. Channel Tree – The Channel Tree displays all defined channels.
2. 'Channel Enabled' checkbox – Enables/disables selected channels.
3. Sensor Settings – The drop-down menus in this section allow you select and configure the sensor channel assignments.

   Sensor – Assigns a sensor to the selected (highlighted) channel. All sensors that appear in this drop-down list are configured in the 'Sensors' configuration window

   Gain – Sets the desired gain for the selected channel

   Cal – Selects the calibration options:

   VCAL – Places 1.02 volts on the input (Voltage Calibrator)
   RCAL – Places a 100K resistor in parallel with the input (Shunt Calibrator)
   EXT – Keeps the signal on the input when using external calibration

Bal Type - Specifies the Balance enable option for the selected channel (the Balance function simply removes channel offsets). The options are 'YES', 'NO', and 'PREV' (Previous). If 'YES', then Balance will be applied to that channel when the Balance function (F10) is selected in the Runtime screen. If 'NO', then Balance will not be applied to the channel when the Balance function is selected. If 'PREV', then the last stored Balance offset (or the offset loaded with the test) will be applied when the Balance function is selected.

The Bal Type selection affects the connected device as follows:

YES: Offsets are cleared when the device powers up. New offsets are calculated and applied when a balance operation is performed. Balance values will persist as long as the device is powered up.

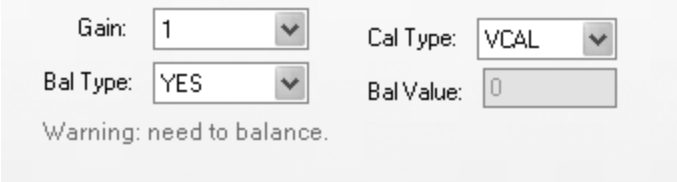
NO: Offsets are cleared when the device powers up. No offsets are applied at runtime.

PREV: The last stored offsets are loaded at power up and applied at runtime. New offsets are calculated and applied when a balance operation is performed. Balance values will persist across power cycles as long as the channel is set to PREV and the offsets are stored.

NOTES:

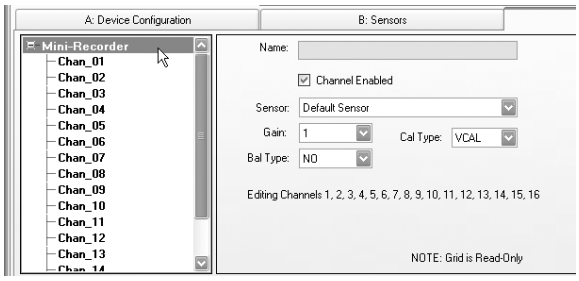
1. Balance values can be stored by selecting the 'Save Offsets' button in the Runtime screen, or by stopping and then re-starting the device scan after a balance operation has been performed.

2. Balance values are only valid for the gain, divider setting, and excitation values when the balance operation was performed. A new balance operation should be performed when any of these parameters (or the sensor connected to the channel) changes. TCS will display a warning message below the Bal Type field when the values are invalid and a new balance operation should be performed:

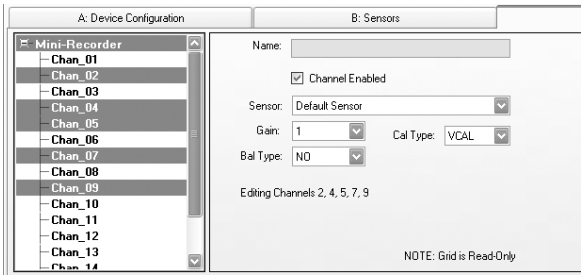


4. Table of defined channels. The table provides a non-editable overview of all defined channels for the current test. By default, each channel is initially assigned to a voltage sensor.
5. Function keys – In the Tags and Channels window, the F1 function key is used to connect and disconnect to the selected Titan device. The F9 function key gets the Balance Values. The F10 function key allows you to issue Manual Commands to the connected device (the F10 button duplicates the 'Send Manual Command' selection found in the DEVICE menu)
6. Channel Name field – Allows you to enter a unique channel name.
7. Displays sensor information inherited from the 'Sensors' configuration window.

NOTE: *To configure all channels globally, click on the Titan device label at the top of the Channel Tree:*



To make 'island' selections in the Channel Tree, hold the CTRL key while selecting the desired channels:



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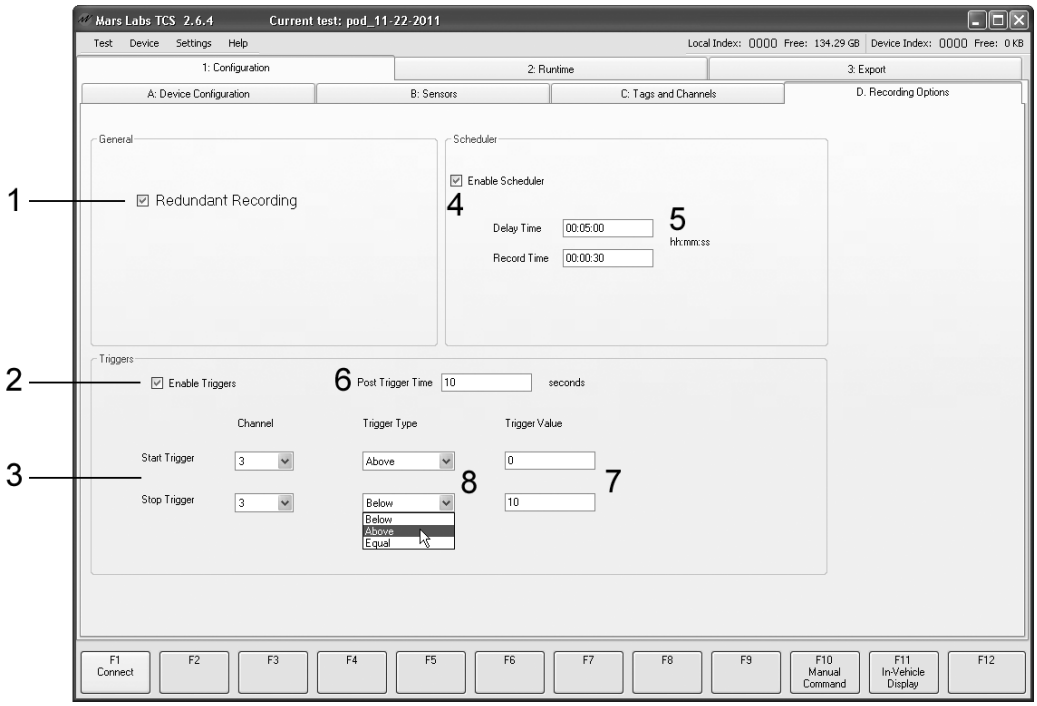
Recording Options

The *Recording Options* screen is where you configure the Trigger parameters of the connected Titan device and/or Schedule the frequency and duration of non-continuous recordings.



The main components of the *Recording Options* screen are:

1. 'Redundant Recording' checkbox - When checked, will always record to both Local and Remote when either recording option is selected in TCS, or when Remote recording is activated on the Mini-Recorder while the device is connected to TCS.

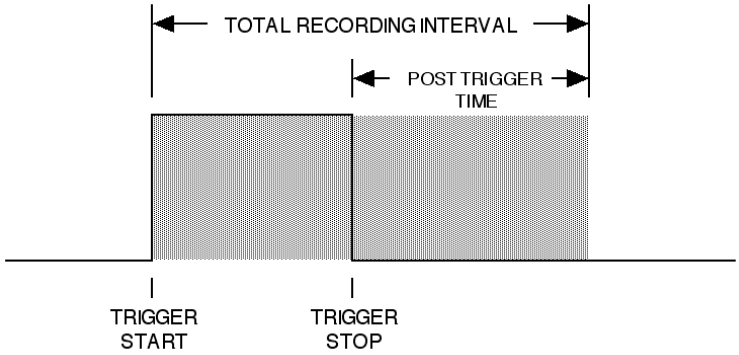
2. 'Enable Trigger' checkbox – Enables/disables the Trigger function.

3. 'Start Trigger'/ 'Stop Trigger' – The drop-down menus in this section select the individual trigger channels.

4. 'Enable Schedule' checkbox – Enables/disables the Schedule function.

5. 'Delay Time' / 'Record Time' fields – When the Schedule function is enabled, local recording takes place according to the frequency (Delay Time) and duration (Record Time) parameters specified. Data must be entered in 'hh:mm:ss' format for both fields.

6. ‘Post Trigger Time’ field – Specifies the recording time interval after the Stop Trigger is received:



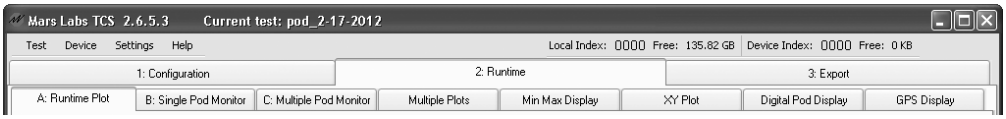
7. ‘Trigger Value’ field – Specifies the trigger threshold in counts.

8. Trigger Type – The drop-down menus in this section select the trigger modes for the Start and Stop Triggers.

‘Above’ – Recording starts when the input goes above the trigger value.
‘Below’ – Recording starts when the input goes below the trigger value.
‘Equal’ – Recording starts when the input is equal to the trigger value.

Runtime Tab

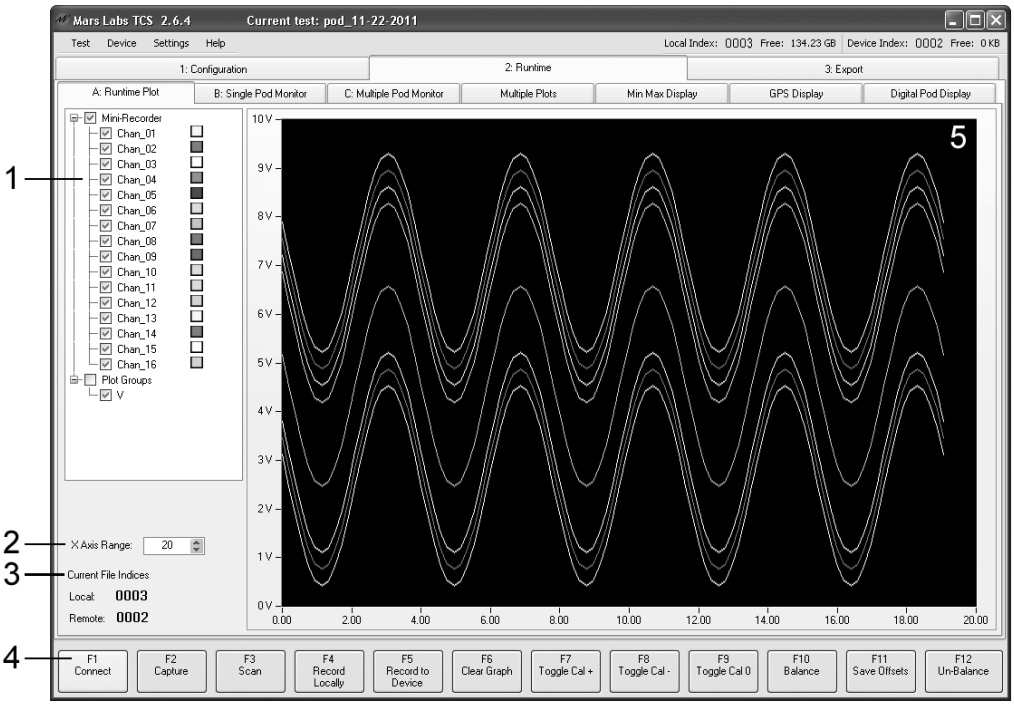
The ‘Runtime’ tab provides a series of related screens that allows you to view and record sensor data. Individually tabbed windows are provided for each of these functions:



***NOTE:** The GPS and DIGITAL POD DISPLAY display tabs will only appear in the Runtime screen when the ‘GPS’ and ‘DIGITAL POD’ checkboxes are checked and configured on the Device Configuration page. If either box is unchecked, the associated display tab(s) will not appear.*

Runtime Plot

The *Runtime Plot* screen allows you view sensor data graphically in a continuous scrolling window. Any channel or groups of channels can be displayed, and the X-axis can be lengthened or shortened as necessary.



The main components of the *Runtime Plot* screen include:

1. Channel Tree – The Channel Tree allows you to select which channels will be displayed on the plot. Specific channel groupings can also be selected here (for more information, see ‘Plot Groups’ below). Additionally, channel color codes can be freely reassigned by right-clicking on a channel and selecting from a color palette.

Runtime Plot screen components (con't):

NOTE: *To appear in the Channel Tree list, a channel must be enabled in the Tags and Channels screen.*

2. X-Axis Range – Allows you to select the display interval of the X-axis, from as short as 1 second to 3600 seconds (1 hour). The default interval of 20 seconds provides a continuous 20-second scrolling display.

NOTE: *There are several Runtime Plot options available. You access these in the SETTINGS menu, under 'Plot Options"*

3. 'Current File Indices' – This field displays the current data file indices for locally-recorded and remotely-recorded tests. The example here shows that 3 tests were recorded locally, and 2 tests were recorded remotely.

4. Function keys – In the Runtime window, the Function keys are assigned the following functions:

   F1 - Connects/disconnects to the selected Titan device
   F2 - Selects the Capture function
   F3 - Initiates data scanning
   F4 - Initiates Local recording (records to the PC)
   F5 - Initiates Remote recording (records to the device). If the connected Titan device does not support remote recording, this button has no function
   F6 - Clears the plot widow
   F7 - Toggles the 'Cal+' function
   F8 - Toggles the 'Cal-' function
   F9 - Toggles the 'Cal 0' function
   F10 - Selects the Balance function. Balance will be applied to all channels that have Balance enabled in the Tags and Channels screen (Bal Type = YES). For more on the operation of the Balance function, see page 85.
   F11 - Saves the channel offsets for all channels to the connected Titan device. Channels that have Balance disabled in the Tags and Channels screen will get an offset value of '0' (no offset).
   F12 - Restores channel offsets

5. Plot Window - A scrolling view of selected data channels

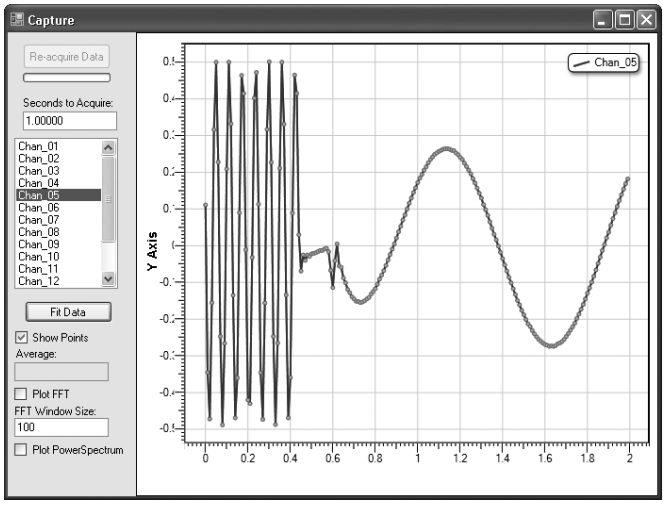
The Capture Function

The Capture function allows you to acquire and display a pre-defined amount of sensor data from a single channel.

When you press ‘Capture’ (F2), a dedicated capture window appears. Within the window are fields to select the channel and the amount of data to acquire in seconds.

Each time you press the ‘Re-acquire Data’ button, TCS will capture and display the data from the selected channel.

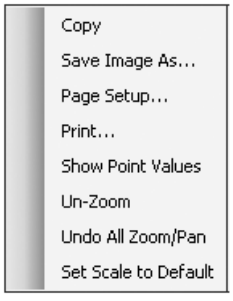
NOTE: *The maximum amount of data that can be acquired is 10,000 samples.*



‘Show Points’ checkbox - Toggle the sample points ON/OFF
Average - Displays the average value of all data points in Eng Units
‘Plot FFT’ checkbox - Replaces the XY plot with an FFT of the sampled data
FFT Window Size - Set the size of the FFT window
‘Plot Power Spectrum’ checkbox - Replaces the XY plot with a Power Spectrum plot

NOTE: *The ‘Plot FFT’ and ‘Plot Power Spectrum’ checkboxes operate like radio buttons - only one box can be selected at a time.*

Additional options in the Capture screen are accessed by right-clicking in the plot window:

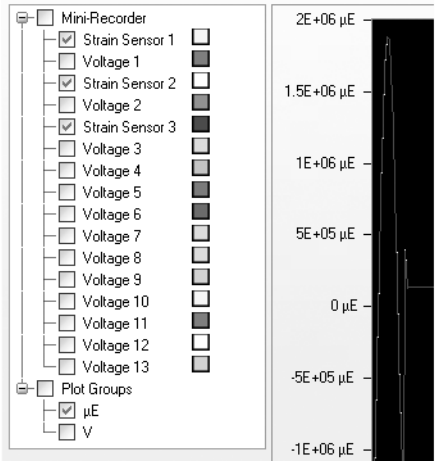


The Plot Groups Function

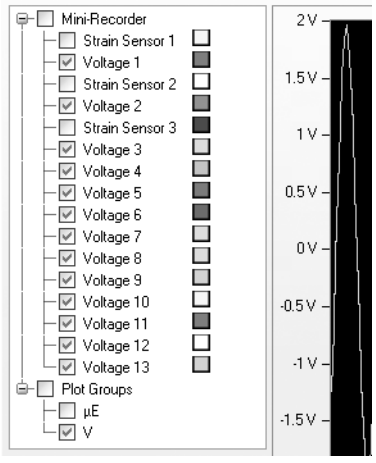
The Plot Groups function appears at the bottom of the Channel Tree pane. ‘Plot Groups’ allows you to conveniently group and display related sensor types.

To illustrate how the Plot Groups function works, suppose you have a 16-channel Titan device where channels 1, 3 and 5 are connected to Strain Gauges and all other channels are connected to Voltage sensors. The Plot Groups function allows you to display the like-sensor types by selecting the engineering value that represents these sensors. To illustrate how this works, refer to the examples below. The example on the left shows that when the micro-strain value (µE) is selected in ‘Plot Groups’ only those channels with Strain Gauge sensors connected will be charted on the plot; voltage channels will be excluded.

The example on the right shows the reverse condition - when the voltage value (V) is selected, only those channels with Voltage sensors connected will be charted on the plot; channels assigned to Strain Gauge sensors will be excluded.



Selecting the Strain Gauge sensor groups using the Plot Groups function

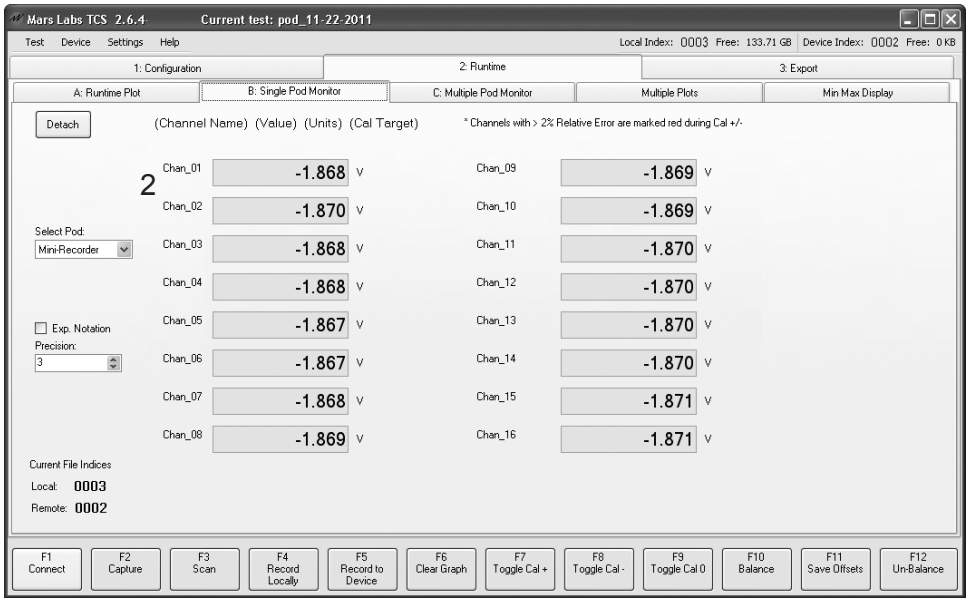


Selecting the Voltage sensor groups using the Plot Groups function

NOTE: *The Plot Groups function is not available for CPU test configurations.*

Single Pod Monitor

The ‘Single Pod Monitor’ screen allows you view numerical sensor data for a single Pod or Mini-Recorder. The screen will only display channels that are enabled in the Tags and Channels window.



The main features of the Single Pod Monitor screen include:

1. Detach button – The Detach button opens a separate ‘Digital Monitors’ window containing the numerical data. This allows you to view the graphical and numerical data simultaneously.

2. Numerical Display fields – Each data field is identified by the name assigned in Tags and Channels screen.

3. ‘Select Pod’ - This drop-down allows you to select the desired Pod or Mini-Recorder when more than one Titan device is connected.

4. ‘Exp Notation’ checkbox – When this box is checked, the data is displayed in exponential notation.

5. Precision – This drop-down allows you to select from 0 to 7 values of precision in the displayed data.

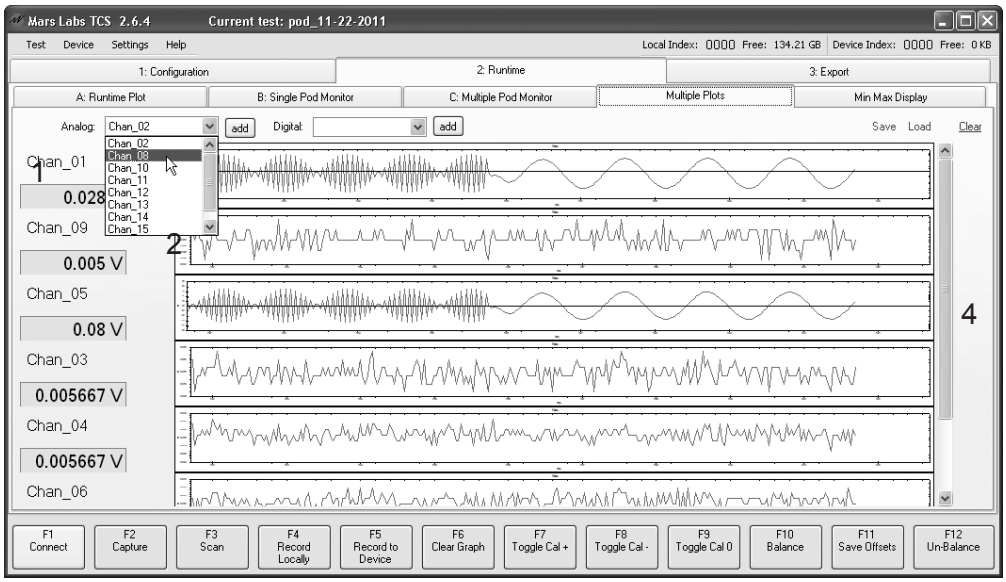
6. ‘Current File Indices’ – Displays the current data file indices for locally -recorded and remotely-recorded tests. The example above shows that 3 tests have been recorded locally.

Multiple Pod Monitor

Described on page 22.

Multiple Plots

The ‘Multiple Plots’ screen allows you view sensor data on selected channels:



The main features of the Multiple Plots screen include:

1. Add Channels – Selects specific analog and/or digital channels to display in the plot window. After making a selection, click on the ‘ADD’ button. As channels are added, the plots will automatically be resized to fit into the window.

2. Channel selection drop-down

3. ‘Clear’ button – A button that removes all plots from the display.

4. Scroll bar – The scroll bar appears when more than five plots are displayed at one time in an unexpanded window.

> ***NOTE:*** *The ‘Multiple Plots’ screen will allow you to view up to ten channels maximum, regardless of the size of the viewing window.*

Min Max Display

Described on page 23.

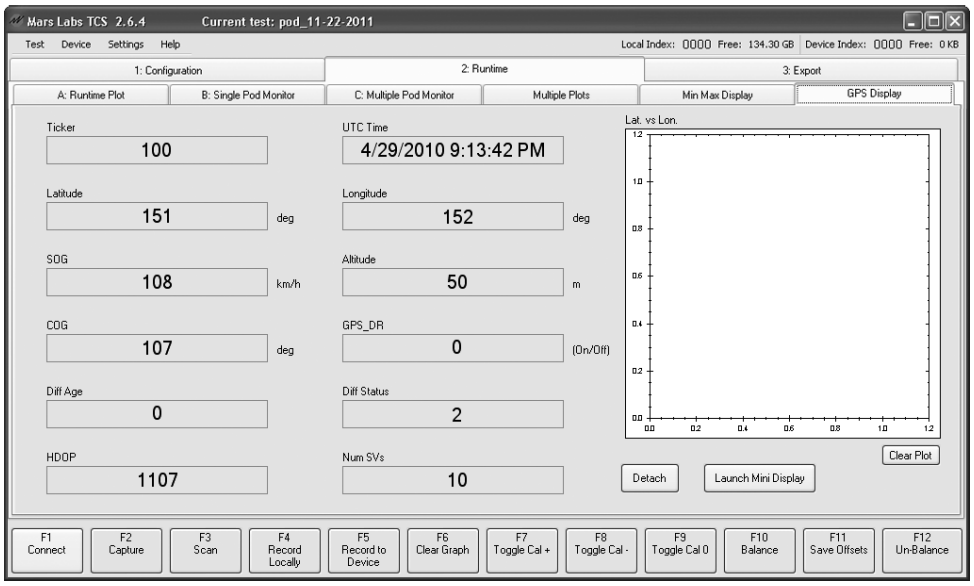
XY Plots

Described on page 24.

GPS Display

The ‘GPS Display’ screen allows you view the GPS data. A ‘Detach’ button places the GPS data into a separate, movable window, allowing you to view both the GPS and the plotted or numerical data at the same time.

> ***NOTE:*** *When you click on the ‘Detach’ button, it opens a separate GPS Display window, and the button label changes to ‘Reattach’. When you click on ‘Reattach’, the GPS Display window closes and the data in that window reappears under the ‘GPS Display’ tab.*



GPS field definitions:

Ticker – The scan count when recording. Used to match which scan the GPS message belongs to.

UTC Time – Coordinated Universal Time, displayed as:
MM/DD/YYYY HH/MM/SS AM/PM

Latitude – Latitude hemisphere (N or S), measured in degrees

Longitude – Longitude hemisphere (E or W), measured in degrees

Altitude – Height above mean sea level, measured in meters.

SOG – Speed Over Ground in Kilometers per hour (kph). The SOG value is multiplied by 10 to remove the decimal component.

COG – 'Course Over Ground' in degrees. The COG value is multiplied by 100 to eliminate decimal points.

GPS_DR – GPS Dead Reckoning. Not implemented.

NUM SV's – Number of Satellites Visible

HDOP – Horizontal Dilution Of Precision. The HDOP value is multiplied by 100 to eliminate the decimal point. Values range from 500 to 9990.

DIFF AGE – Not implemented.

DIFF STATUS – GPS lock status. Values:

0: No lock
1: Non-differential GPS lock
2: Differential GPS lock
6: Estimated lock

Digital Pod Display

Described on page 25.

IMU Display

Described on page 26.

WFT Plot/WFT Display

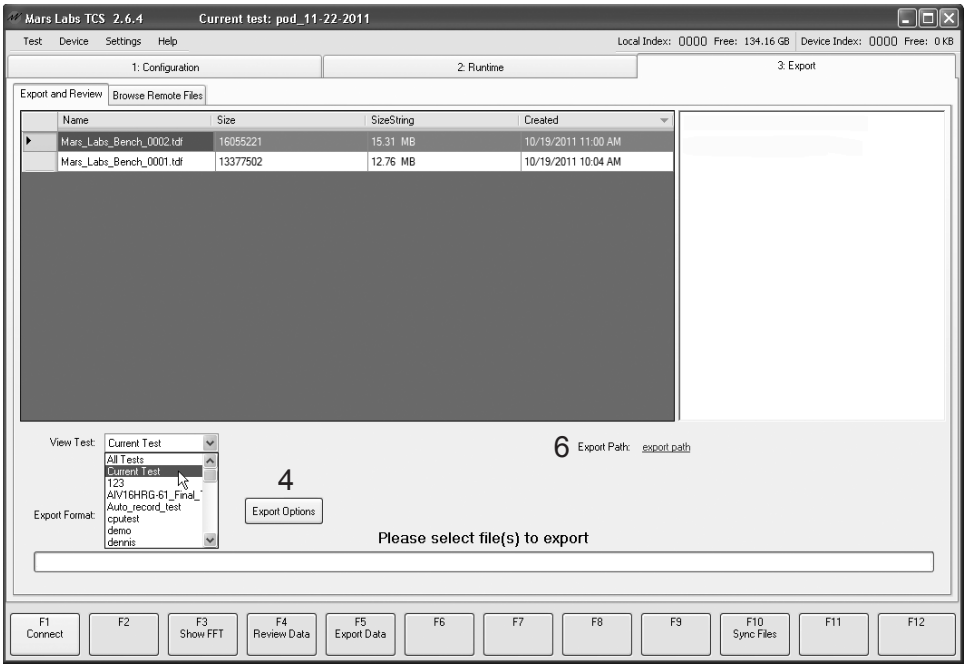
Described on page 27.

Export Tab

The ‘Export’ tab provides two related screens that allow you to review and export locally and remotely recorded data sets.

Export and Review Tab

The ‘Export and Review’ screen allows you to view all of the locally recorded data sets created under the current test name, as well as previously recorded data sets acquired under other test names.



The main components of the Export and Review screen include:

1. Data set list – A list of all of the data sets recorded under the current test name.
2. ‘View Test’ – A drop-down menu that allows you to select a different test.
3. ‘Export Format’ - A drop-down menu to select the desired export format (pg 32).
4. ‘Export Options’ – Presents a list of Export Options for the various export formats (pg 33).

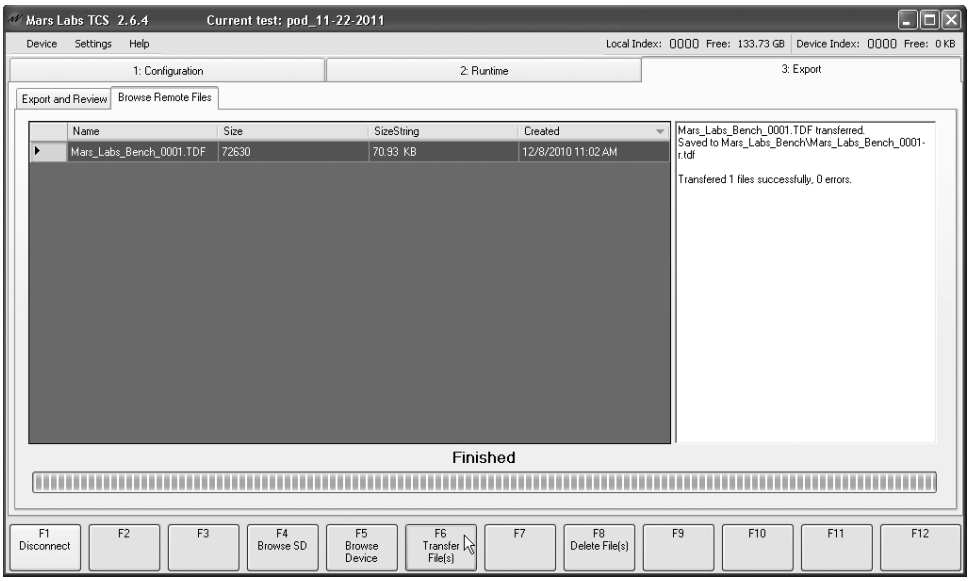
5. Function keys – In the Export and Review window, the Function keys are assigned the following functions:

   F1 - Connects/disconnects to the selected Titan device
   F3 - Displays the FFT Review window (see page 29)
   F4 - Displays the Review Data window (see page 31)
   F5 - Exports the selected data set according to the selected export format and GPS checkbox status.
   F10 - Synchronizes multiple GPS Pulse Per Second (PPS) files

6. Export Path – Displays the current export path.

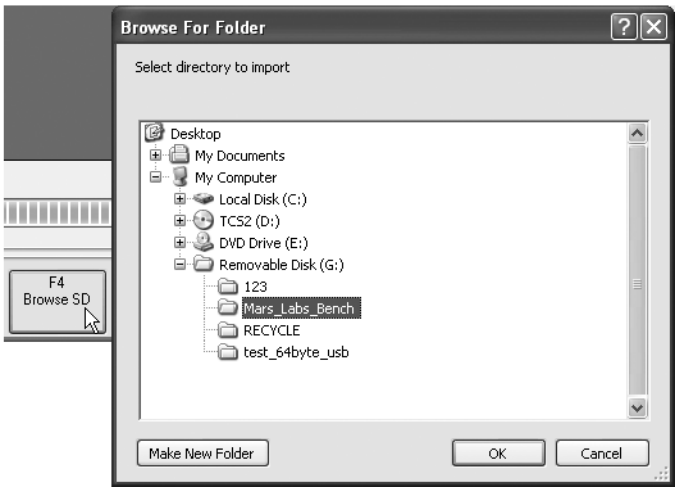
Browse Remote Files Tab

The 'Browse Remote Files' screen allows you to access files stored on the connected Titan device or files stored at another location, and transfer the files into TCS:



To view files located on the Titan device, click on the 'Browse Device' button (F5). Files recorded under the current test name will be displayed. To transfer the file for viewing in TCS, select a file and then click on 'Transfer Files' (F6), or simply double-click on the file name. The file will be transferred and a status message will be displayed in the status pane on the right. The newly transferred file will appear in the 'Export and Review' screen data set list.

To access Titan files from a different location, click ‘Browse SD’ (F4). A ‘Browse for Folder’ window will appear. You will need to navigate to the directory where the data files are stored:



After selecting the desired file, clicking the ‘OK’ button will transfer the files into TCS.

NOTES:

1. *Test files that are recorded remotely will always have a ‘-r’ appended to the file name:*

   Sample_Test_0002-r.tdf

2. *Test files that are imported from alternate locations will have an ‘- i’ appended to the file name:*

   Imported_Test_003-i.tdf

TCS File Definitions

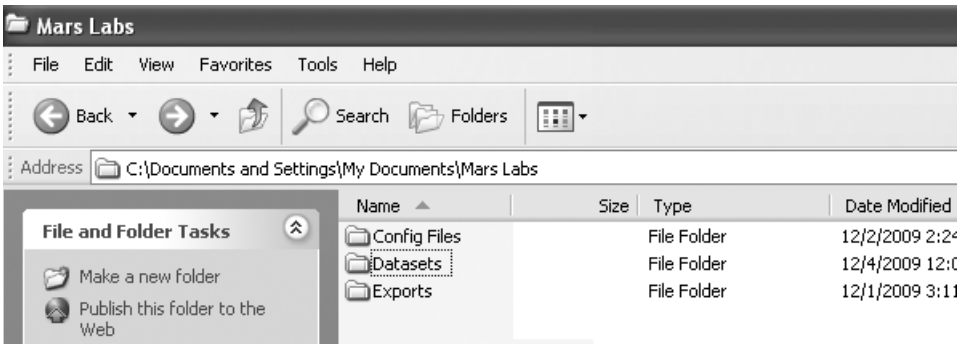
The TCS application creates three types of test files: config (configuration) files, data files and export files.

Config files contain the setup information of each test, including device configuration, sensors, and tag and channel assignments. Config files have a '.tcf' (TCS Configuration File) extension.

Data files contain the raw recorded data. Since a new data file is created every time you start and stop the recording process, there can be many data files associated with a given config file. Data files have a '.tdf' (TCS Data File) extension.

Export files contain the data in individual '.tdf' data files converted to common file formats. Export files can be '.wav', '.csv', '.tsv', or any of the available file export options. The file type is specified in the Export window.

The default path of all three file types is:
'C:\....\My Documents\MarsLabs\



Data File Nomenclature

Since there can be several data files associated with a given configuration file, the TCS application assigns each data file a unique name. For example, for a test file called 'LabTest', the name of a data file captured during that test might look like this:

LabTest_0004.tdf

where:

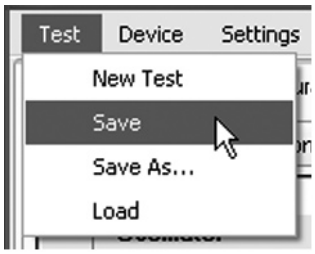
'LabTest' is the test file name
'0004' indicates the fourth recorded dataset

NOTE: *When a file is recorded remotely, a '-r' is appended to the file name.*

TCS Menus

The menus in TCS allow you to perform a variety of operations, including basic Load/Save test operations, advanced control of connected Titan devices, and data viewing options in the Runtime screen. A description of TCS menus follows.

TEST:



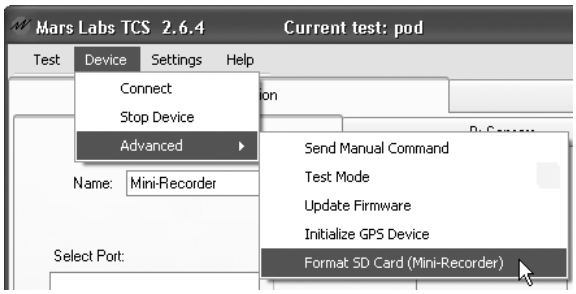
'New Test' opens a New Test window to create a new test.

'Save' creates a directory with the same name as the current test name and places the directory in the root path location. The current test is saved in this directory. If the test is saved again after making changes, TCS will display a warning message about overwritting the test file.

'Save As' allows you to save the current test with a different name. 'Save As' creates a directory with the same name as the new test name and places the directory in the root path location. The new test is saved in this directory.

'Load' allows you to load an existing test. You will be presented with an 'Open' dialog box where you can search for and select an existing test file. TCS test files have the '.tcf' (Titan Configuration File) extension.

DEVICE:



'Connect' is used to connect and disconnect the selected Titan device. This command performs the same function as pressing the 'F1' function key.

The 'Stop Device' command stops the connected device.

The Advanced menu allows you to access advanced program features:

'Send Manual Command' allows you to send manual commands to the connected Titan device. For a complete list of the available commands, refer to the *ICD Specification for Titan Recorder Devices*.

'Test Mode' allows you to enable/disable Test Mode, which applies a ramp wave on all configured channels.

DEVICE (con't):

'Update Firmware' allows you to update the firmware of the connected device (function currently not implemented).

NOTE: *Currently, firmware updates are implemented with the Titan Programmer, a dedicated programming application for Titan devices. Contact the factory for more information.*

'Initialize GPS Device' initializes the GPS device for the proper baud rate and messaging needed to communicate with TCS.

'Format SD Card (Mini-Recorder)' allows you to format the SD memory card in the Mini-Recorder.

NOTE: *New memory cards should always be formatted in the Mini-Recorder using the 'Format SD Card' selection in the DEVICE menu. Use the following procedure:*

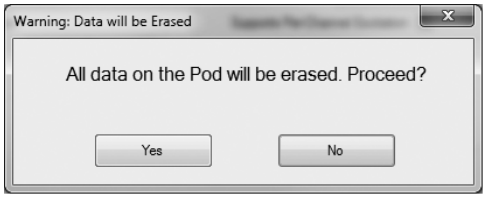
1. Insert the memory card to be formatted into the Mini-Recorder, and then connect the Mini-Recorder to the PC via USB.

2. Launch TCS

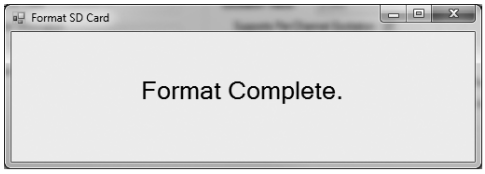
3. In TCS, connect to the Mini-Recorder ('F1 - Connect')

4. Select 'Format SD Card (Mini-Recorder)' from the DEVICE menu

5. A warning message will be displayed:

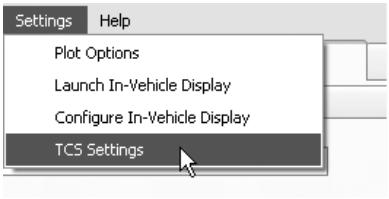


6. Click 'YES' to proceed, and the card will be formatted. When the formatting operation is complete, a 'Format Complete' message will be displayed:



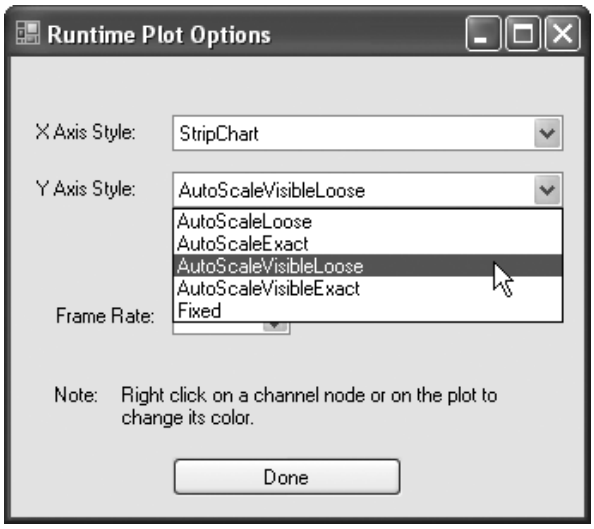
7. Close the message window and disconnect in TCS, or proceed with test configuration and setup.

SETTINGS:



The SETTINGS menu allows you to change basic settings in TCS and select alternate display options.

'Plot Options' - Displays a window that allows you to select alternate viewing options for the Runtime plot data (see figure). Viewing options include



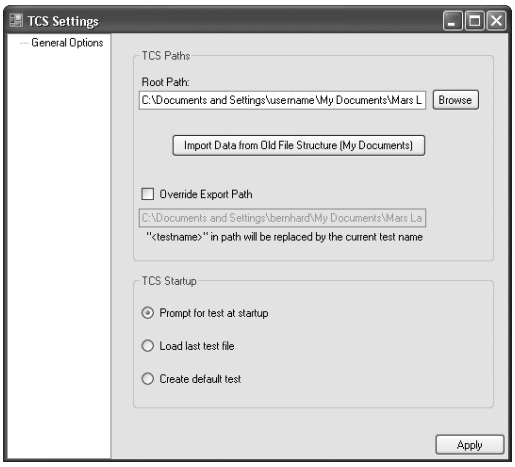
'Launch In-Vehicle Display' - Selects an alternate display interface that uses keyboard-based control. This display is useful when controlling TCS with a standard PC mouse or trackpad is impractical, such as during an in-vehicle test. For details on the In-Vehicle Display, see page 107.

> ***NOTE:*** *The 'Launch In-Vehicle Display' function can also be accessed on the Configuration screen using function key F11, 'In-Vehicle Display'.*

'Configure In-Vehicle Display' - Allows you to configure the function keys for the In-Vehicle Display. For details, see page 109.

SETTINGS (Con't):

'TCS Settings' - Displays a window for changing basic settings in TCS. The window allows you to change the root path, override the export path, import and convert data from older versions of TCS, and specify the startup condition.



TCS Paths:

The TCS Paths pane displays the Root Path, Export Path override feature, and an 'Import Data from Old File Structure' button.

Initially, the Root Path defaults to:

'My Documents\MarsLabs\<current_test_name>'

To change the root path, enter the new path in the Root Path text field.

The Export Path defaults to the Root Path. To change the Export Path, click on the 'Override Export Path' checkbox and specify a new path.

The 'Import Data from Old File Structure (My Documents)' button converts the file structure from previous versions of TCS (prior to v2.6.4) to the new file structure. Clicking on the button automatically converts all of the files in the Root Path.

NOTES:

1. The new file structure organizes the data by test name, whereas the older file structure organized the data by type.

2. When data is imported, the old file structure remains untouched - it is not deleted

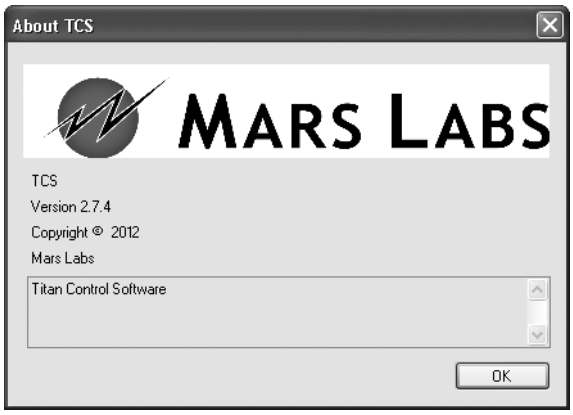
TCS Startup:

The TCS Startup pane allows you to select the desired startup condition using the radio buttons.

After making changes in the 'TCS Settings' window, click the 'Apply' button to have the changes take effect.

HELP:

'About' - Displays an information message box about the TCS application:



'Help' - Displays context-sensitive information from the embedded TCS User Manual. When 'Help' is evoked, either from the menu or by pressing 'CTRL H', the TCS User Manual launches (in Adobe Acrobat) and displays information about the currently displayed TCS screen.

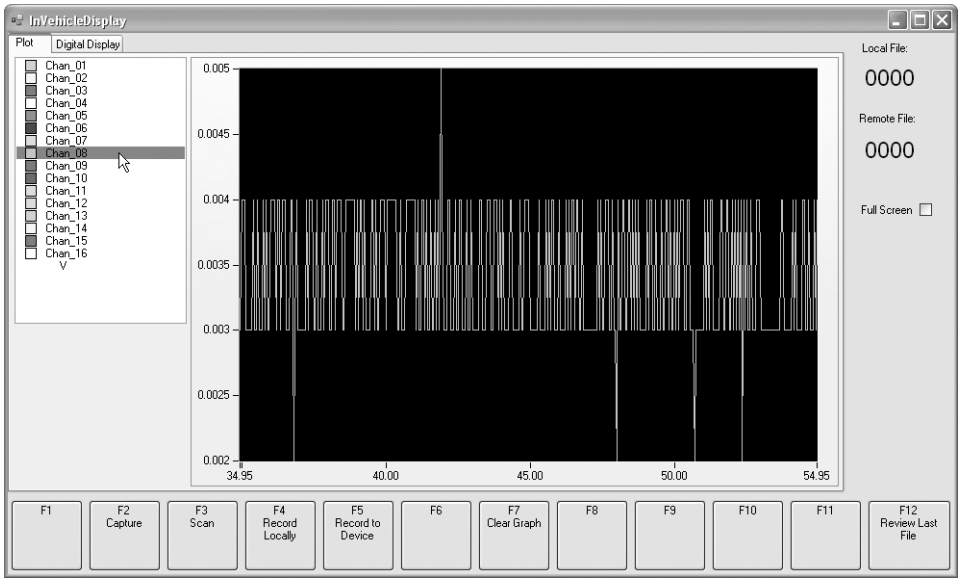
Note: You must have Adobe Acrobat Reader (or equivalent) installed. The reader is available from Adobe:

www.adobe.com/products/acrobat

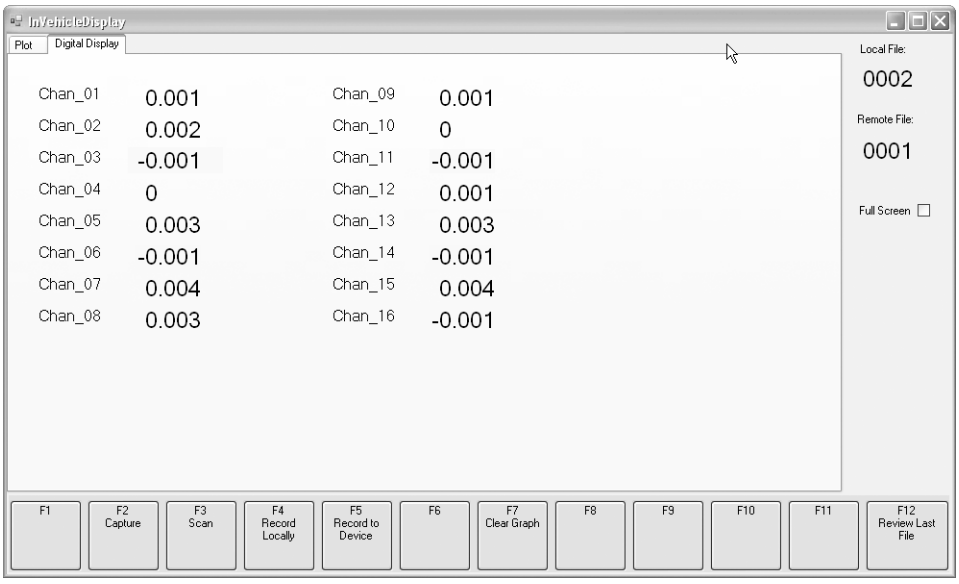
In-Vehicle Display

The ‘In-Vehicle Display’ provides an alternate display interface that makes use of simple keyboard-based control - no mouse or trackpad input required.

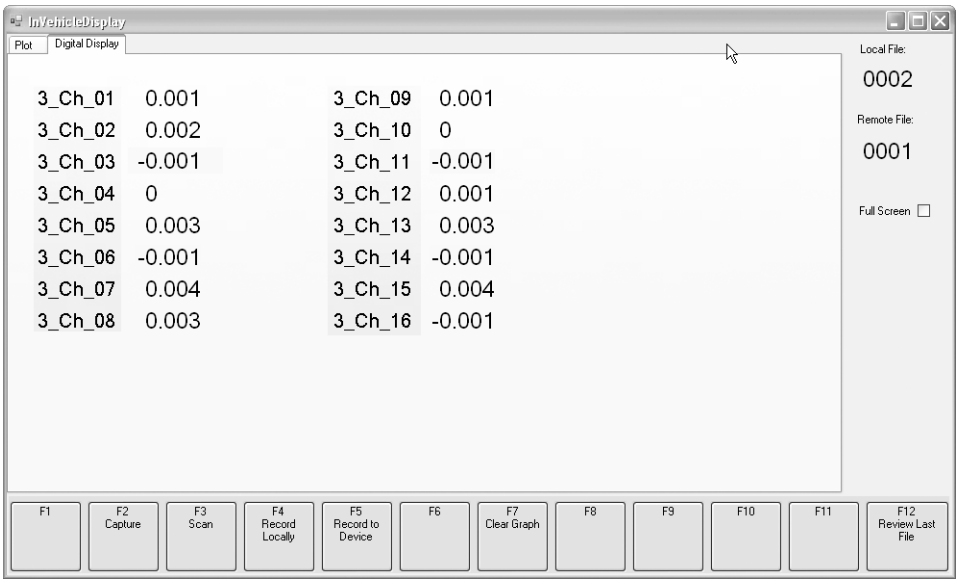
When ‘In-Vehicle Display’ is selected, a new window replaces the standard TCS window, offering Plot and Digital Display views. In the Plot screen, channels are selected using the UP and DOWN cursor keys, and the function keys are used to activate the recording and calibration functions:



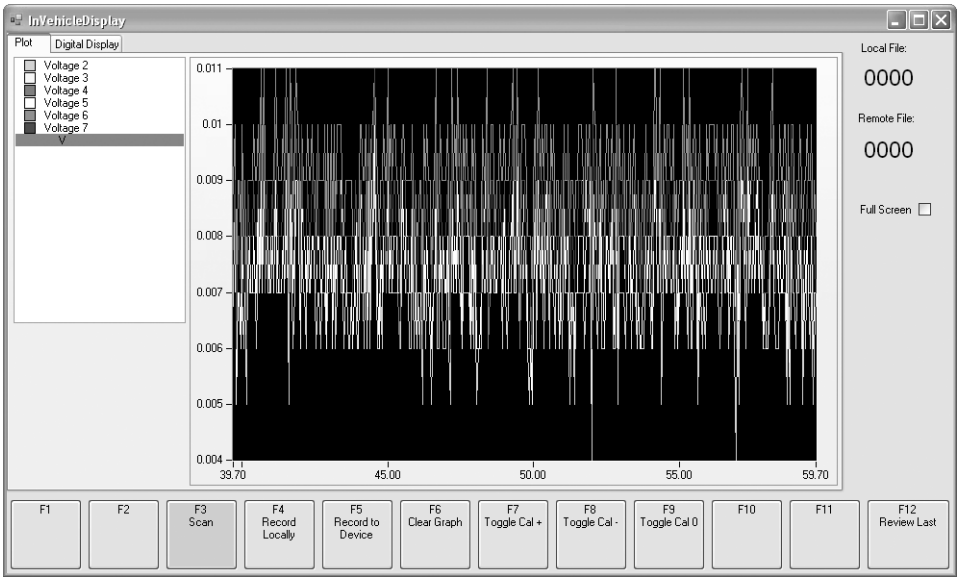
To switch between Plot and Digital Display tabs, press the LEFT or RIGHT cursor keys:



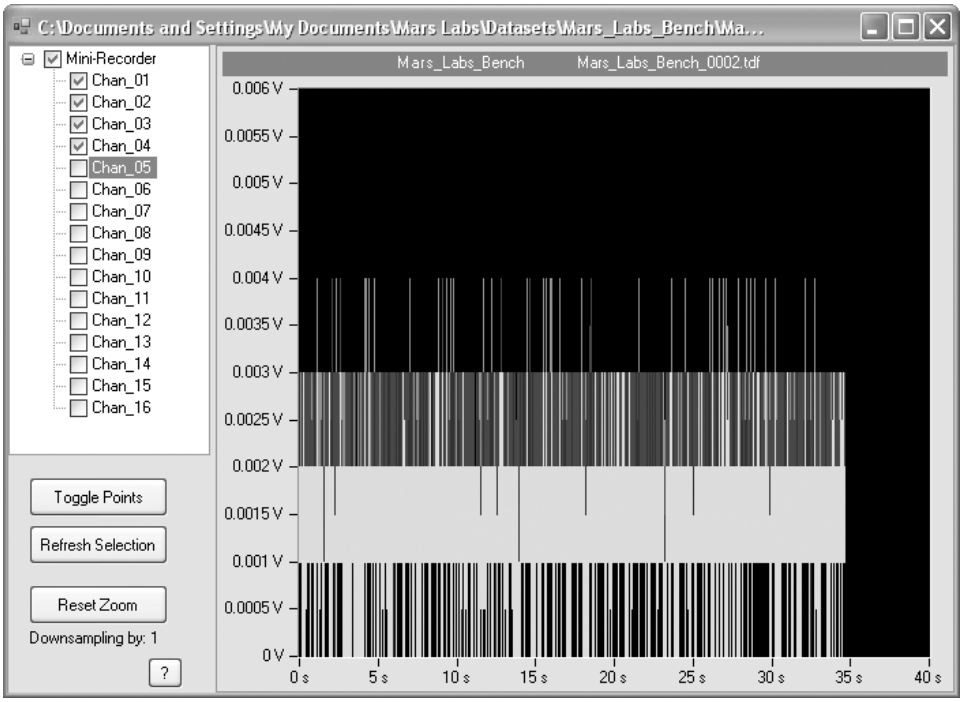
In the Digital Display screen, when two or more Titan devices are connected with a CPU, the UP and DOWN arrows are used to select the desired Pod or Mini-Recorder data. In the example below, 16 channels of data are displayed from the third connected device.



The Plot display also incorporates the Plot Groups functionality (described on page 91), which provides a grouped display of related sensor types:

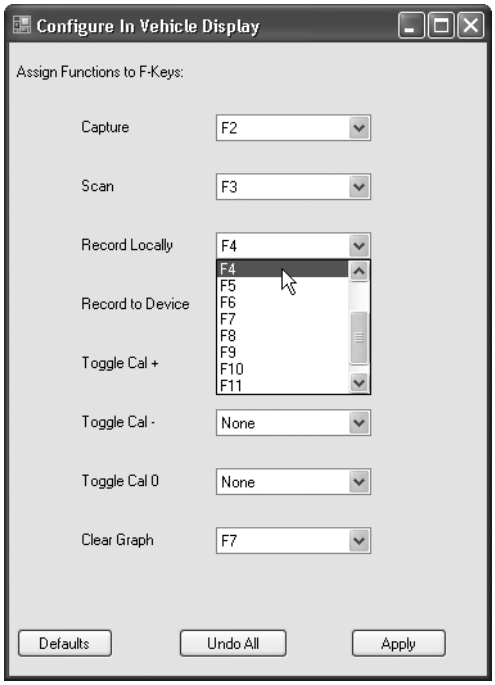


The ‘Review Last’ function allows you to review the last file that was recorded. When viewing the recorded file, the UP/DOWN and LEFT/RIGHT cursor keys can be used to select and enable/disable the display of any channel:



Configuring the In-Vehicle Display

The ‘Configure In-Vehicle Display’ window (found in the TCS *SETTINGS* menu) allows you to assign specific operations to the function keys in the In-Vehicle display as shown. The operations are identical to those in the standard TCS window, and they perform the same functions.



After making the assignments, clicking on ‘Apply’ will apply the changes. The assigned labels will appear on the Function Key button bar.

Running with RS-422 (COMM)

There are circumstances when you may need to configure communication with a single Mini-Recorder or Pod via RS-422 (COMM) instead of USB. Such circumstances include:

1. Difficulty operating in Low Speed mode under Windows Vista.
2. Issues with USB 3.0
3. The need to operate using cable runs that are longer than USB will support

To configure communication with a Mini-Recorder or Pod via RS-422, you will need USB/RS422 adapter hardware and device drivers. Both are available from Mars Labs and from Future Technology Devices International (FTDI):

MarsLabs: MLCBL10046 - USB/422 Titan Serial Adapter Cable
FTDI: USB-RS422-WE (Cable)
Note: the un-terminated end must be wired to an RJ-45 plug matching the Titan pinout - contact the factory for wiring details
USB-COM422-PLUS2 (PCB)

The adapter should be installed close to the PC that is running TCS. This permits longer cable runs to be used with a single Mini-Recorder or Pod.

NOTES: *When using the RS-422 connection, you will need to power the Mini-Recorder or Pod from an external source.*

In addition to obtaining the adapter, you will need to install the device driver. The device driver is found on the TCS installer disc, and can also be obtained from www.ftdichip.com on the Drivers\VCP page.

After installing the driver, if you experience blocky or slow data at the Low Speed rate over RS-422, try adjusting the Receive Threshold FTDI driver setting:

1. Open the Windows Device Manager
2. Under ‘Ports’, right-click on the port you are using and select ‘Properties’
3. Switch to the ‘Port Settings’ tab
4. Click on ‘Advanced’
5. In the USB Transfer Sizes box, change ‘Receive (Bytes)’ to ‘1024’
6. Click ‘OK to close both windows and select ‘NO’ if requested to restart the PC.
7. Uplug the FTDI and plug it back in.
8. Connect the device and open it with TCS

Troubleshooting

If you are having difficulties installing or configuring TCS, refer to the troubleshooting section below. This section addresses common issues with the installation and setup of TCS. If your specific issue is not addressed, please contact the factory for additional assistance.

Issue: Dotnet installed, but TCS doesn't run

Dotnet is installed, but TCS doesn't run, or TCS produces an error message about updating dotnet.

Solution

TCS requires Microsoft .NET Framework (AKA "Dotnet") version 3.5 or greater be installed (older versions of Dotnet are not compatible with TCS). The Dotnet installer is found in the dotnet installer folder on the TCS installation disc.

Issue: Titan device drivers not installed

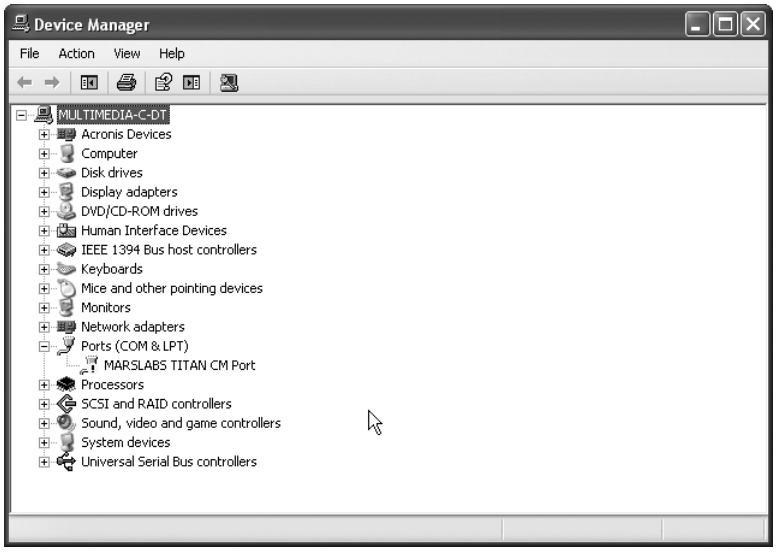
When a Titan device is connected to USB, a 'Found New Hardware' window appears asking you to locate the Titan device driver.

Solution

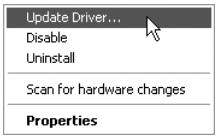
The Titan device driver needs to be installed. The driver is found on the installation disc (filename "titanvcom.inf"). If the 'Found New Hardware' window is still active, simply navigate to the installation disc, select the driver and respond to the prompts. If the 'Found New Hardware' window is not active, you will need to install the driver using the Windows Device Manager as follows:

1. Keep the Titan device plugged in and open the Device Manager. The Device Manager is located by right-clicking on the My Computer icon and selecting 'Properties'. The Device Manager is located under the 'Hardware' tab.

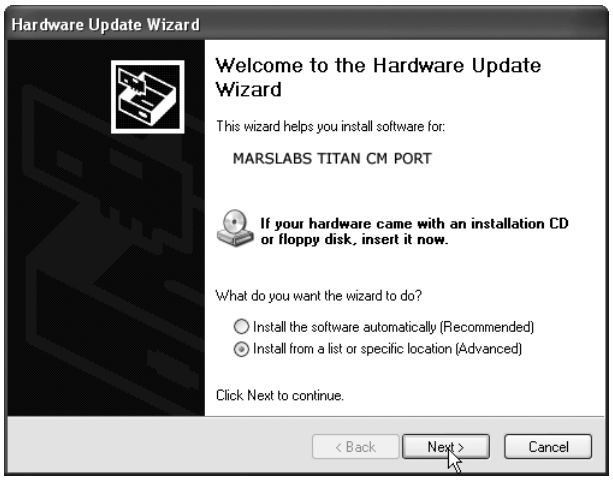
2. With the Device Manager open, double-click on ‘Ports’ to reveal the missing Titan driver (the missing driver may have a yellow question mark superimposed on the missing driver icon) :



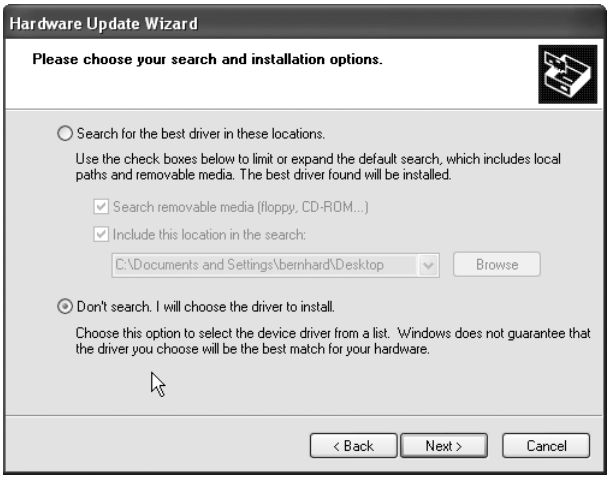
3. Right-click on the missing driver and select ‘Update Driver’:



4. Follow the Hardware Update prompts to perform the update. In the first window, select the option to install the driver from a specific location and then click ‘Next’:



5. In the next window, select the option to choose the driver to install, and then click ‘Next’:

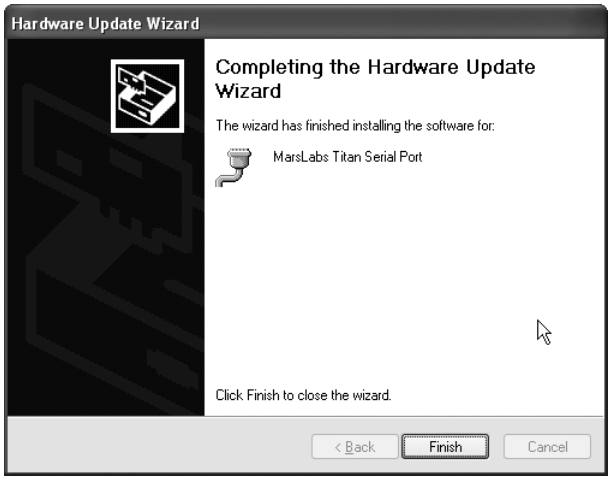


6. Navigate to the location of the VCOM driver and select it.

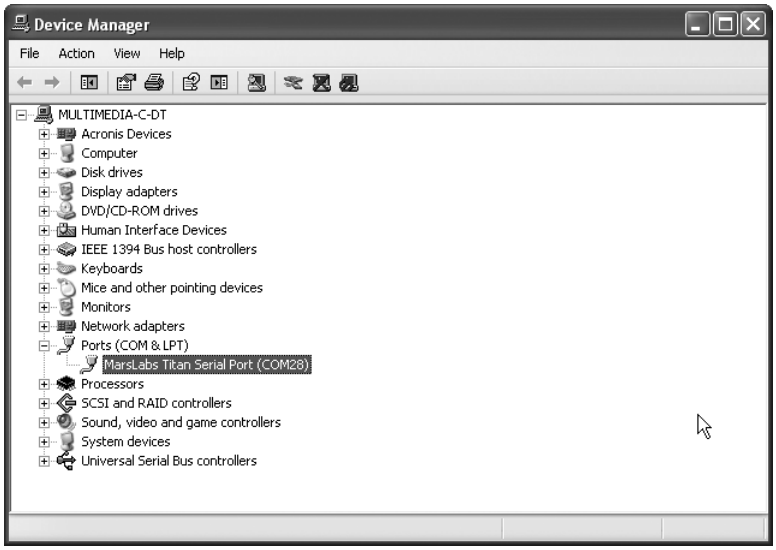
Path: C:\Program Files (x86)\MarsLabs\TCS2\Drivers

Hardware Update may display a warning message as shown. Click ‘Continue Anyway’ to dismiss the message and install the driver:

7. When the Hardware Update is complete, it will display a message like that shown below. Click 'Finish' to complete the installation.



8. The Device Manager will now display the Titan driver and COMM port that the Titan device is connected to:



NOTE: *Recent Windows updates include the STMicro VCOM driver, which works with the Titan Mini-Recorder or Pod. If you have this update, you may not need to install the Titan driver separately.*

Notes & Known Issues

This section offers additional operational information about TCS not covered elsewhere.

Known Issues:

CPU Configuration:
1. When using the CPU, if you receive a network error you must Disconnect and then Reconnect in TCS to restore the connection. Remote recordings will continue on the device uninterrupted, however.

2. When 'Monitor Mode' is enabled, the 'Auto Start' and 'Auto Record' functions are disabled.

Digital Sensors:
When a Digital Sensor is selected (either Period or Totalizer mode), the GPS Pulse Per Second (PPS) option must be disabled in both the Device Configuration and the Digital Pod configuration screens.

Help:
If TCS is loaded with a configuration file that is not in located in the Mars Labs directory (Documents and Settings\User\My Documents\MarsLabs), the Help function will produce a blank screen when Help is evoked.

Digital Pod Configuration:
Whenever the GPS/PPS option is enabled in the Digital Pod, PPS must also be enabled on the Device Configuration page. If the PPS option is not selected, PPS data exports will not increment as expected.

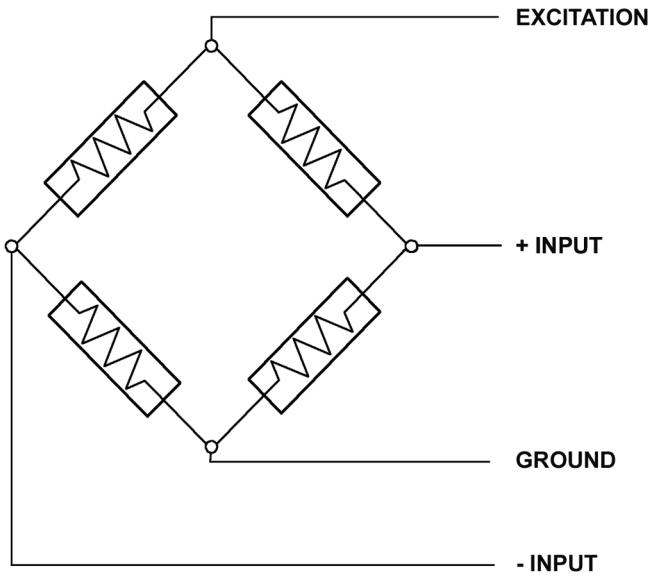
Acquisition stutters at low scan rates:
TCS expects to receive data packets at regular intervals. For certain combinations of enabled & disabled channels at low scan rates, the data is not processed and transmitted sufficient to match what TCS is expecting to receive, and TCS will then time out and stop scanning. Shortly thereafter, TCS receives a new packet and begins scanning again. This behavior repeats, resulting in a scan that stutters (starts & stops, starts & stops). Note also that TCS will not support local recording under these conditions, but remote recording will not be affected.

If you experience the 'stuttering' behavior in TCS, you should either switch to a higher scan rate or increase the number of channels. Either action will increase the amount of data being transferred and eliminate the problem.

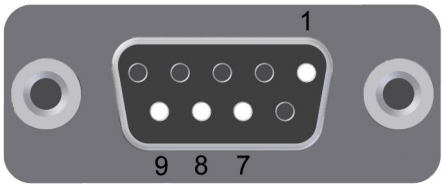
Appendix A: Sensor Configurations for Titan Pod & Mini-Recorder Hardware

This section provides information on common sensor connections.

Full Bridge Sensor:

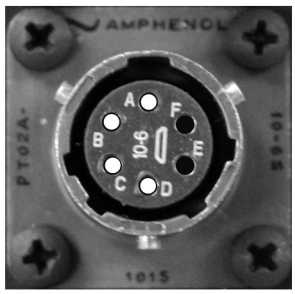


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:

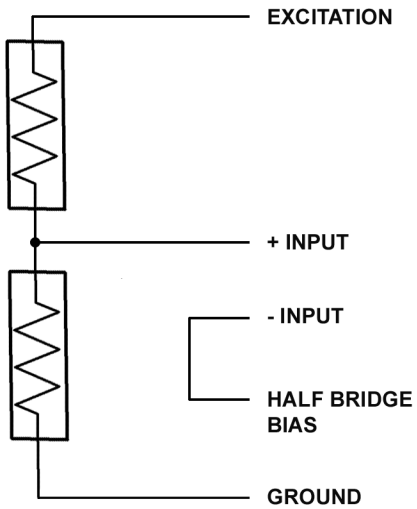


Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	**Ground**
E	QB Completion Resistor
F	Half Bridge Bias

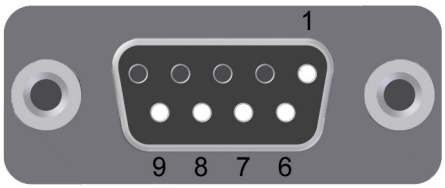
NOTE: *For Full Bridge configurations, the input dividers must be OFF.*

See Strain Sensor configuration (pg 63)

Half Bridge Sensor:

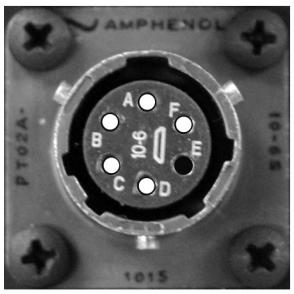


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	**Half Bridge Bias**
7	**– Input**
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:

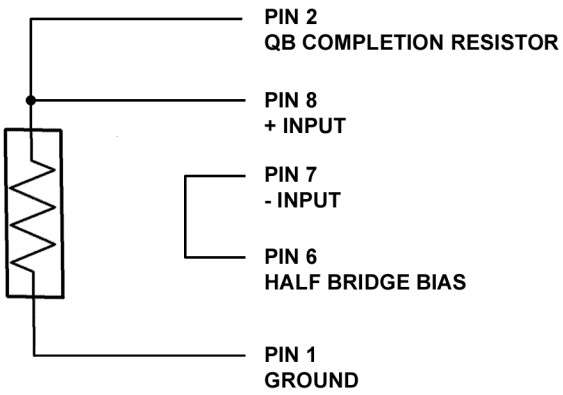


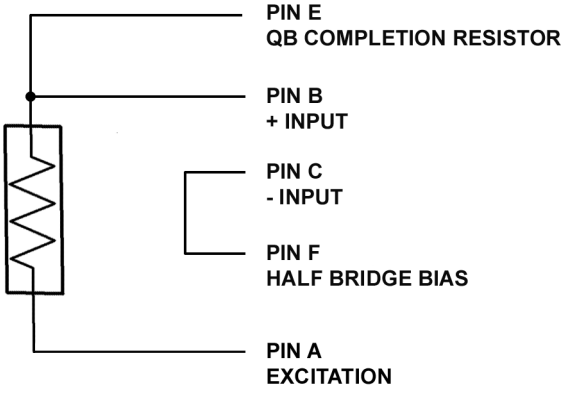
Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	**Ground**
E	QB Completion Resistor
F	**Half Bridge Bias**

NOTE: *For Half Bridge configurations, the input dividers must be OFF*

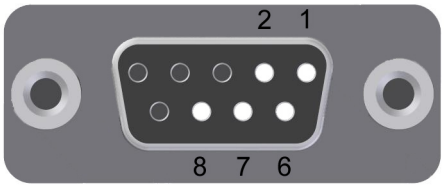
See Strain Sensor configuration (pg 63)

Quarter Bridge Sensor:



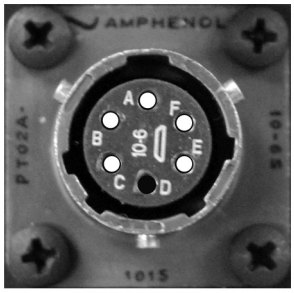


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	**QB Completion Resistor**
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	**Half Bridge Bias**
7	**– Input**
8	**+ Input**
9	Programmable Excitation

Bendix Connector:

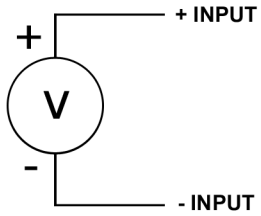


Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	Ground
E	**QB Completion Resistor**
F	**Half Bridge Bias**

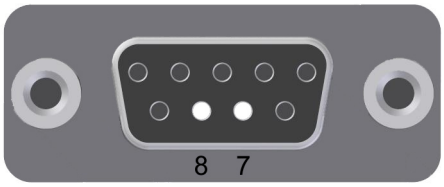
NOTE: *For Quarter Bridge configurations, the input dividers must be OFF.*

See Strain Sensor configuration (pg 63)

Voltage Sensor:

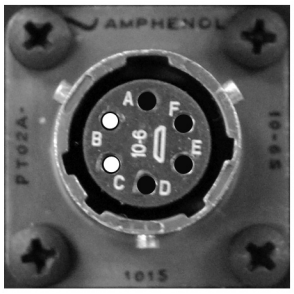


DB9 Connector:



Pin Assignment	*Function*
1	Ground
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	Programmable Excitation

Bendix Connector:

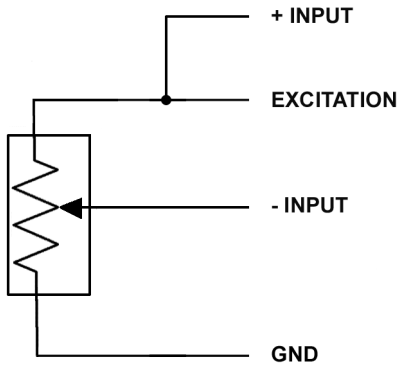


Pin Assignment	*Function*
A	Programmable Excitation
B	**+ Input**
C	**- Input**
D	Ground
E	QB Completion Resistor
F	Half Bridge Bias

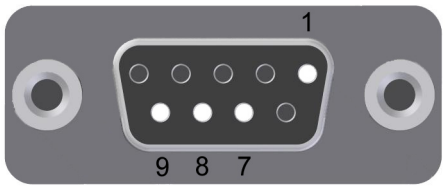
NOTE: *For Voltage Sensor configurations, the input dividers must be ON.*

See Voltage Sensor configuration (pg 71)

String Pot Sensor (Cable Extension Transducer):

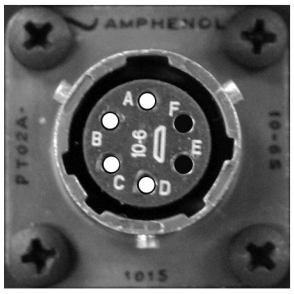


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:

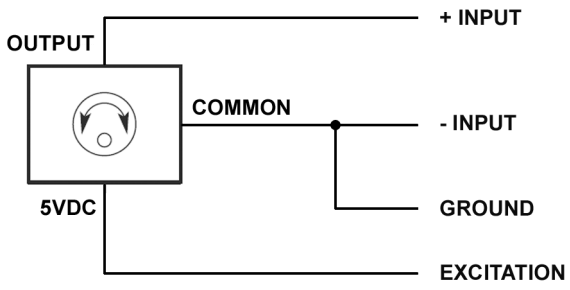


Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	**Ground**
E	QB Completion Resistor
F	Half Bridge Bias

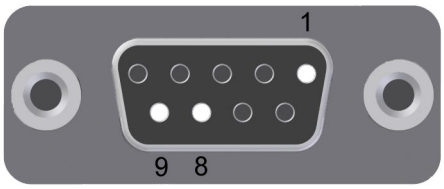
NOTE: *For String Pot configurations, the input dividers must be OFF.*

See Displacement Sensor configuration (pg 59)

RVIT (Rotary Variable Inductive Transducer), 60 Degrees:

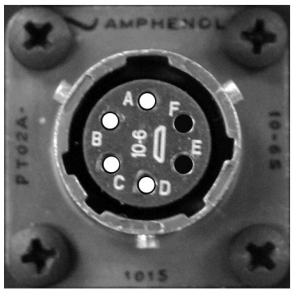


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:

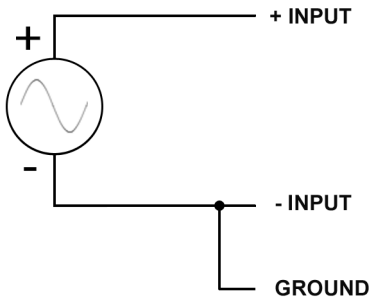


Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	**Ground**
E	QB Completion Resistor
F	Half Bridge Bias

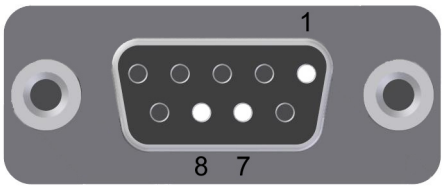
NOTES:

1. *For RVIT configurations, the input dividers must be ON.*
2. *The configuration shown above is for the Schaevitz Sensors Model RVIT-15-60. For other RVIT sensors, consult the manufacturer's data sheet*

Frequency Sensor - Generator:

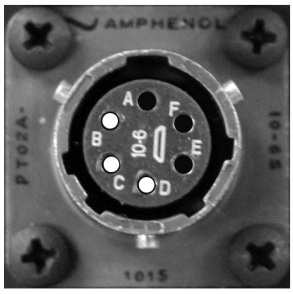


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	Programmable Excitation

Bendix Connector:



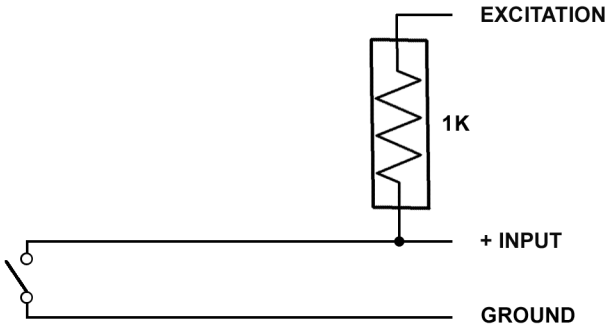
Pin Assignment	*Function*
A	Programmable Excitation
B	**+ Input**
C	**- Input**
D	**Ground**
E	QB Completion Resistor
F	Half Bridge Bias

NOTES:

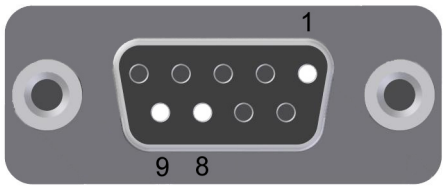
1. *Frequency sensors are only supported on channels 1, 8 and 16; only one frequency sensor may be used at a time.*
2. *When a Frequency Sensor is used, the GPS Pulse Per Second (PPS) option must be disabled in both the Device Configuration and the Digital Pod configuration screens in TCS.*
3. *Frequency senors measurements are valid to approximately 7 KHz*

See Digital Sensor configuration (pg 58)

Frequency Sensor - Switch Closure:

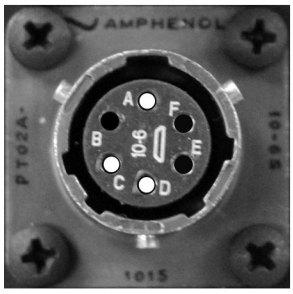


DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	– Input
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:



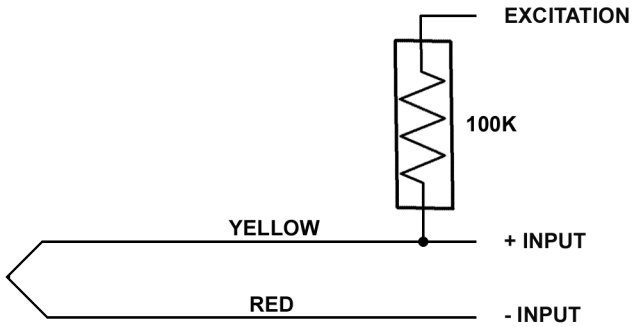
Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	- Input
D	**Ground**
E	QB Completion Resistor
F	Half Bridge Bias

NOTES:

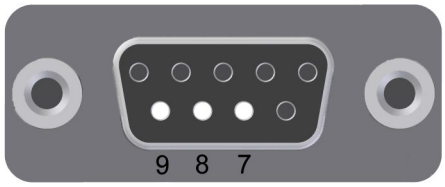
1. *Frequency sensors are only supported on channels 1, 8 and 16; only one frequency sensor may be used at a time.*
2. *Frequency sensors measurements are valid to approximately 7 KHz*

See Digital Sensor configuration (pg 58)

Thermocouple Sensor:

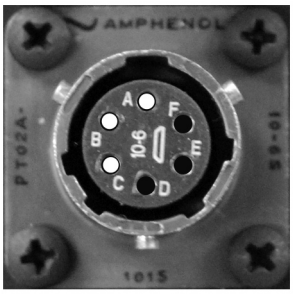


DB9 Connector:



Pin Assignment	*Function*
1	Ground
2	QB Completion Resistor
3	Current source
4	ICP Capacitor
5	Auxiliary Voltage
6	Half Bridge Bias
7	**– Input**
8	**+ Input**
9	**Programmable Excitation**

Bendix Connector:

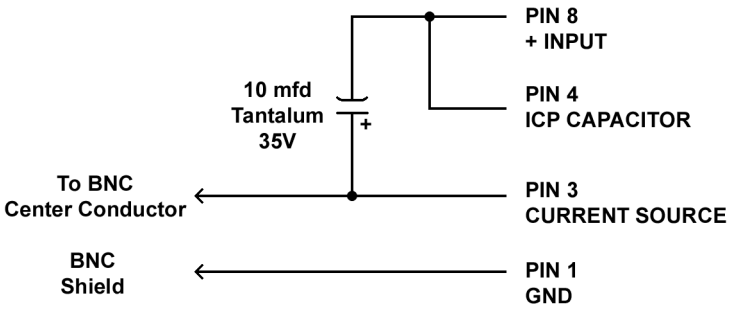


Pin Assignment	*Function*
A	**Programmable Excitation**
B	**+ Input**
C	**- Input**
D	Ground
E	QB Completion Resistor
F	Half Bridge Bias

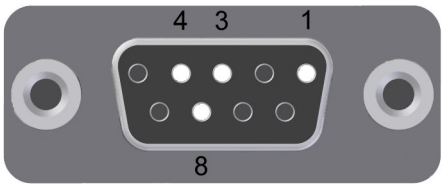
NOTE: *The colors displayed above are for a Type K thermocouple*

See Thermocouple Sensor configuration (pg 66)

ICP Sensor:



DB9 Connector:



Pin Assignment	*Function*
1	**Ground**
2	QB Completion Resistor
3	**Current source**
4	**ICP Capacitor**
5	Auxiliary Voltage
6	Half Bridge Bias
7	– Input
8	**+ Input**
9	Programmable Excitation

Appendix B: TCS Changelog

V2.7.4.3:
- Removed a condition that caused exporting issues with a Titan CPU

V2.7.4.2:
- Corrects an issue with PPS exports
- The baud rate 'SET' checkbox defaults to the unchecked condition
- Baud rate 'SET' functionality limited to 3M or 921,600
- TCS now sends double 'STOP' commands (addresses a DAC-specific issue)

V2.7.3.4:
- Adjusted the exported HDF5 GPS COG (Course over Ground) and SOG (Speed over Ground) values.
- Removed HDF5 GPS Export channel name units ('deg.' 'm.' 'km/h'). Replaced abbreviated names with the names spelled out.
- Changed 'Save As...' behavior. When 'Save As...' is selected, TCS now creates a directory with the new test name and places the test in that directory.
- Added Root Path to the Title Bar.

V2.7.3
- Added GPS data to the HDF5 Exporter.
- Reduced HDF5 padded data.
- Added channel entry fields to the J1939 Digital Pod configuration window.
- Split the J1939 message field into individual PGN, source and priority fields.

V2.7.2.1
- Added HDF5 library files to the installer. (The installer for v2.7.2 did not include HDF5 libraries. Although PC's with older installations will not have issues — the HDF5 libraries were installed in previous TCS versions — PCs with no previous TCS2 installation will not have the required library files, resulting in failed HDF5 and Review export functions.)

V2.7.2
- Corrects an issue with the display of RCAL data from the last Pod when one or more channels is disabled.
- Excitation added to Digital Sensor.
- Excitation added to Sensor table.
- RCAL information is now displayed in the Load Sensor grid table.

V2.7.1

- Changed Digital Pod graphical display to Digital Display.
- Changed initial test selection screen to read ‘Mini-Recorder + DAC’.
- Added DAC scan rate reminders on all Device Configuration screens.

V2.7.0

- Baud rates changed
- Scope plot UI changed, ‘Average’ added
- Units added to the Runtime plot
- In-Vehicle Display includes CPU Mode
- Modified In-Vehicle Display to support Digital channels

V2.6.5.0

- Added context-sensitive help, accessed through the HELP Menu or by entering ‘CTRL-H’. The Help file utilizes a PDF of the User Manual (Adobe Reader must be installed in order to view it).
- RCAL calibration now uses negative cal when the Excitation voltage is something other than 2.048V. Calibration includes additional labeling information.
- Power Spectrum Plot and Averaging functions added to the Capture screen
- Data Export Decimation added for Export Options (decimation value from 2 to 1000)
- ‘Capture’ function added to In-Vehicle Display
- PPS now defaults to disabled condition on the GPS Config screen

V2.6.4.3

- Fixed channel mapping with PCAL through the CPU with multiple pods
- Fixed error when executing Physical Calibration twice in a row with the CPU
- Improved error message when USB devices are disconnected

V2.6.4

- Updated data file organization
- Save data files in a user specified path organized by test name
- Added Digital Pod Support
- Added Sensor Import/Export
- Added HDF5 Export Format
- Added ATC BLOb Export Format with user specified config file
- Updated Data Reviewer to handle Digital Data (Exports to HDF5 first)

V2.4.7

- Added CPU Monitor Mode for long-running DAC tests
- Fixed scaling for FFT plots
- Fixed loading all test files instead of the current test when changing to the Export tab
- Commit changes in text fields when the ENTER key is pressed
- Fixed updating the remote index with invalid values
- Fixed crash in digital monitor grid when a key is pressed

V2.4.5

- Fix error getting excitation capability with old firmware versions
- Fix potential crash when querying for CPU IP addresses
- Improve responsiveness when changing tabs
- Ensure the function buttons are updated promptly
- Stop loading file when review window is closed
- Improved export interface
- Disable Export button while exporting
- Export multiple files sequentially and display the progress for each file
- Display progress while preprocessing RPCIII files

V2.4.4

- Add option to include GPS channels in RPCIII exports
- Added DAC test type
- Set and save the baud rate for serial connections
- Improved display of device information
- Improved check for running devices when connecting
- Fixed Clear Bal with low speed devices
- Don't allow deleting rows in the export grid
- Fixed reviewer resetting zoom and refreshing the plot when visible channels are changed
- Fixed Min/Max display numeric values getting cut off
- Added Redundant Recording option to always record both locally and to the device
- Added free space and file index display
- Save export settings
- Fix timestamps with the CPU
- Fix FTP errors with the CPU
- Added configuration of the In Vehicle Display
- Fix plot hanging with large numbers of channels
- Always disable PPS to fix frequency counters
- Fix sending the config file through the DAC
- Fix multiple file export synchronization with PPS
- Add option to disable PPS alignment
- Allow PPS alignment for CPU exports
- Add scan rate and filter frequency to matlab exports
- Prompt to use the current test when no test exists in a dataset at export
- Fix error message for ascii exports
- Add GM WFT settings
- Send the SET_TARGET_MODE command for direct connections
- Set max scan rate for CPU to 2500 Hz
- Fix RPCIII exports not using user specified export path
- Stop and notify user when a pod is not responding to Get Device Info queries through a CPU
- Removed some unused fields from test structure
- Changed the way panels are created
- Fix bug that allows deleting a sensor that is in use with the CPU
- Remove delay in serial read file to fix file transfers over the serial port
- Fix reviewer with files > 2 GB
- Fix bug with renaming pods through the CPU ("Channel Exists" messages)
- Fix connecting to a running DAC

V2.4.2

- Updated GPS display
- Added units
- Fixed field precision
- Added latitude/longitude plot
- Added “Mini-Display”
- Fix GPS Course over Ground (COG) and Speed over Ground (SOG) values (were previously given in hundredths and tenths)
- Warn on exit when scanning (only warn once for save test / running)
- Removed unused fields from test
- Added Kistler Wheel Types
- Specify Trigger Values in Eng Units
- Ignore case in USB detection
- Fix packaging of wiring diagrams
- Corrected issue with switching Calibration modes in 2.4.1.2 (internal release)
- Add Easting and Northing fields to GPS exports
- Handle non-ascii characters in matlab exports
- Create the output directory for matlab exports
- Add high impedance sensor correction when input dividers are enabled
- Fix bug with decimation in reviewer
- Added Min/Max display for first 16 channels
- Added wiring diagrams to Sensor Help
- Remember main window state and size
- Added option in the installer to create file associations for .tdf and .tcf files
- Remove dependency in the Capture plot (to a non-WPF control)

V2.4.0

- Added support for Kistler Wheel Force Transducer
- Added correction for sensors with High Output Impedance
- Added Delete for CPU
- Fixed crash when doing PCal without running normally first
- Fixed bug with RPCIII exporter not creating destination folder
- Set per-channel excitation through the CPU
- Disable user interface while configuring device

V2.3.11:

- Added Balance warning message
- Added sensor help

V2.3.10:
- Fix strain sensor transform with 1 active arm
- Set excitation for PCAL when programmable excitation is supported

V2.3.8.9:
- Don’t auto query for CPU’s

V2.3.8.8:
- Fix strain sensor transform updating
- Added FFT to Capture mode
- Added excitation options to Voltage Sensor

V2.3.8.1:
- Added support for configuring digital sources through the CPU
- Fix RPCIII exports

V2.3.7:
- Added Type J Thermocouple transforms
- Added FFT Reviewer
- Added X Range selector bar for Reviewer
- Initial CAN implementation
- Auto-detect CPUs on the network.
- Implemented Low Speed GPS support

V2.3.6 (beta):
- Added FFT reviewer
- Set excitation to 2.048 for thermocouple bias
- Preliminary CAN plot

V2.3.5 (beta):
- Small fix for progress bar

V2.3.4 (beta):
- Support for Per-Channel Excitation
- Preliminary Matlab Exporter
- Preliminary support for Aux. Serial Data
- Removed range option from thermocouple sensors - range is selected dynamically based on input value
- PCAL support for all sensor types except Strain, Other, Frequency, Thermocouple
- PCAL support for the CPU
- Preliminary support for syncing GPS files with PPS

V2.2.8.2:
- Don’t select all channels by default in reviewer
- Auto-reload plot after zoom in reviewer

V2.2.8.1:
- Output time offset instead of scan count in GPS exports

V2.2.8:
- Number the CPU ports by the physical port
- Allow setting high speed rates for the CPU

V2.2.7:
- Added support for Triggers and simple Scheduling
- Added a header field to RPCIII exports containing the number of padded scans (NUM_PADDED_SCANS)
- Added the In-Vehicle Display
- Retry the Auto-Record and Auto-Start commands

V2.1.15:
- A few more changes to RPCIII exporting:
- Scale to the max occurring value (* 1.1) instead of full range for the channel
- Fix padding the last value
- Fix issue with building the header with disabled channels

V2.1.14:
- Added support for 8000Hz and 4000Hz scan rates in High Speed mode

V2.1.12:
- Use full transforms for RPCIII (including Sensor Offsets)
- Fix running with CPU tests with different port orders

V2.1.9:
- Check FW version for PPS support
- Improve querying and sending commands to the CPU
- Fixed bug with Load Sensor
- Fixed Sensor Offsets for Other, Thermocouple, and Frequency Sensors
- Adding structures for Triggers and Per-Channel Excitation

V2.1.0:
- Added GPS support
- Support for 8-port Titan CPU
- Fixed reading FTP timestamps from CPU
- Fixed RPCIII exports with disabled channels
- Fixed thermocouple sensors not transforming to ºF after loading a test

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