NATIONAL INSTRUMENTS

DIAdem™

Hands-on

An Introduction to Using DIAdem 2014

in step by step Exercises

These Hands-On Exercises can be downloaded from:

http://www.ni.com/support/diasupp.htm

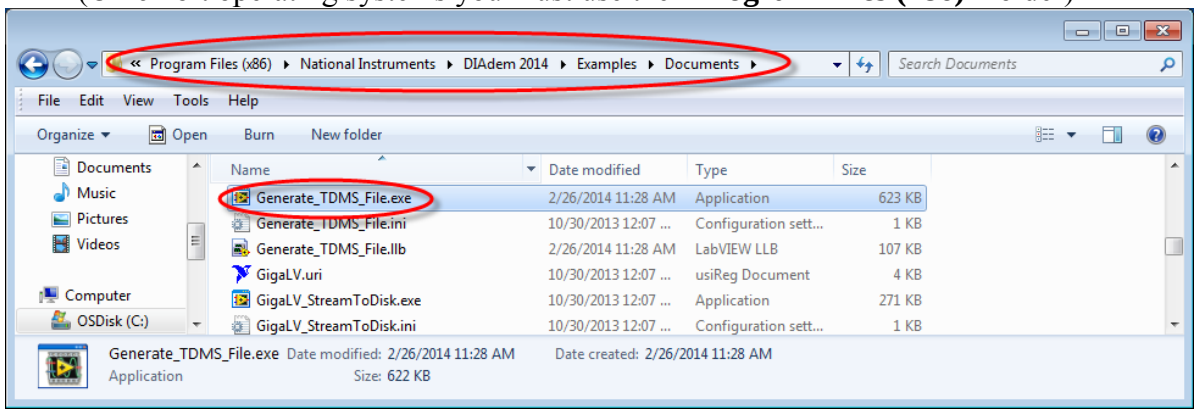
Outline of Hands-On Exercises

Exercise #0 Writing a TDMS File in LabVIEW

Scenario: You've been charged with finding or creating a data file format that your company can use to maximize productivity (or some other typically vague managerial request). You have heard that National Instruments has a good default file format and claims to offer "Data Management", whatever that is. You decide to take a closer look and see if what NI has to offer is a fit for you. In this exercise you will inspect and use the LabVIEW functions for writing TDMS data files which, in addition to the data values, also contain key information that can be searched on later. You will use the TDM Excel Add-in to load these TDMS files directly into Excel to verify openness and portability. Finally, you will find the TDMS files you have created by running a simple search in DIAdem and immediately see a graphical preview of the data channels you stored.

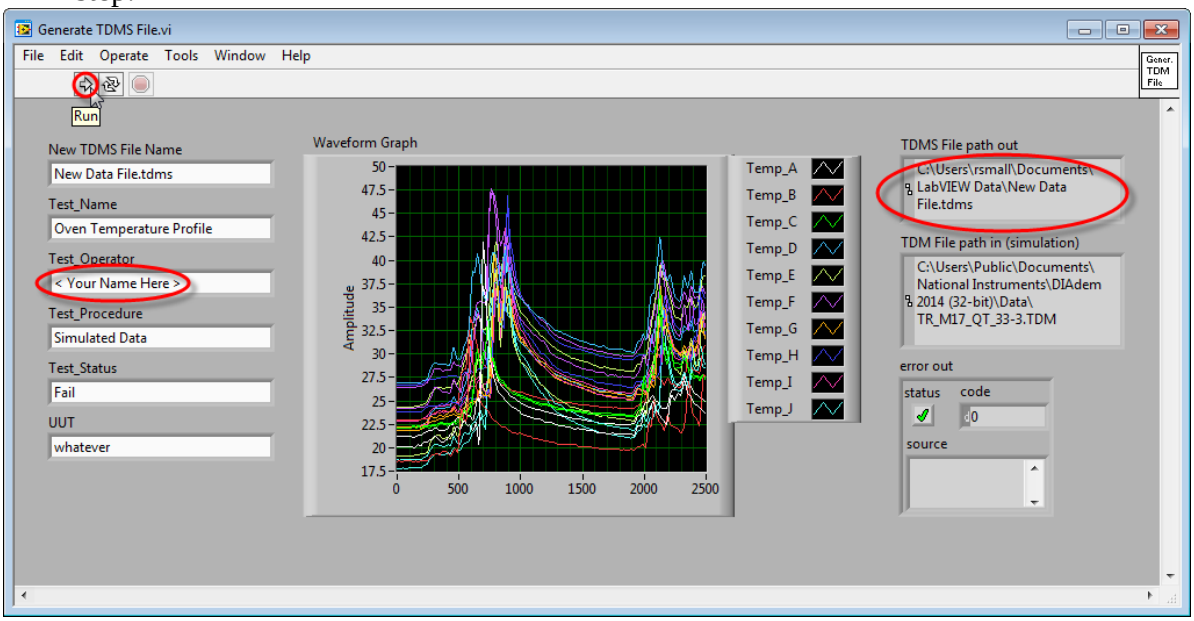
NOTE: LabVIEW is NOT required for this exercise-- DIAdem 2014 is sufficient. If, however, the *.vi file below does not open for you, re-run the DIAdem 2014 installer and choose to install the LabVIEW Runtime Engine option.

0.0 Your first task is to load a LabVIEW example that actually ships with DIAdem. Launch Windows Explorer to find and run the LabVIEW example. If you took all the defaults when installing DIAdem, you will find the LabVIEW example in the following folder on your hard drive:
"C:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"
If, on the other hand, you are in an official National Instruments seminar, look in
"D:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"
The LabVIEW example you need to launch is called "Generate_TDMS_File.exe".
Double-click the **"Generate_TDMS_File.exe"** LabVIEW application to launch it.
(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)

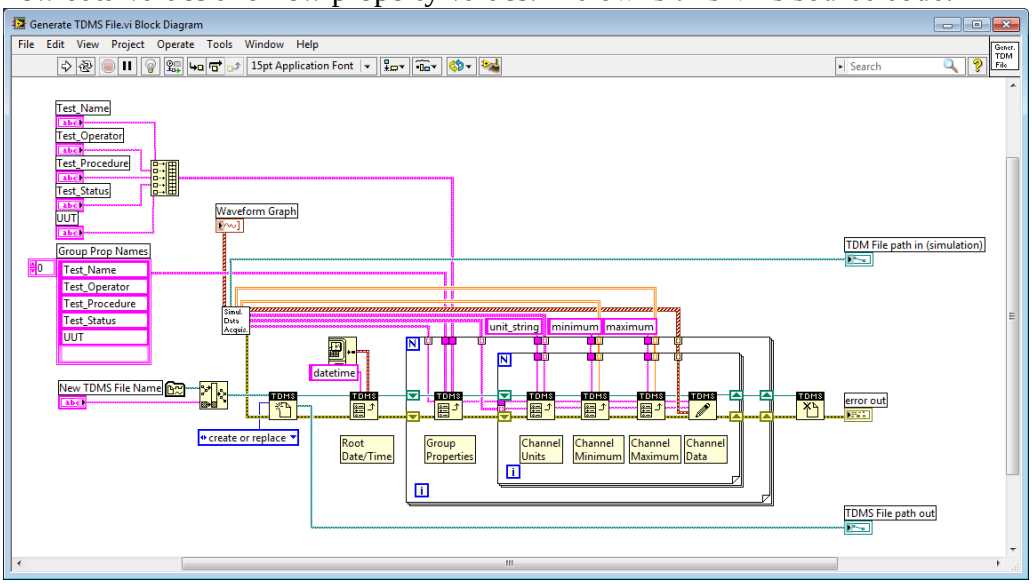


NOTE: DIAdem optionally installs the LabVIEW run-time engine— this is why you do not need to have LabVIEW installed in order to run this compiled LabVIEW application. If you have a recent version of LabVIEW installed and want to look at the source code for this example, you can double-click on the "Generate_TDMS_File.llb" (also shown in the dialog above) and select the main "Generate TDMS File.vi", from which the executable was compiled.

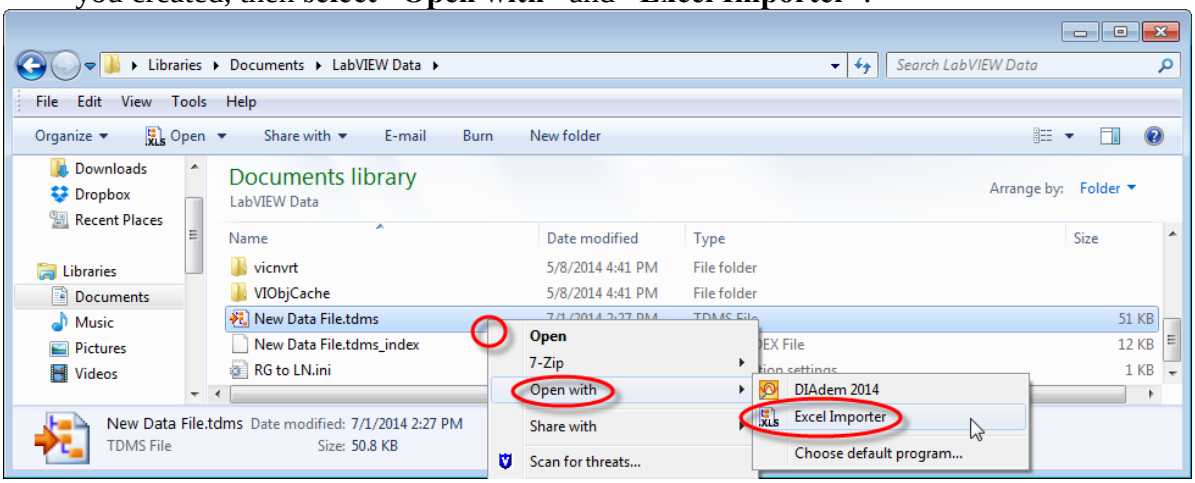
0.1 This LabVIEW application runs as soon as you launch it— that's why you see data already in the "Waveform Graph". This application simulates the acquisition of 20 channels of temperature data, showing you different data curves each time you run it— this is why the data on your graph is not identical to the data in the screenshot below. This application also saves useful descriptive information with the data values, giving you the ability to change the values written to the "Test_Name", "Test_Operator", "Test_Procedure", "Test_Status", and "UUT" properties. **Change the "Test_Operator" property value to be your own name**, then **click on the white arrow icon** at the top left of the application to run it again, causing a new file to be created with your name stored in the "Test_Operator" property. Finally, **copy** the resulting **"TDMS File path out"** indicator contents to the clipboard for use in the next step.



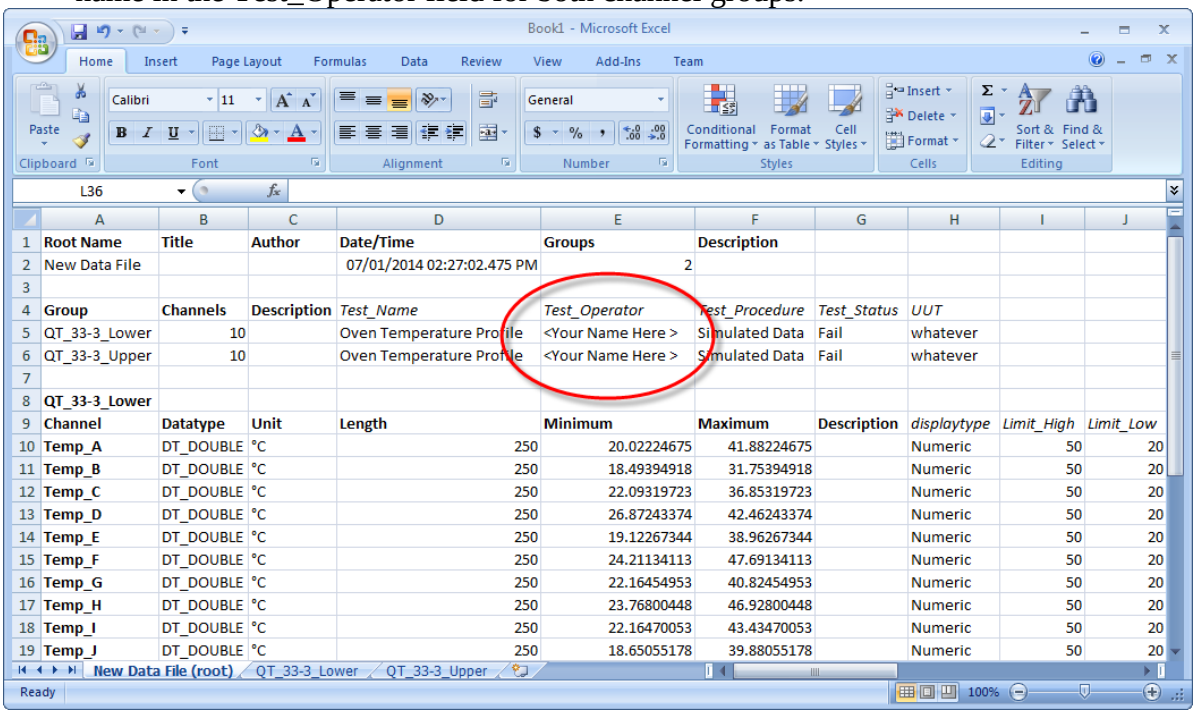
NOTE: You may change as many property values as you want and run this VI as many times as you want, but be aware that if you leave the "New TDMS File Name" field unchanged and re-run the application, it will automatically overwrite the old file with the new data values and new property values. Below is this VI's source code:



0.2 One of the stated benefits of the TDMS data file format is that it can be read into Microsoft Excel using a free "TDM Excel Add-in". You decide to check this out by trying to read into Excel the TDMS file(s) you just created in the previous step. **Paste** the **TDMS file path** you copied in the last step **into Windows Explorer** or **navigate to** the folder **"…\My Documents\LabVIEW Data"** and **right-click** on the **TDMS file** you created, then **select "Open with"** and **"Excel Importer"**.



0.3 The TDMS file you created opens right up in Excel, and you can quickly find your name in the Test_Operator field for both channel groups.



	A	B	C	D	E	F	G	H	I	J
1	**Root Name**	**Title**	**Author**	**Date/Time**	**Groups**	**Description**				
2	New Data File			07/01/2014 02:27:02.475 PM	2					
3										
4	**Group**	**Channels**	**Description**	*Test_Name*	*Test_Operator*	*Test_Procedure*	*Test_Status*	*UUT*		
5	QT_33-3_Lower	10		Oven Temperature Profile	<Your Name Here >	Simulated Data	Fail	whatever		
6	QT_33-3_Upper	10		Oven Temperature Profile	<Your Name Here >	Simulated Data	Fail	whatever		
7										
8	**QT_33-3_Lower**									
9	**Channel**	**Datatype**	**Unit**	**Length**	**Minimum**	**Maximum**	**Description**	*displaytype*	*Limit_High*	*Limit_Low*
10	**Temp_A**	DT_DOUBLE	°C	250	20.02224675	41.88224675		Numeric	50	20
11	**Temp_B**	DT_DOUBLE	°C	250	18.49394918	31.75394918		Numeric	50	20
12	**Temp_C**	DT_DOUBLE	°C	250	22.09319723	36.85319723		Numeric	50	20
13	**Temp_D**	DT_DOUBLE	°C	250	26.87243374	42.46243374		Numeric	50	20
14	**Temp_E**	DT_DOUBLE	°C	250	19.12267344	38.96267344		Numeric	50	20
15	**Temp_F**	DT_DOUBLE	°C	250	24.21134113	47.69134113		Numeric	50	20
16	**Temp_G**	DT_DOUBLE	°C	250	22.16454953	40.82454953		Numeric	50	20
17	**Temp_H**	DT_DOUBLE	°C	250	23.76800448	46.92800448		Numeric	50	20
18	**Temp_I**	DT_DOUBLE	°C	250	22.16470053	43.43470053		Numeric	50	20
19	**Temp_J**	DT_DOUBLE	°C	250	18.65055178	39.88055178		Numeric	50	20

0.4 The TDM Excel Add-in imports all the file, group, and channel properties into the "New Data File (root)" worksheet, shown below. Note that your TDMS file has a date/time property in cell D2 and Unit, Minimum, and Maximum properties for each channel, etc. Each group in the TDMS file is assigned to its own Excel Worksheet where all its channel values are imported as columns. **Click on the "…Lower" worksheet** to view its channel values

	A	B	C	D	E	F
1	**Root Name**	**Title**	**Author**	**Date/Time**	**Groups**	**Description**
2	New Data File			07/01/2014 02:27:02.475 PM	2	
3						
4	**Group**	**Channels**	**Description**	*Test_Name*	*Test_Operator*	*Test_Procedure*
5	QT_33-3_Lower	10		Oven Temperature Profile	<Your Name Here >	Simulated Data
6	QT_33-3_Upper	10		Oven Temperature Profile	<Your Name Here >	Simulated Data
7						
8	**QT_33-3_Lower**					
9	**Channel**	**Datatype**	**Unit**	**Length**	**Minimum**	**Maximum**
10	**Temp_A**	DT_DOUBLE	°C	250	20.02224675	41.88224675
11	**Temp_B**	DT_DOUBLE	°C	250	18.49394918	31.75394918
12	**Temp_C**	DT_DOUBLE	°C	250	22.09319723	36.85319723
13	**Temp_D**	DT_DOUBLE	°C	250	26.87243374	42.46243374
14	**Temp_E**	DT_DOUBLE	°C	250	19.12267344	38.96267344
15	**Temp_F**	DT_DOUBLE	°C	250	24.21134113	47.69134113
16	**Temp_G**	DT_DOUBLE	°C	250	22.16454953	40.82454953
17	**Temp_H**	DT_DOUBLE	°C	250	23.76800448	46.92800448
18	**Temp_I**	DT_DOUBLE	°C	250	22.16470053	43.43470053
19	**Temp_J**	DT_DOUBLE	°C	250	18.65055178	39.88055178
20						
21	**QT_33-3_Upper**					
22	**Channel**	**Datatype**	**Unit**	**Length**	**Minimum**	**Maximum**
23	**Temp_A**	DT_DOUBLE	°C	250	21.13051414	37.20051414
24	**Temp_B**	DT_DOUBLE	°C	250	22.94155726	33.82155726
25	**Temp_C**	DT_DOUBLE	°C	250	22.24952932	34.23952932

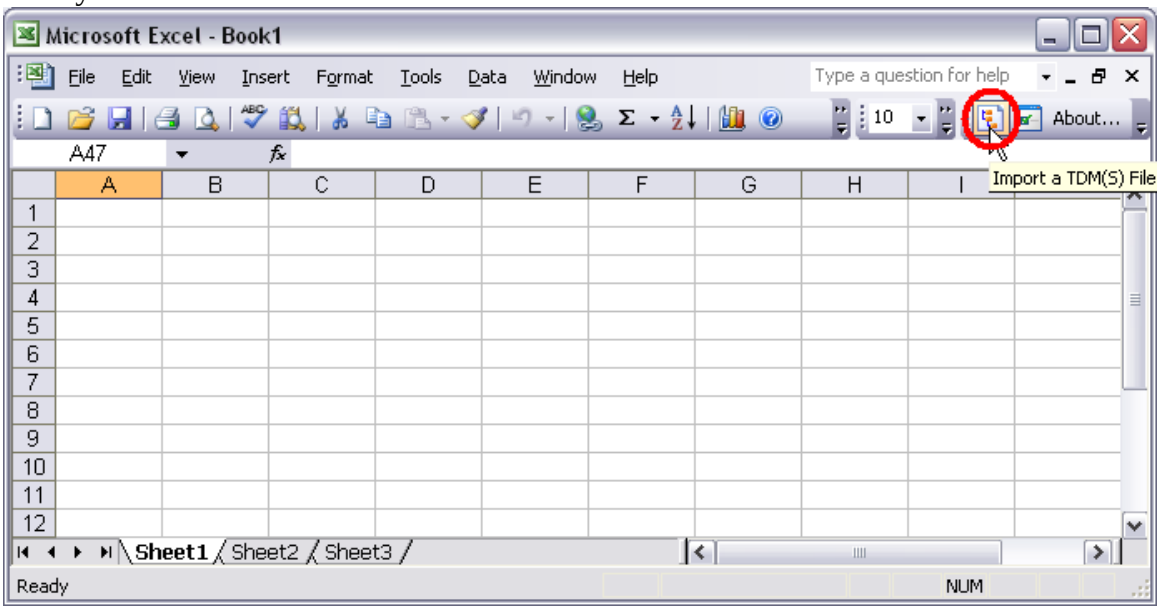
New Data File (root) | QT_33-3_Lower | QT_33-3_Upper

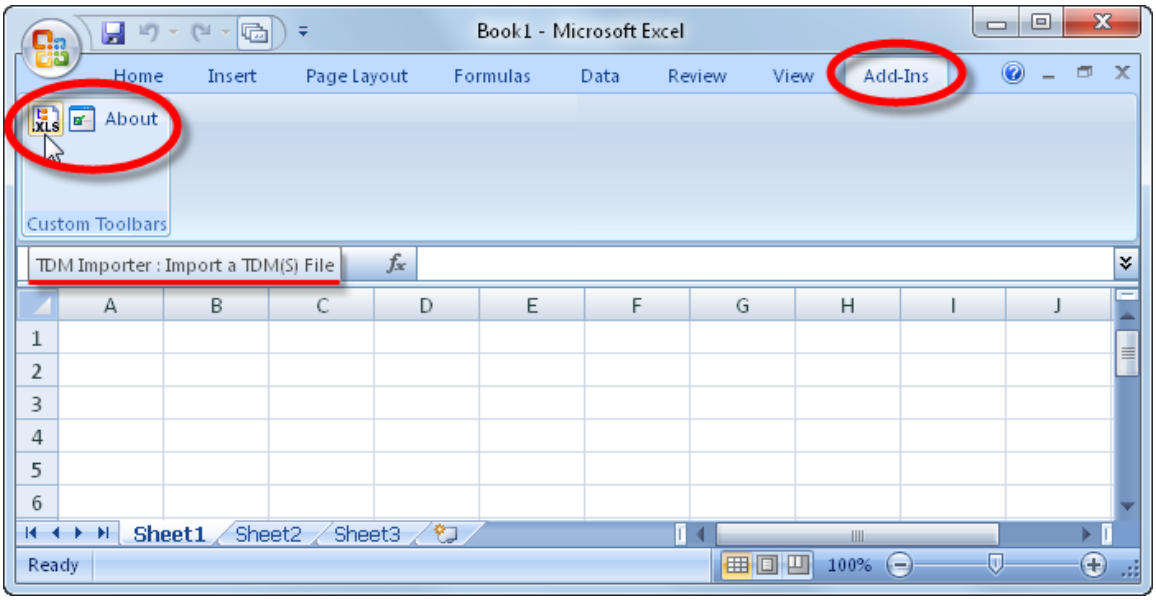
0.5 Here you see that all the channel values you saw graphed in the LabVIEW application are faithfully loaded into Excel. It appears that you really can load TDMS files into Excel— which means you can send them to anybody without having to first convert to an ASCII file format.

	A	B	C	D	E	F	G	H	I	J
1	**Temp_A**	**Temp_B**	**Temp_C**	**Temp_D**	**Temp_E**	**Temp_F**	**Temp_G**	**Temp_H**	**Temp_I**	**Temp_J**
2	20.12224675	18.49394918	22.10319723	26.97243374	19.13267344	24.22134113	22.27454953	23.77800448	22.17470053	18.75055178
3	20.12224675	18.56394918	22.10319723	26.90243374	19.13267344	24.22134113	22.21454953	23.77800448	22.17470053	18.68055178
4	20.12224675	18.59394918	22.10319723	26.87243374	19.13267344	24.22134113	22.17454953	23.77800448	22.17470053	18.65055178
5	20.12224675	18.55394918	22.10319723	26.91243374	19.13267344	24.22134113	22.16454953	23.77800448	22.17470053	18.68055178
6	20.12224675	18.50394918	22.10319723	26.97243374	19.13267344	24.22134113	22.17454953	23.77800448	22.17470053	18.73055178
7	20.12224675	18.51394918	22.10319723	26.94243374	19.13267344	24.22134113	22.17454953	23.76800448	22.16470053	18.76055178
8	20.12224675	18.56394918	22.10319723	26.89243374	19.13267344	24.22134113	22.17454953	23.76800448	22.16470053	18.76055178
9	20.12224675	18.60394918	22.10319723	26.87243374	19.13267344	24.22134113	22.17454953	23.80800448	22.20470053	18.75055178
10	20.12224675	18.60394918	22.10319723	26.93243374	19.13267344	24.22134113	22.17454953	23.86800448	22.25470053	18.75055178
11	20.12224675	18.59394918	22.10319723	26.98243374	19.13267344	24.22134113	22.17454953	23.86800448	22.26470053	18.75055178
12	20.13224675	18.60394918	22.09319723	26.98243374	19.13267344	24.22134113	22.17454953	23.81800448	22.22470053	18.75055178
13	20.11224675	18.58394918	22.11319723	26.97243374	19.13267344	24.22134113	22.17454953	23.77800448	22.16470053	18.75055178
14	20.06224675	18.52394918	22.17319723	26.97243374	19.12267344	24.22134113	22.17454953	23.81800448	22.16470053	18.75055178
15	20.02224675	18.49394918	22.20319723	26.97243374	19.13267344	24.22134113	22.17454953	23.87800448	22.17470053	18.75055178
16	20.03224675	18.54394918	22.15319723	26.97243374	19.18267344	24.21134113	22.17454953	23.88800448	22.18470053	18.75055178
17	20.10224675	18.59394918	22.10319723	26.97243374	19.23267344	24.21134113	22.17454953	23.87800448	22.17470053	18.75055178

New Data File (root) | QT_33-3_Lower | QT_33-3_Upper

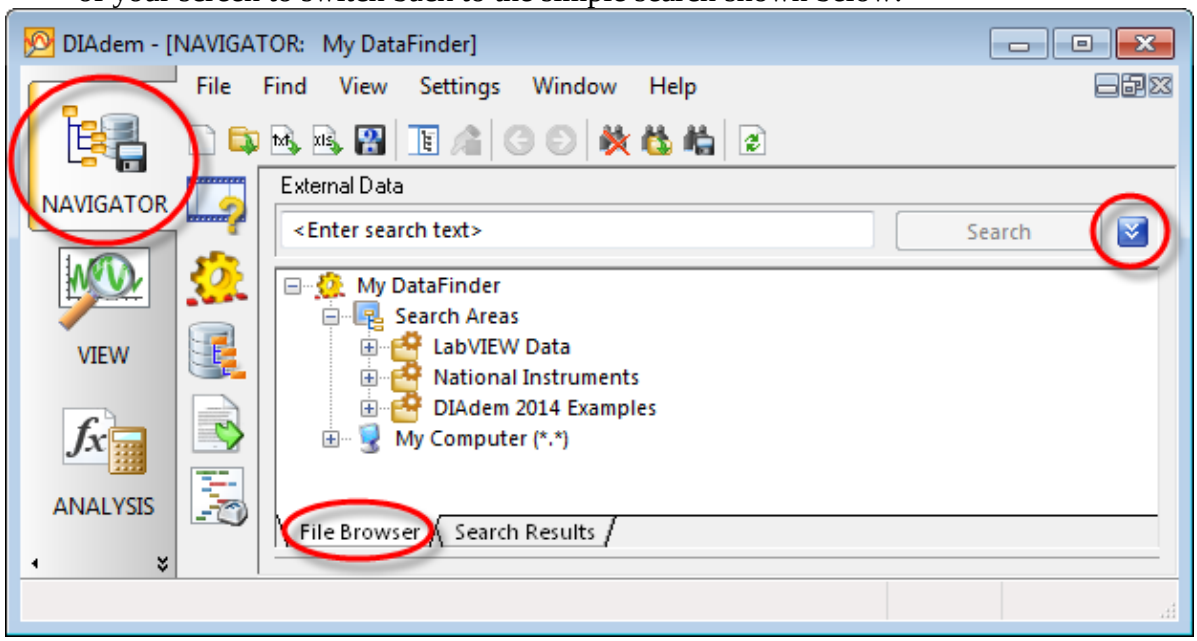
0.6 You can also load TDMS files directly from the Excel environment. When installed, this TDM Excel Add-in appears as a new icon with an orange and blue tree-view on a white background, with the tip strip "Import a TDM(S) File". In Excel 2007 or later, you must first click on the "Add-Ins" tab to see the TDM Excel Add-in icon.



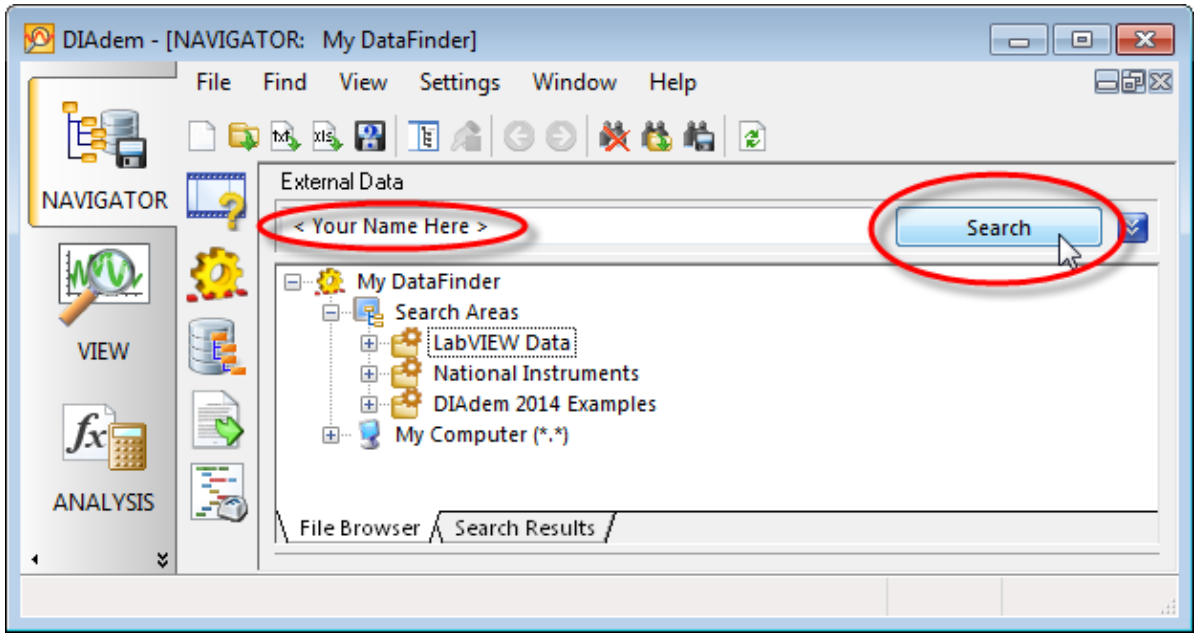


NOTE: LabVIEW 2014 and DIAdem 2014 automatically install the Excel TDM Add-in, but if the person you send your TDMS files to doesn't have it, here are the steps for them to download it for free. Close Excel completely, launch your web browser (Internet Explorer, etc.) and navigate to www.ni.com/tdms. Scroll down near to the bottom of that page and click on the TDM Excel Add-In Tool for Microsoft Exel User Guide and after that the TDM Excel Add-In Download Page link to get to the download page. Finally, download and install the TDM Excel Add-in. Now restart Excel and find and click on the "Import a TDM File" icon

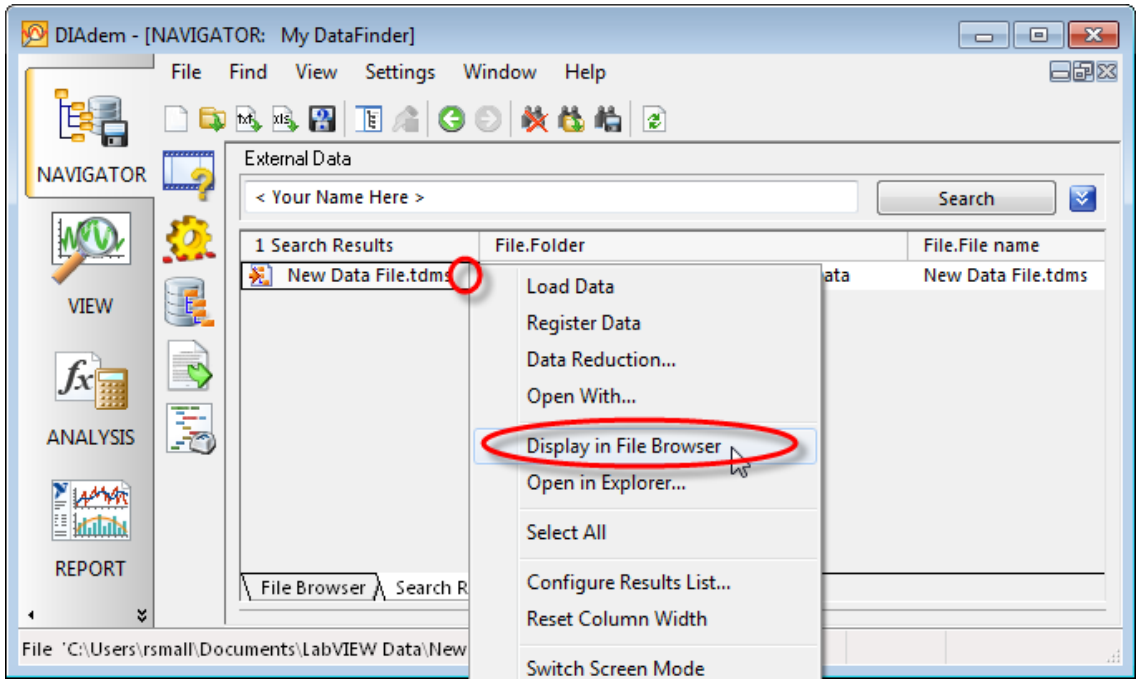
0.7 Now you decide to try out DIAdem, to see if it is any better than Excel. Launch DIAdem and make sure that the "**NAVIGATOR**" tab at the top left of your screen is selected. Next make sure the "**File Browser**" tab is selected at the bottom left of your screen. Finally, if you don't see the **simple search bar** (pictured below with the text "<Enter text to find in search areas>"), then click on the toggle button at the top right of your screen to switch back to the simple search shown below.



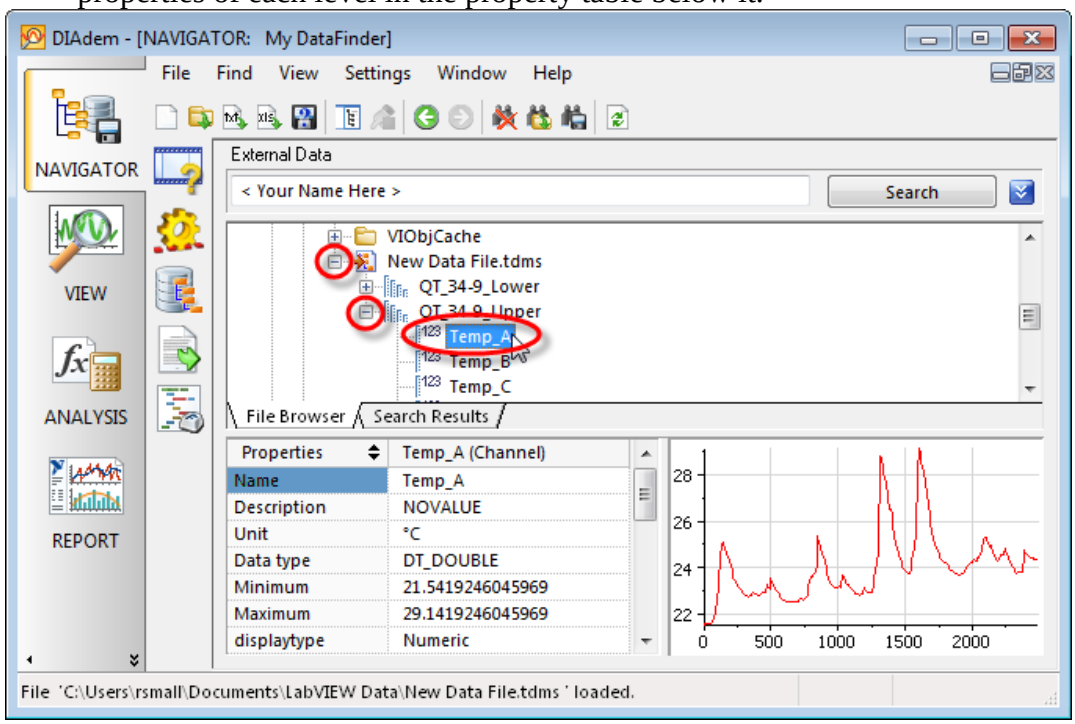
0.8 DIAdem has already noticed the TDMS files you created and indexed them into its built-in "DataFinder" data base. You don't have to pop up a file dialog or know the exact folder to navigate to. Just **type in your name in the simple search text**, where the "< Your Name Here >" text is located below (exactly as you typed it in the LabVIEW application), and **click on the "Search" button** at the top right of your screen.



0.9 DIAdem should find all the TDMS files you created, plus any others which have your name as a property value somewhere. **Right-click on one of your TDMS** files and **select the context menu "Display in Browser"** so that DIAdem will show you where this TDMS file is located in the NAVIGATOR tree view.



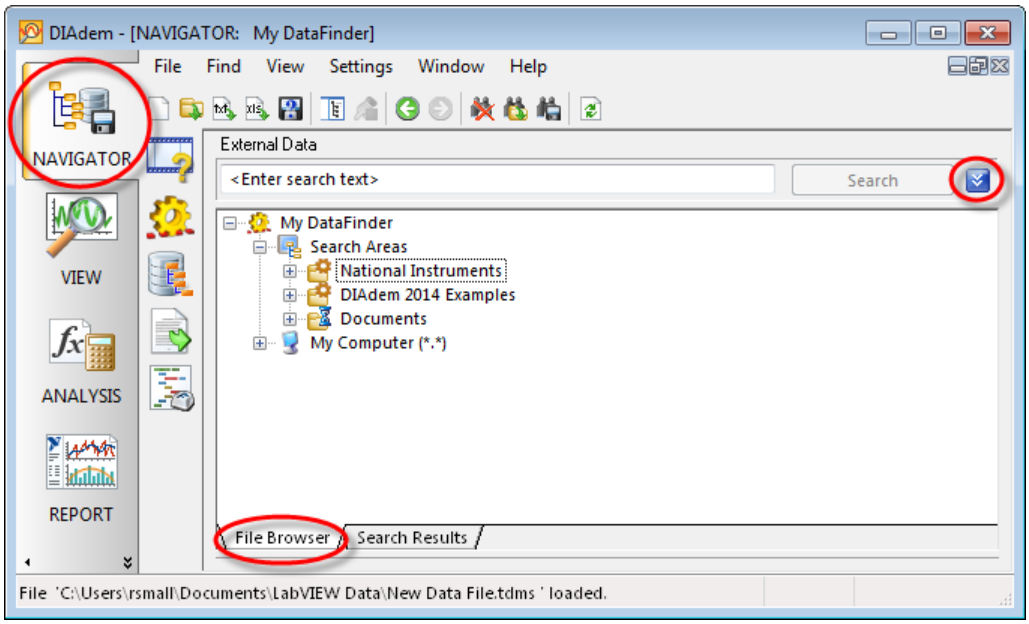
0.10 DIAdem highlights in the tree view the file you found with your simple search. Now **open** up **this file** down **to the channel level**— **click on** the **"+"** sign to the left of the **file**, then click on the **"+"** sign to the left of the file's "…**Upper**" **group**. **Click on the first channel, called "Temp_A",** to see a graphical preview of that channel. Notice how DIAdem shows you the 3 level hierarchy right in the tree view and shows you the properties of each level in the property table below it.



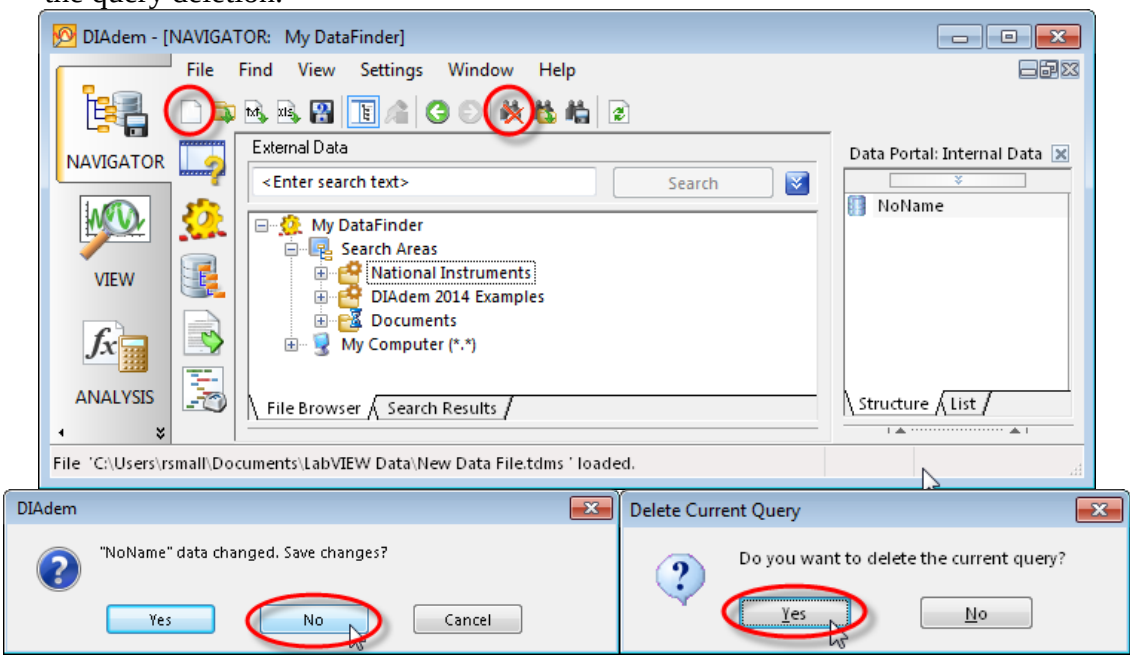
Exercise #1 DataFinding and Automated Reporting

Scenario: You've been charged with finding out why so many tests show furnace temperatures exceeding their allowable thermal profiles. You know a few key facts about these data files, but over time the files have been stored in different folders by lots of different people, and it's not obvious where all the data is located. You will use the DataFinder to locate all the files which contain out-of-range temperature data. You will install and use a predefined custom menu in DIAdem (that a colleague of yours sent you) to automatically calculate histograms of the out-of-range temperatures. You will use another predefined custom menu (from this same colleague) to create a trend graph of the out-of-range temperatures. Finally you will output these graphs to a PDF file so that you can email your initial findings to your boss.

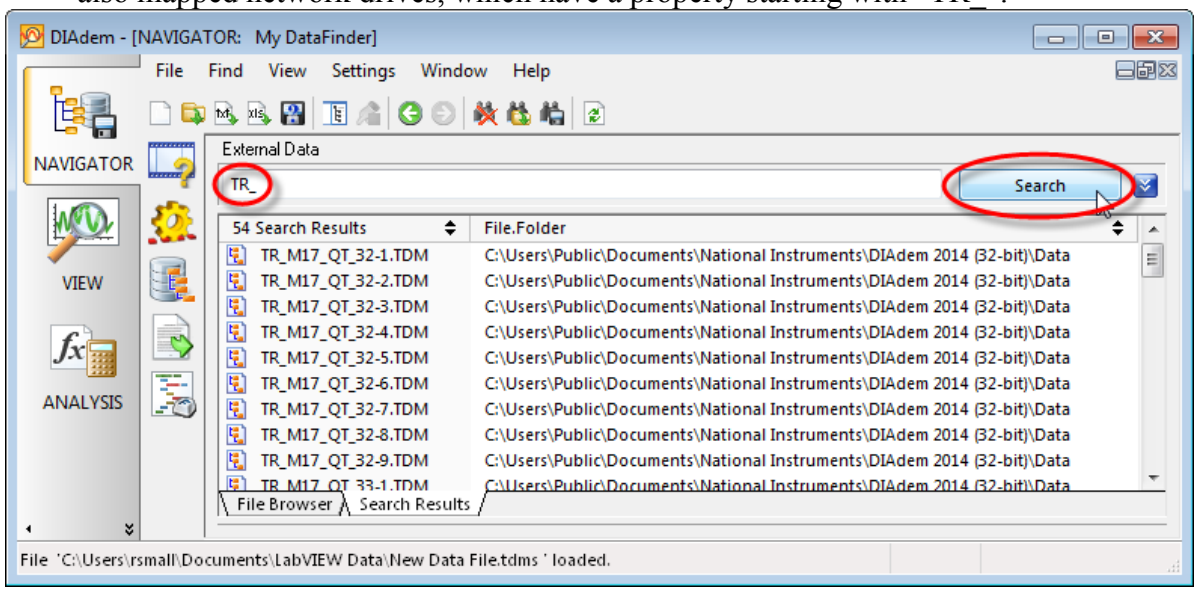
1.1 First get ready to search in DIAdem. Make sure that the "**NAVIGATOR**" tab at the top left of your screen is selected. Next make sure the "**File Browser**" tab is selected at the bottom left of your screen. Finally, if you don't see the **simple search bar** (pictured below with the text "<Enter text to find in search areas>"), then click on the toggle button at the top right of your screen to switch back to the simple search shown below.



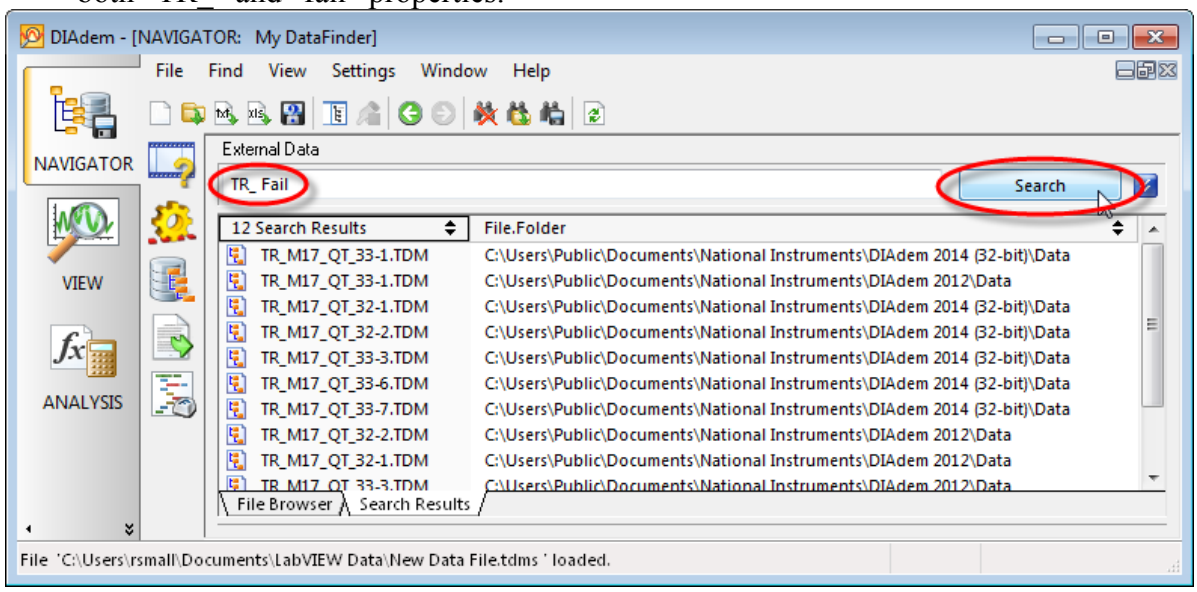
1.2 **Click** on the "**Delete Internal Data**" icon at the top left of your screen to delete any data currently loaded in DIAdem. Notice that now the Data Portal to the right of your screen is empty. **Click** on the "**Delete Query**" icon (binocular with red X) at the top of your screen to reset the DataFinder query to the empty query pictured below. Click the "No" button if asked to save data changes and the "Yes" button if asked to confirm the query deletion.



1.3 One thing you know about all these data files is they all have file names starting with "TR_". **Type** the text **"TR_"** into the simple search keyword field and either hit the <Enter> key on your keyboard or **click** on the "**Search**" button to the right of the search text. Now you see a list of data files from all over your hard drive, or perhaps also mapped network drives, which have a property starting with "TR_".

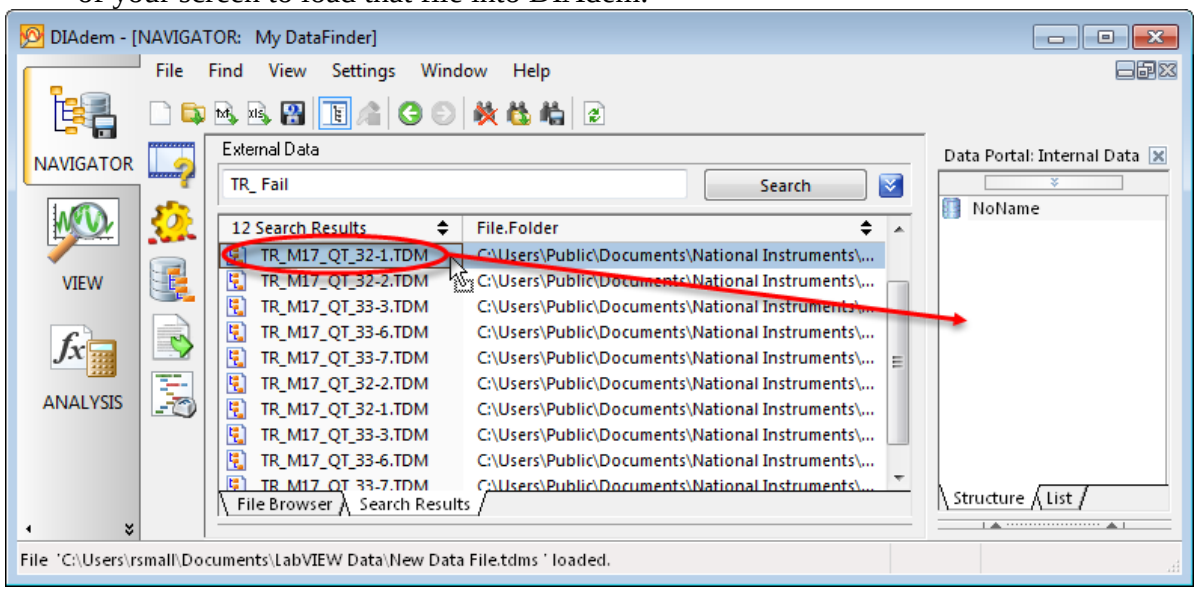


1.4 Another thing you know about the data files you need to analyze is that they all failed the temperature threshold test. **Add** the "**Fail**" keyword to the simple **search text** so that you now have "TR_ fail" in the search text field (make sure there is a space between the search terms). **Hit return** again or click on the "Search" button to execute the new search. Now you find a much smaller number of files which contain both "TR_" and "fail" properties.



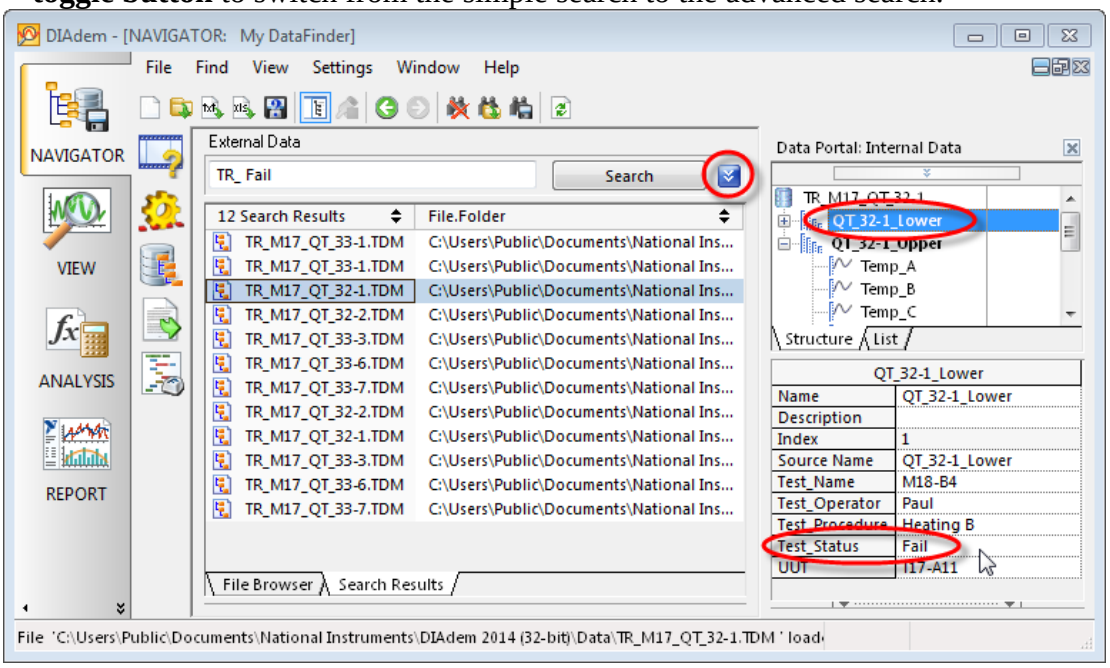
NOTE: DataFinder queries are NOT case-sensitive

1.5 Thus far the searching you've done in DIAdem has been very similar to other desktop search software from Google, Microsoft, etc. One huge difference with DIAdem is that the story doesn't end with the search results list. **Click** on the **first data file** in the search results to highlight it, then **drag** that data file **into** the **DataPortal** on the right of your screen to load that file into DIAdem.

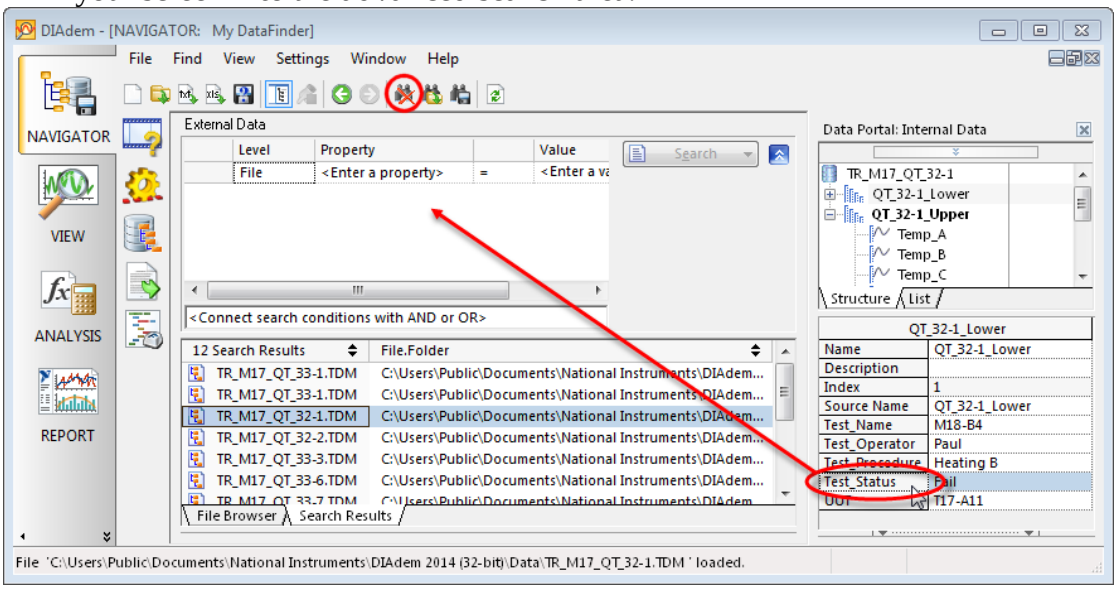


NOTE: You must drag the data file from the "Search Results" column

1.6 Now the entire contents of that data file are loading into DIAdem. You can see that this file has 2 groups of 10 channels each. **Click** on the "…**Lower**" group in the Data Portal so that you see group properties in the Data Portal property window at the lower right of your screen. In particular, you can now see that the property with the value "Fail" in it is the group property "Test_Status". Now **click** on the square, blue **search toggle button** to switch from the simple search to the advanced search.

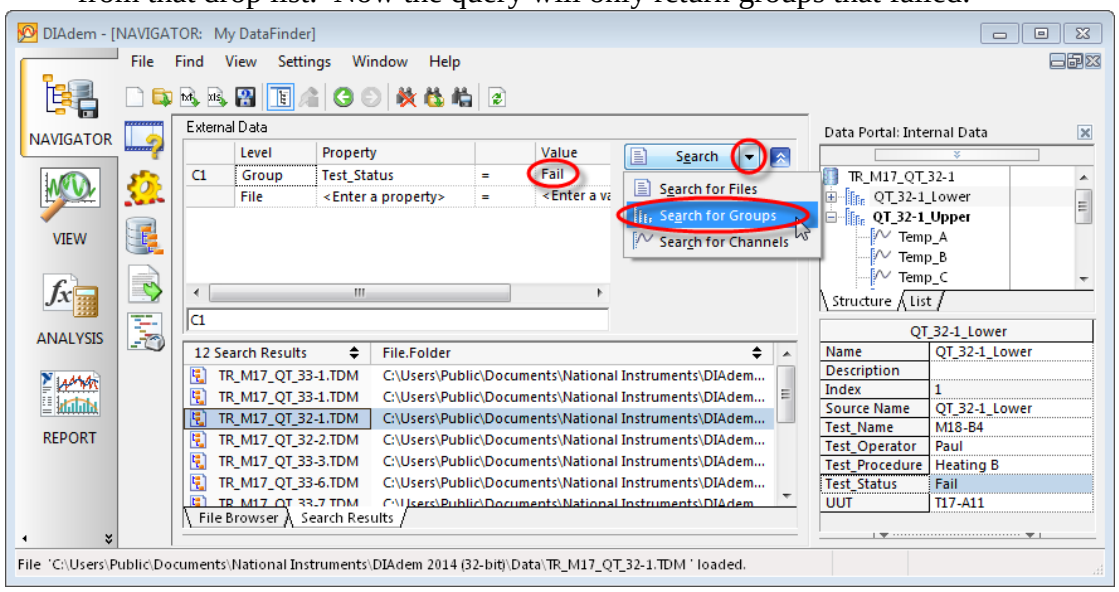


1.7 The advanced search in DIAdem enables you to construct a series of exact conditions, each based on a specific property, operator, and comparison value. **Click** on the **"Delete Query"** icon at the top of your screen to start with an empty query (click on the "Yes" button if asked to confirm the query deletion). Now **drag** the "**Test_Status**" **property** from the Data Portal property window at the bottom right of your screen **into** the **advanced search** area.



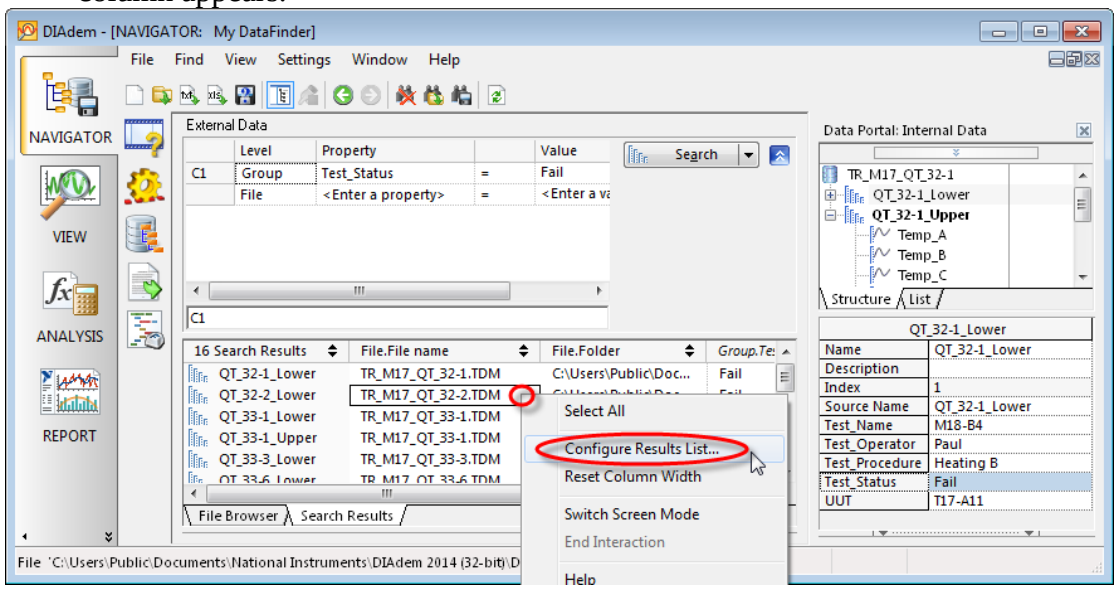
NOTE: You must drag from the property name (in this case "Test_Status")

1.8 If you do not see the text "Fail" in the automatically inserted query condition, as pictured below, click on that field and type in "Fail" so that you do (You could have loaded a test file with one group that failed and a second group that passed). So far you have always returned a list of files that matched your query conditions, but DIAdem can also query the structure inside the files. **Click** on the **far right** of the **"Search" button** so that you see the below drop list, then **select** "**Search for Groups**" from that drop list. Now the query will only return groups that failed.

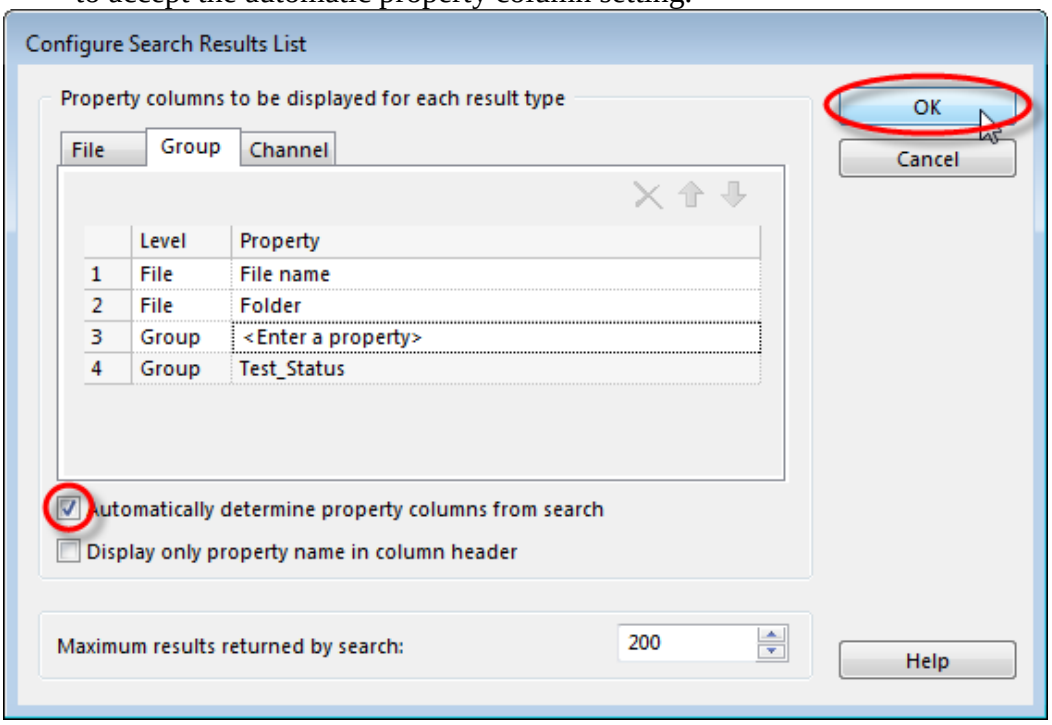


NOTE: DIAdem always inserts an empty "File" condition at the bottom of your query.

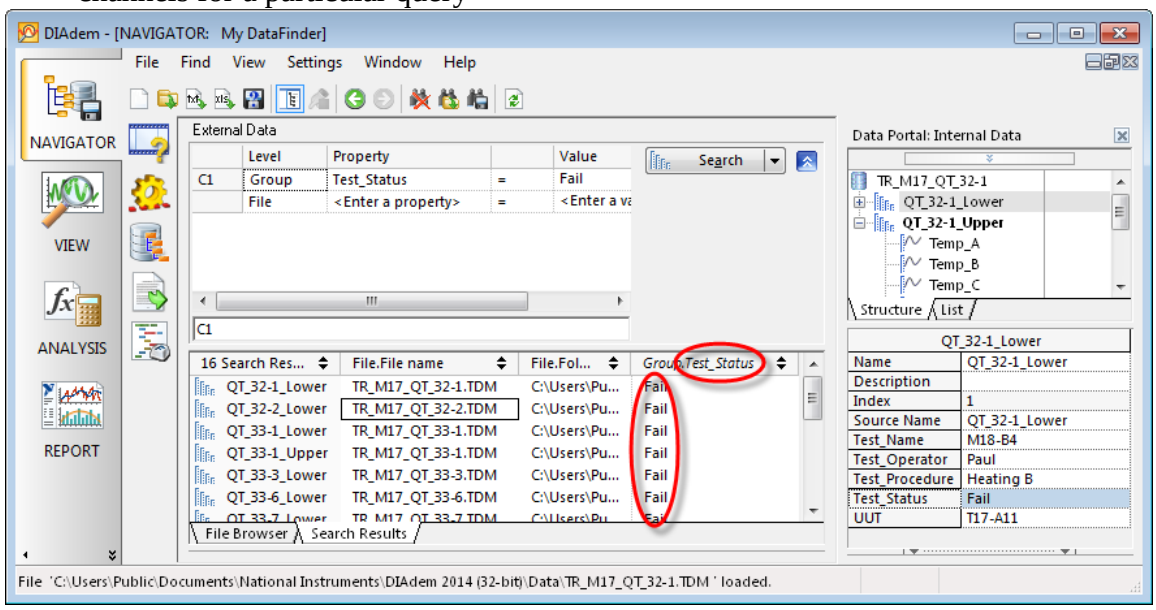
1.9 Your search has returned a list of all failed groups from various files located across any number of directories. You can configure which property columns appear in the Search Results list— in the below screenshot only "File.File name" and "File.Folder" appear, and you'd really like to see the "Group.Test_Result" property column to verify your query returned the correct results. **Right-click** on any of the **cells in the Search Results**, then **select** the **"Configure Results List…"** menu to make sure that property column appears.



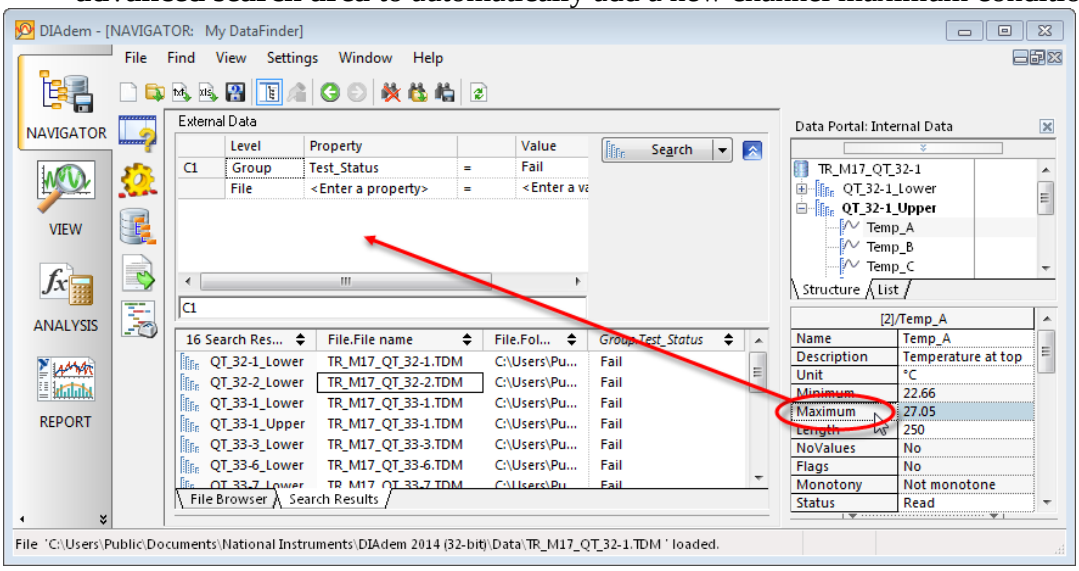
1.10 Here you see a list of all the property columns you have configured to appear in the Search Results list. **Check** the **"Automatically determine property columns from search"** checkbox at the lower left of this dialog, if it is not already checked. This causes the "Group.Test_Status" and any further properties used in queries to automatically appear as property columns in the Results List. **Click** the **"OK"** button to accept the automatic property column setting.



1.11 Now you can verify that all the groups returned by your query did indeed fail by looking at the "Group.Test_Status" property column. Some of the data files have 2 groups which failed, while other data files have only 1 group that failed. The advanced search in DIAdem enables you to return matching files, matching groups, or matching channels for a particular query

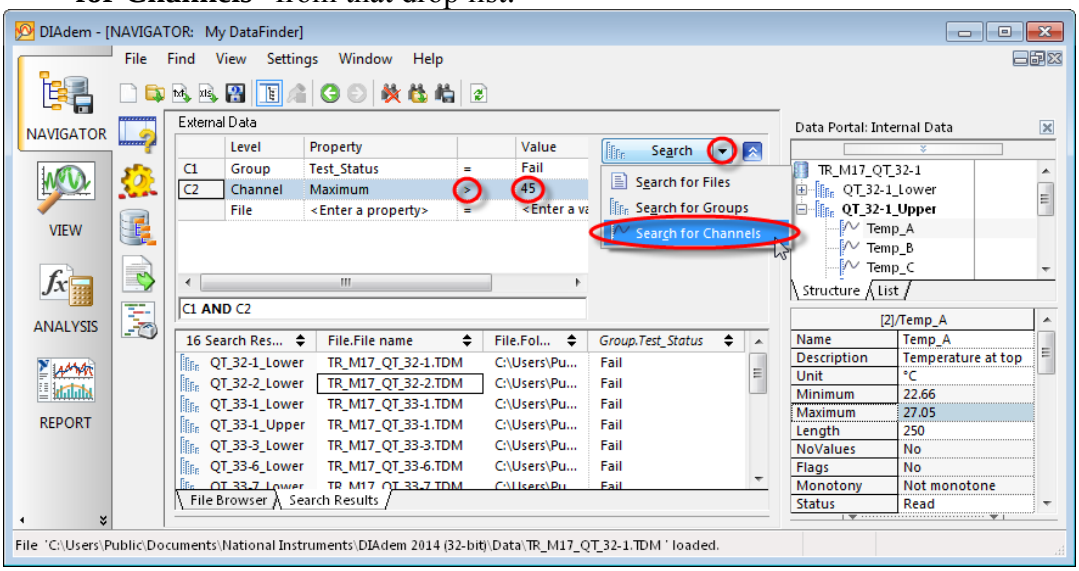


1.12 You actually only want to look at the data channels inside these groups which exceeded the thermal threshold value of 45°C. **Click** on the "**Temp_A**" channel in the second group in the Data Portal to the right of your screen, then find the "Maximum" property in the property window below it. **Drag** the "**Maximum**" property **into** the **advanced search area** to automatically add a new channel maximum condition.

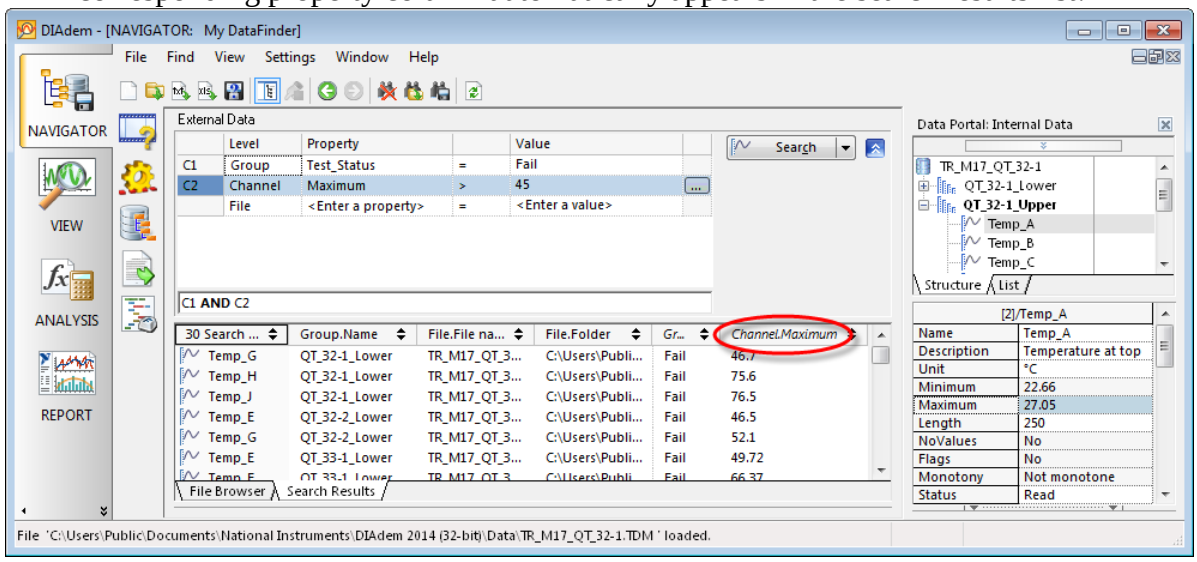


NOTE: You must drag from the property name (in this case "Maximum")

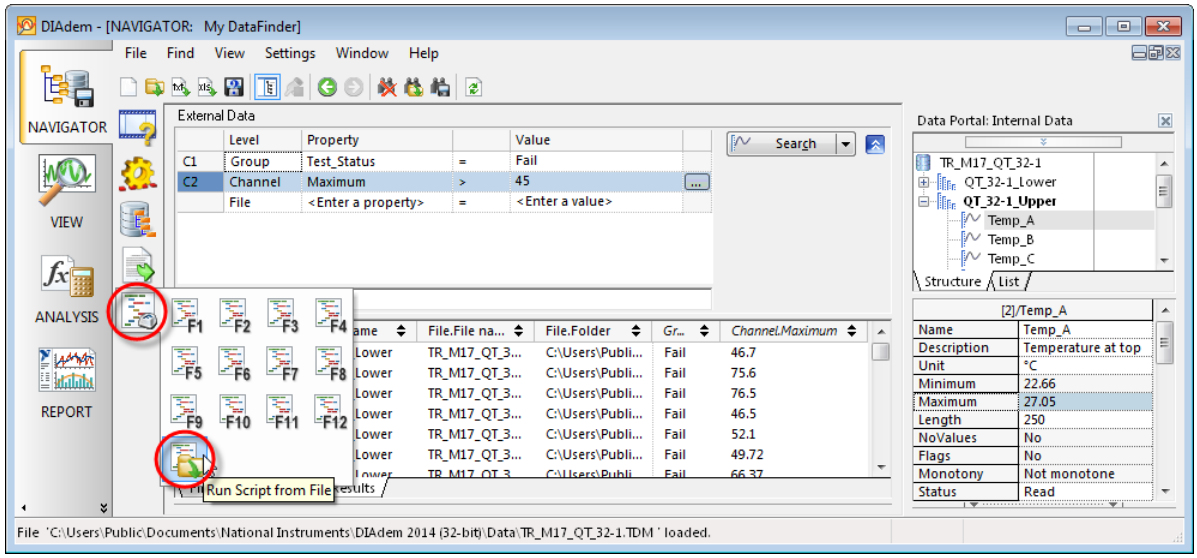
1.13 **Change** the **operator** in this new channel condition **to** be **">"** and the comparison **value to** be **45** (double-click on the 45 to change it). Now you want the query to return only the channels in those failed groups which exceeded 45°C. **Click** on the **far right** of the **"Search" button** so that you see the below drop list, then **select** "**Search for Channels**" from that drop list.



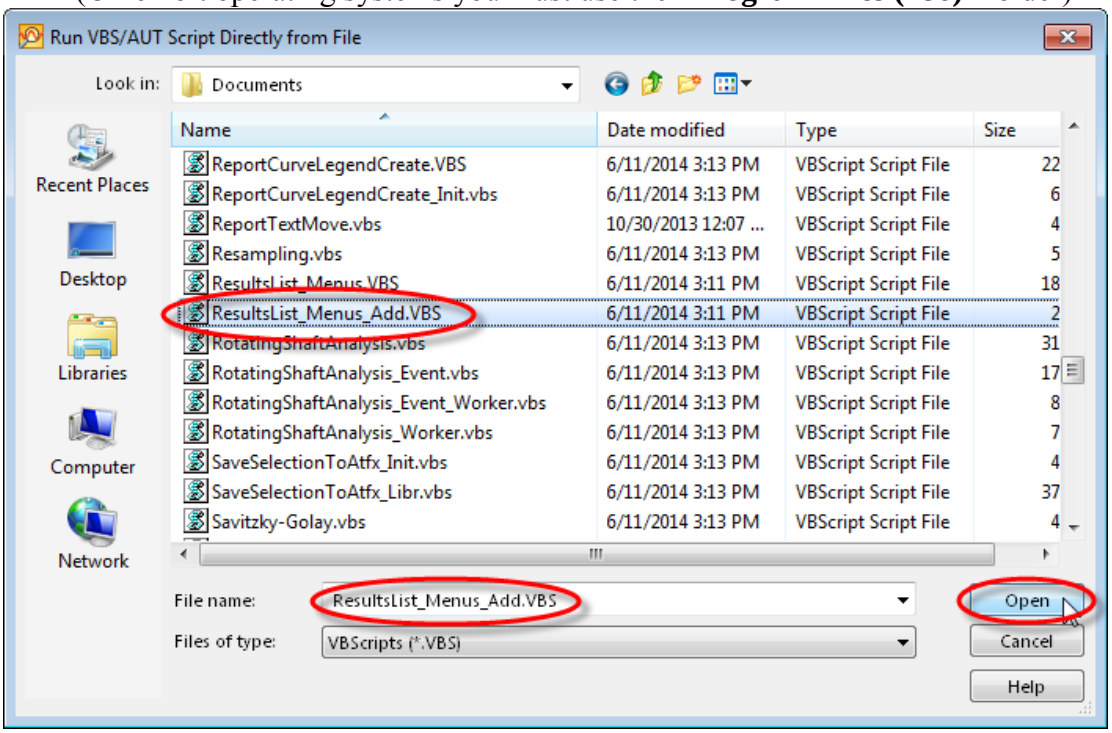
1.14 This query returns only the out-of-range channels inside failed groups. Notice that now each time you add a new condition like "Test_Status" or "Maximum", a corresponding property column automatically appears in the search results list.



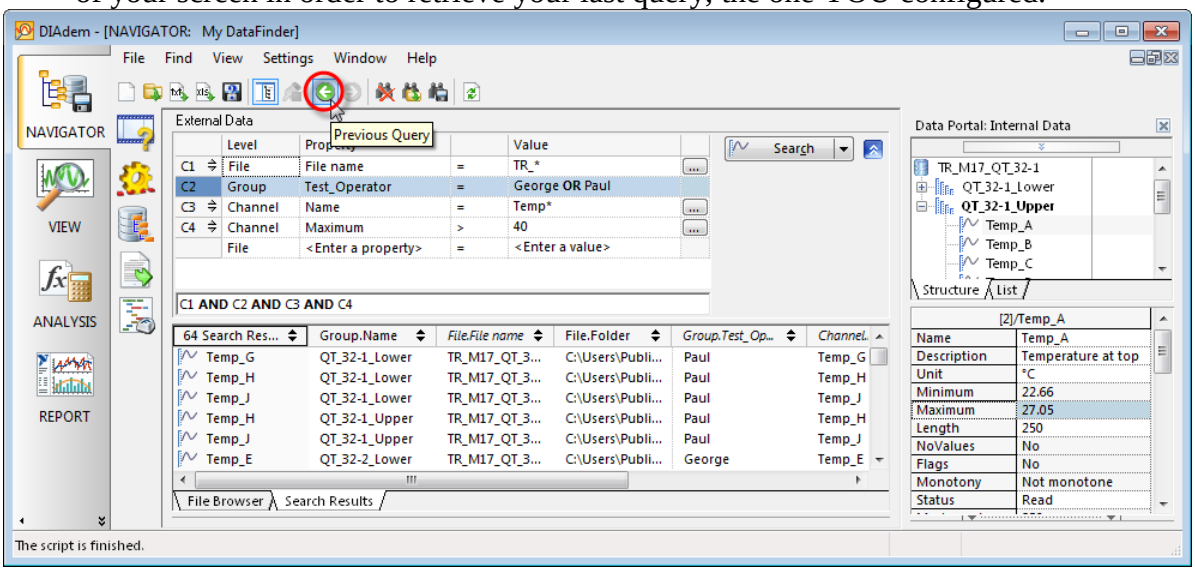
1.15 You can't really get a good idea of the distribution of these channel maxima by looking at their values in this search results table. What you need to do is to turn the "Maximum" column into a histogram graph. A colleague has just sent you a VBScript she says will install two very useful custom menus into the context menu of your search results table, and one of them is a histogram menu. **Click** on the small "**DIAdem Scripts…**" icon (not the big tab SCRIPT icon), then **select** the "**Run Script from File**" icon at the bottom in order to run your colleague's VBScript and install the two new custom context menus to the search results table.



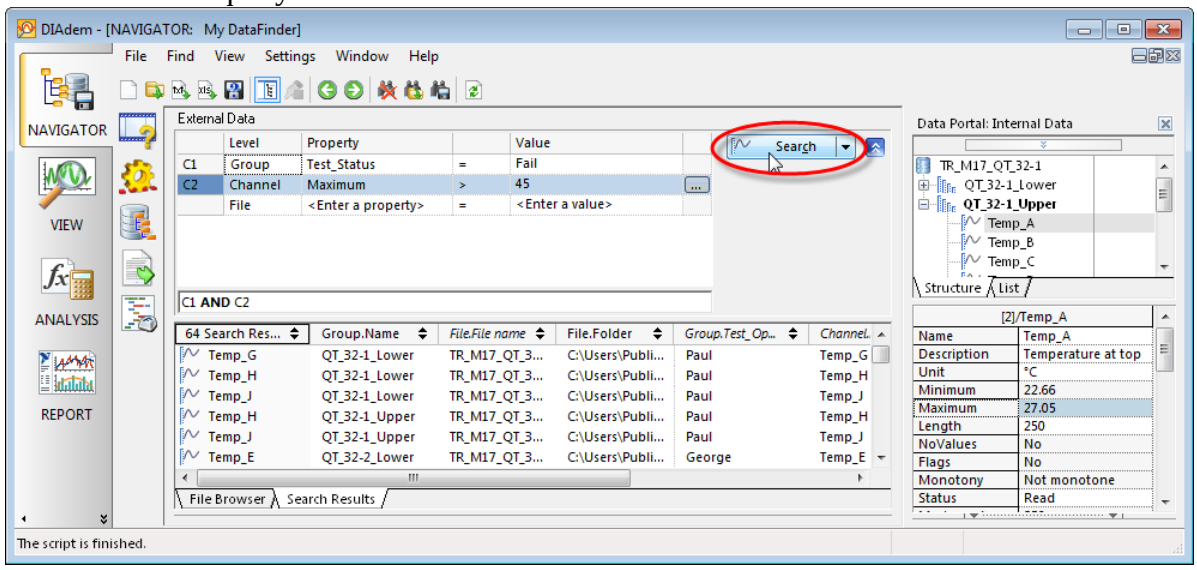
1.16 **Navigate** to the **"…\Program Files\National Instruments\DIAdem 2014\Examples\Documents\"** directory and **select** your colleague's "**ResultsList_Menus_Add.VBS**" (Note the "**_Add**" suffix) script file. If you don't see this VBScript file, double-check that the "Documents" directory is in fact under "Program Files". Finally, **click** on the **"Open"** button to run the VBScript that adds her two custom menus.
(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)



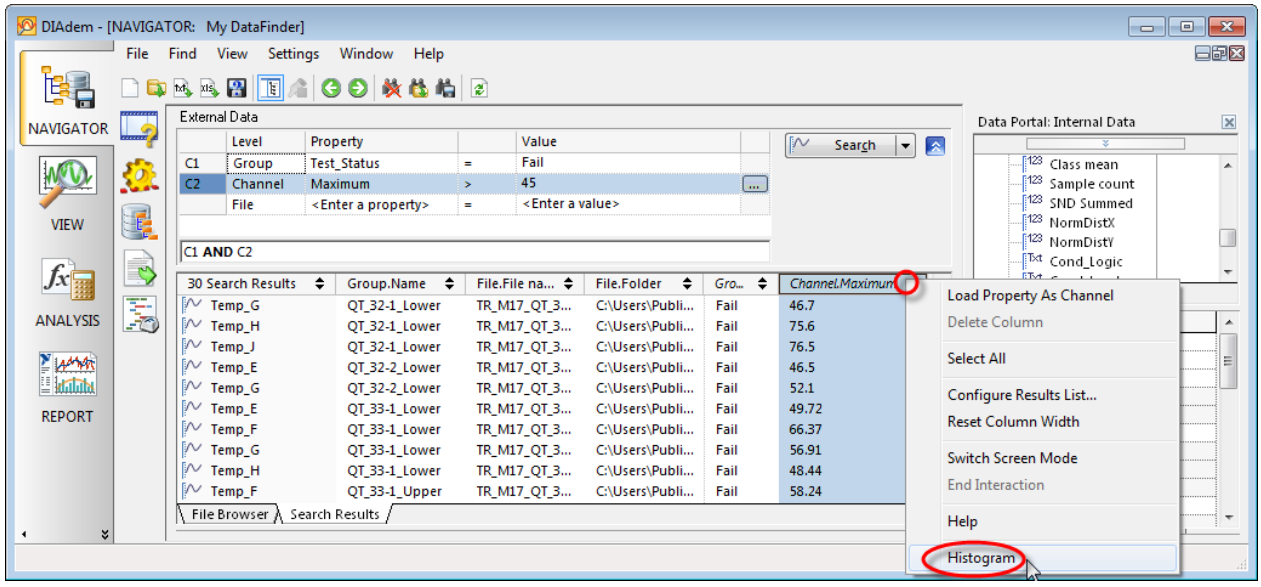
1.17 Whoops! It looks like that VBScript not only installed the custom context menus, it also loaded up your colleague's favorite query. Don't worry, though, DIAdem stores every query that you've run— **click** on the white and green **"back arrow"** at the top of your screen in order to retrieve your last query, the one YOU configured.



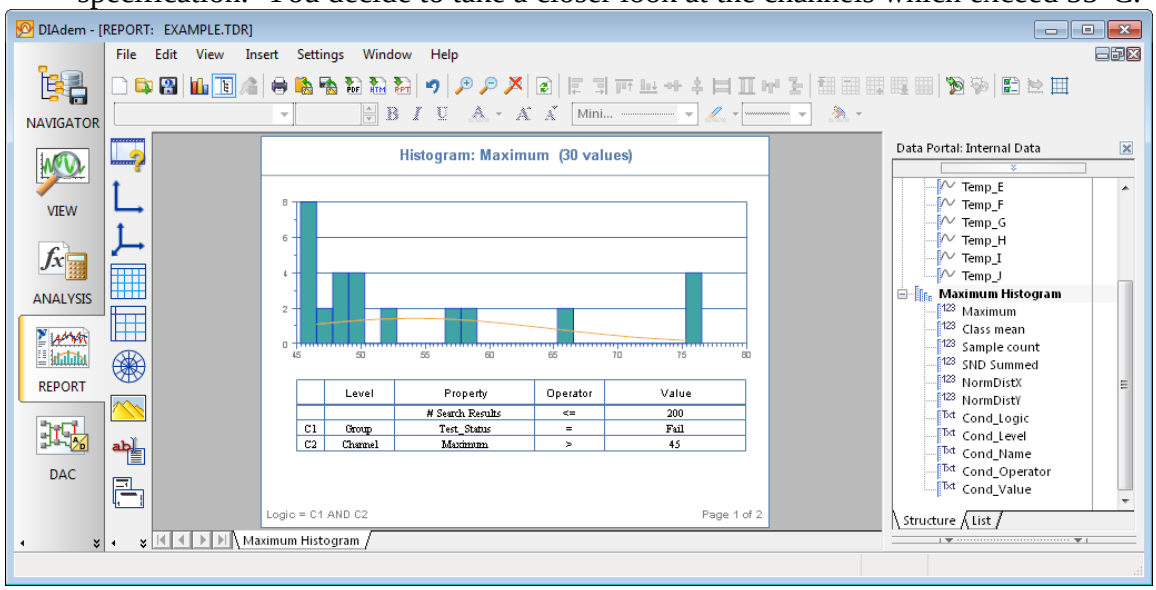
1.18 Now you have recovered the query you configured. **Click** on the **"Search"** button to re-run this query.



1.19 Now **right-click** on the "**Channel.Maximum**" property column heading and **select** the custom "**Histogram**" menu that your colleague's script just inserted. The DIAdem environment can be adapted and customized in many ways to make your everyday activities much more streamlined and convenient. This "Histogram" menu automatically loads the "Maximum" column values as a new channel in the Data Portal, calculates the histogram of this channel, and configures a histogram report of the data and a table of the search conditions which defined it.

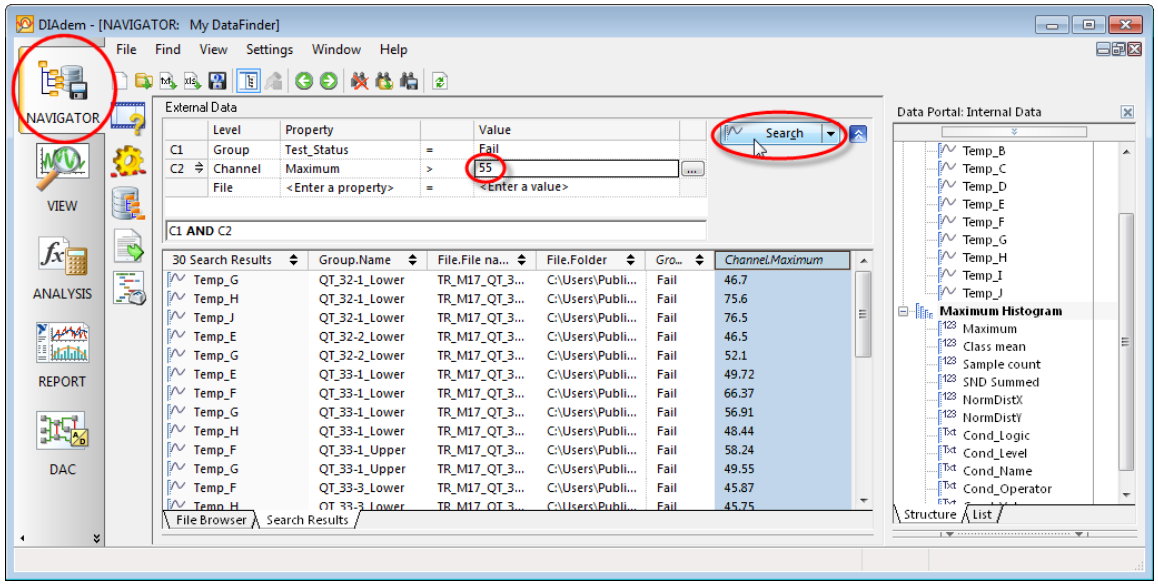


1.20 Now you can see that the bulk of the exceptions lie in the 45°C - 55°C range, with a few particularly hot sensors exceeding 55°C. You begin to suspect that there are a few hot spots on the furnace which are pulling the whole thermal profile out of specification. You decide to take a closer look at the channels which exceed 55°C.

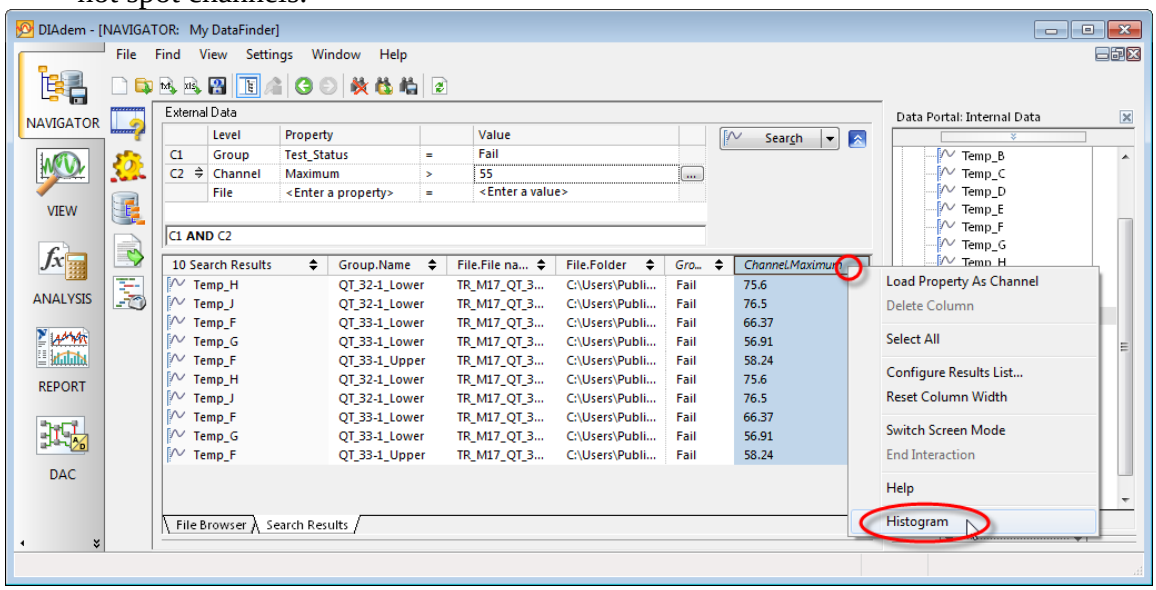


NOTE: Your queried data will look slightly different than the graph above

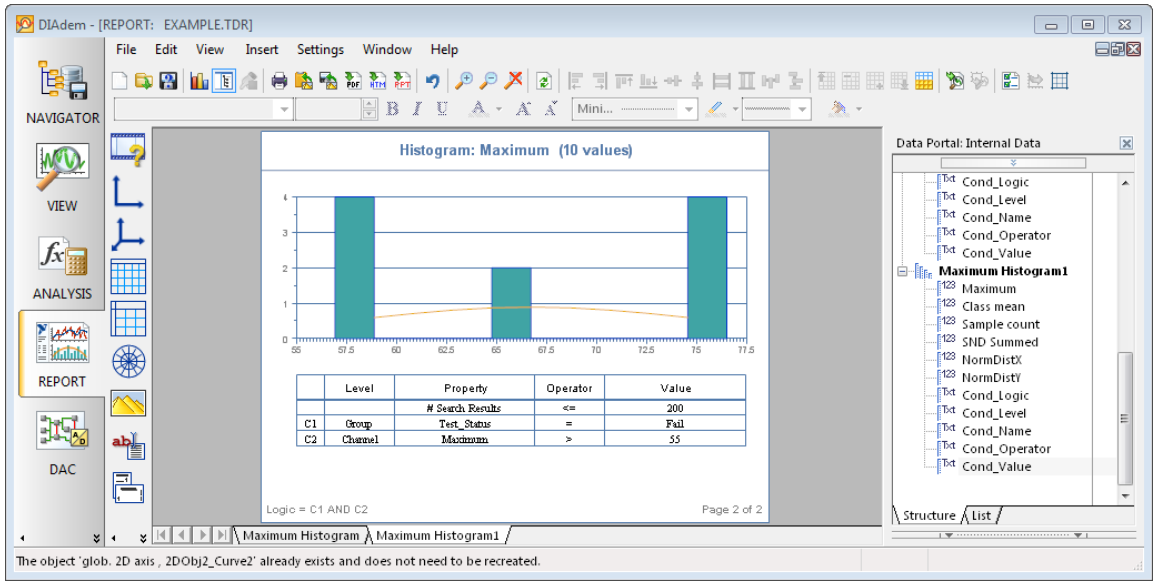
1.21 **Click** on the "**NAVIGATOR**" tab at the top left of your screen to switch back to the advanced search, then **change** the channel maximum **comparison value** to **55** and **click** on the "**Search**" **button**.



1.22 Now you see that there are only a few of these suspected hot spots among the original out-of-range channels. **Right-click** on the "**Channel.Maximum**" column heading and **select** the "**Histogram**" menu again to automatically create a histogram report of these hot spot channels.

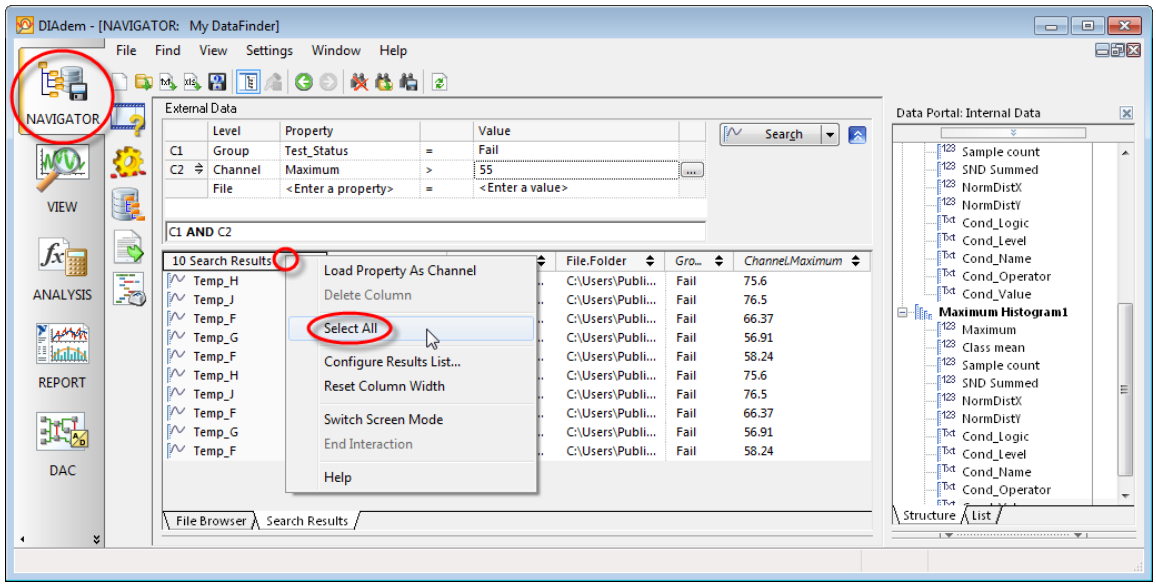


1.23 You see that you have indeed isolated the hottest channels. Note that each time you run the "**Histogram"** menu, the property column you selected is loaded into a new channel in a new group in the Data Portal, and the histogram and normal distribution are calculated from the loaded channel.

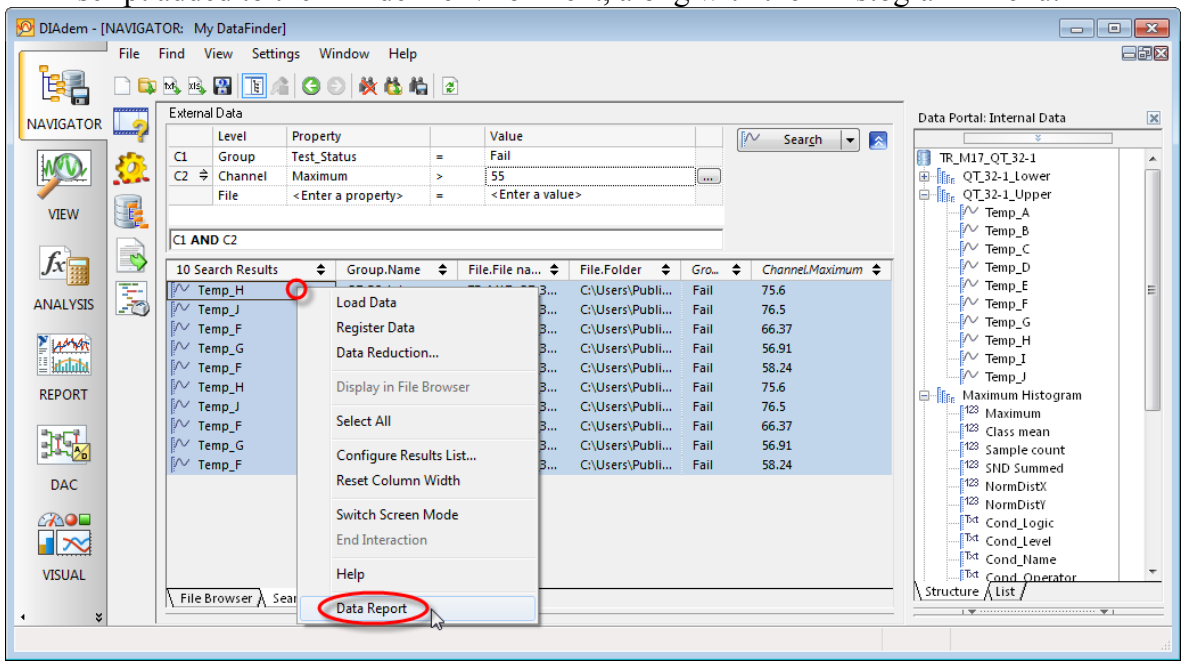


NOTE: Your queried data will look slightly different than the graph above

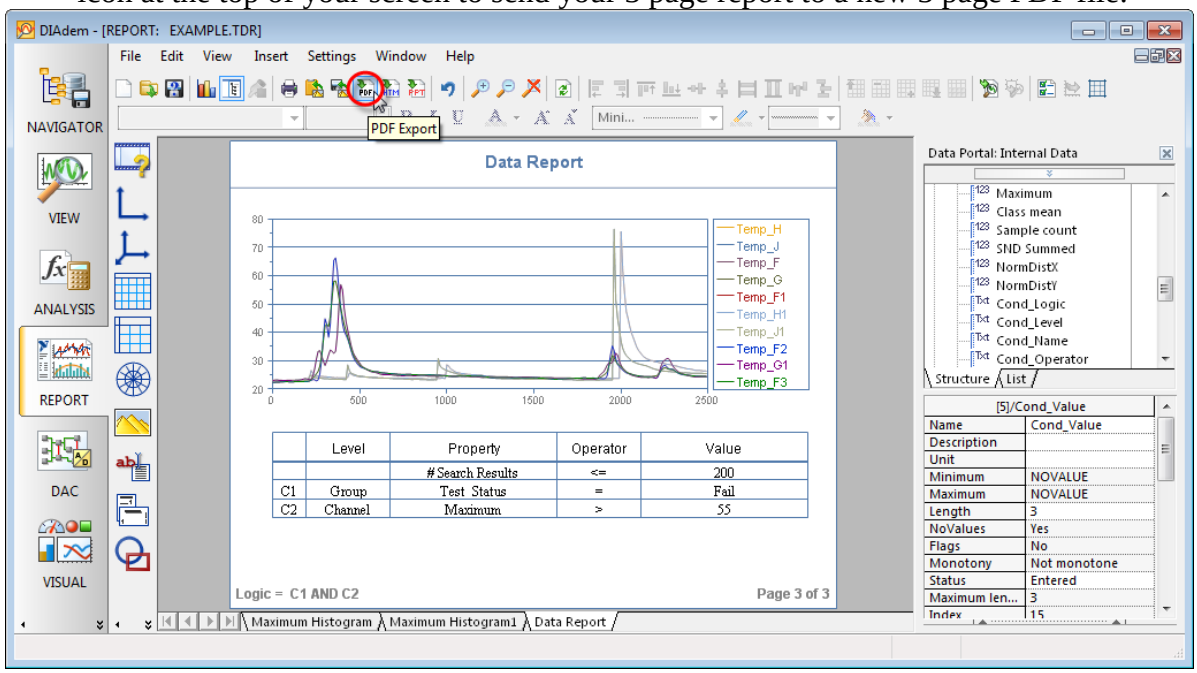
1.24 **Click** on the "**NAVIGATOR**" tab at the top left of your screen to switch back to the advanced search. You want to plot all of these out of range data channels, but first you need to highlight them all. **Right-click** on the "Search Results" column header, then **choose** the "**Select All**" **menu**.



1.25 Now **right-click** on a **cell in** the first **"Search Results"** column and **select** the "**Data Report**" **menu**. The first "Search Results" column represents the array of data in each channel. The "Data Report" menu is the second custom menu that your colleague's script added to the DIAdem environment, along with the "Histogram" menu.

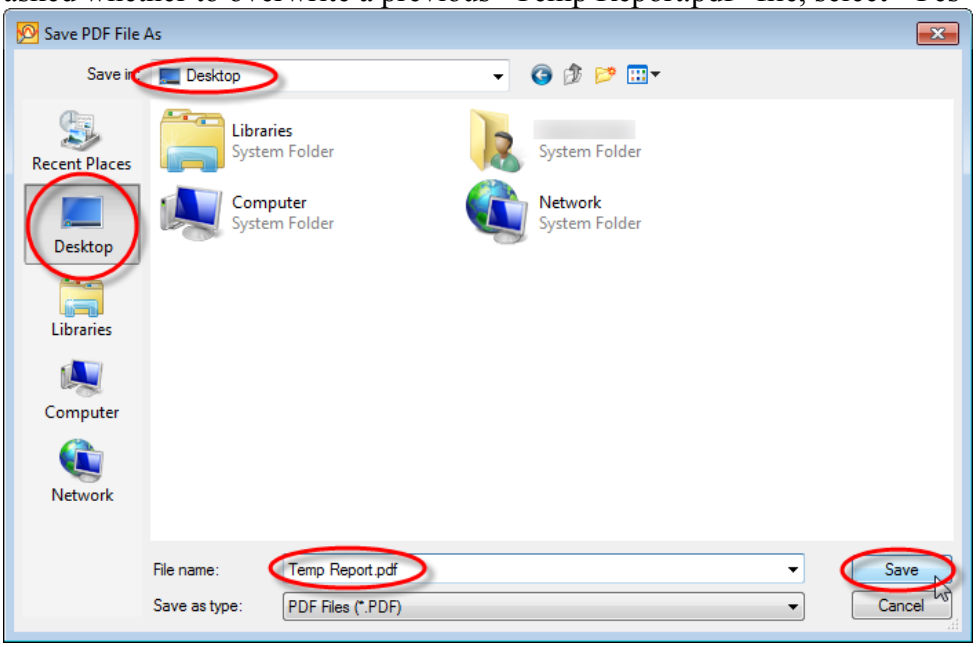


1.26 This custom "Data Report" menu automatically loads and plots the selected channels on a standard report. Now you have your initial results, and you need to email these back to your boss, who doesn't have DIAdem installed. **Click** on the "**PDF Export**" icon at the top of your screen to send your 3 page report to a new 3 page PDF file.

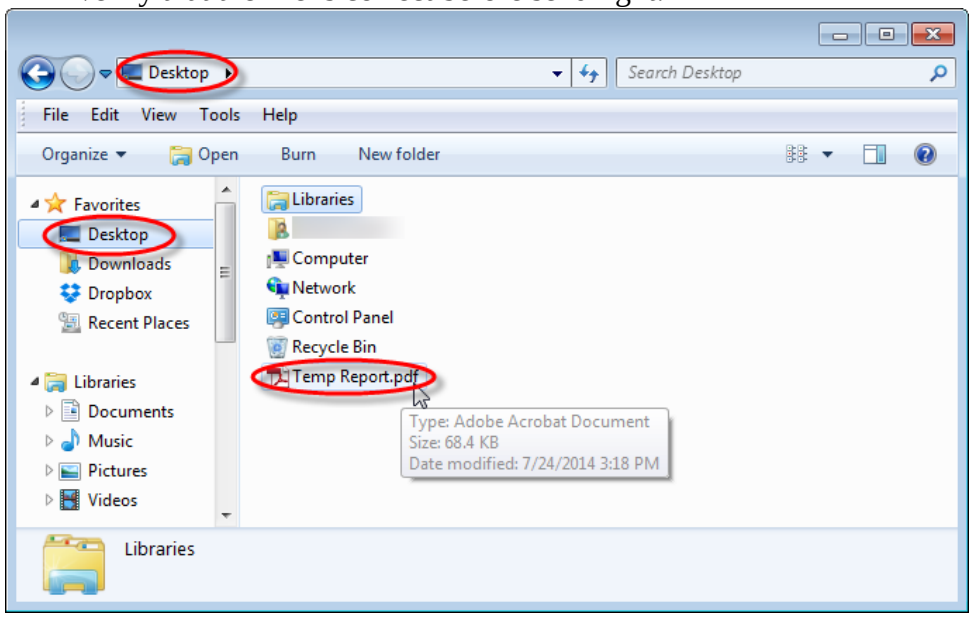


NOTE: Your queried data will look slightly different than the graph above

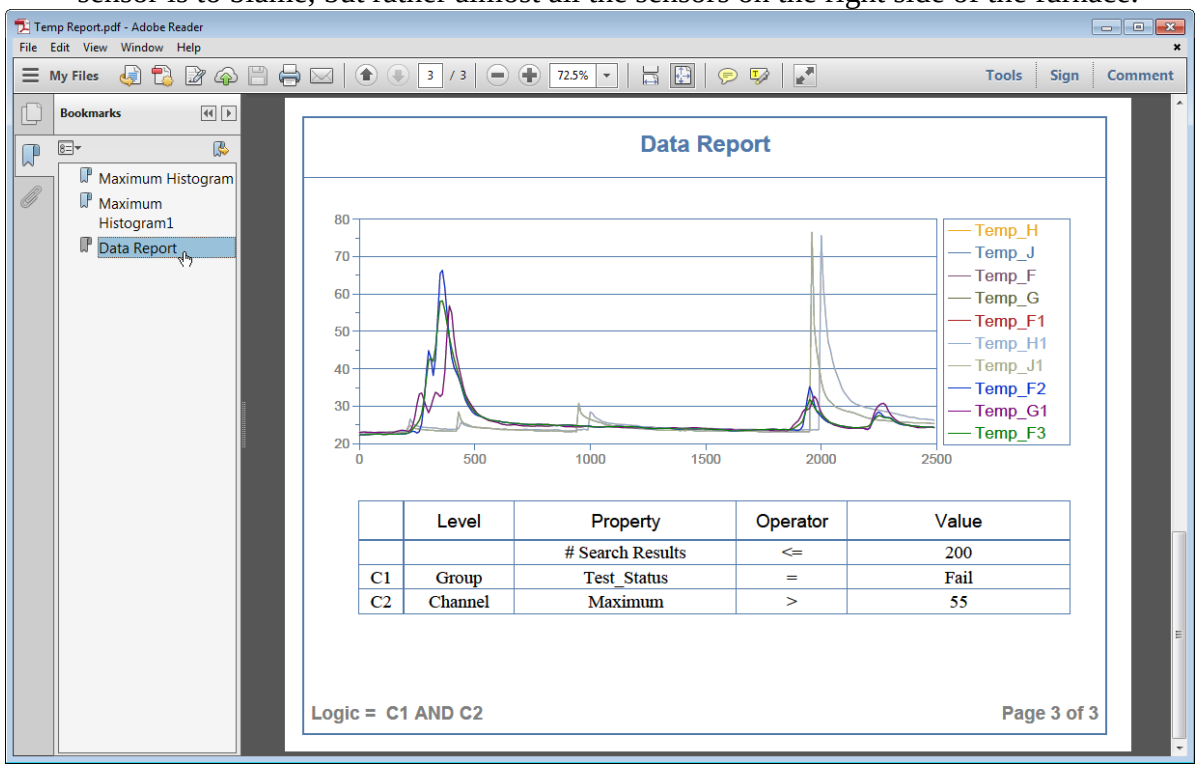
1.27 In the "Save PDF File As" dialog, **Navigate to** the **Desktop**, **name** the new **file** "**Temp Report.pdf**", then **click** on the "**Save**" button to create the new PDF report. If asked whether to overwrite a previous "Temp Report.pdf" file, select "Yes".



1.28 **Open** your **Windows Explorer**, navigate **to** the Desktop, then **double-click** on the newly created "**Temp Report.pdf**" file to open it up in a PDF file reader, in order to verify that the file is correct before sending it.



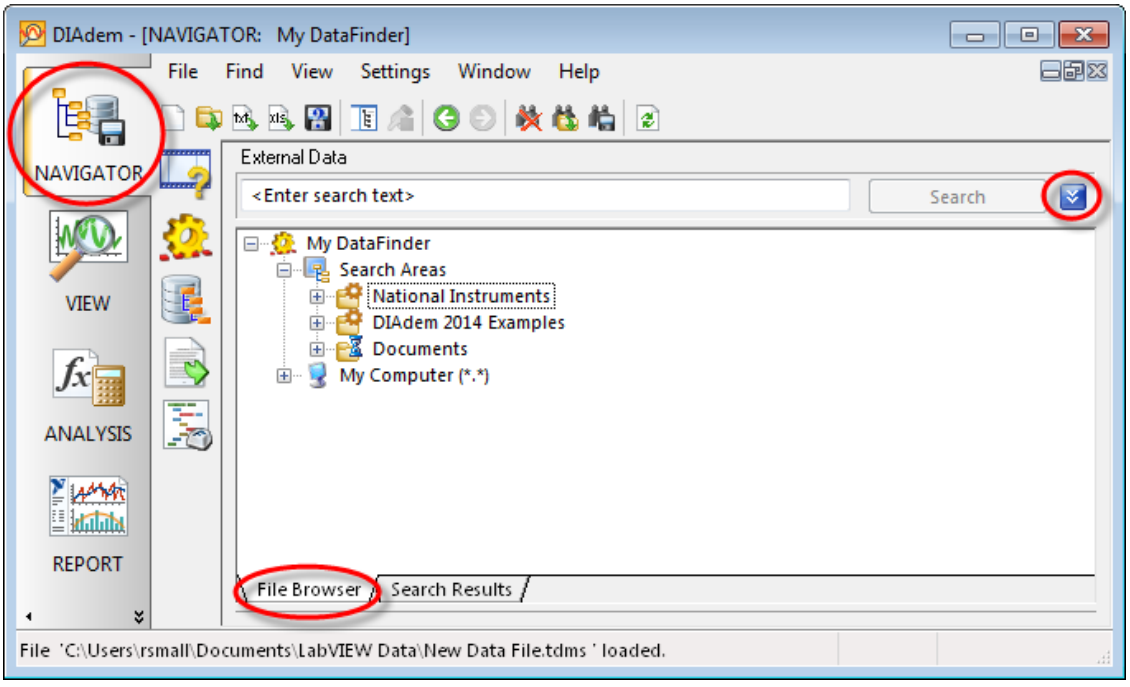
1.29 Here are the 3 report pages you just created in DIAdem, faithfully encoded in a manager-friendly PDF file. Notice the names of the furthest-out-of-range sensors pictured below (on the 3rd page of your report). You have "Temp_F", "Temp_G", "Temp_H" and "Temp_J". Sensors A – E are on the left side of your furnace, and sensors F – K are on the right side of your furnace. It doesn't look like only one sensor is to blame, but rather almost all the sensors on the right side of the furnace.



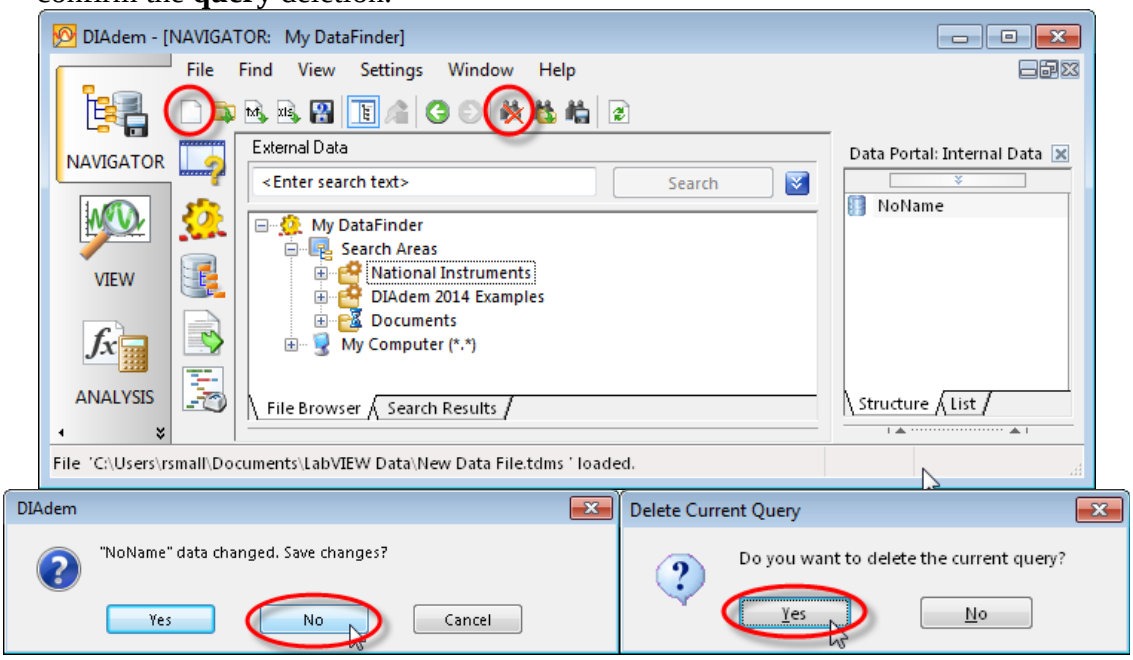
Exercise #2 Data Mining and Interactive Reporting

Scenario: You have been asked to hand-craft a special report of the excessively hot furnace temperatures in recent test runs. Your boss is particularly concerned that the furnaces could have been damaged by these unexpectedly high thermal profiles. You need to create a report that shows the raw data from all over-limit channels, a table of possibly pertinent properties to look for the cause, and proof that no part of any furnace had a temperature swing of more than 60°C. You will use the DataFinder to locate all the out-of-range temperature data. You will manually import both the raw data and the properties from the DataFinder into channels in the Data Portal. You will calculate the temperature swing of each out-of-range channel and manually create graphs of the data traces and a table of the property values. Finally, you will output this report to an HTML page so that you can post your findings for others to view.

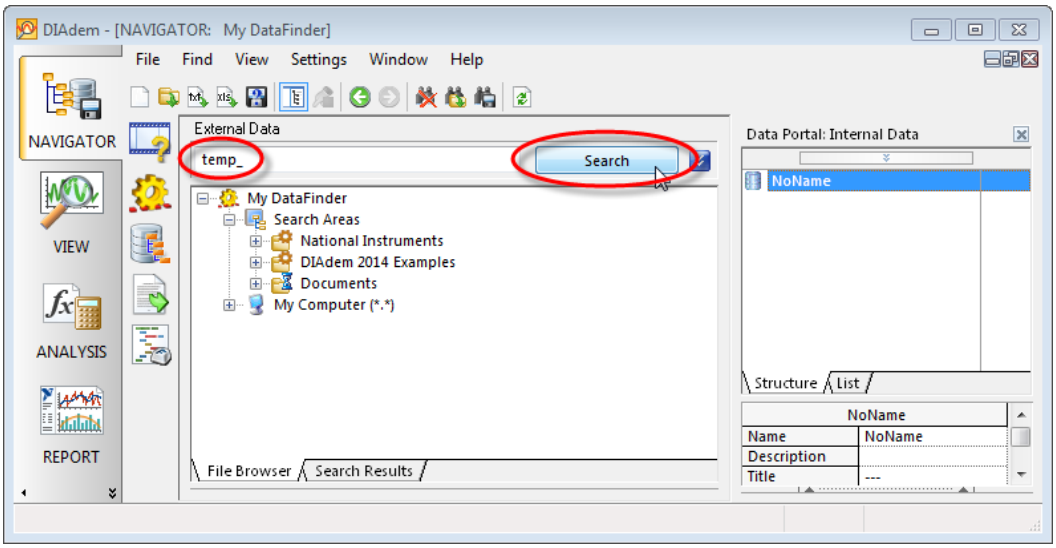
2.1 First get ready to search in DIAdem. Make sure that the "**NAVIGATOR**" tab at the top left of your screen is selected. Next make sure the "**File Browser**" tab is selected at the bottom left of your screen. Finally, if you don't see the **simple search bar** (pictured below with the text "<Enter text to find in search areas>"), then click on the toggle button at the top right of your screen to switch back to the simple search shown below.



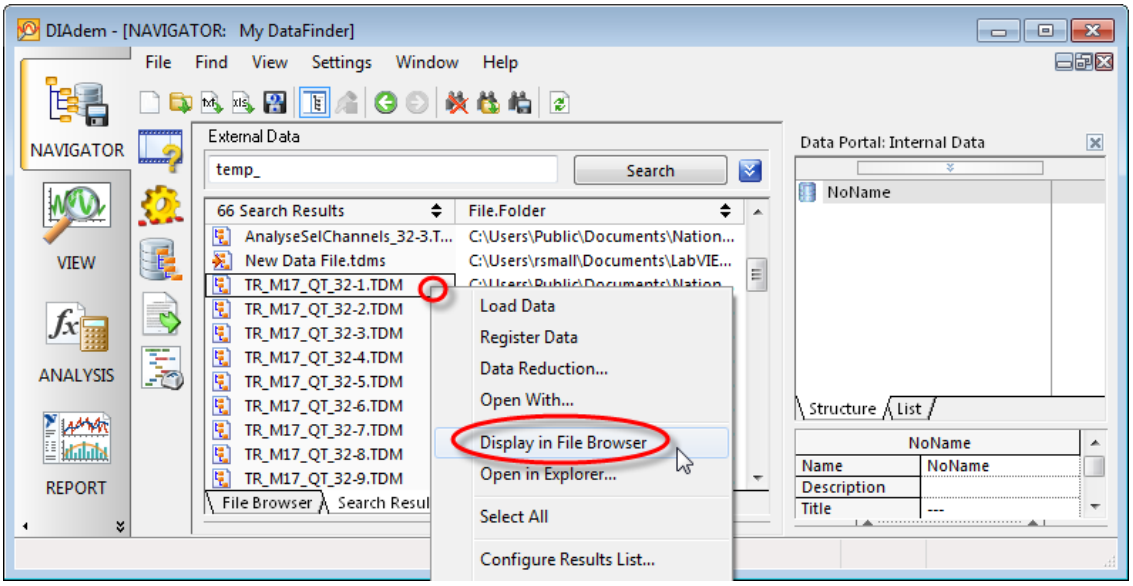
2.2 **Click** on the "**Delete Internal Data**" icon at the top left of your screen to delete any data currently loaded in DIAdem. Notice that now the Data Portal to the right of your screen is empty. **Click** on the "**Delete Query**" icon at the top of your screen to reset the DataFinder query to the empty query pictured below. **Select** the "**No**" button when asked to save changes to the previous **data**, and **select** the "**Yes**" button when asked to confirm the **query** deletion.



2.3 You know that all the furnace temperature channels have a name starting with "Temp_". **Type "Temp_"** into the search text area and hit the <Enter> key on your keyboard or **click** on the "**Search**" button to have the DataFinder locate all the files with at least one such channel.

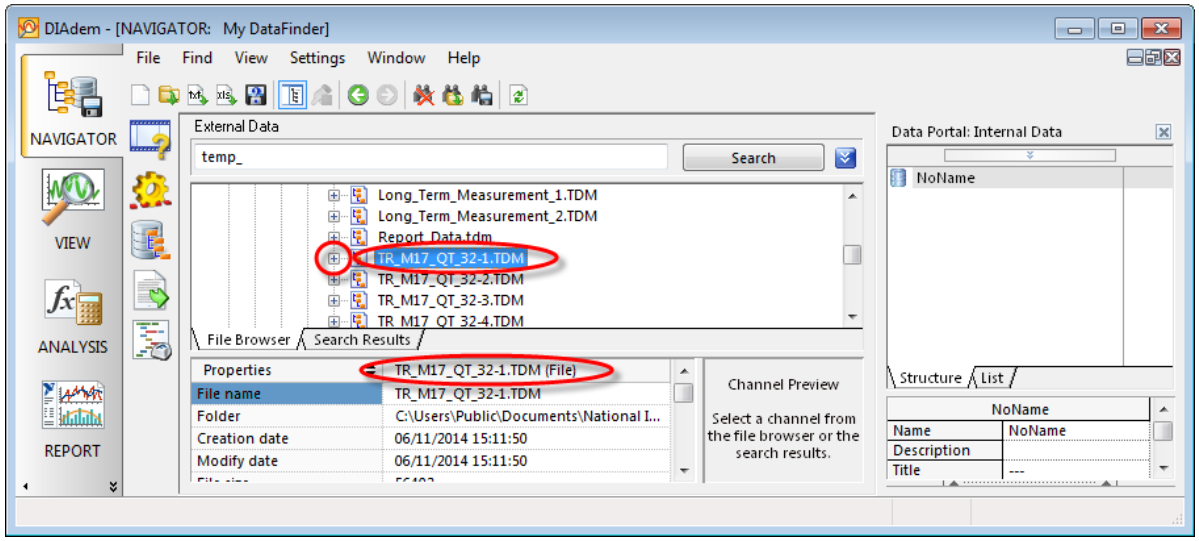


2.4 The DataFinder simple text search always returns a list of files in the search results table, even if the text searched for was found in a group or channel property. You can look inside any of these files without loading them into DIAdem by finding them in the NAVIGATOR file browser. **Right-click** on the first TDM file that has a name starting with **"TR_"** and **select** the **"Display in File Browser"** menu in order to automatically find this file in the NAVIGATOR file browser.

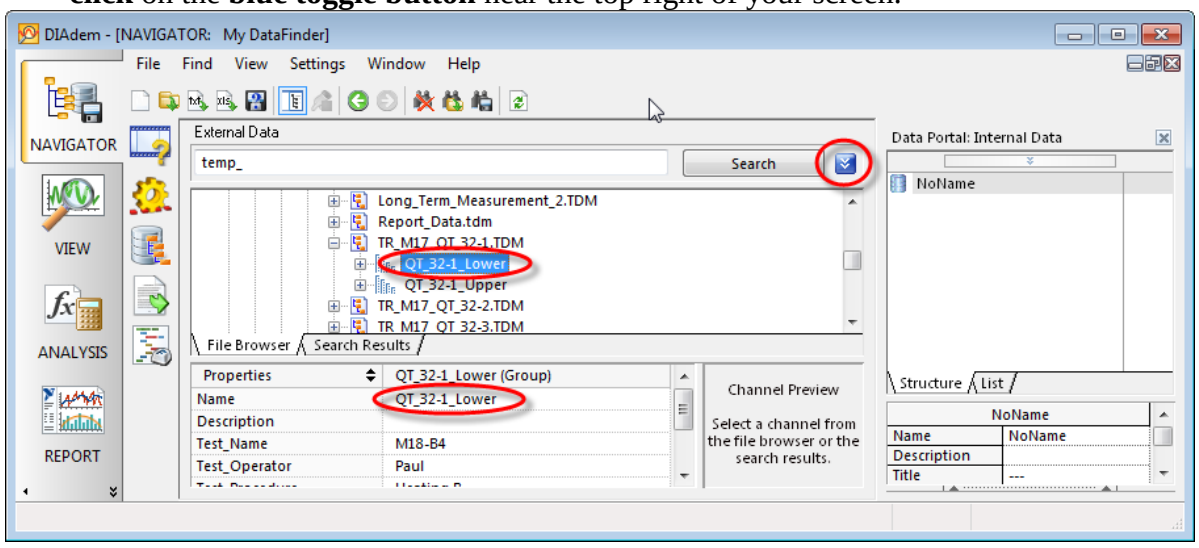


NOTE: The first column of the Search Results list is different from the others. The first column (pictured above with the heading "70 Search Results") represents the data array stored with every channel— the actual measured values. Every other column (such as the "File.Folder" column pictured above) represents a single scalar property stored with every file. You will likely have a different number of search results than pictured.

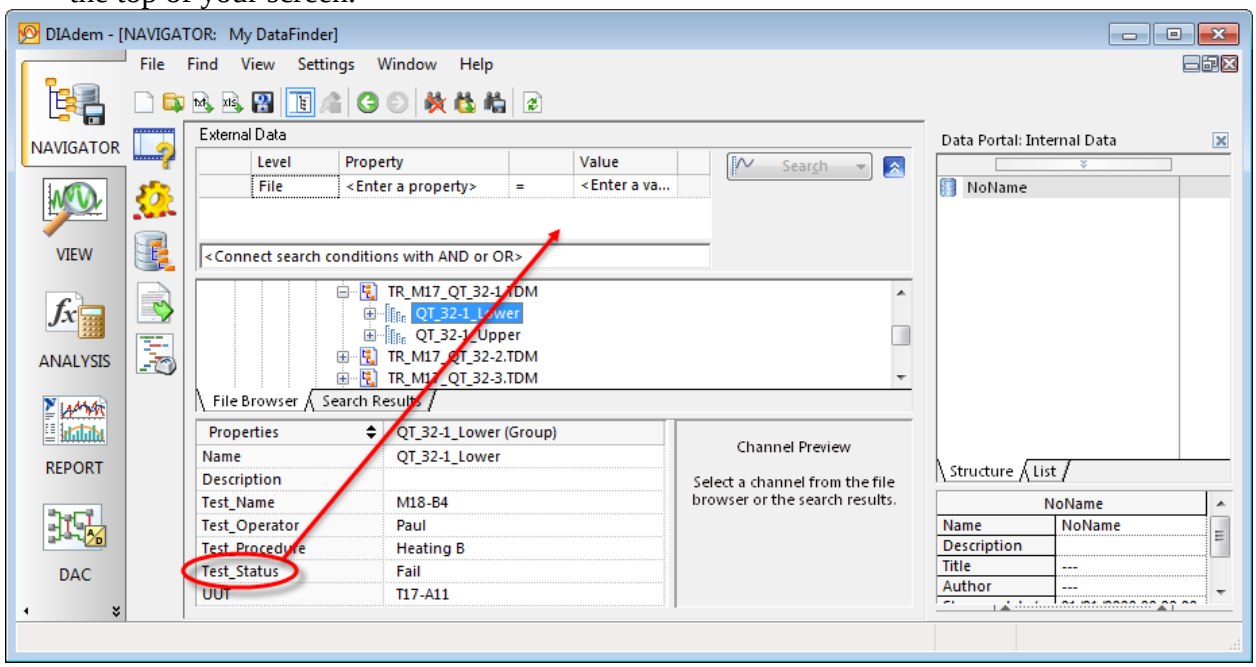
2.5 Here is the first "TR_...TDM" file you found with the simple search shown in the NAVIGATOR file browser. Note that when a file is highlighted in the tree view you can see its file properties in the property table at the bottom of your screen. Now you can **click** on the **"+" sign** to the left of this file to open it up and **display** all the **groups** inside it in the NAVIGATOR tree view.



2.6 Here you see that this "TR_...TDM" file has two groups, corresponding to the sensors on the lower half of the furnace and those on the upper half of the furnace. **Select** the "**…_Lower**" group in order to review its properties in the property window at the bottom of your screen. You want to search for all sensor groups where Test_Status = Fail. For this, you need the DataFinder advanced search, which you can get if you **click** on the **blue toggle button** near the top right of your screen.

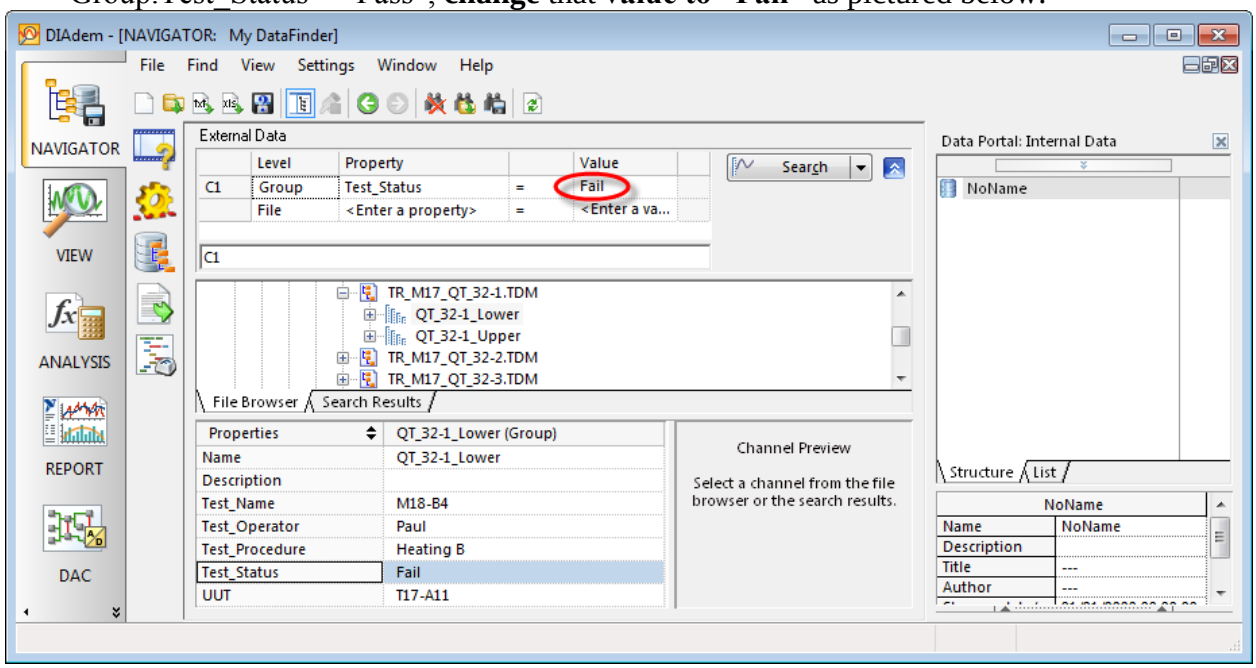


2.7 The easiest way to add this query condition is to **drag** the "**Test_Status**" property from the property window at the bottom of your screen **into** the **search conditions** table at the top of your screen.

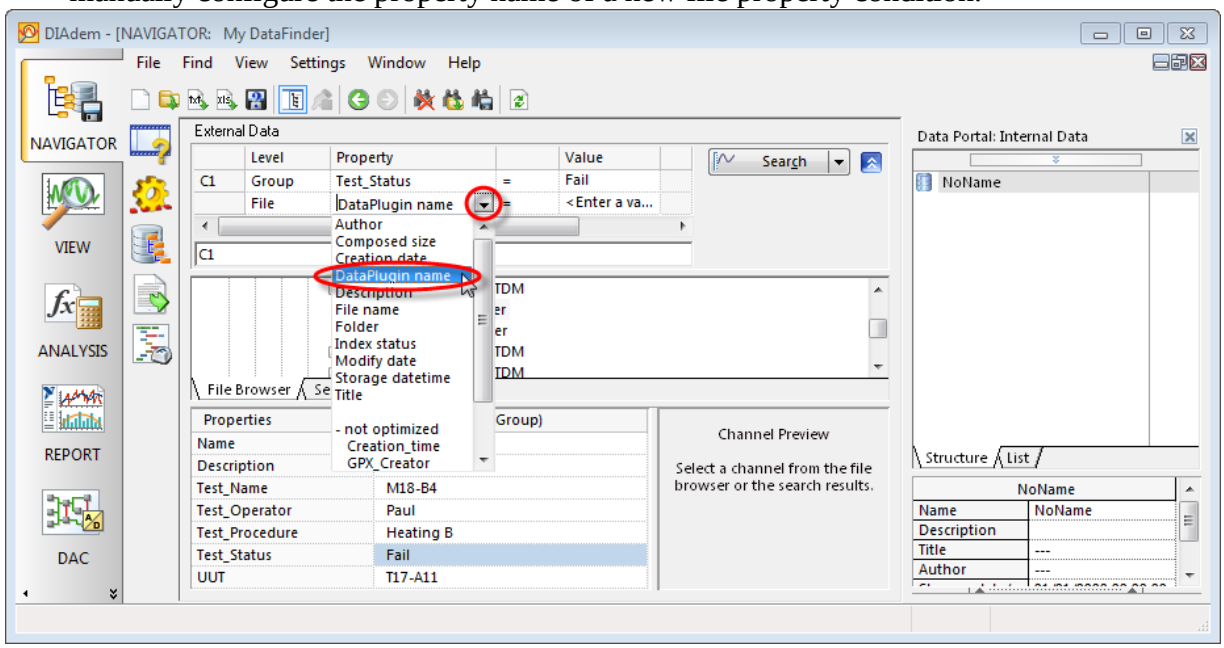


NOTE: You must drag the property from its property name field (in this case the "Test_Status" field).

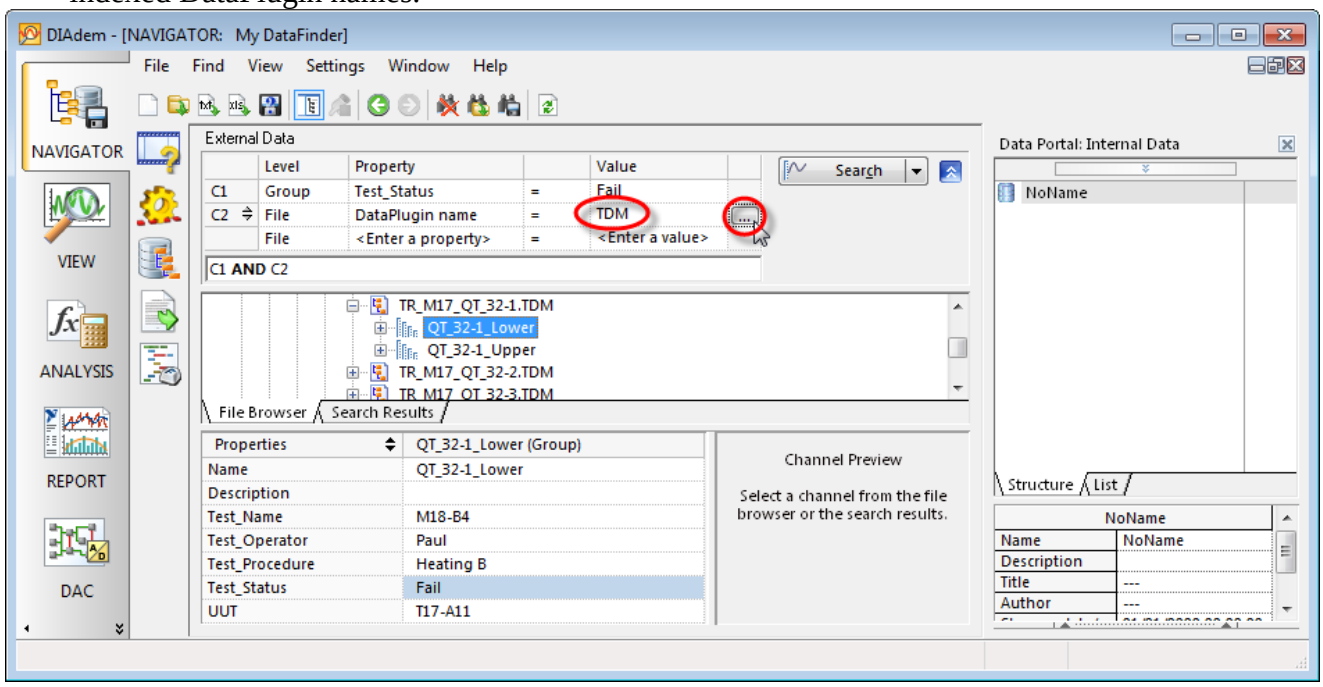
2.8 Now you see that there is a new condition inserted in the search conditions table which exactly matches the group "Test_Status" property you dragged from the property window. If you happened to drag from a Group that had the property state Group.Test_Status = "Pass", **change** that **value to "Fail"** as pictured below.



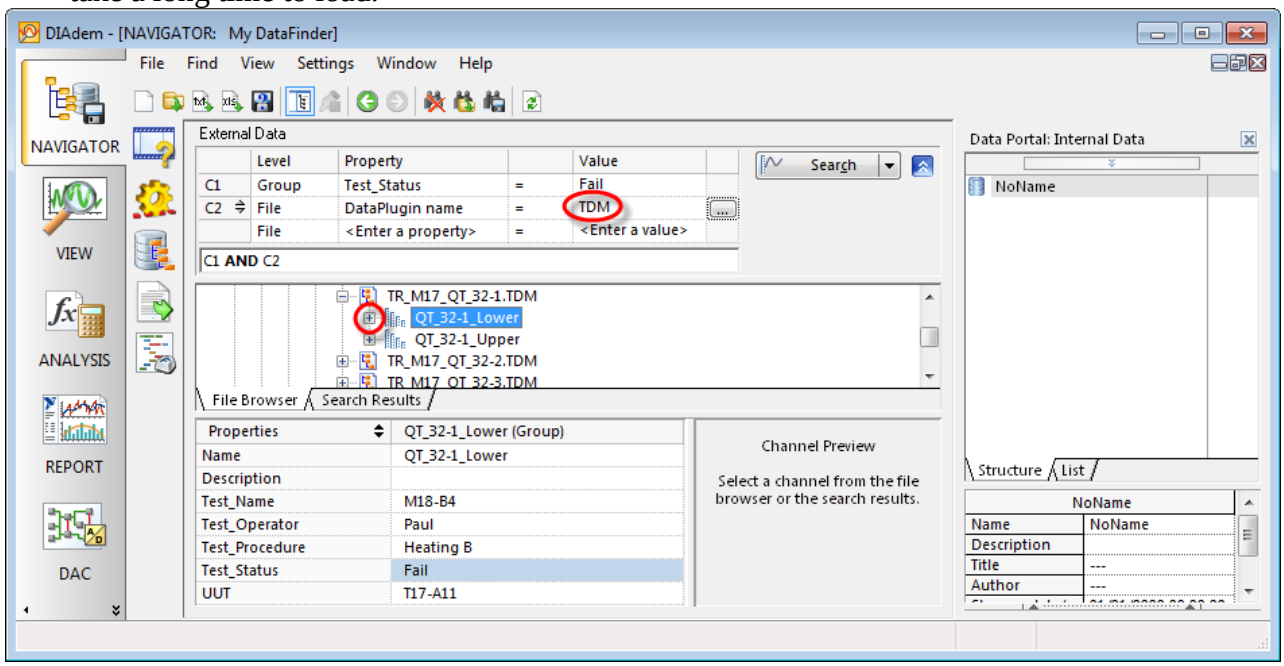
2.9 You noticed in your earlier search results that a number of non-TDM files appeared, which you would like to exclude. **Click** on the **"<Enter a Property>"** field in the "Property" column and select the **"DataPlugin name"** file property in the drop list to manually configure the property name of a new file property condition.



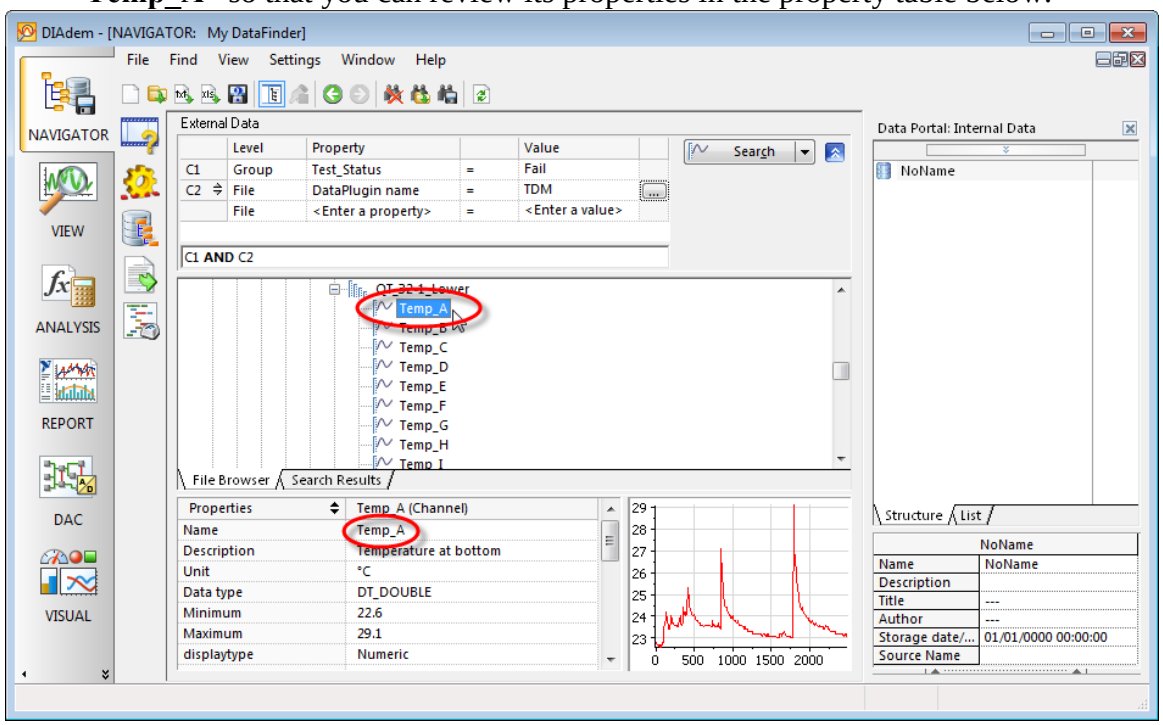
2.10 To complete the DataPlugin name condition, you need to require that it equal "TDM", so **double-click** in the **"Value" field** to the right of the "DataPlugin name" condition and **type** in **"TDM"**, then hit the <Enter> key on your keyboard. You can alternatively click on the […] button to the right of the "Value" field and select from a drop list of indexed DataPlugin names.



2.11 Now **click** on the **"+" sign** to the left of the first group in the tree view to open it up and **display** all the **channels** inside. In this way you can browse the entire hierarchy (File >> Groups >> Channels) and property structure of the file without ever having to load it into DIAdem. This is particularly useful when the file is very large and would take a long time to load.

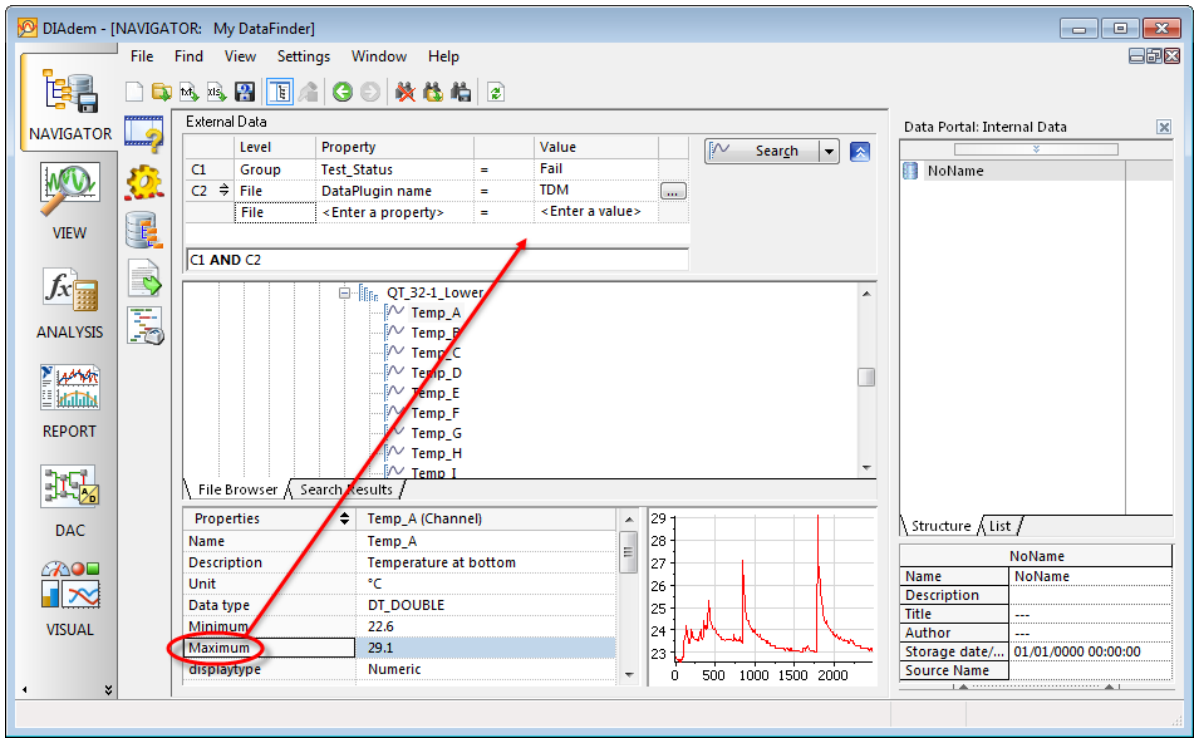


2.12 Now you see all the "Temp_..." channels in this group, any one of which would have single-handedly satisfied your original simple query. **Select** the first **channel**, **"Temp_A"** so that you can review its properties in the property table below.



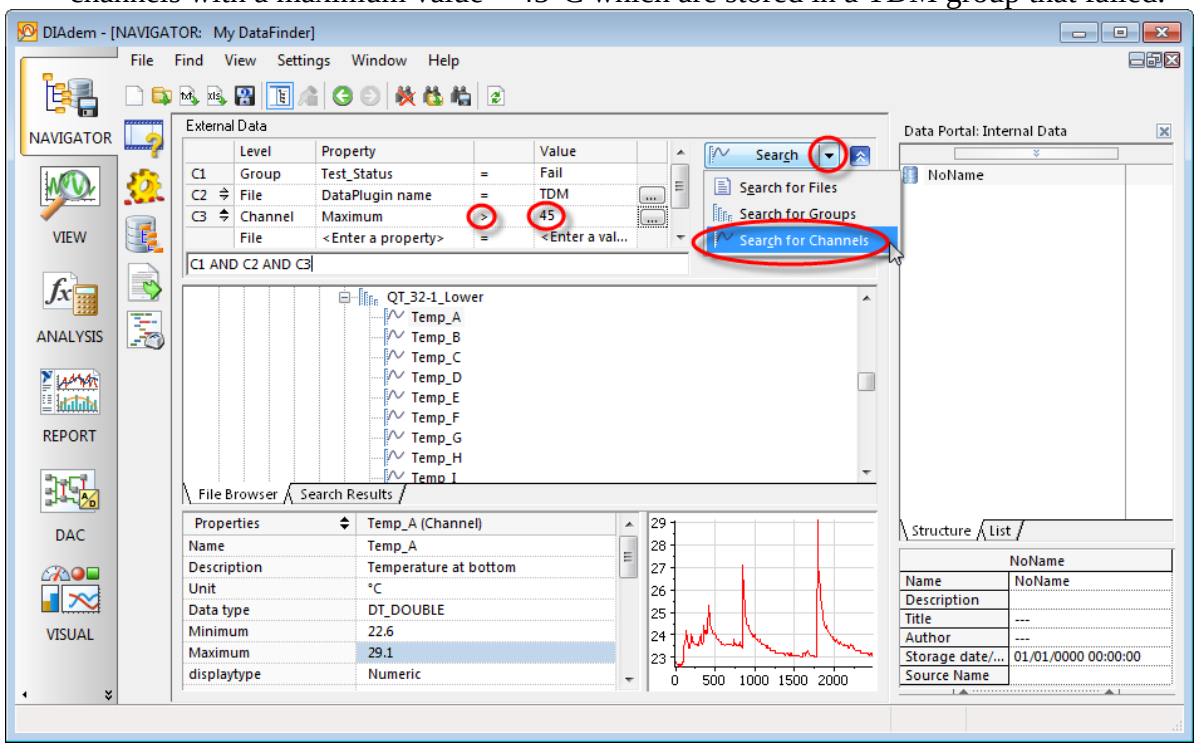
NOTE: When you select a channel, you get an immediate preview of that channel's waveform in the preview window at the bottom right of your screen.

2.13 You need to search for just the channels which have an out-of-range maximum value (> 45°C), so **drag** the **"Maximum" property** from the property window below **into** the **search conditions** table above.

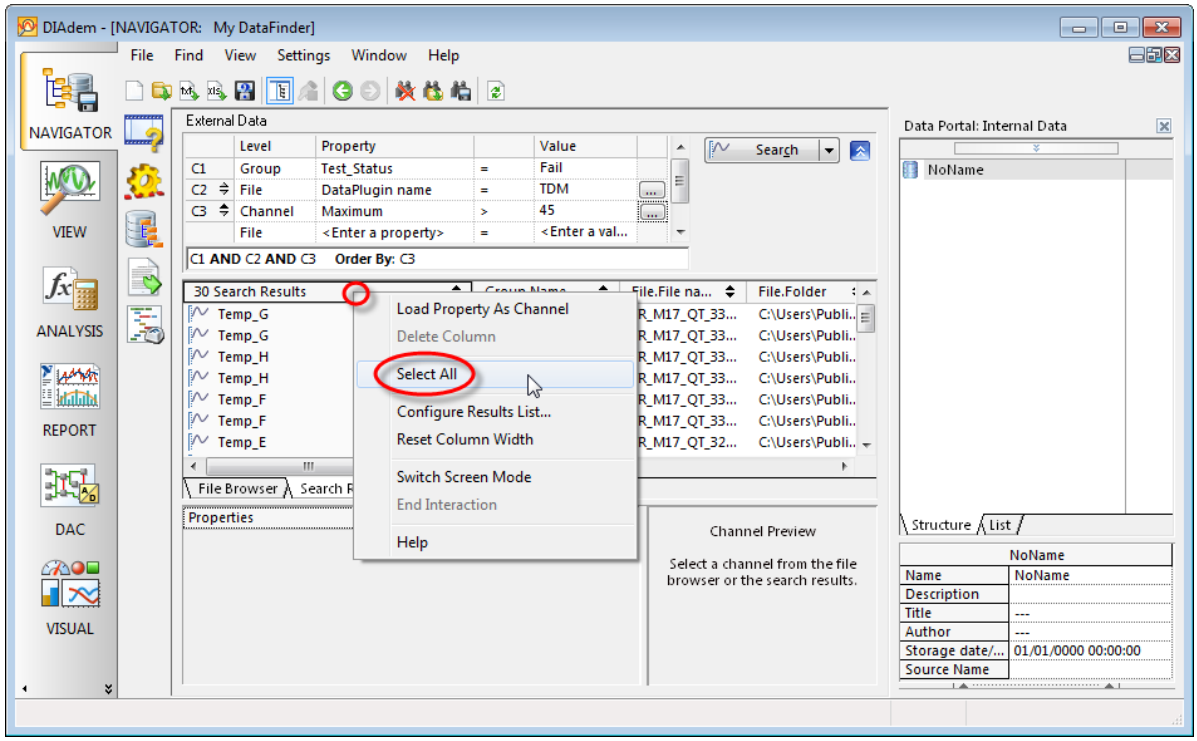


NOTE: You must drag the property from its property name field (in this case the "Maximum" field).

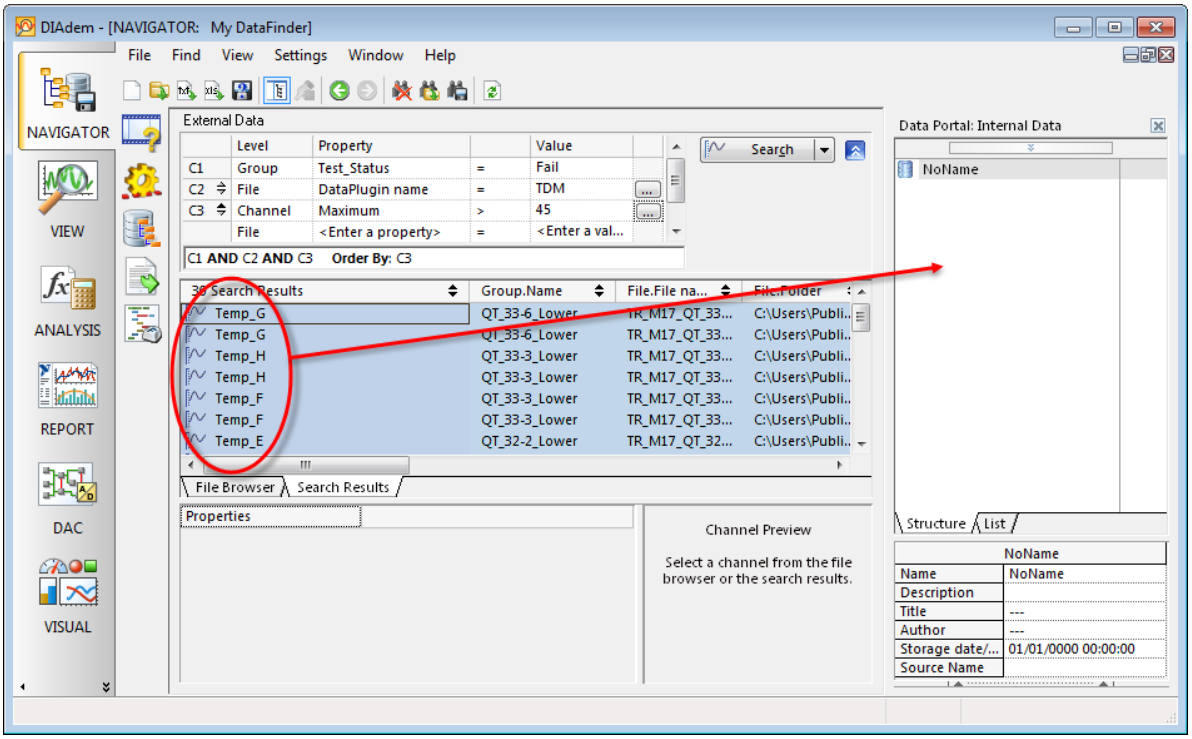
2.14 This time neither the comparison operator nor the property value of the new condition are quite right. **Change** the channel **maximum operator** from **"=" to ">",** then **change** the comparison **value to 45** (°C). **Click** on the **enumeration icon** at the far right of the "Search" button and **select** "**Search for Channels**" to search for all the channels with a maximum value > 45°C which are stored in a TDM group that failed.



2.15 You need to select all of these out-of-range temperature traces so that you can load them into DIAdem. **Right-click** the first **"Search Results" column** and **choose** the **"Select All" menu**.

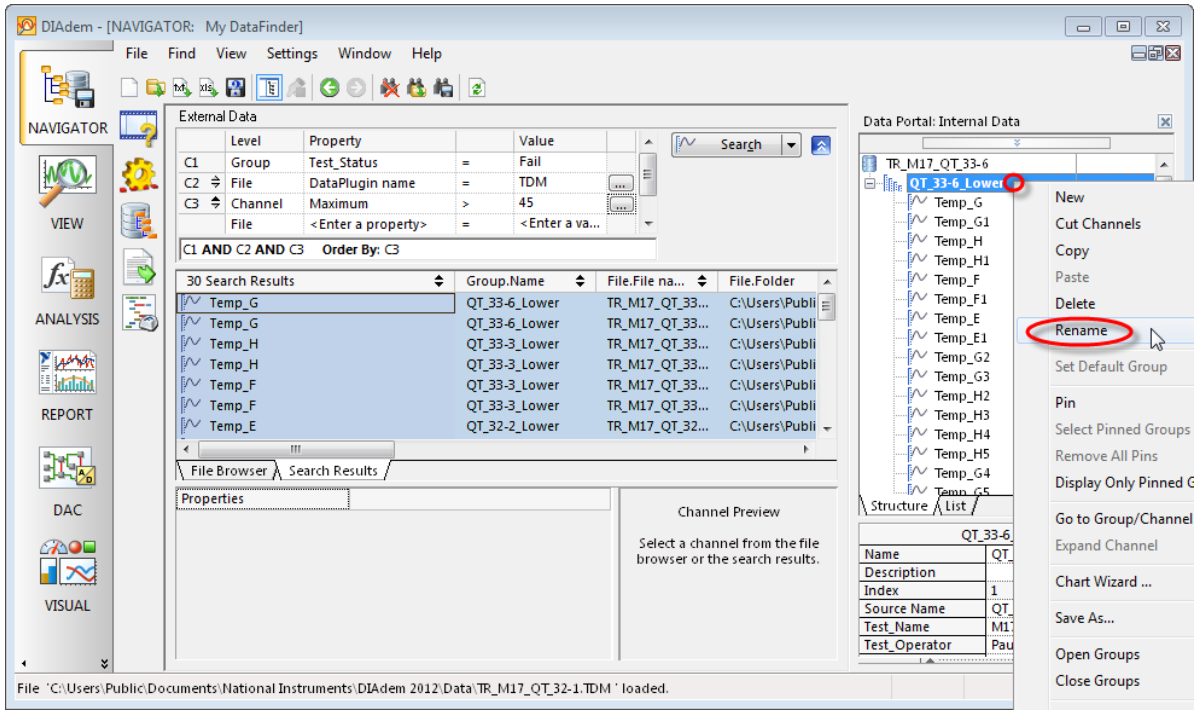


2.16 Now **drag all** the selected **channels** from the search results table in the center of your screen **into** the **Data Portal** on the right side of your screen. This loads all the data values for these channels.

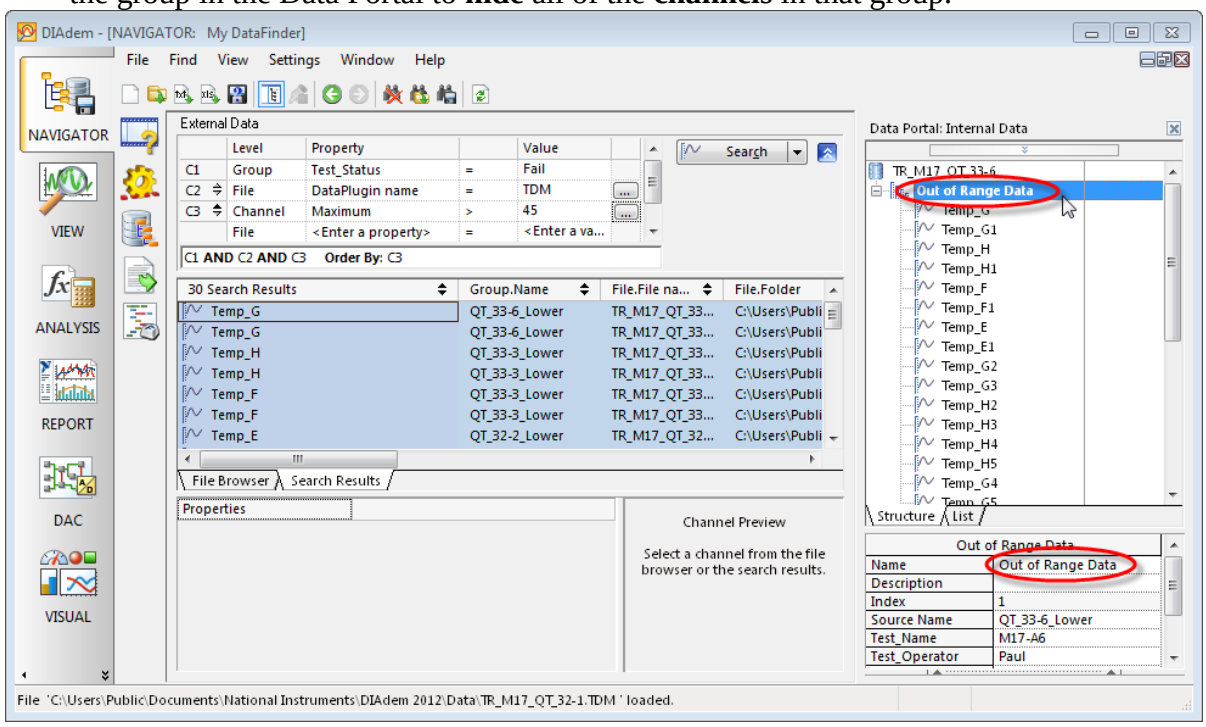


NOTE: You must drag from the first column as shown above or you will lose your channel selection.

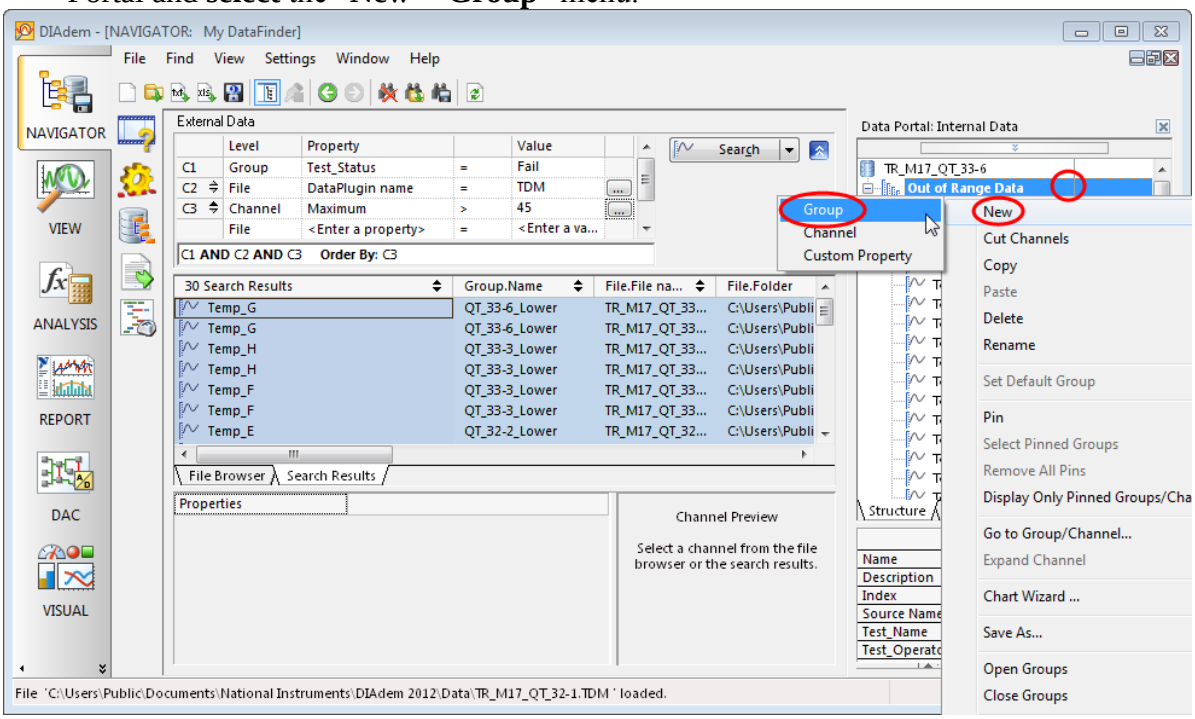
2.17 DIAdem loads all these channels from their respective files into one group in the Data Portal and automatically avoids any duplicate channel names by adding an enumeration suffix to the channel name (i.e. Temp_H1). DIAdem automatically names the group to be that of the first channel loaded, but most of these channels came from different groups. **Right-click** on the group and **select** the "**Rename**" menu to assign the group a more accurate name.



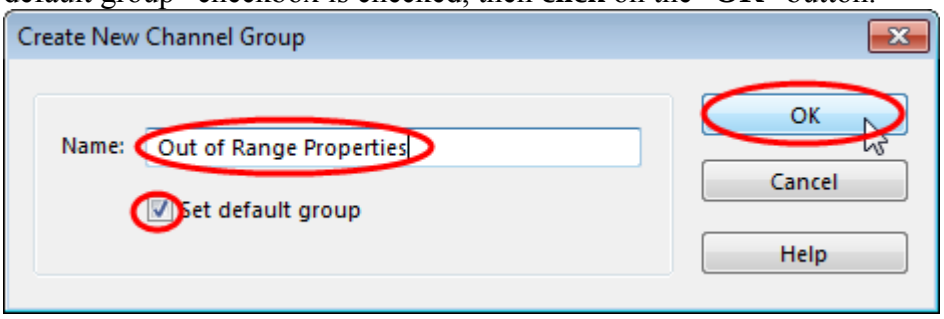
2.18 Type in the text "**Out of Range Data**" as the new group name and hit the <Enter> key on your keyboard to assign the new group name, then **click** on the **"-" sign** to the left of the group in the Data Portal to **hide** all of the **channels** in that group.



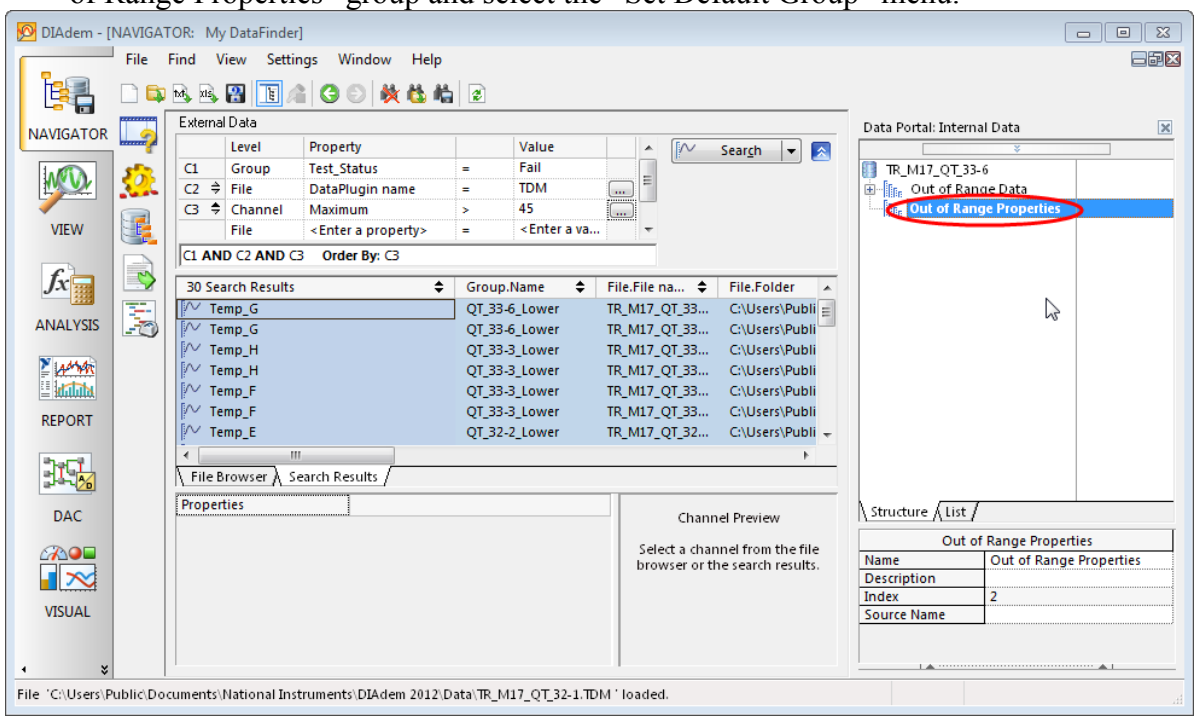
2.19 Now that all the temperature traces are loaded, the next step is to load all the measurement properties for the out-of-range data. It will be convenient for these properties to go to channels in a new group. **Right-click** on the **group** in the Data Portal and **select** the "**New>>Group**" menu.



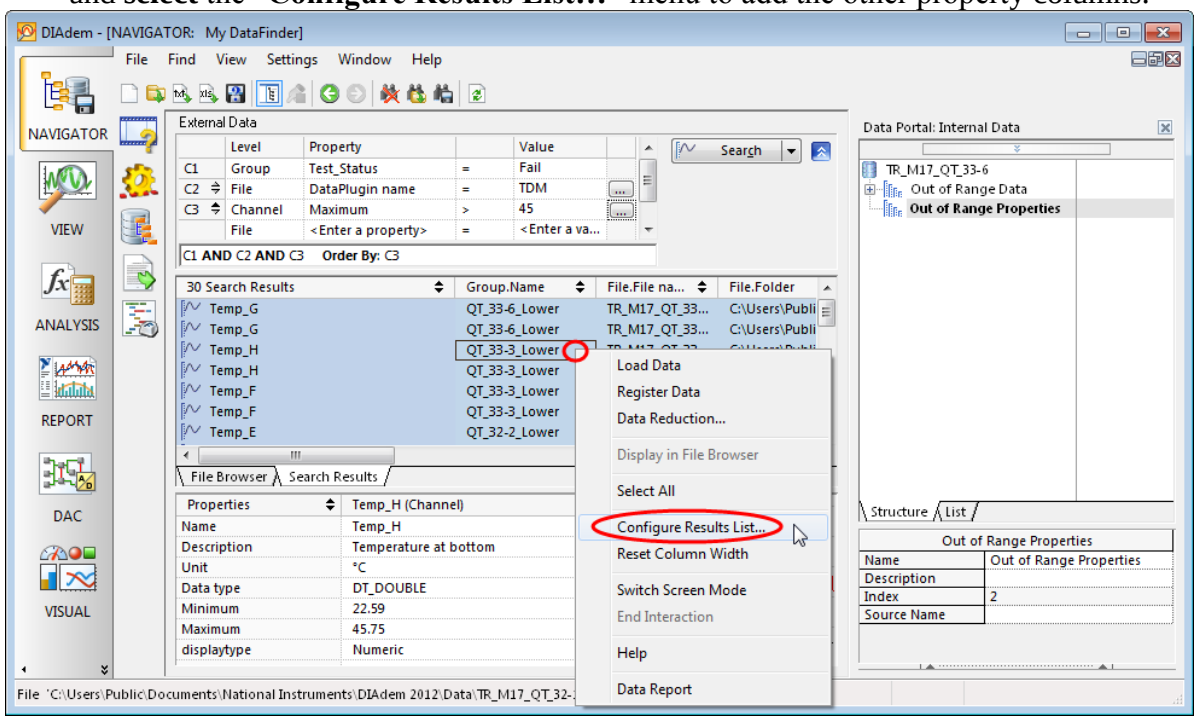
2.20 Type in "**Out of Range Properties**" to name the new group, make sure the "Set default group" checkbox is checked, then **click** on the "**OK**" button.



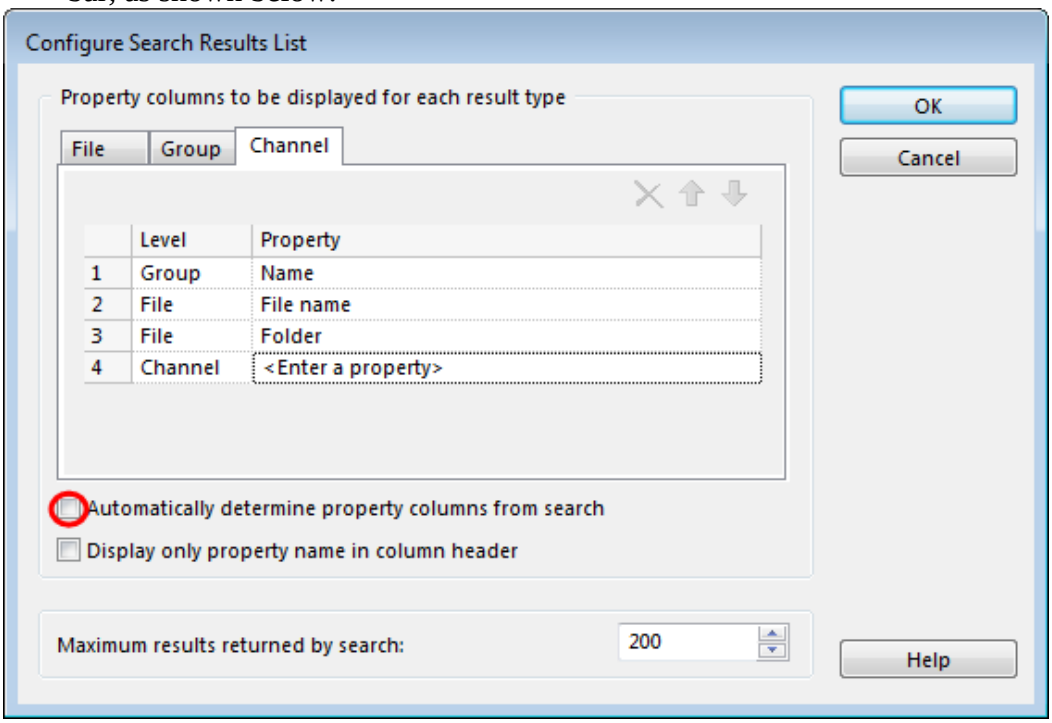
2.21 Notice that the new **"Out of Range Properties"** group you just created is in bold type, while the old "Out of Range Data" group is in normal type. This tells you that the "Out of Range Properties" group is the default group in the Data Portal, and any newly imported channels will be assigned to it, which is exactly what you want. If the "Out of Range Properties" group happens not to be bold, you need to right-click on the "Out of Range Properties" group and select the "Set Default Group" menu.



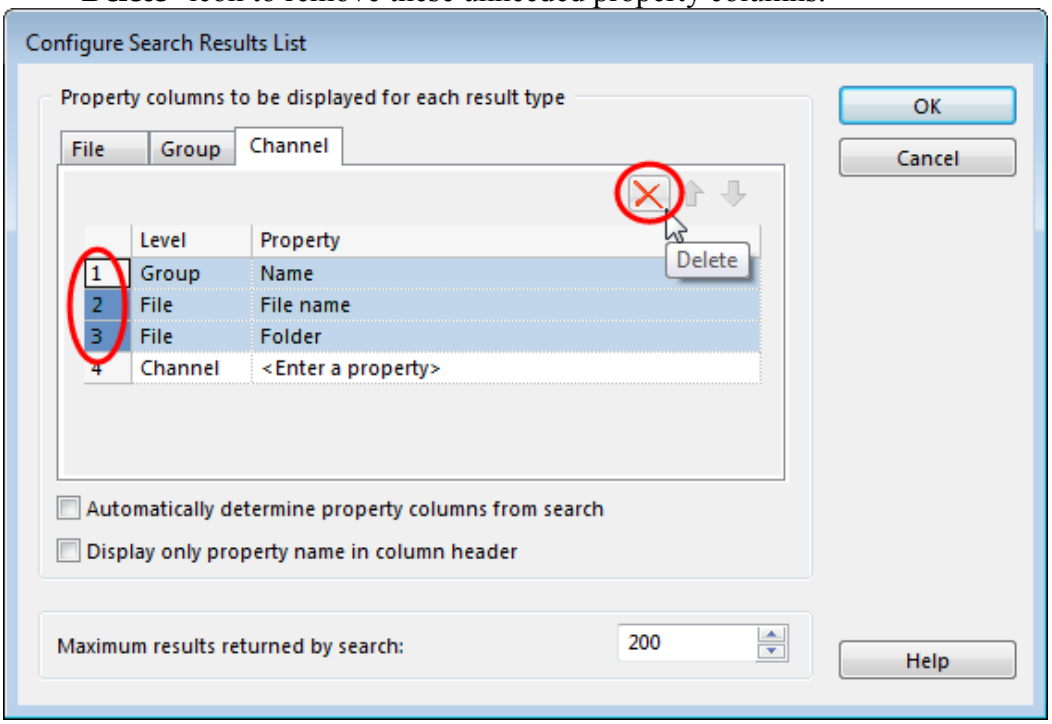
2.22 The properties you want to import should show up in the search results table as columns, like the Channel.Maximum property. **Right-click** on the search results table and **select** the "**Configure Results List…**" menu to add the other property columns.



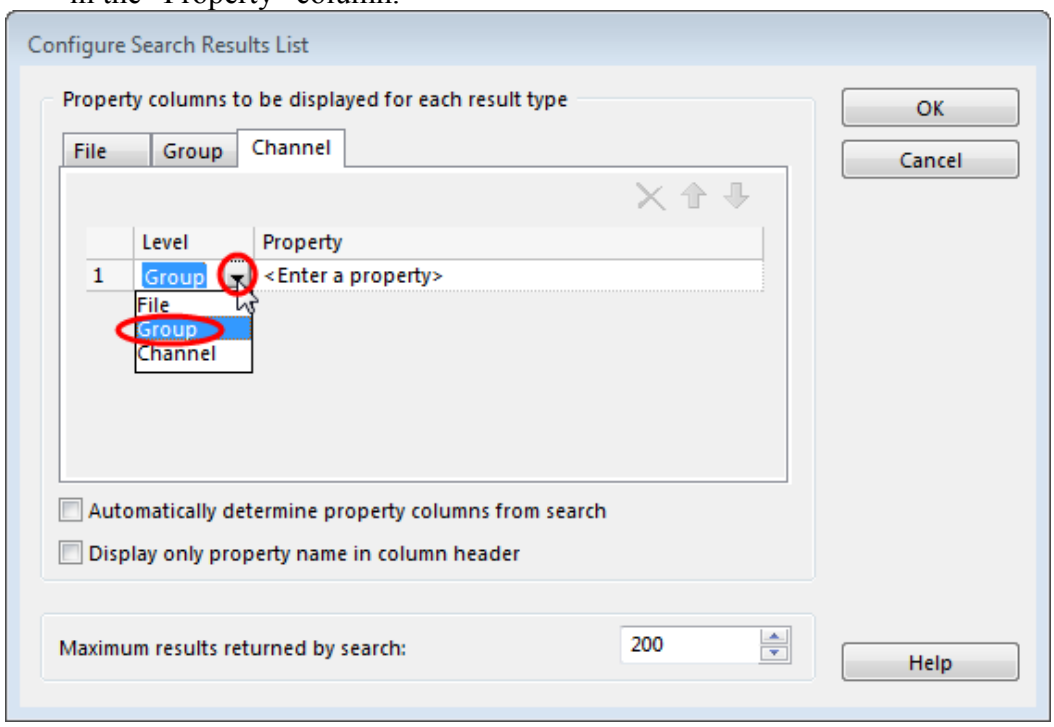
2.23 By default, any search conditions you enter automatically result in that property showing up in the search results table as a new property column. **Uncheck** that **checkbox** in the lower left of this dialog to cancel this effect so that you can manually select only the property columns you need to import. Then place your mouse at the top of the dialog and **drag the dialog taller** until all the properties appear with no scroll bar, as shown below.



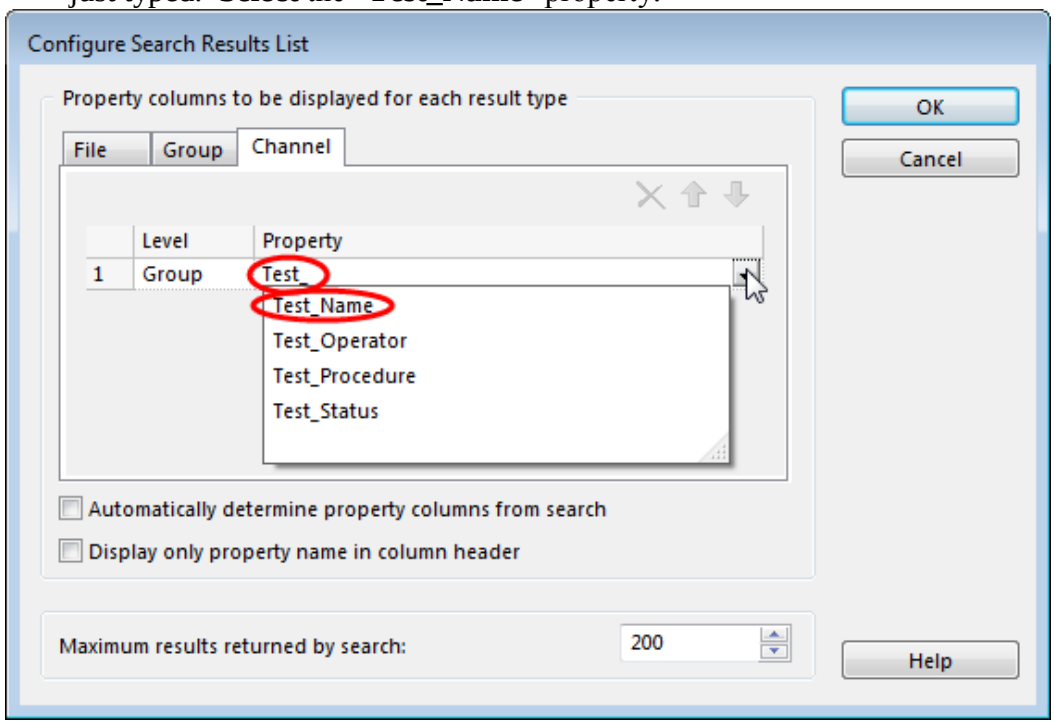
2.24 None of the remaining properties are ones you care about in building your report. **Select all but the <Enter a property> row** in the below table and **click** on the red **X** "**Delete**" icon to remove these unneeded property columns.



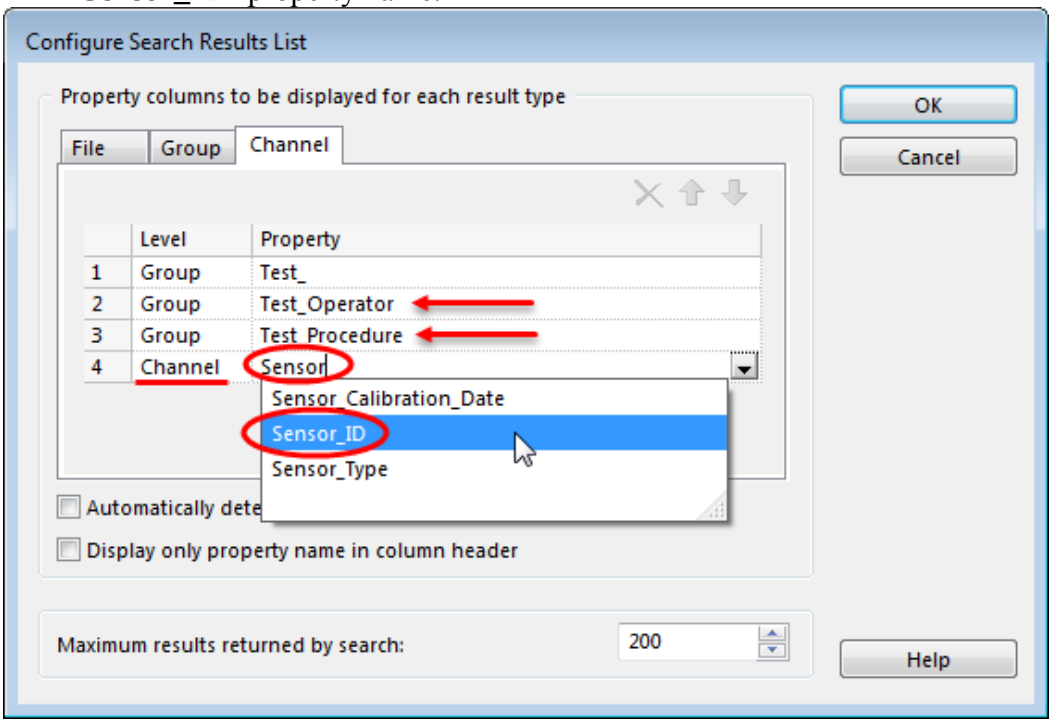
2.25 The first set of property columns you want to add are at the group level. **Click** at the right of the "Level" column and an **enumeration icon** will appear, then **select** the "**Group**" level from the drop-down list. Now only group property names will show up in the "Property" column.



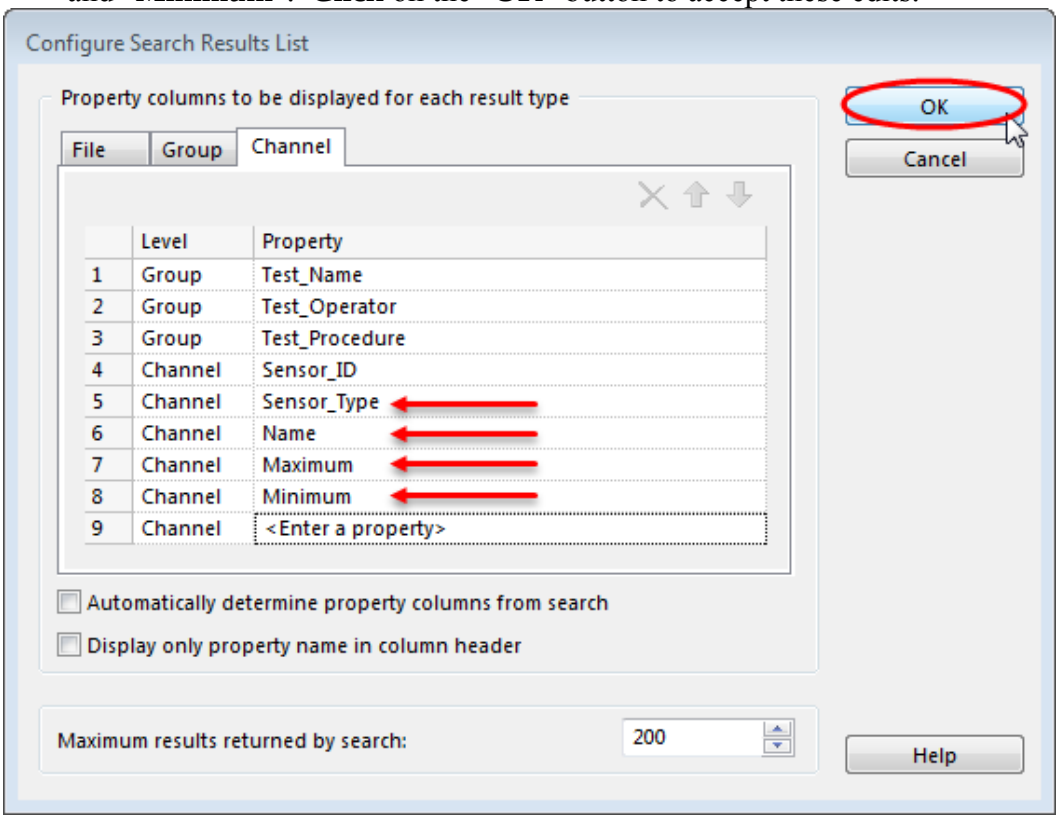
2.26 Double-click on the **property value field** and **type** in "**Test_**". You will see that a pick-list of matching group property names automatically appears below the text you just typed. **Select** the "**Test_Name**" property.



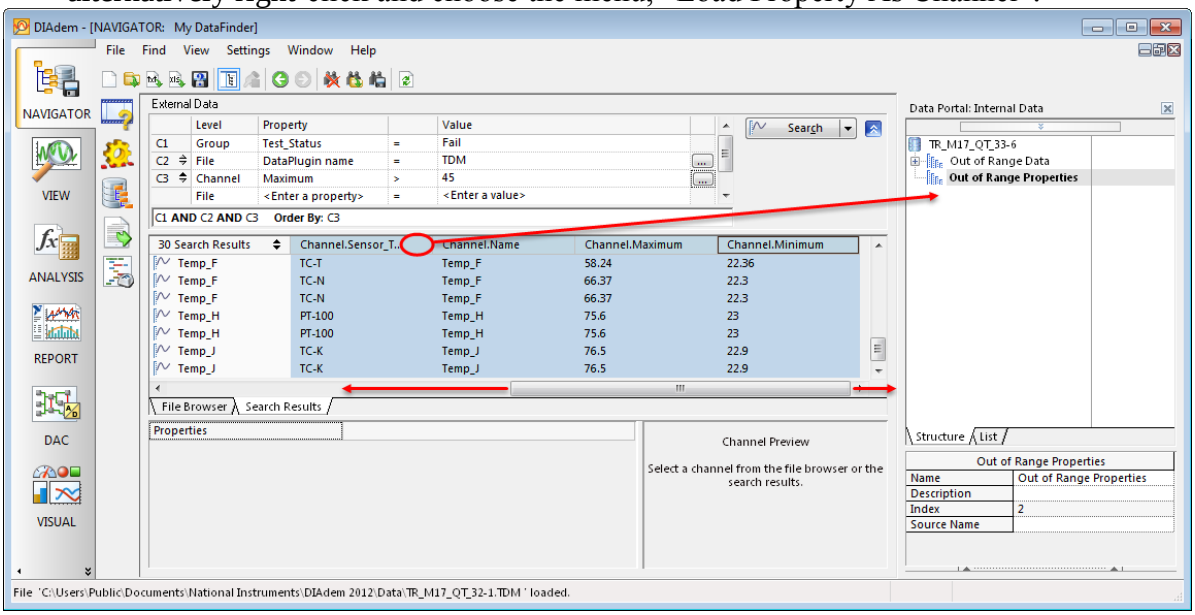
2.27 In the same way as above, **add** the group properties "**Test_Operator**" and "**Test_Procedure**". Next **leave** the default **"Channel" level** in the first column of **row 4**, then **type** in "**Sensor**" in the "Property" column of **row 4** and **select** the "**Sensor_ID**" property name.



2.28 In the same way **add** the channel properties "**Sensor_Type**", "**Name**", "**Maximum**", and "**Minimum**". **Click** on the "**OK**" button to accept these edits.

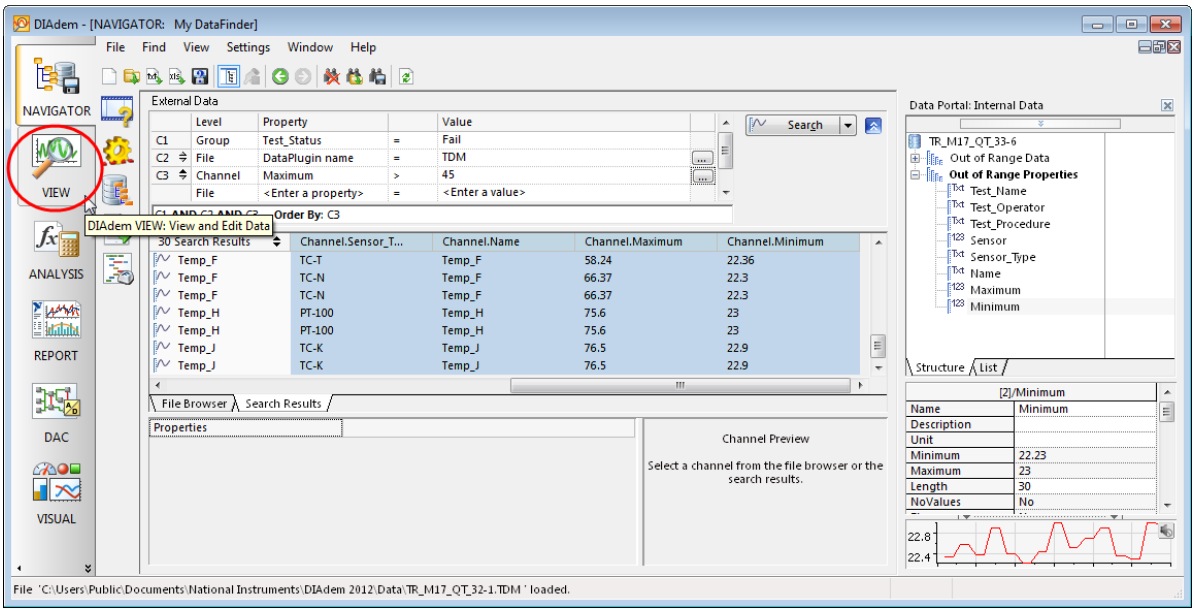


2.29 Observe that now all of your configured property columns appear in the search results table. **Select all 8** of these **columns** (but NOT the first column) by clicking on the columns headings and **using** the **<Shift>** key **and** the **scroll bar**, then **drag them** together **into** the **Data Portal**. This loads all 8 of these property columns as new Data Portal channels into the default "Out of Range Properties" group. You could alternatively right-click and choose the menu, "Load Property As Channel".

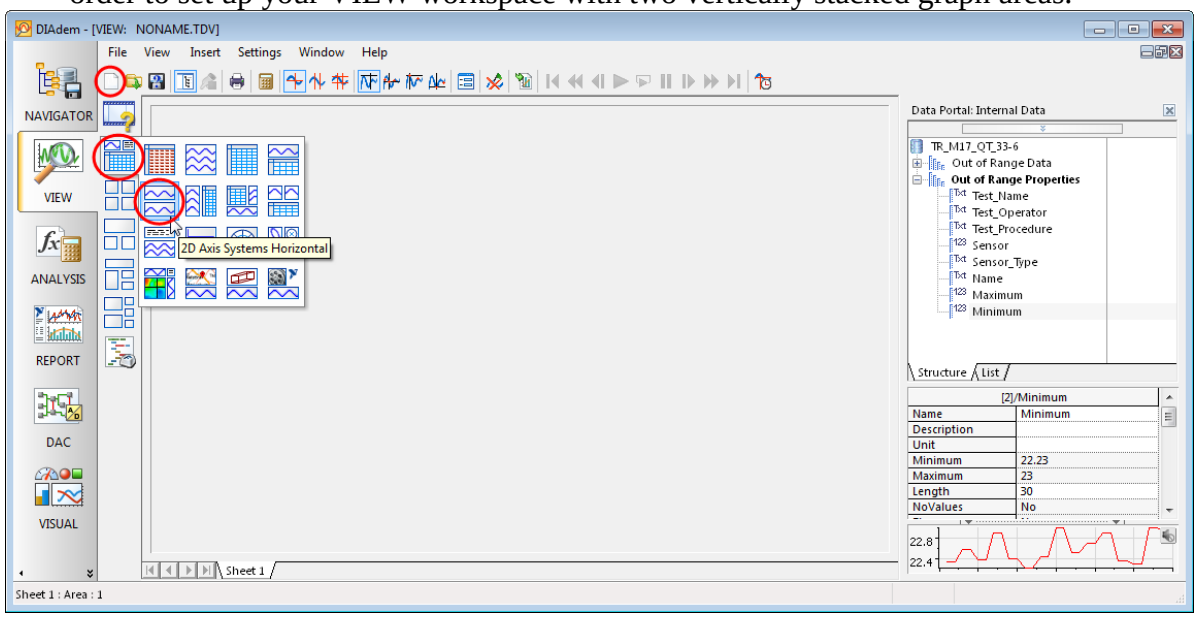


NOTE: You must drag from a column heading or you will lose your column selection.

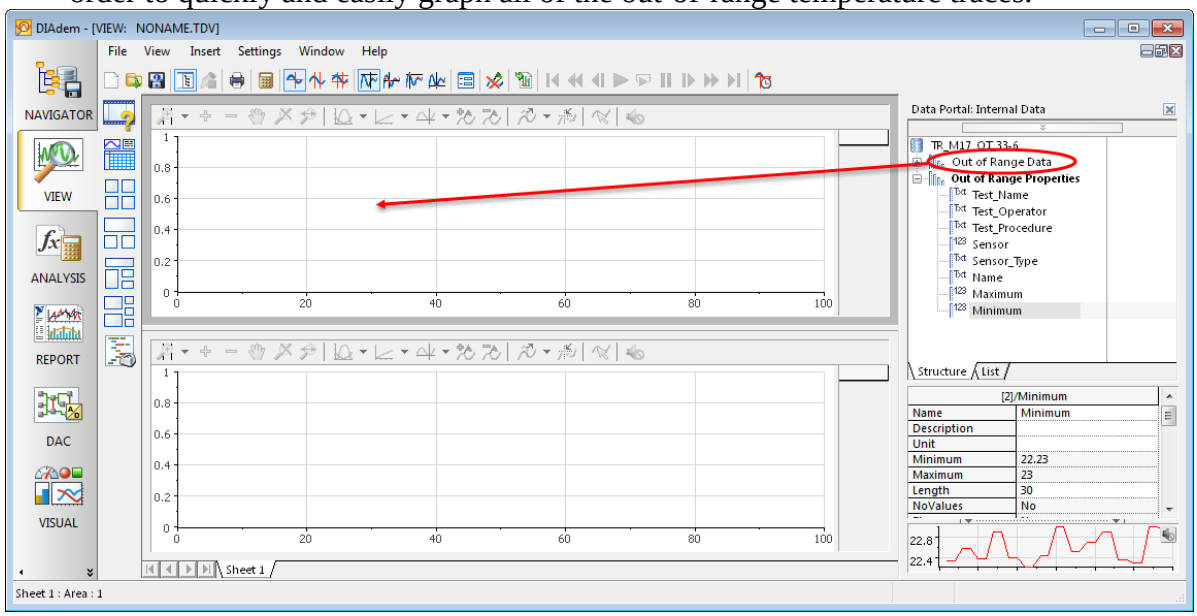
2.30 Now that you have found and loaded both the out-of-range data and their properties into DIAdem as new channels in the Data Portal, you can begin looking at this data. **Click** on the **VIEW** icon at the far left of your screen to switch to the VIEW panel of DIAdem.



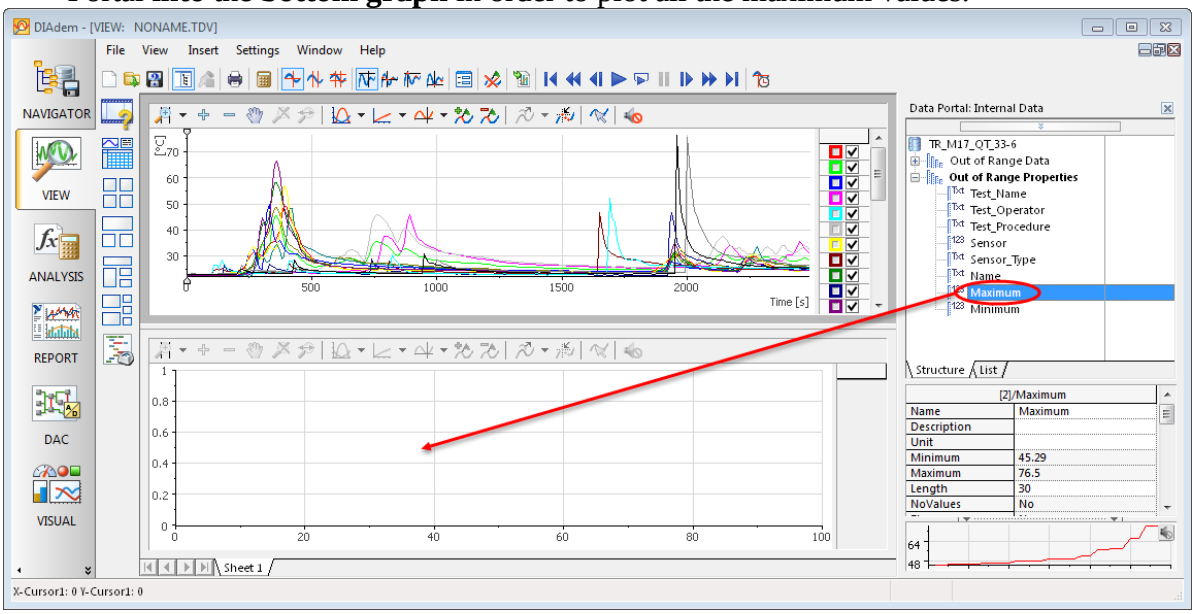
2.31 DIAdem VIEW is where you can get a quick look at the data in the Data Portal. First **click** on the "**New Layout**" icon at the top left of your screen to clear the VIEW panel, then **select** "**Assigned Worksheet Partitions**" and "**2D Axis Systems Horizontal**" in order to set up your VIEW workspace with two vertically stacked graph areas.



2.32 Drag the "**Out of Range Data**" group from the Data Portal **into** the **top graph** area in order to quickly and easily graph all of the out-of-range temperature traces.

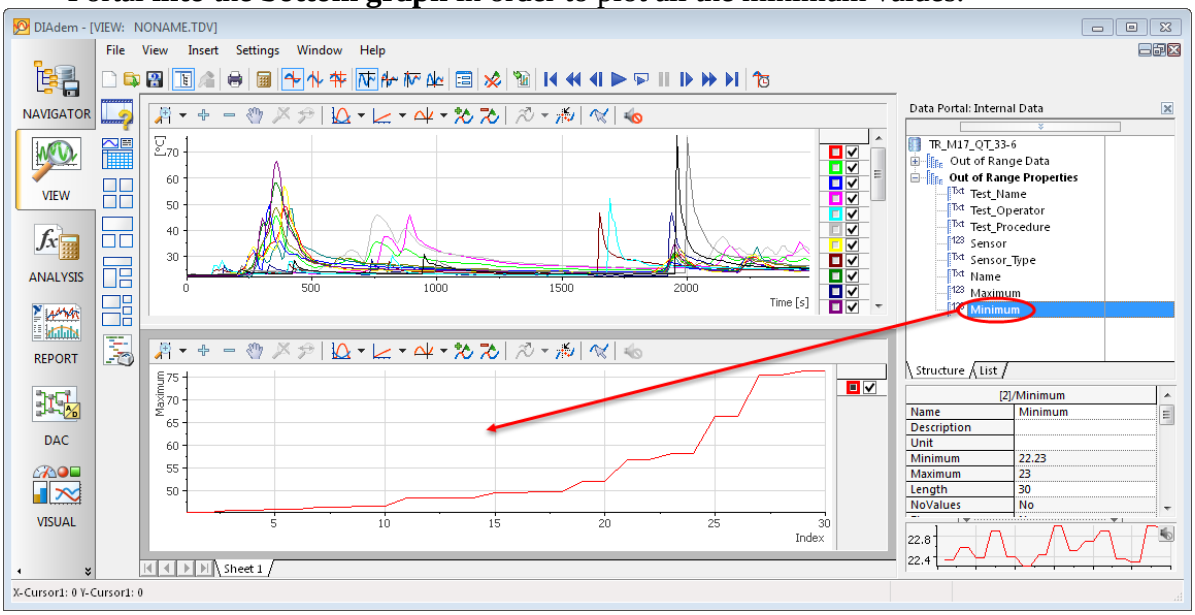


2.33 Drag the "**Maximum**" **channel** from the "Out of Range Properties" group in the Data Portal **into** the **bottom graph** in order to plot all the maximum values.



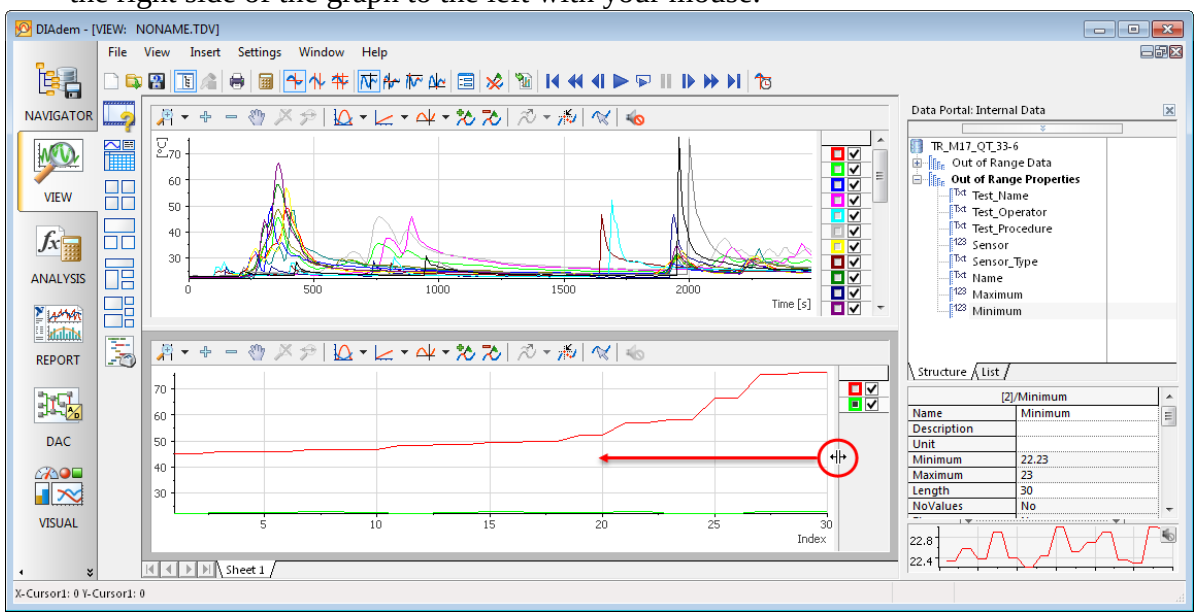
NOTE: Your queried data may look slightly different than the graph above

2.34 Drag the "**Minimum**" **channel** from the "Out of Range Properties" group in the Data Portal **into** the **bottom graph** in order to plot all the minimum values.



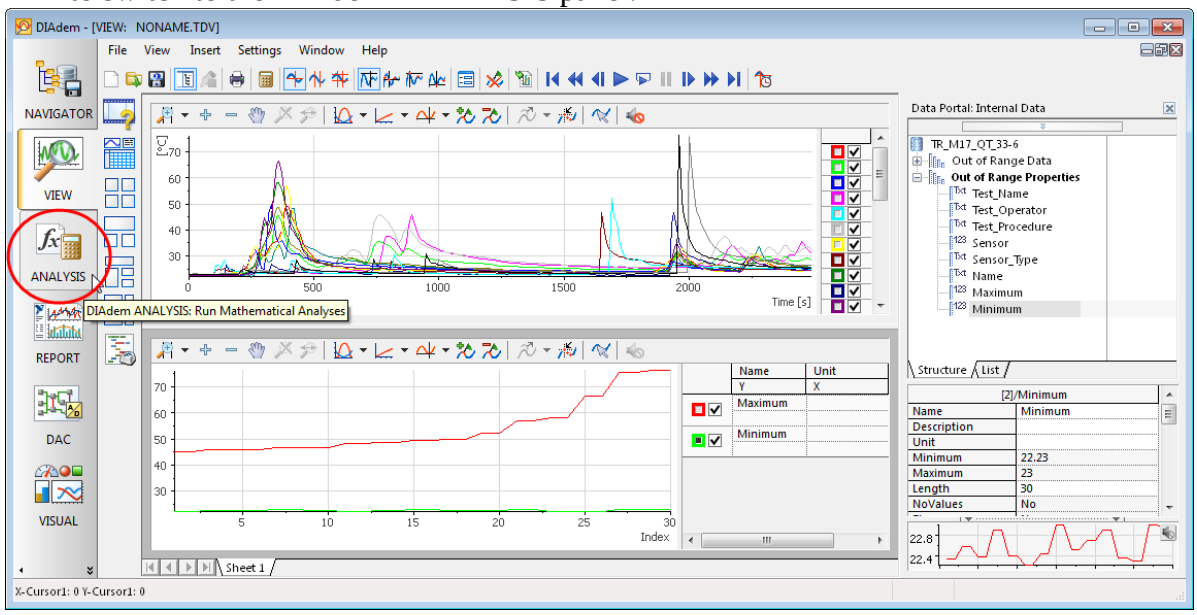
NOTE: Your queried data may look slightly different than the graph above

2.35 Both the "Maximum" and Minimum" values are plotted vs. array index, from 1 to 15 in the below pictured case. **Draw out** the VIEW **legend** of the **bottom graph** by pulling the right side of the graph to the left with your mouse.

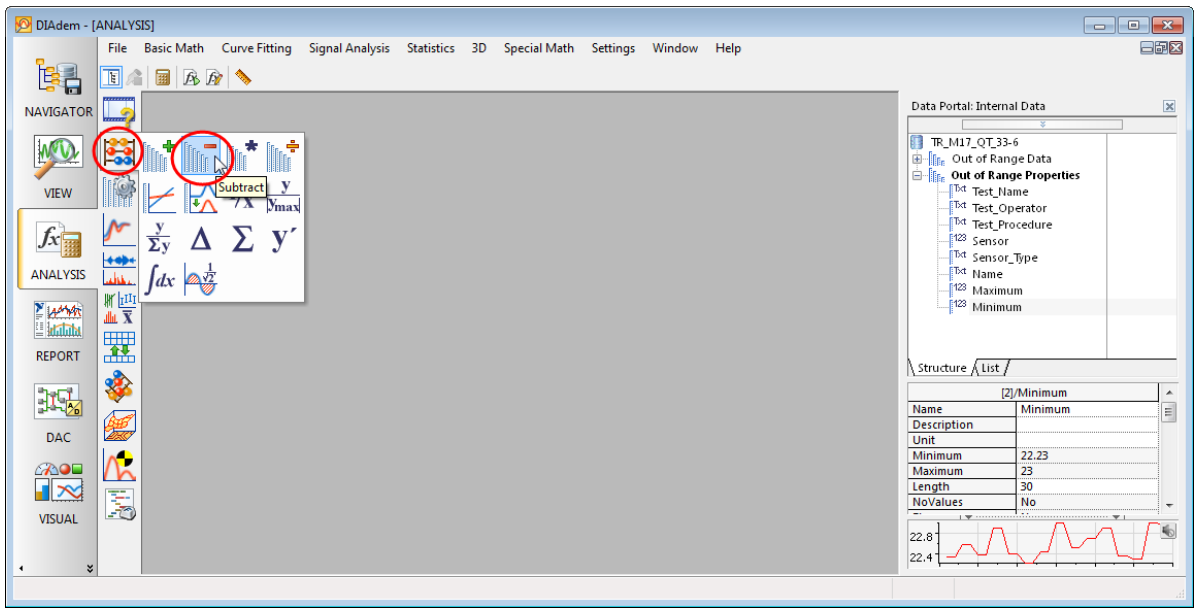


NOTE: Your queried data may look slightly different than the graph above

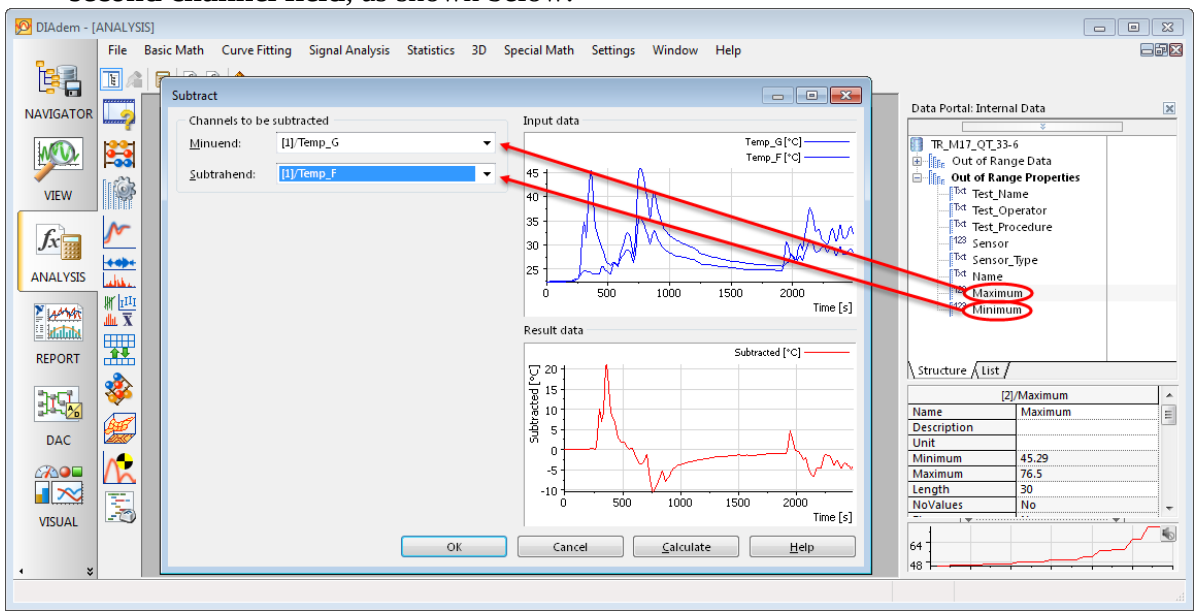
2.36 In addition to plotting these out-of-range values, your boss has asked you to verify that no sensor ever logged a temperature change of greater than 60°C. You can calculate this temperature change by subtracting each "Minimum" value from its corresponding "Maximum" value. **Click** on the "**ANALYSIS**" **icon** at the left of your screen in order to switch to the DIAdem ANALYSIS panel.



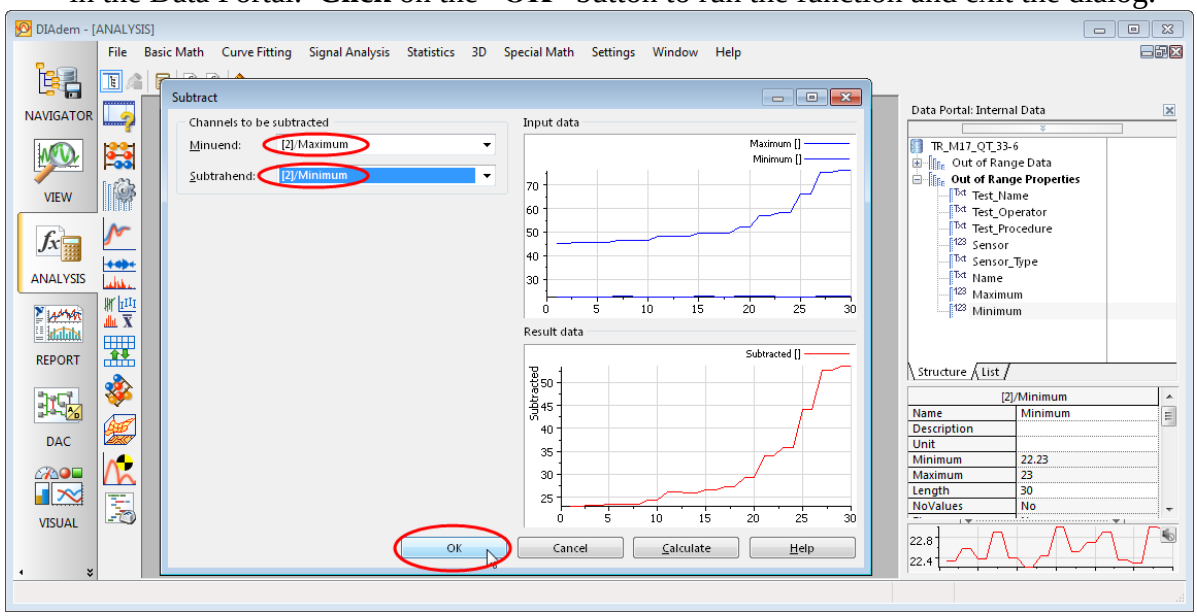
2.37 DIAdem ANALYSIS is where you go in DIAdem to make calculations based on channels you have loaded in the Data Portal. **Click** on the "**Basic Mathematics**" icon and **select** the "**Subtract**" function.



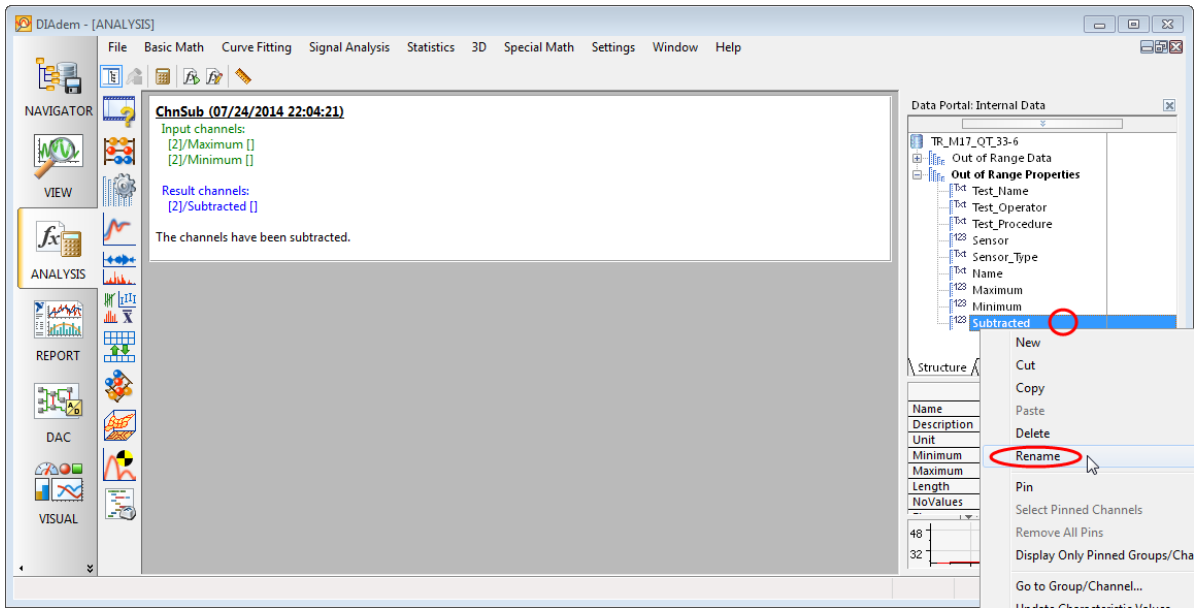
2.38 Each function in DIAdem ANALYSIS pops up a configuration dialog where you select the Data Portal channels to use and any additional function parameters. In this case you just need to select the two channels to subtract one from the other. You can select the channels by choosing from the enumerated drop-lists in the dialog or by dragging channels from the Data Portal. **Drag** the "**Maximum**" **channel** from the Data Portal **into** the **first channel field** and the "**Minimum**" **channel** from the Data Portal **into** the **second channel field**, as shown below.



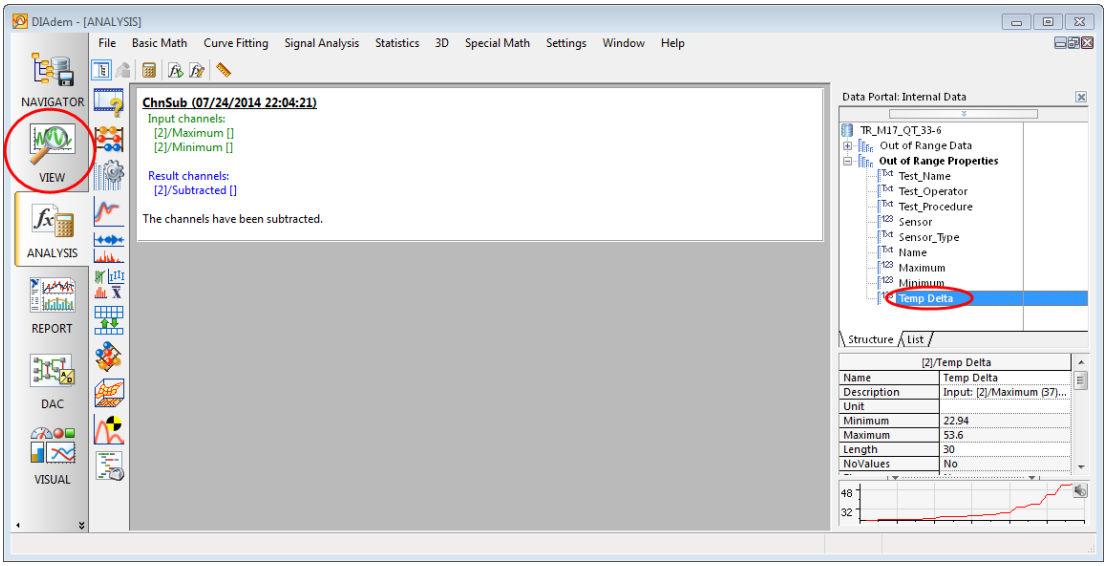
2.39 This function has no further parameters to cofigure, it will just subtract each minimum value from its matching maximum value and create a new channel of difference values in the Data Portal. **Click** on the **"OK"** button to run the function and exit the dialog.



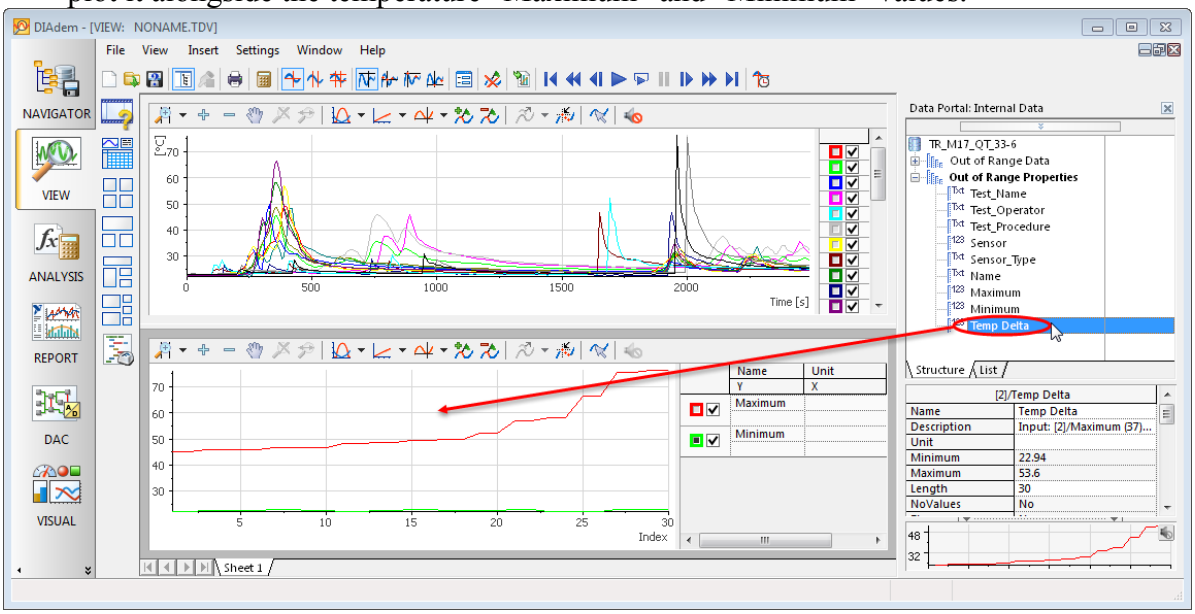
2.40 Notice that the output of this "Subtract" function is a new channel in the Data Portal called "Subtracted". **Right-click** on this new "**Subtracted**" channel and **select** the "**Rename**" menu.



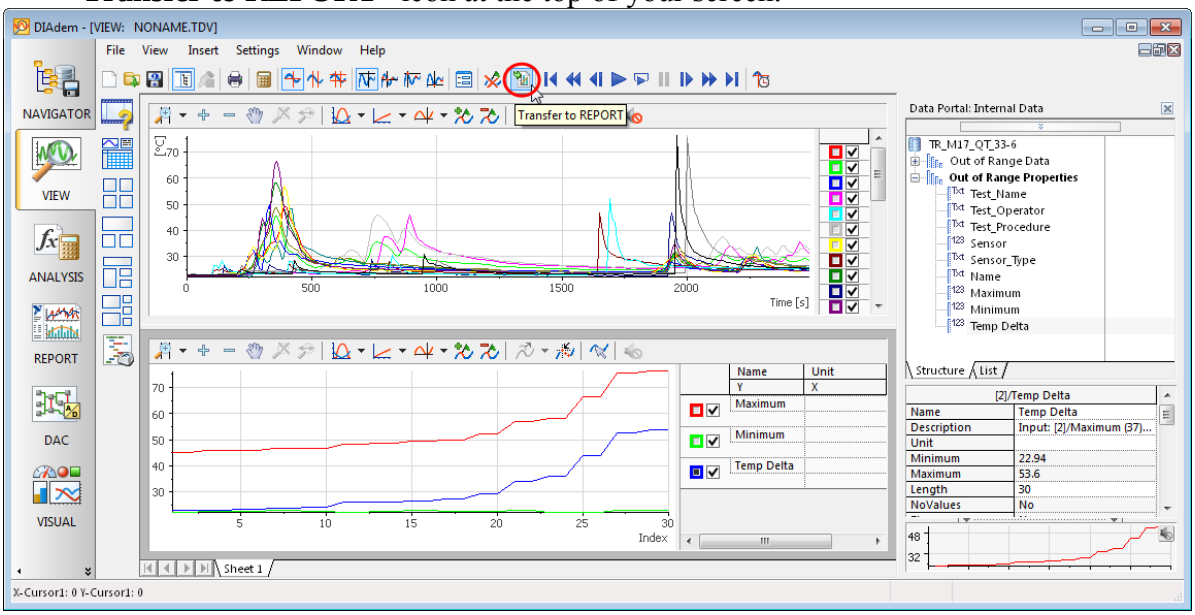
2.41 Type in "**Temp Delta**" and hit the <Enter> key on your keyboard to name the difference between the minimum and maximum appropriately. Now you are ready to look at the channel you created, so **click** on the "**VIEW**" **icon** at the left of your screen to switch back to DIAdem VIEW.



2.42 Drag the new "**Temp Delta**" channel from the Data Portal **into** the **bottom graph** to plot it alongside the temperature "Maximum" and "Minimum" values.

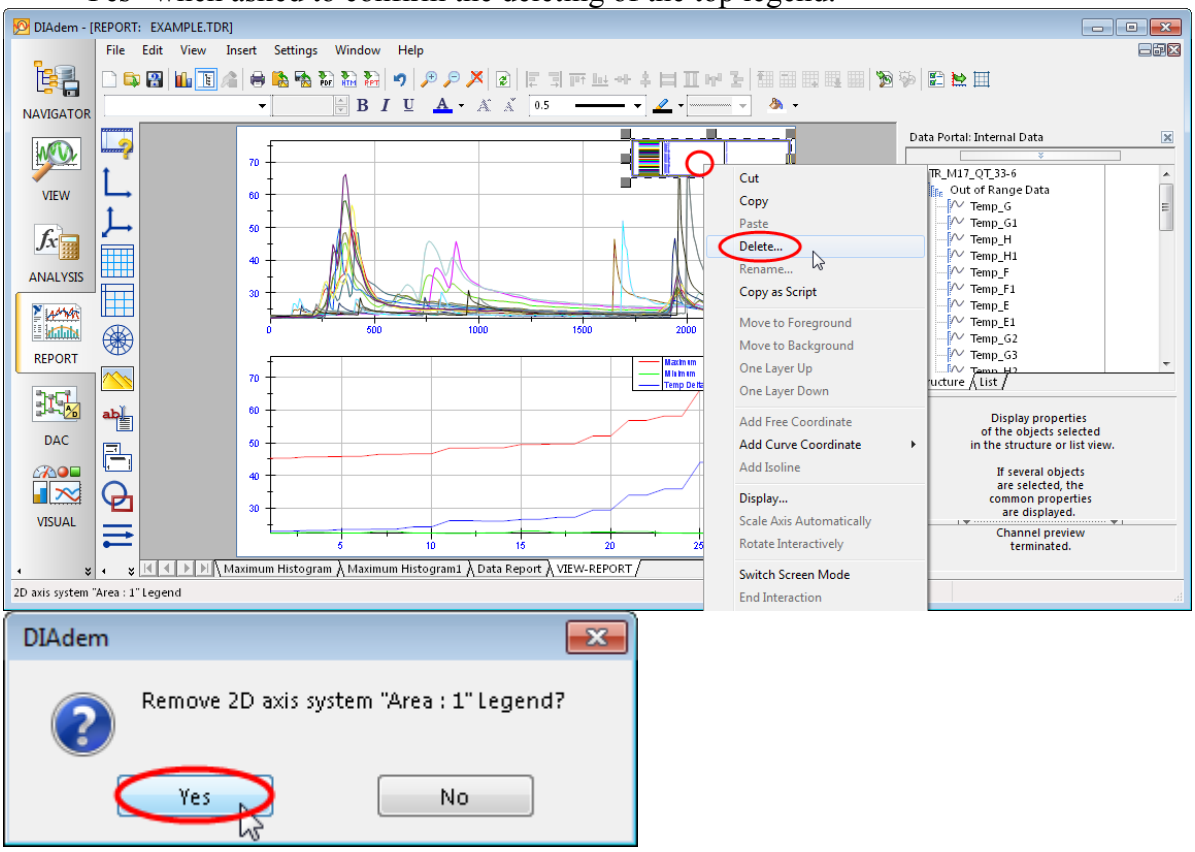


2.43 Now you can see that the "Temp Delta" values for each out-of-range sensor never exceeded 60°C (although they came close), so all your furnaces should still be OK. Your boss will be so pleased. Now you want to turn these graphs into a report you can share with others. In order to re-use what you have here in VIEW, **click** on the "**Transfer to REPORT**" icon at the top of your screen.

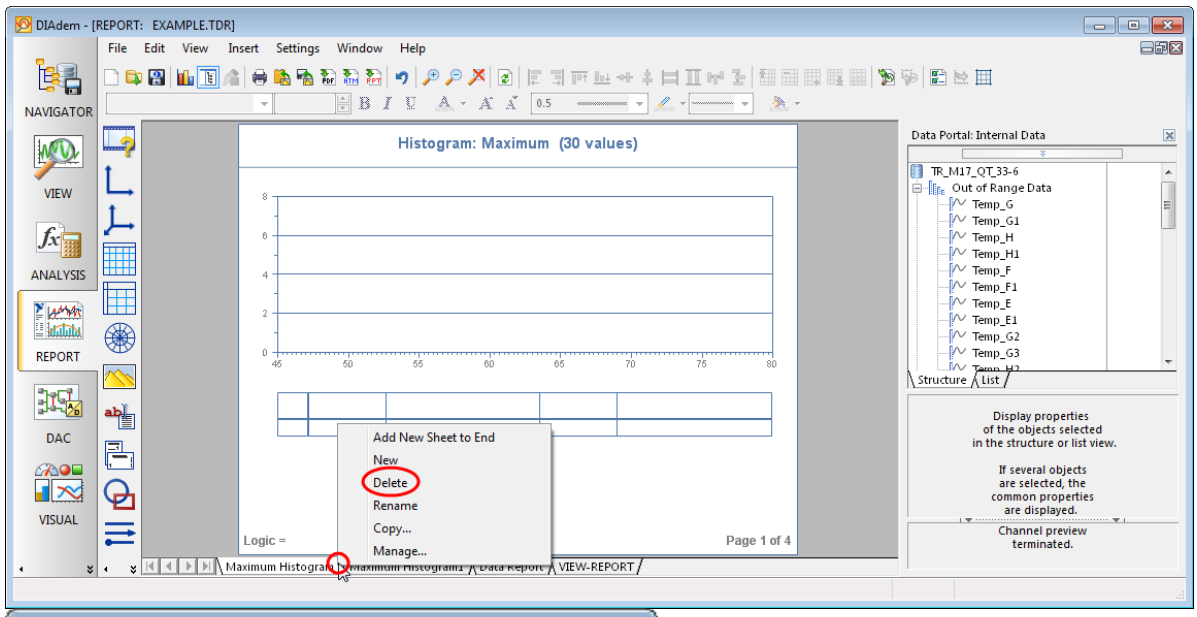


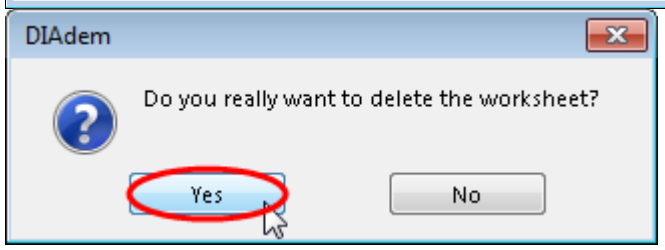
NOTE: Your queried data may look slightly different than the graph above

2.44 The REPORT panel in DIAdem is where you create publication quality reports by dragging and dropping and configuring different report objects. The transfer from VIEW you just selected automatically re-creates the static report you had in VIEW with fully configurable REPORT objects. You don't really need the legend for the top graph, so **right-click** on the **top legend** and **select** the "**Delete…"** menu. Click on "Yes" when asked to confirm the deleting of the top legend.

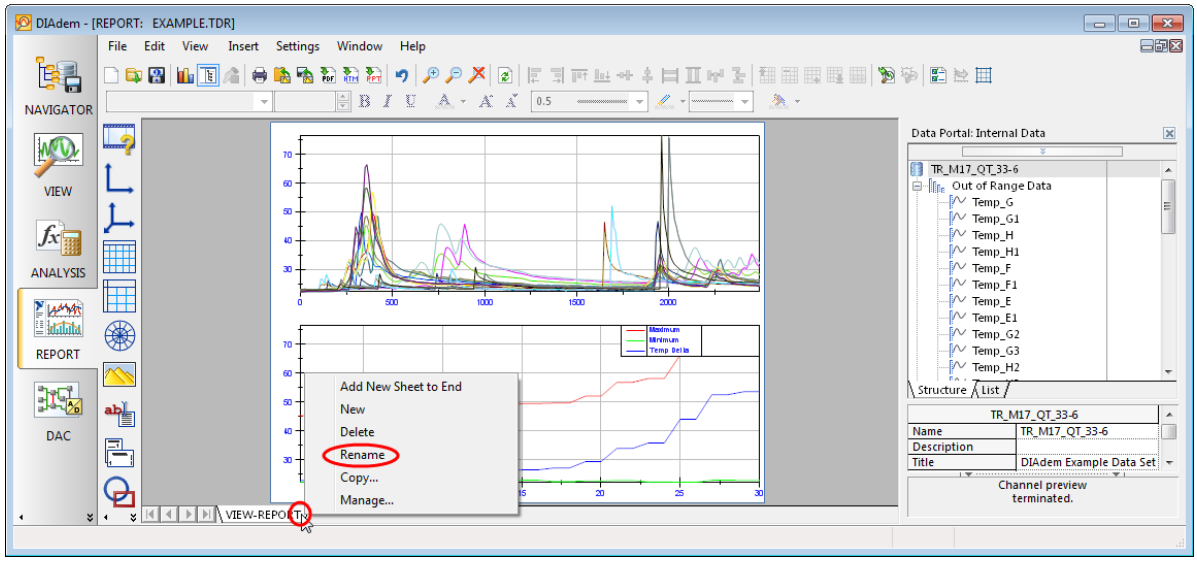


2.45 If you have other sheets in the REPORT panel that were created prior to the one you just transferred from VIEW, **right-click** on each **old sheet** and **select** the "**Delete**" menu. Click on the "Yes" button when asked to confirm the sheet deletion.

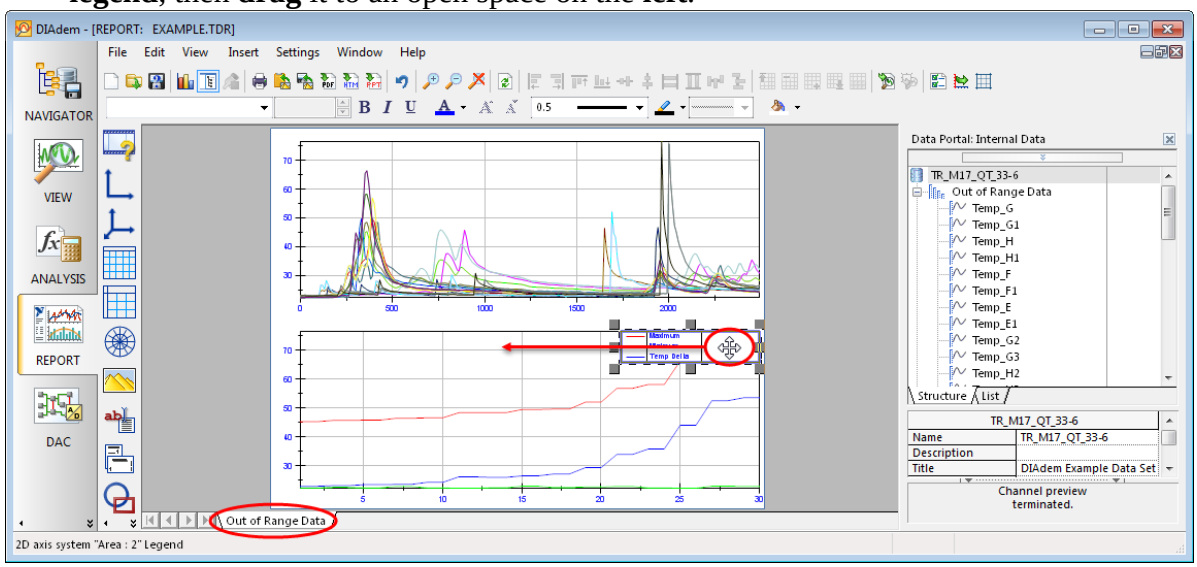




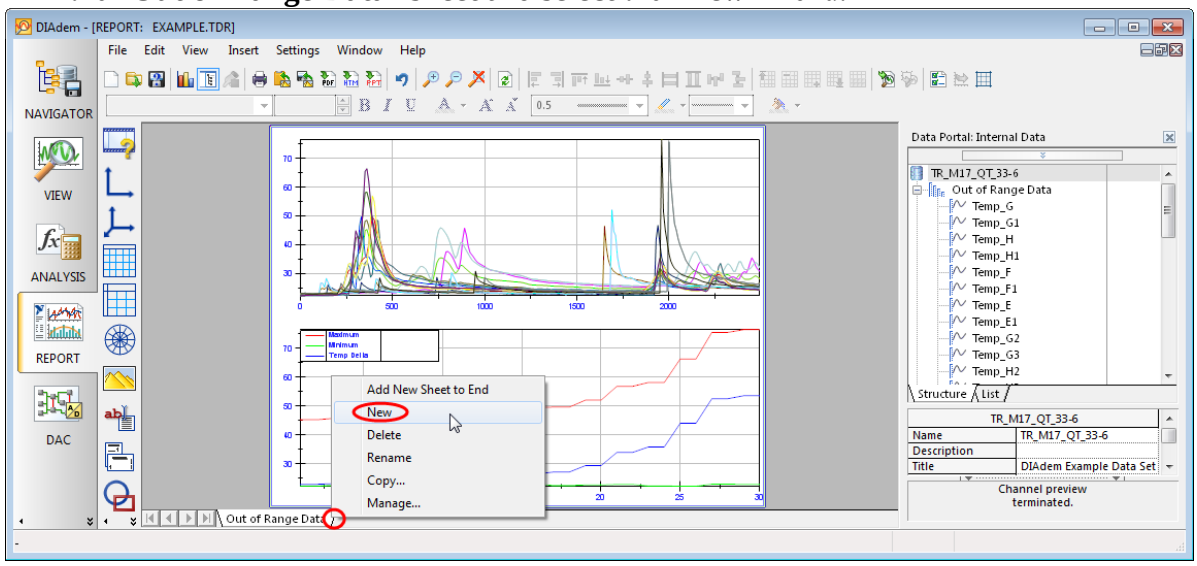
2.46 The default sheet name "VIEW-REPORT" is not very helpful in describing the out-of-range data graphs you've created. **Right-click** on the "**VIEW-REPORT**" **sheet** and **select** the "**Rename**" menu.



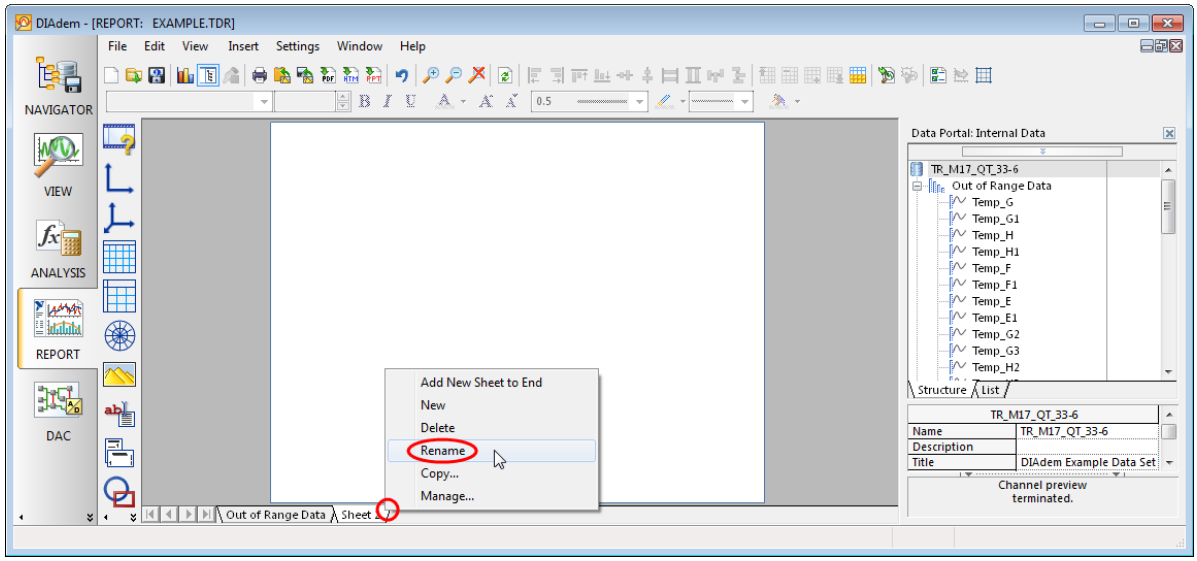
2.47 Type "**Out of Range Data**" to rename the group and **hit** the **<Enter>** key on your keyboard. It looks like the legend in the bottom graph is hiding part of the data. Luckily, each object on your REPORT layout can be moved at will. **Click** on the **legend**, then **drag** it to an open space on the **left**.



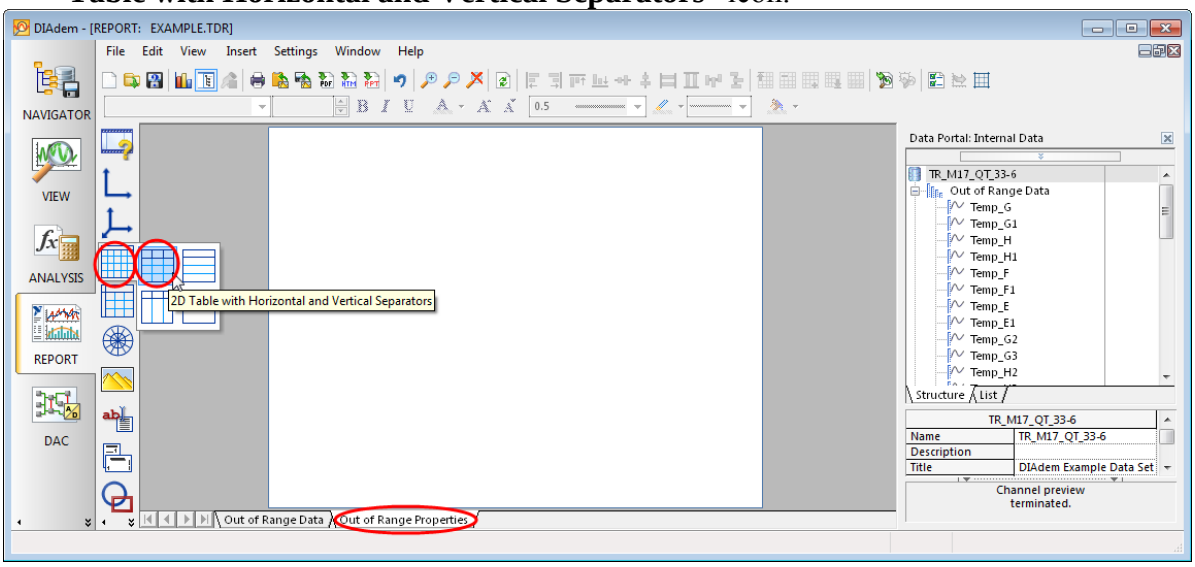
2.48 You need to add a table of the measurement properties to this report, but there is no more room on this sheet, so you should add a second REPORT sheet. **Right-click** on the "**Out of Range Data**" **sheet** and **select** the "**New**" menu.



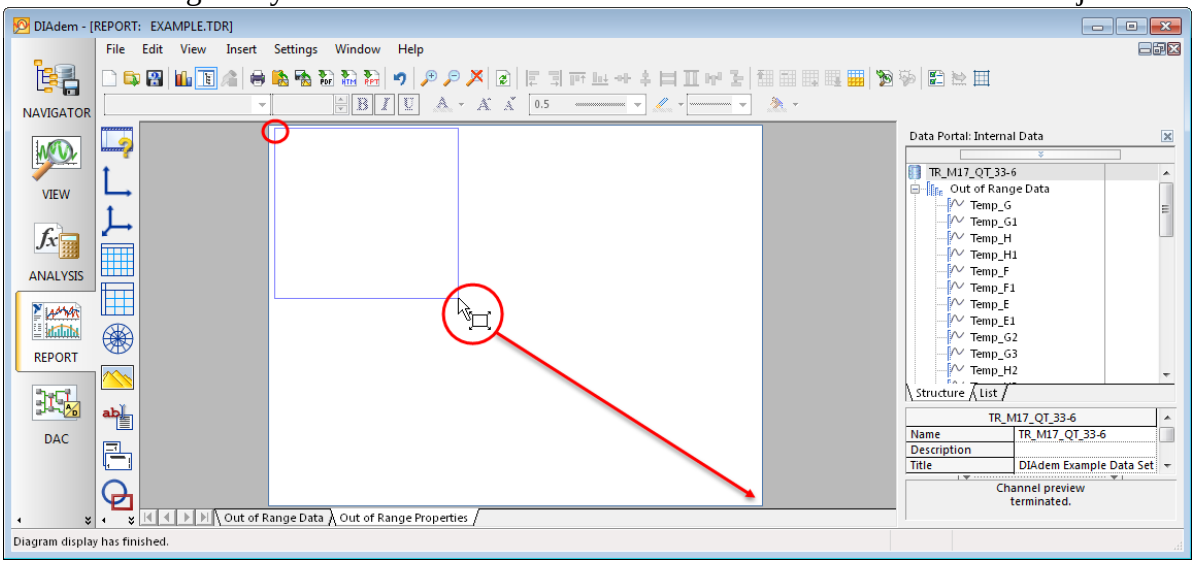
2.49 Right-click on the **new sheet** and **select** the "**Rename**" menu, as before to customize the name of the new sheet.



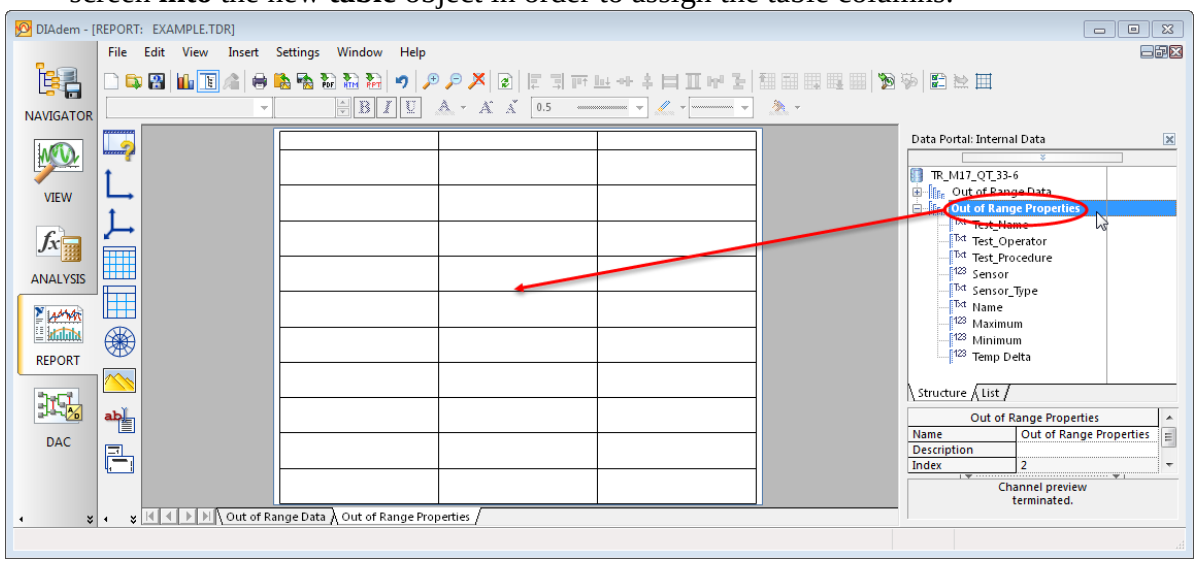
2.50 Type in "**Out of Range Properties**" and **hit** the **<Enter>** key on your keyboard to give this new sheet a descriptive name. Now you want to insert a table object onto this new sheet. **Select** the "**2D Tables**" icon at the left of your screen, then **select** the "**2D Table with Horizontal and Vertical Separators**" icon.



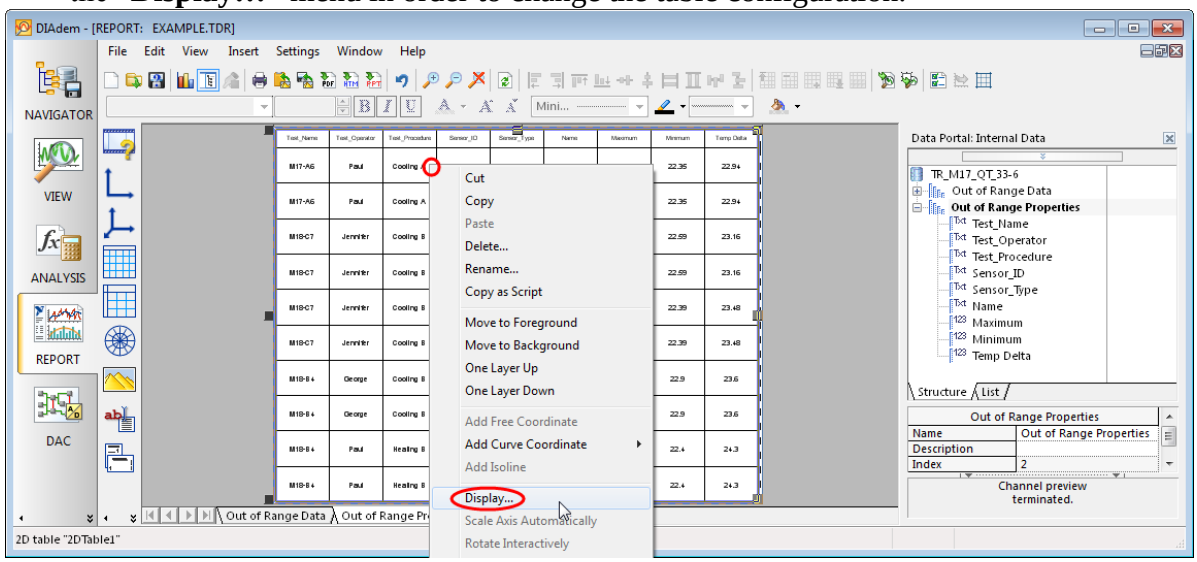
2.51 Now hold the mouse button down while dragging the mouse from the top left to the bottom right of your screen to **outline** the **desired location** of the new table object.



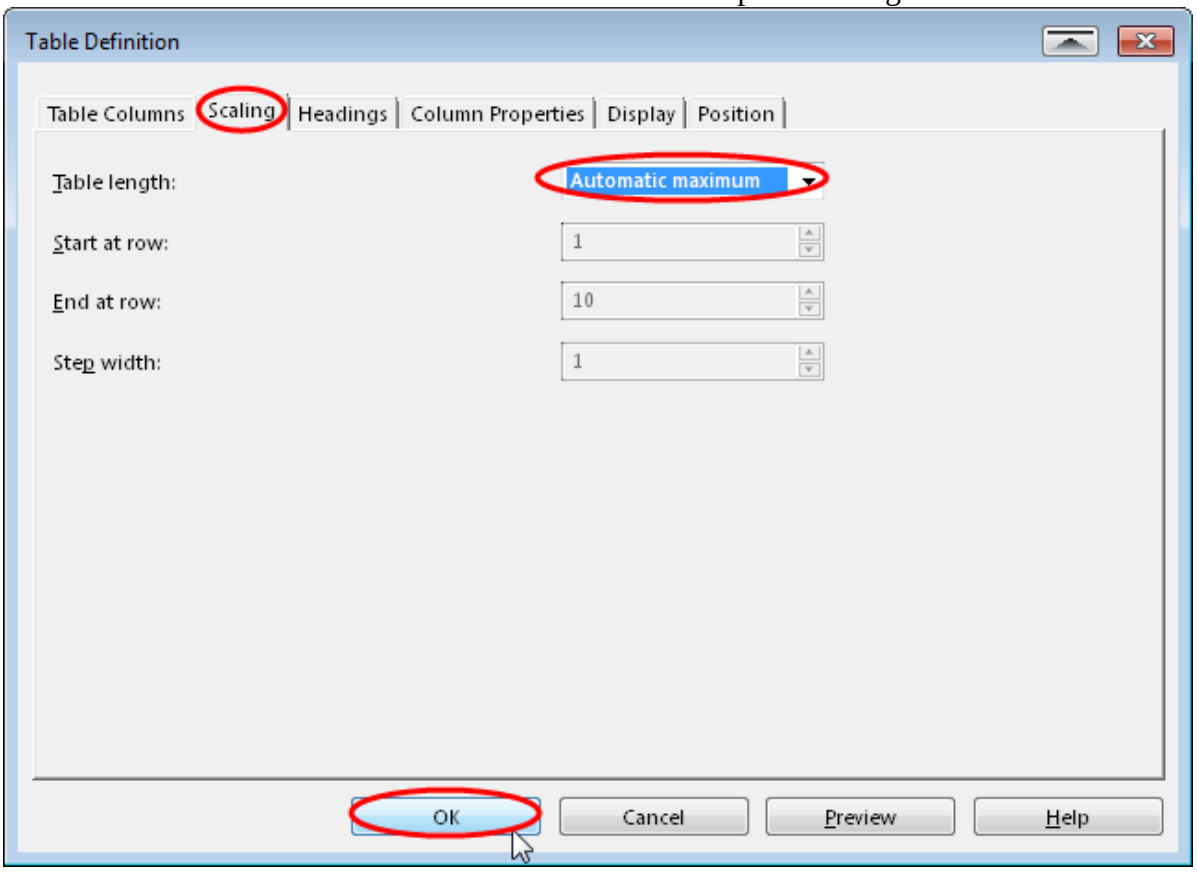
2.52 Drag the "**Out of Range Properties**" **group** in the Data Portal at the right of your screen **into** the new **table** object in order to assign the table columns.



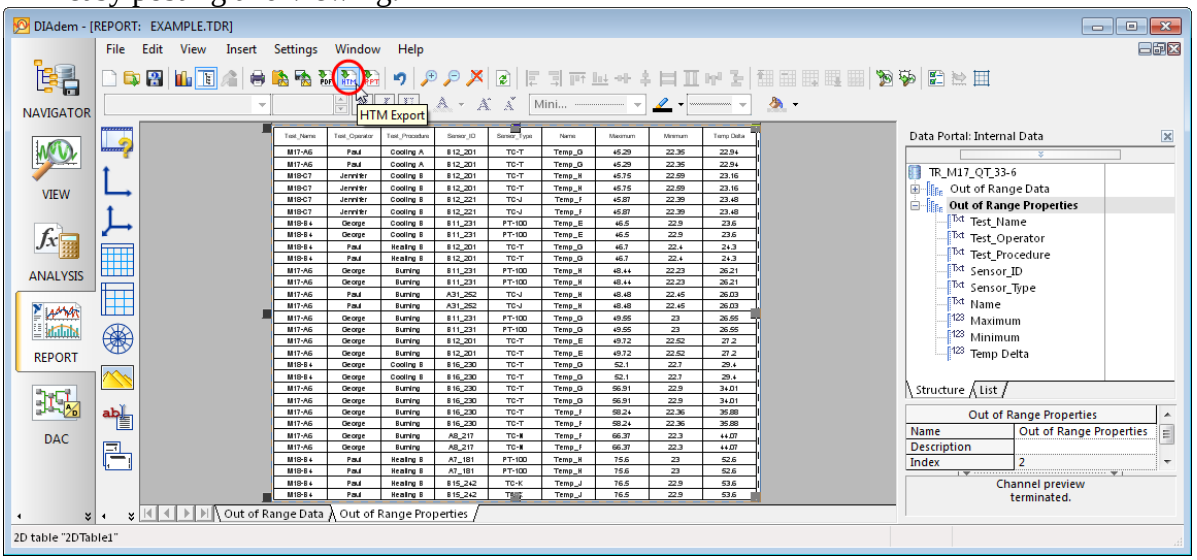
2.53 Now you see the out-of-range properties for the first 10 measurements, because the table object defaults to show only the first 10 rows. **Right-click** on the **table** and **select** the "**Display…**" menu in order to change the table configuration.



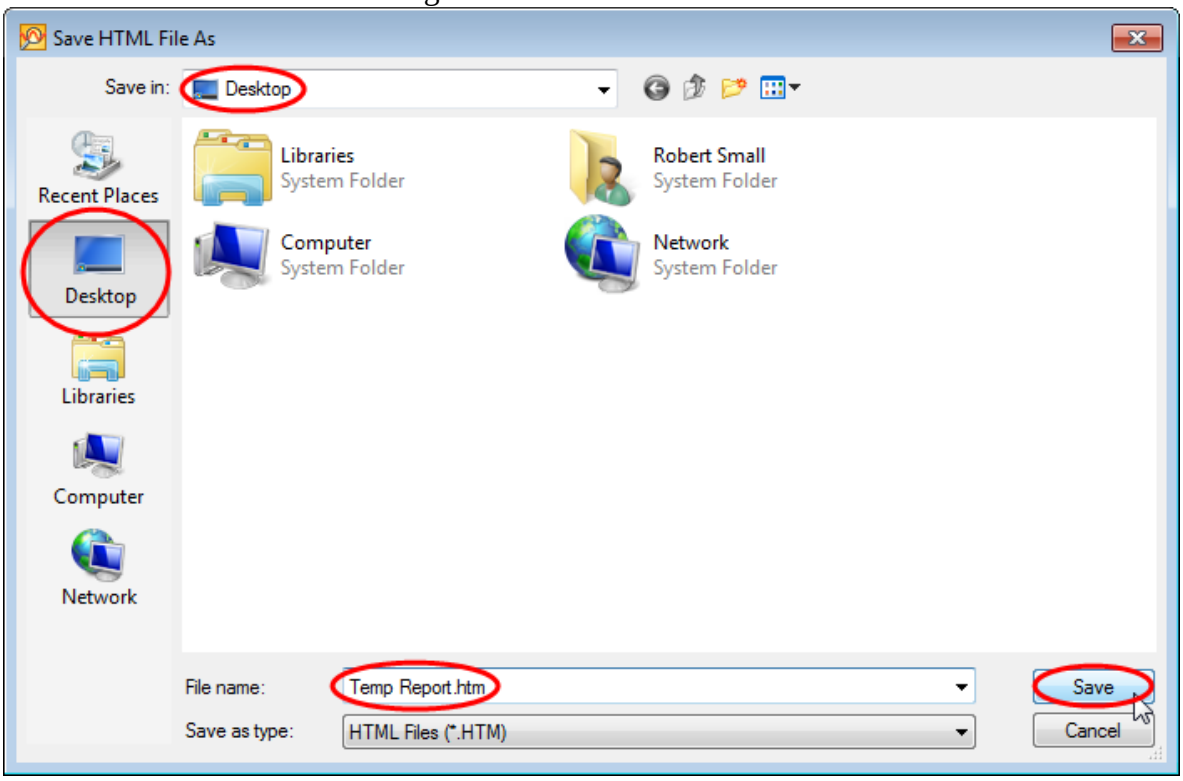
2.54 Click on the "**Scaling**" **tab** in order to find the row property you are after. Now **change** the "**Table length**" setting to "**Automatic maximum**" in order to display all the table rows and **click** on the **"OK"** button to accept this change.



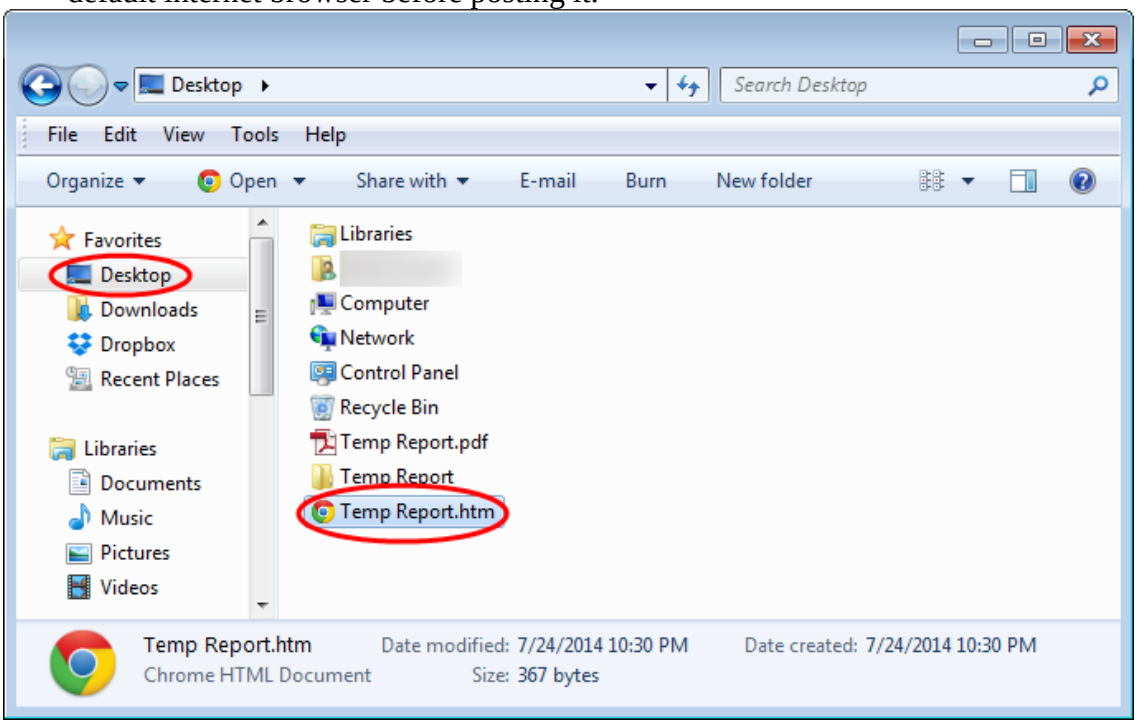
2.55 Now you have created the report your boss wanted. **Click on** the "**HTM Export**" icon at the top middle of your screen in order to output this report to a web page format for easy posting and viewing.



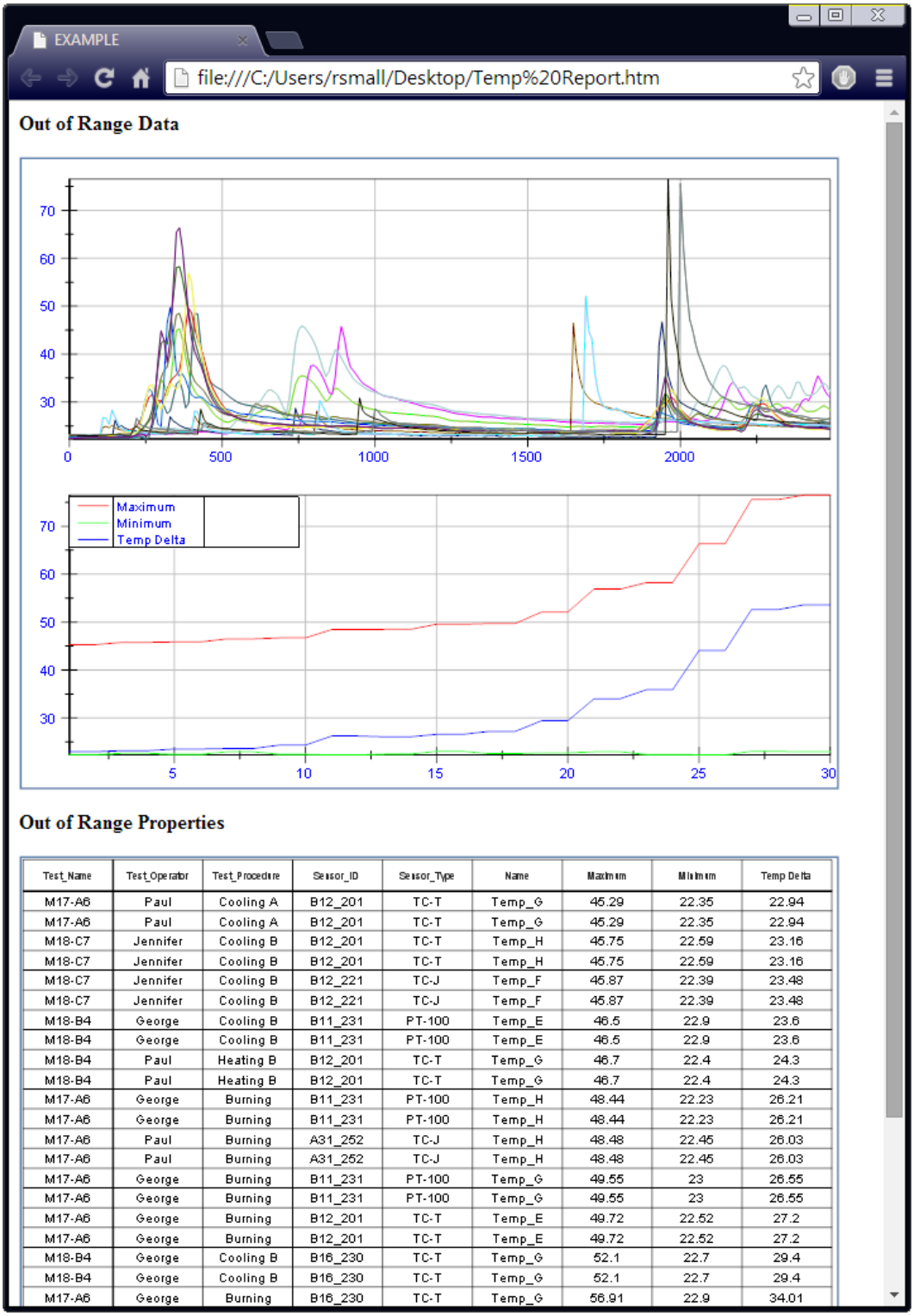
2.56 Select to save the file to **the Desktop, name** the **file** "**Temp Report.htm**", then **click** on the "**Save**" button to save this two page report to HTML format. Click "Yes" if asked to confirm overwriting an HTML file of the same name.



2.57 Open Windows Explorer, **navigate to** the **Desktop**, find the **"Temp Report.htm**" file you just created, and **double-click** on it to review your HTML report in your default internet browser before posting it.



2.58 This is your final report— notice how the sheet tab names in REPORT automatically became section headers in the HTML report as each REPORT sheet was appended below the previous one in the continuous HTML page format.



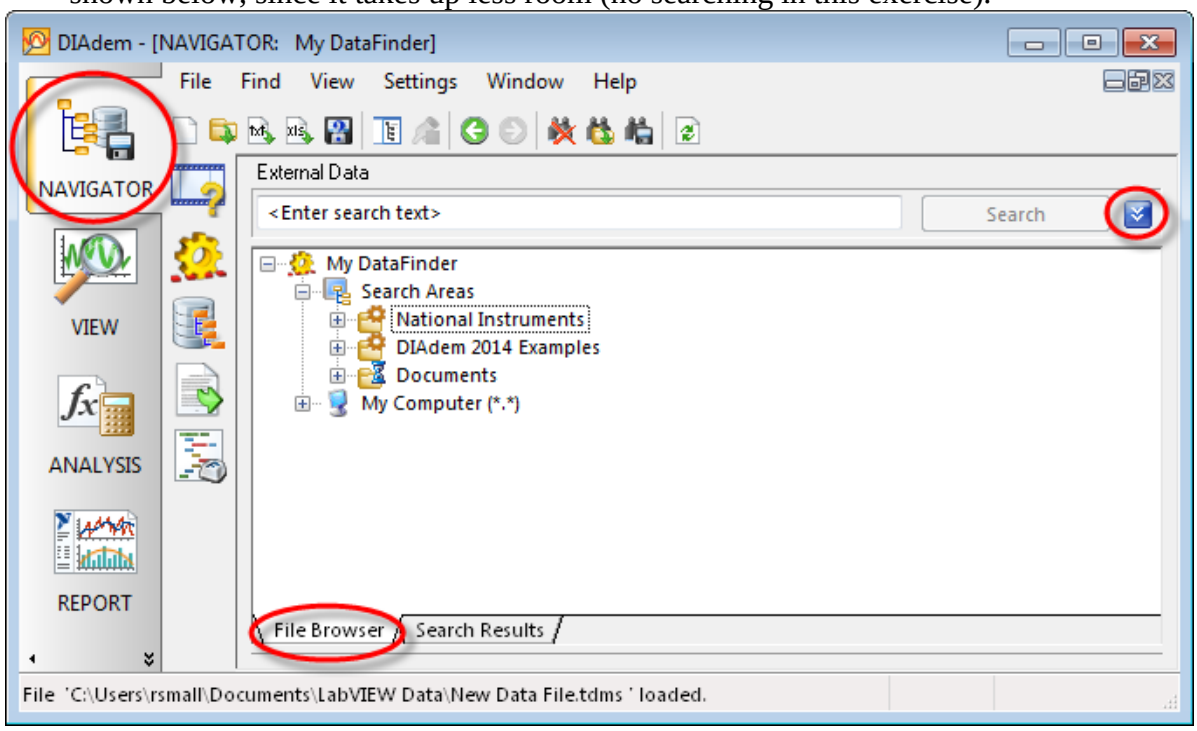
Test_Name	Test_Operator	Test_Procedure	Sensor_ID	Sensor_Type	Name	Maximum	Minimum	Temp Delta
M17-A6	Paul	Cooling A	B12_201	TC-T	Temp_G	45.29	22.35	22.94
M17-A6	Paul	Cooling A	B12_201	TC-T	Temp_G	45.29	22.35	22.94
M18-C7	Jennifer	Cooling B	B12_201	TC-T	Temp_H	45.75	22.59	23.16
M18-C7	Jennifer	Cooling B	B12_201	TC-T	Temp_H	45.75	22.59	23.16
M18-C7	Jennifer	Cooling B	B12_221	TC-J	Temp_F	45.87	22.39	23.48
M18-C7	Jennifer	Cooling B	B12_221	TC-J	Temp_F	45.87	22.39	23.48
M18-B4	George	Cooling B	B11_231	PT-100	Temp_E	46.5	22.9	23.6
M18-B4	George	Cooling B	B11_231	PT-100	Temp_E	46.5	22.9	23.6
M18-B4	Paul	Heating B	B12_201	TC-T	Temp_G	46.7	22.4	24.3
M18-B4	Paul	Heating B	B12_201	TC-T	Temp_G	46.7	22.4	24.3
M17-A6	George	Burning	B11_231	PT-100	Temp_H	48.44	22.23	26.21
M17-A6	George	Burning	B11_231	PT-100	Temp_H	48.44	22.23	26.21
M17-A6	Paul	Burning	A31_252	TC-J	Temp_H	48.48	22.45	26.03
M17-A6	Paul	Burning	A31_252	TC-J	Temp_H	48.48	22.45	26.03
M17-A6	George	Burning	B11_231	PT-100	Temp_G	49.55	23	26.55
M17-A6	George	Burning	B11_231	PT-100	Temp_G	49.55	23	26.55
M17-A6	George	Burning	B12_201	TC-T	Temp_E	49.72	22.52	27.2
M17-A6	George	Burning	B12_201	TC-T	Temp_E	49.72	22.52	27.2
M18-B4	George	Cooling B	B16_230	TC-T	Temp_G	52.1	22.7	29.4
M18-B4	George	Cooling B	B16_230	TC-T	Temp_G	52.1	22.7	29.4
M17-A6	George	Burning	B16_230	TC-T	Temp_G	56.91	22.9	34.01

NOTE: Your graph and table may look somewhat different from those pictured above.

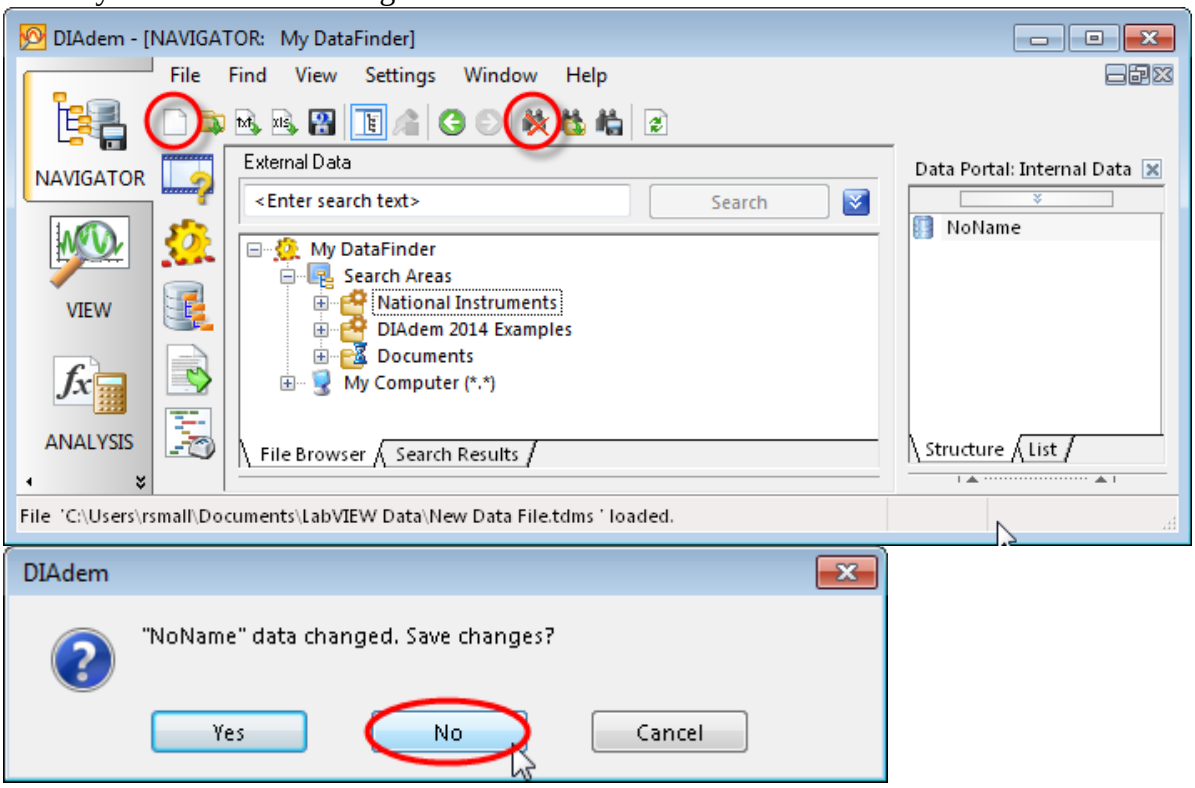
Exercise #3 Create Automated Analysis and Reporting

Scenario: Your group is rolling out a new low frequency acoustic data test rig— you already have three data files with many more coming in soon, and you will be in charge of reporting all this data. You need to look at this early data, determine the best way to analyze and report it, then develop an automatic reporting process so that you can quickly create reports as more and more data come in. You will load the first data set in NAVIGATOR, take a quick look at the data in VIEW, apply a digital filter to the data in ANALYSIS, then create a custom display of the data in REPORT. Once you have gone through these steps interactively for the first data set, you will repeat them with the VBScript recorder running in SCRIPT for the second data set, in order to automatically generate your reporting script. You will then test the new reporting script with the third data set to verify that you are ready for the full roll-out.

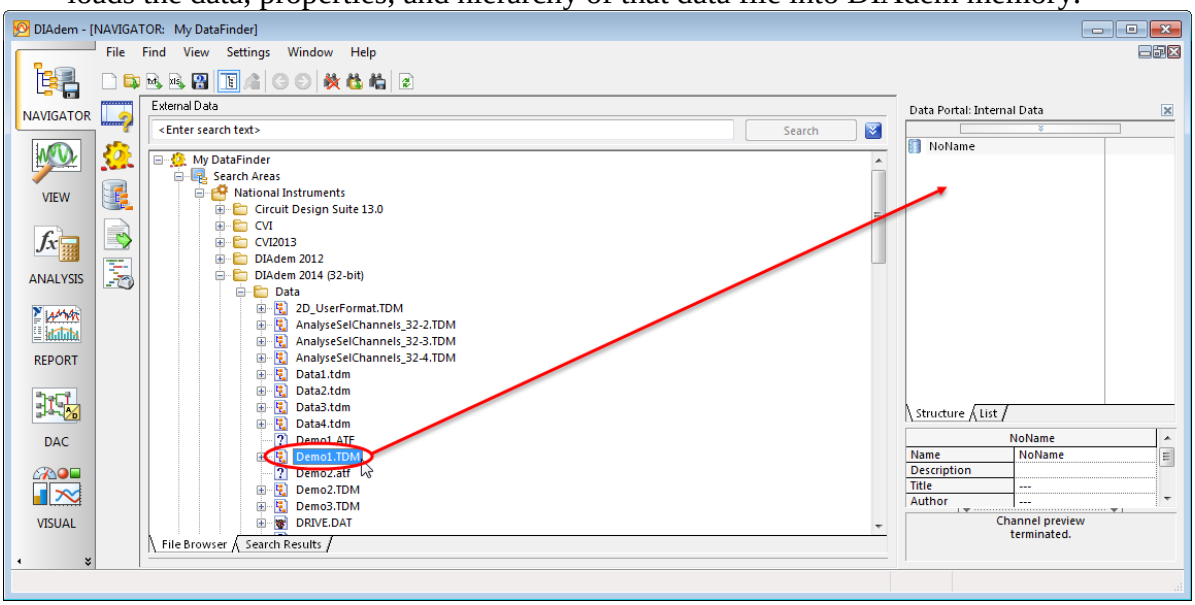
3.1 First get ready to load data into DIAdem. Make sure that the "**NAVIGATOR**" tab at the top left of your screen is selected. Next make sure the "**File Browser**" tab is selected at the bottom left of your screen. Finally, if you don't see the **simple search bar** (pictured below with the text "<Enter text to find in search areas>"), then click on the toggle button at the top right of your screen to switch back to the simple search shown below, since it takes up less room (no searching in this exercise).



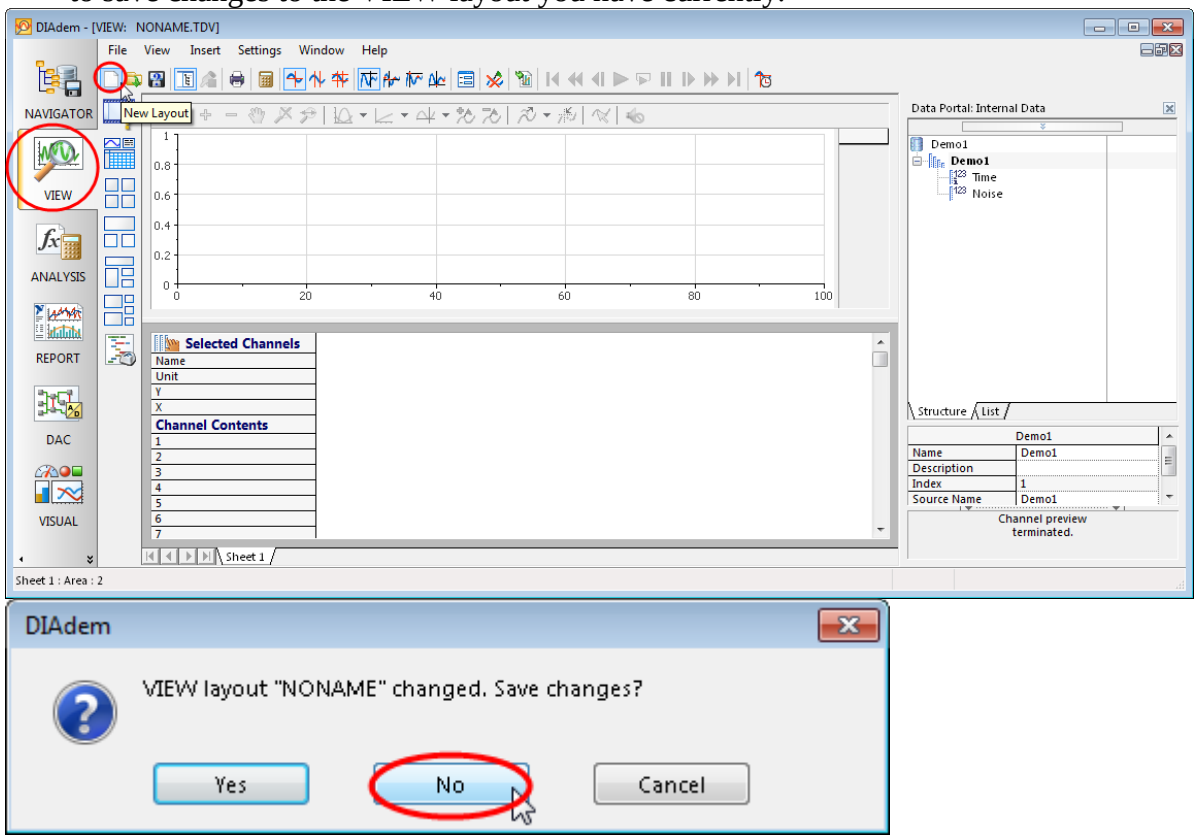
3.2 **Click** on the "**Delete Internal Data**" icon at the top left of your screen in order to clear out the Data Portal and start with a clean slate. Click the "No" button if you are asked if you want to save changes to the data in the Data Portal.



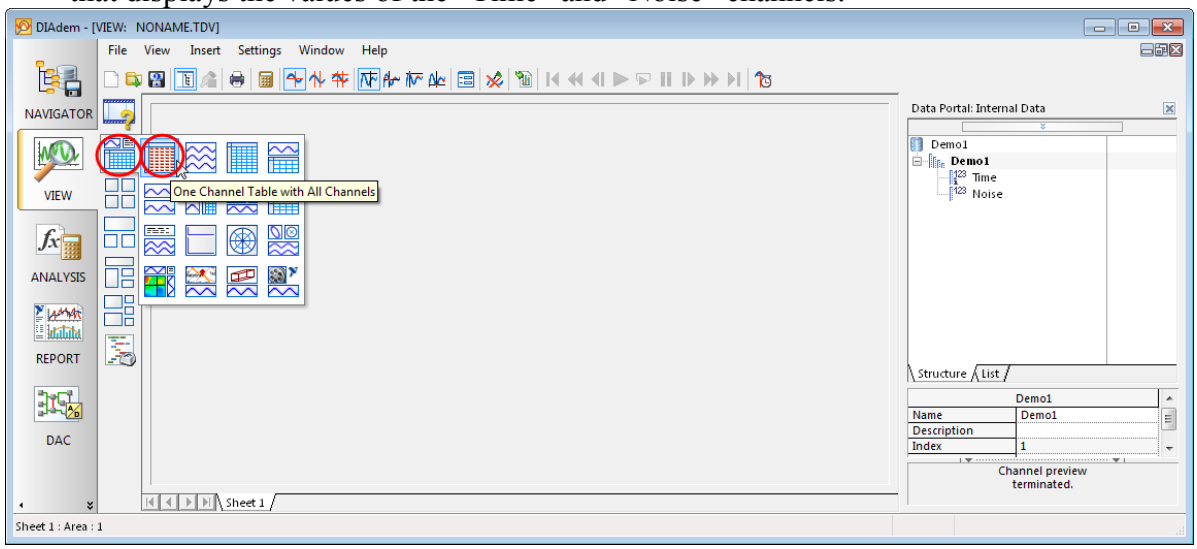
3.3 Open up the "National Instruments" folder under the "Search Areas" node and **navigate** down to the "**DIAdem 2014\Data**" directory. **Drag** the file "**Demo1.TDM**" from the file browser on the left **into** the **Data Portal** on the right of your screen. This loads the data, properties, and hierarchy of that data file into DIAdem memory.



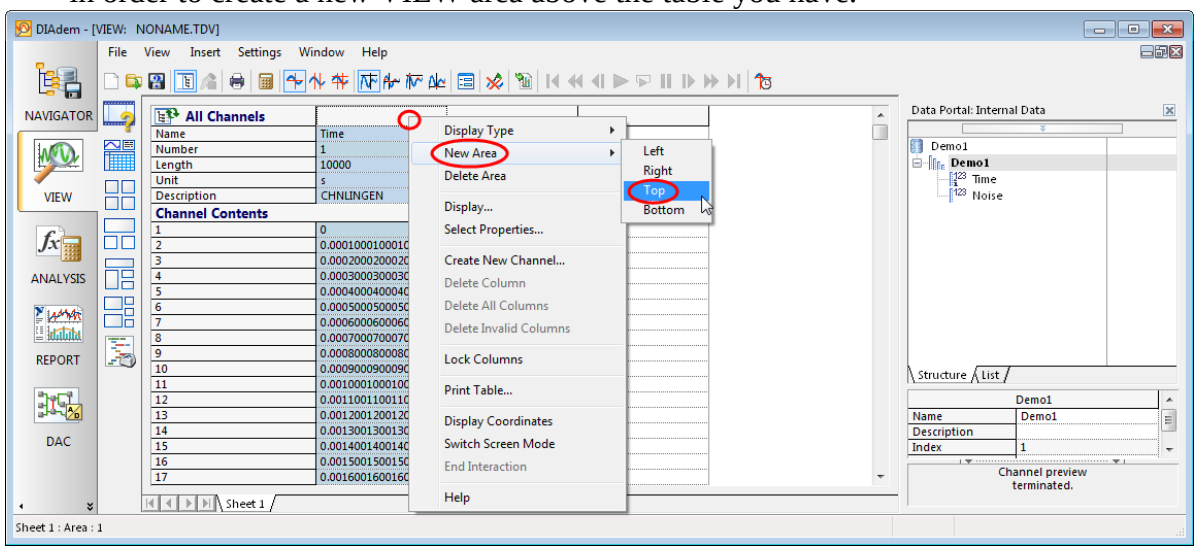
3.4 You see now that the "Demo1.TDM" file contains one group of 2 channels— a "Time" channel and a "Noise" channel. In order to get a quick graphical look at this data, first **change** to the **VIEW panel** by clicking on its icon at upper left corner of your screen. Then **click** on the "**New Layout**" icon at the top left of your screen in order to clear the VIEW panel and start from scratch. Click the "No" button if you are asked if you want to save changes to the VIEW layout you have currently.



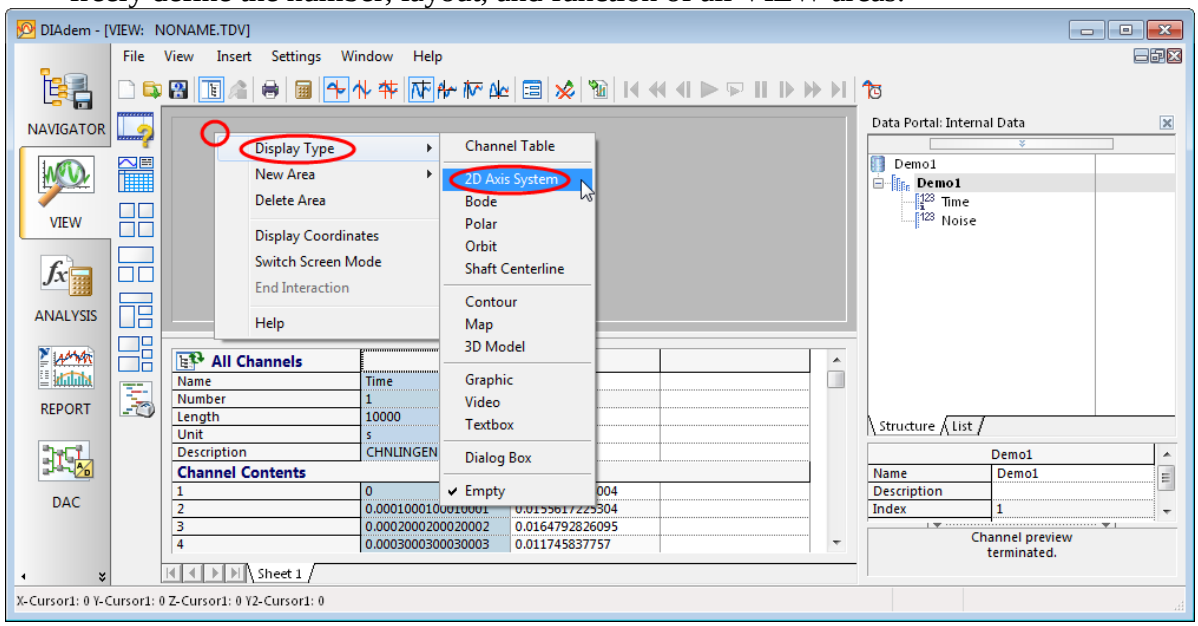
3.5 **Click** on the "**Assigned Worksheet Partitions**" icon at the top left of your screen and then **select** the "**One Channel Table with All Channels**" icon in order to create a table that displays the values of the "Time" and "Noise" channels.



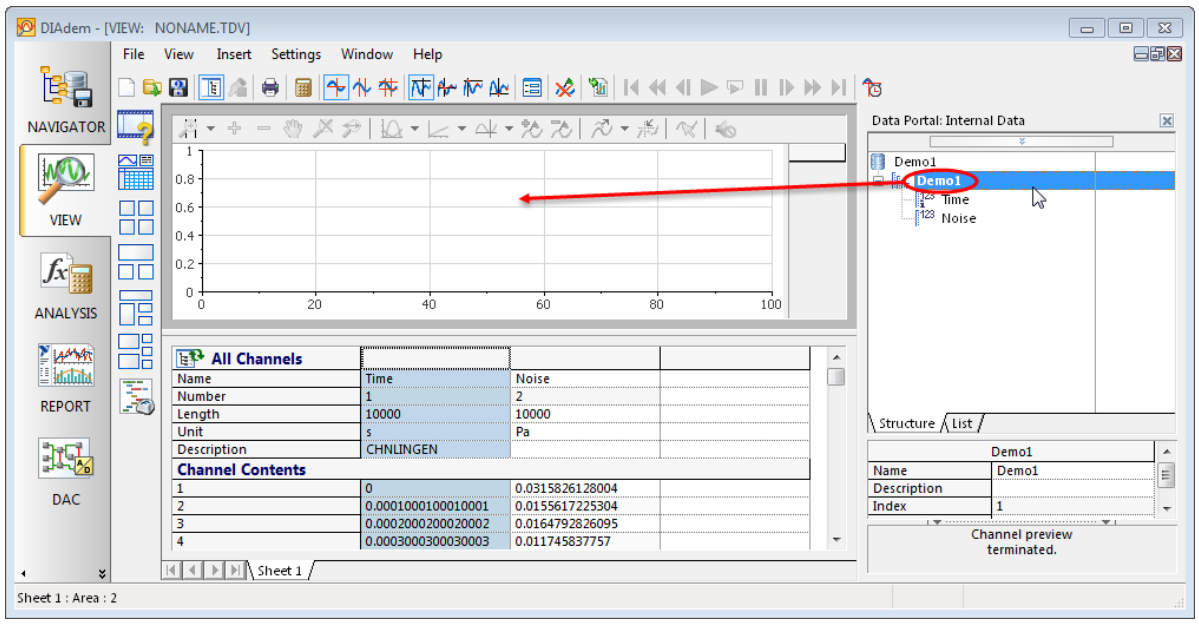
3.6 **Right-click** on the new **table** you just created and **select** the "**New Area>>Top**" menu in order to create a new VIEW area above the table you have.



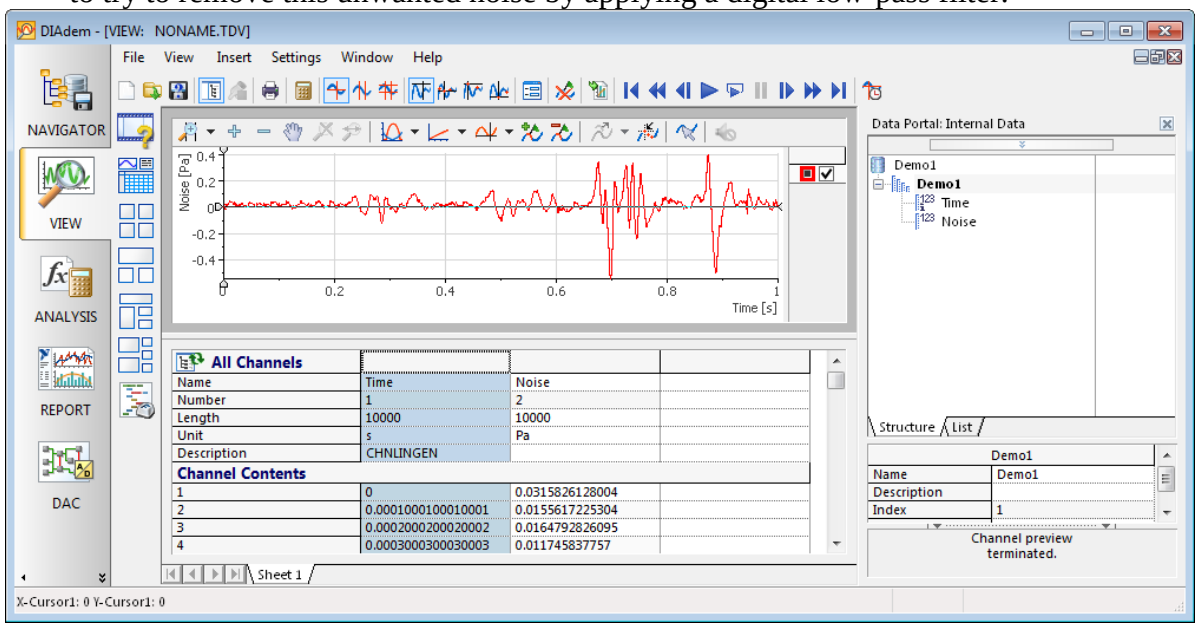
3.7 **Right-click** on this new **blank** VIEW **area** and **select** "**Display Type>>2D Axis System**" in order to define the top area to contain a 2D graph. In this way you can freely define the number, layout, and function of all VIEW areas.



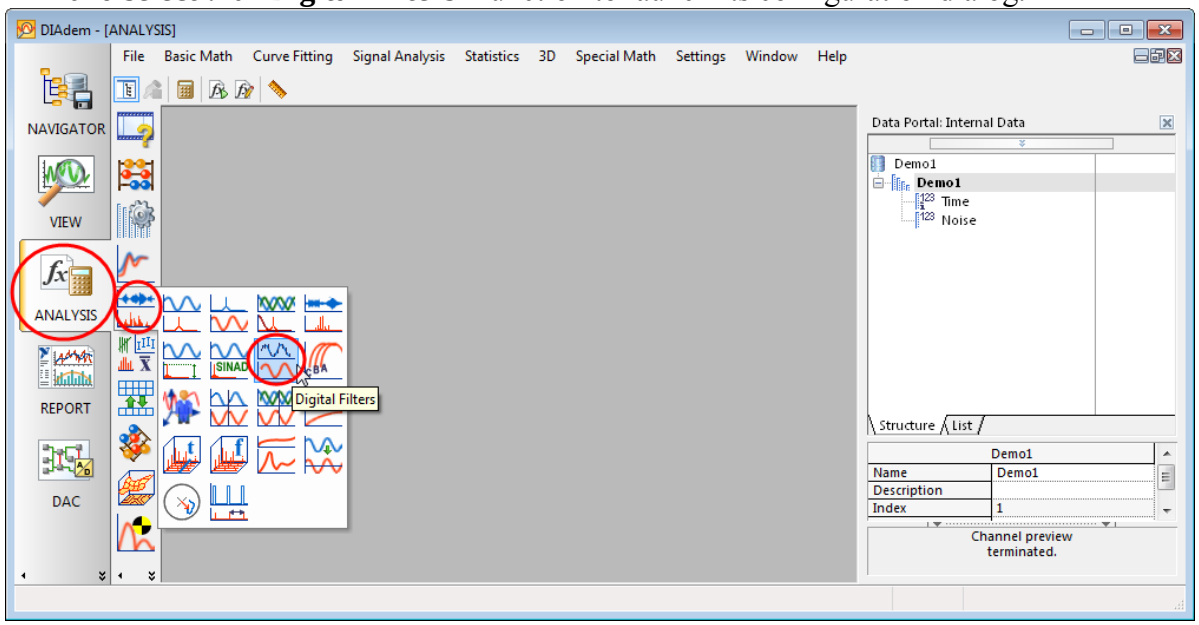
3.8 **Select** the "**Demo1**" group in the Data Portal at the right of your screen and **drag** it **into** the **top** VIEW **area**. Dragging the entire group will automatically graph the "Noise" channel on the Y-axis vs. the "Time" channel on the X-axis.



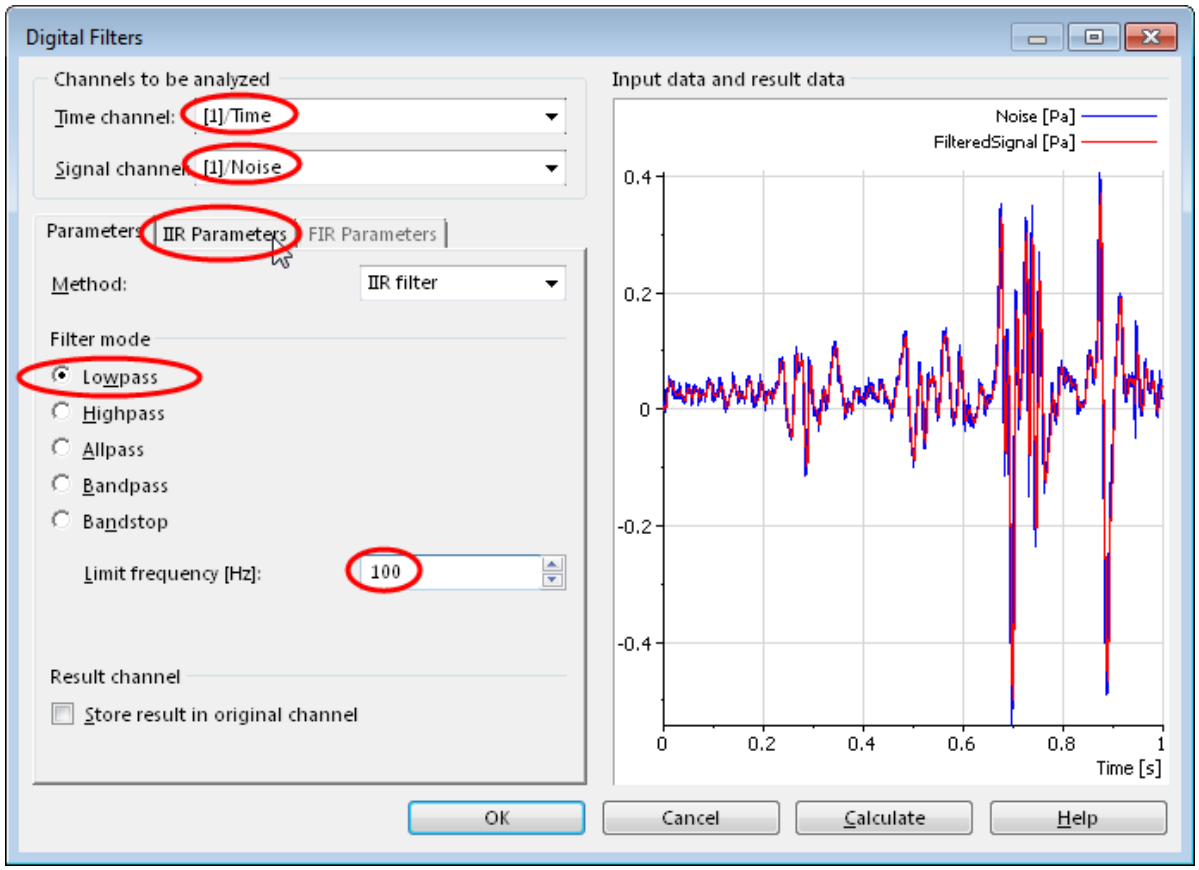
3.9 Now you see the acquired signal from your "Demo1.TDM" file in both graphical and tabular fashion. You suspect there is high frequency noise in this signal, so you decide to try to remove this unwanted noise by applying a digital low-pass filter.



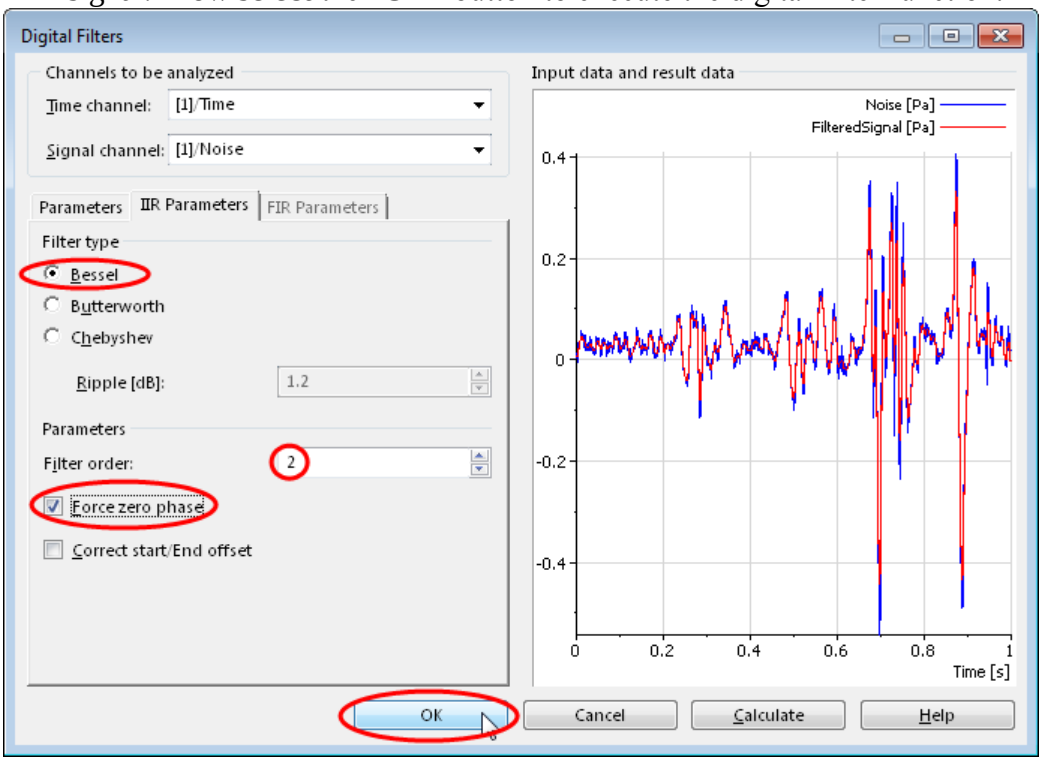
3.10 Click on the **ANALYSIS** tab icon at the left of your screen in order to switch to the ANALYSIS panel, then **click** on the "**Signal Analysis**" icon at the left of your screen and **select** the "**Digital Filters**" function to launch its configuration dialog.



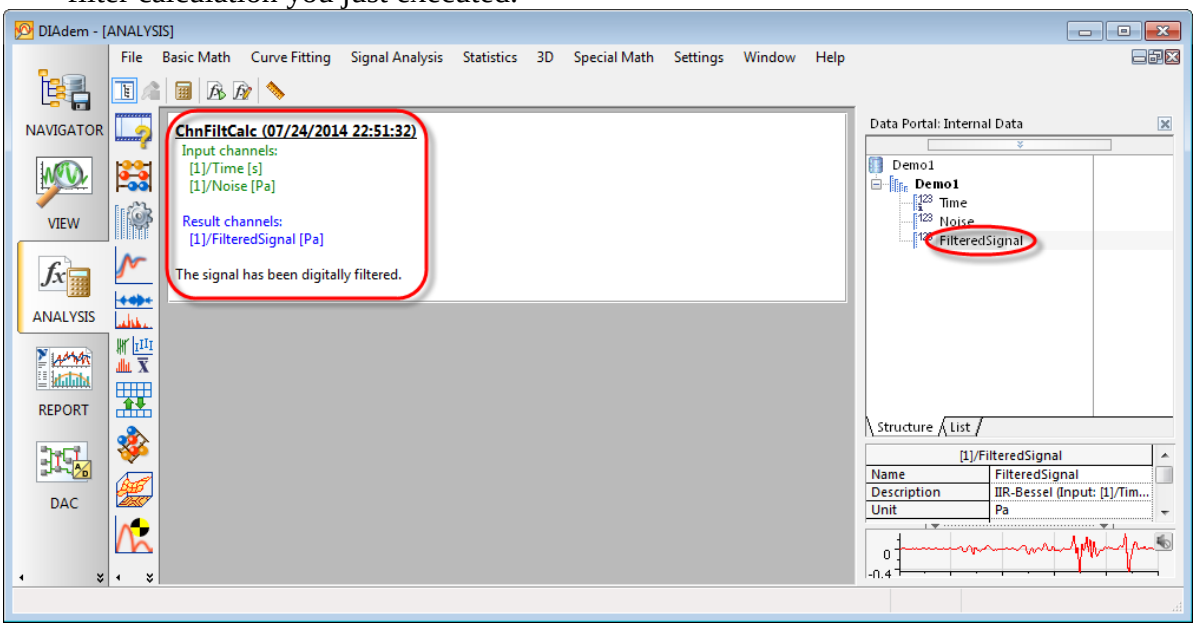
3.11 Note that the "Time" and "Noise" channels are automatically selected in the "Time channel" and "Signal channel" fields, respectively. Make sure the "Filter mode" field is set to "Lowpass" and **type** in "**100**" for the "**Limit frequency [Hz]"** value. Finally **click** on the "**IIR Parameters"** tab to set additional filter details.



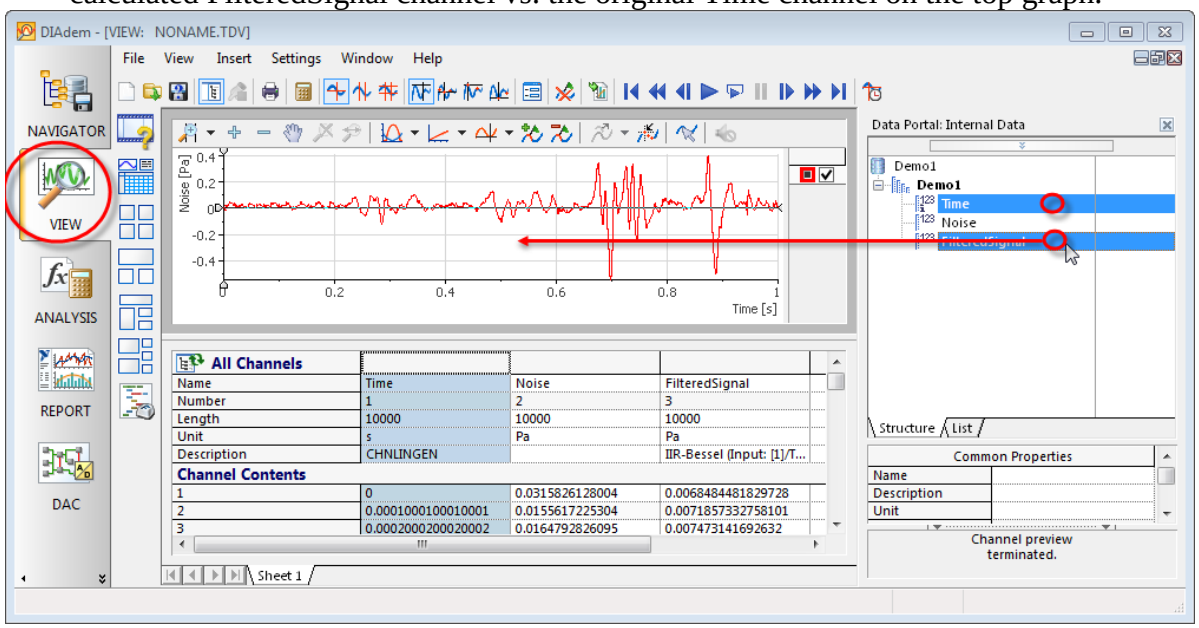
3.12 Make sure the "Filter type" is set to the default "Bessel" value, then **check** the "**Force zero phase**" checkbox— this will make the filtered waveform a better fit of the raw signal. Now **select** the "**OK**" button to execute the digital filter function.



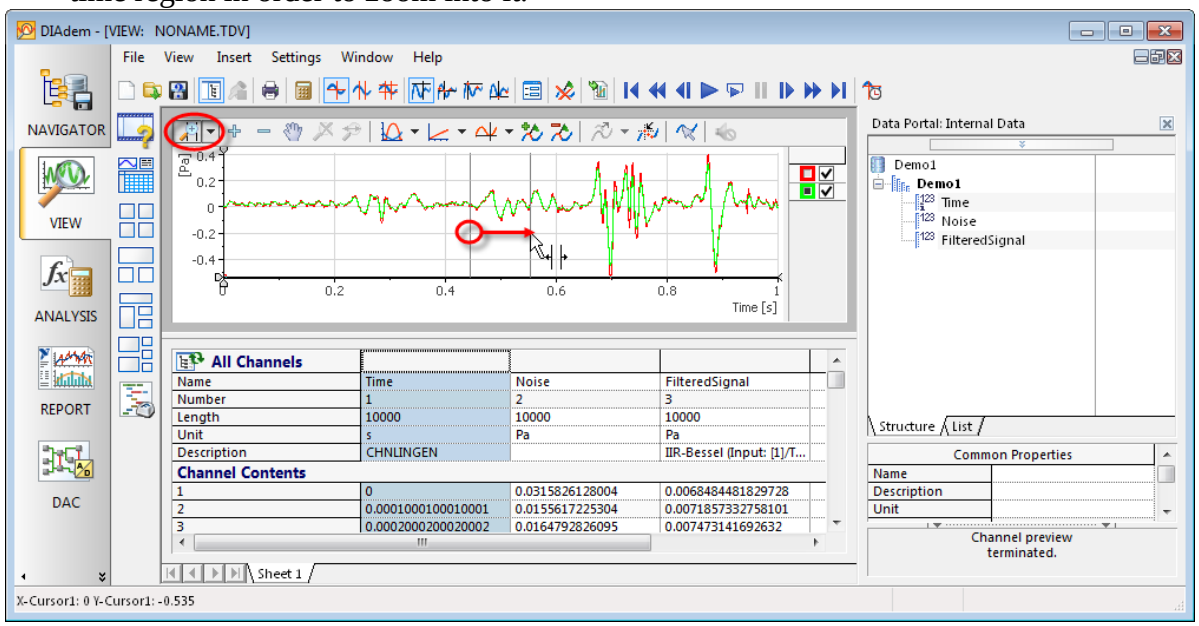
3.13 You can see that the resulting filtered signal is stored as a new channel in the Data Portal called "FilteredSignal". The ANALYSIS panel also shows a log of the digital filter calculation you just executed.



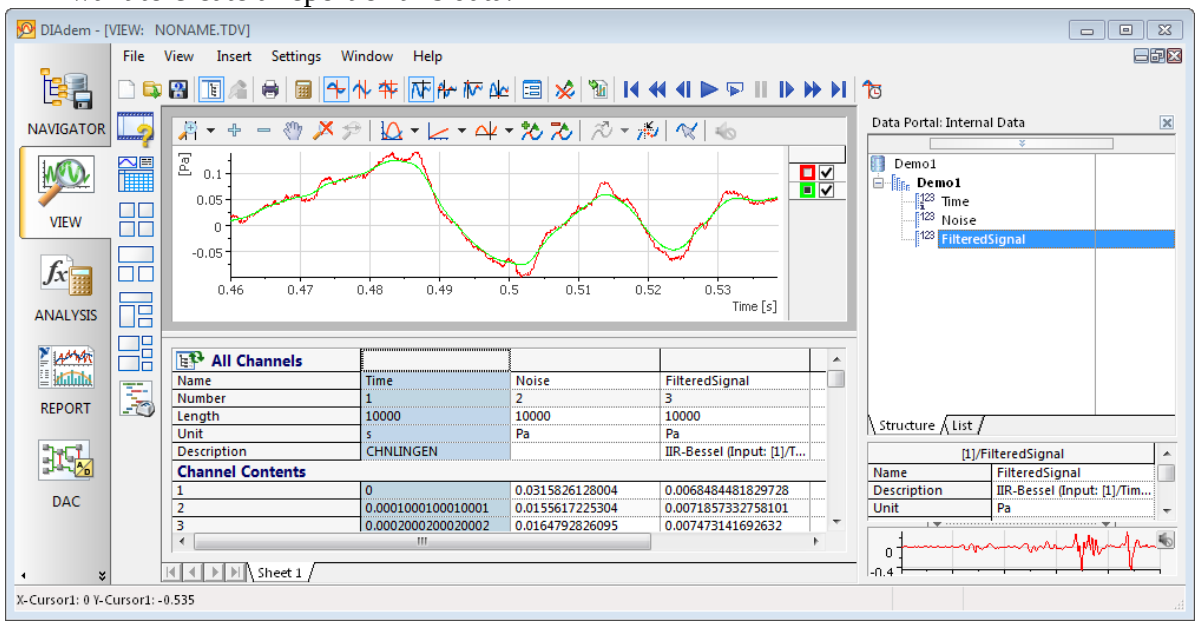
3.14 Click on the **VIEW** icon to switch back to VIEW. Then **click** on the "**Time**" **channel** in the Data Portal and **hold down** the **<Ctrl> button while clicking** on the "**FilteredSignal**" **channel** in the Data Portal— this selects only those two channels. Now **drag** the two selected **channels into** the **top** VIEW **area** to plot the newly calculated FilteredSignal channel vs. the original Time channel on the top graph.



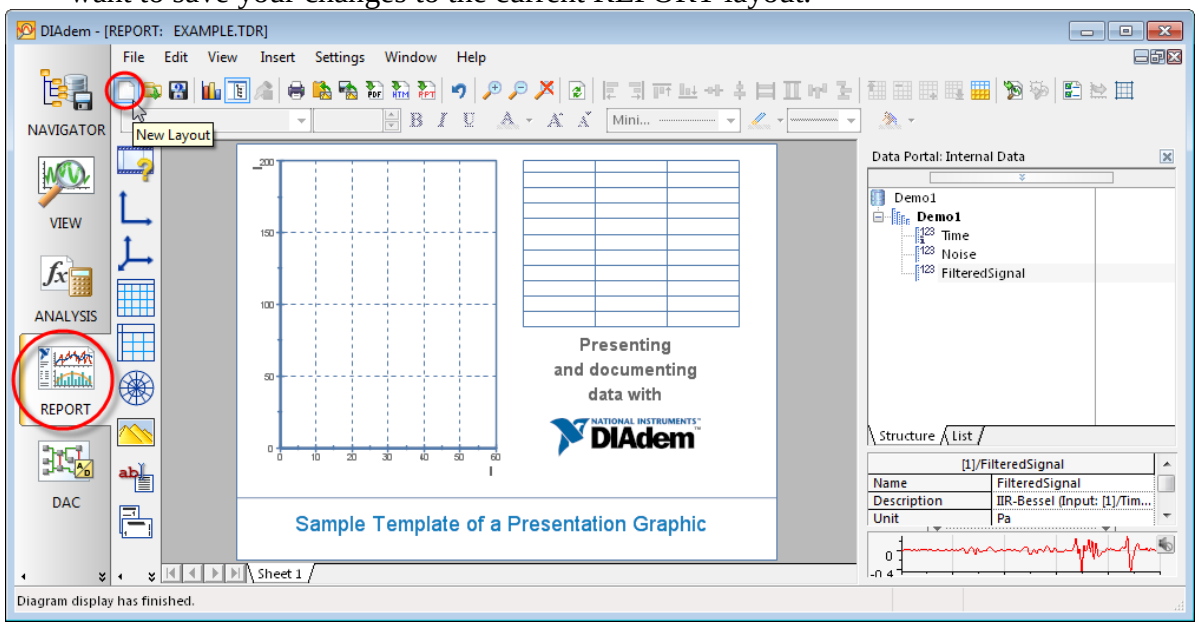
3.15 Now you can see the raw signal and the filtered signal side by side, but it is hard to see the difference at the full graph scale. **Click** on the "**Band Zoom**" icon at the top left of your screen, then **click** on the graph and **drag** the **mouse** to the **right** to outline a small time region in order to zoom into it.



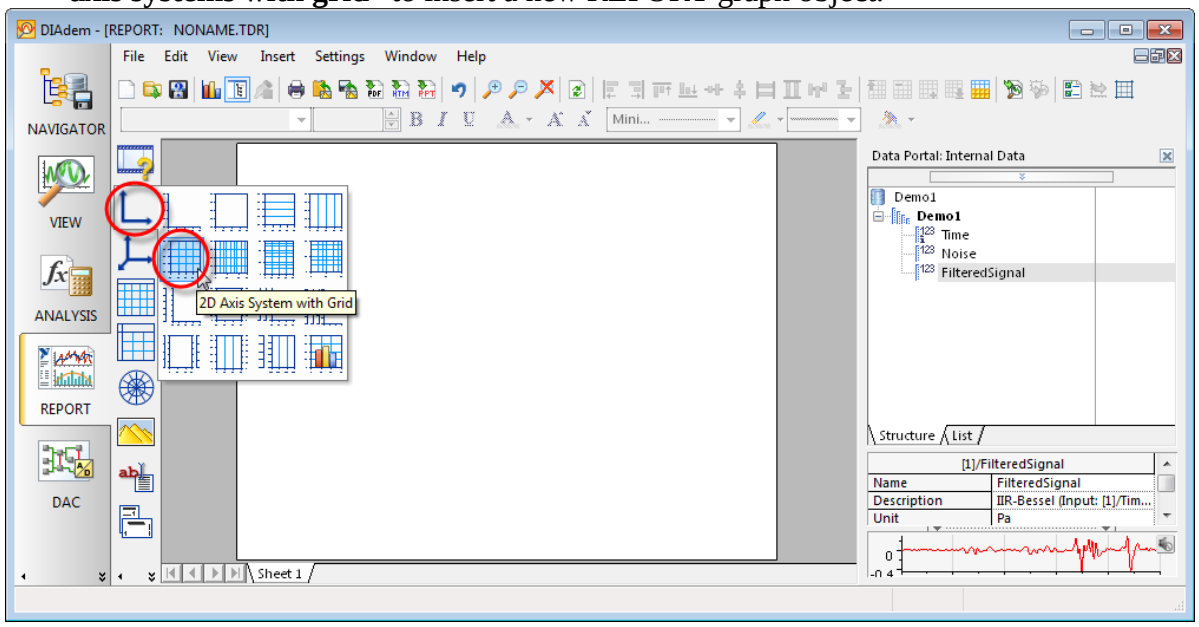
3.16 Now you see only the region you just highlighted with the mouse— and you see that the green digitally filtered signal is nearly the same as the red raw data signal, just much less noisy. You decide this is just the signal processing you need, and now you want to create a report of this data.



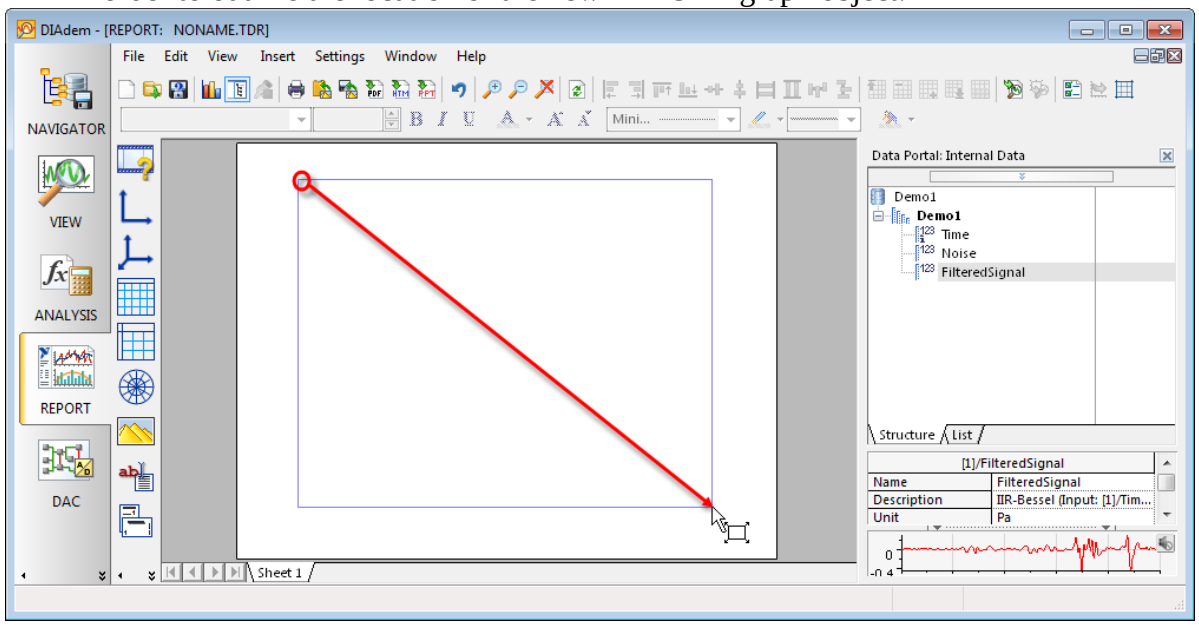
3.17 Click on the "**REPORT**" icon in order to switch to the REPORT panel, then **click** on the "**New Layout**" icon at the top left of your screen in order to clear the REPORT area of any previous sheets or REPORT objects. Click on the "No" icon if asked if you want to save your changes to the current REPORT layout.



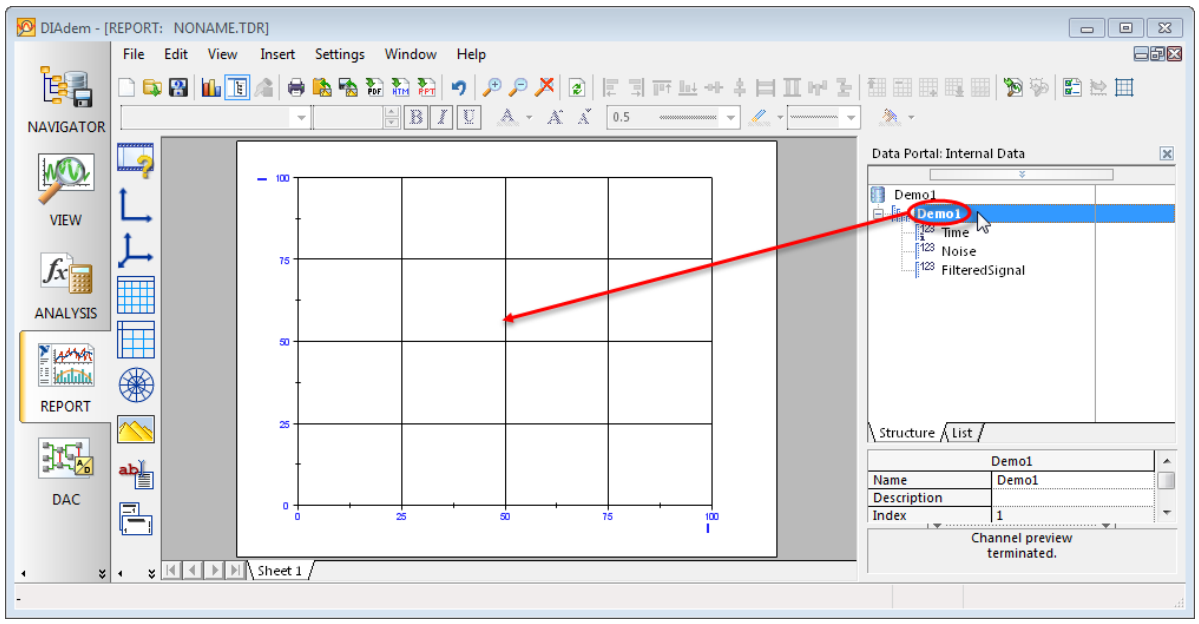
3.18 Click on the "**2D Axis Systems**" icon at the top left of your screen and **select** the "**2D-axis systems with grid**" to insert a new REPORT graph object.



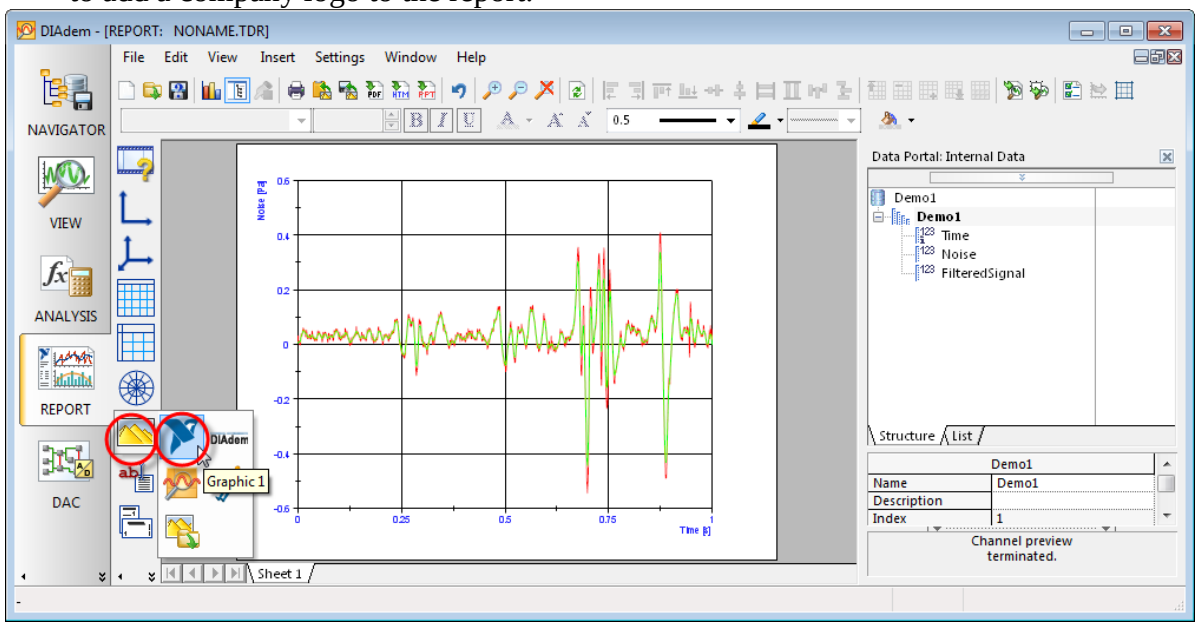
3.19 Click and **drag** your mouse from the **top left** to the **middle right** of the REPORT area in order to outline the location of the new REPORT graph object.



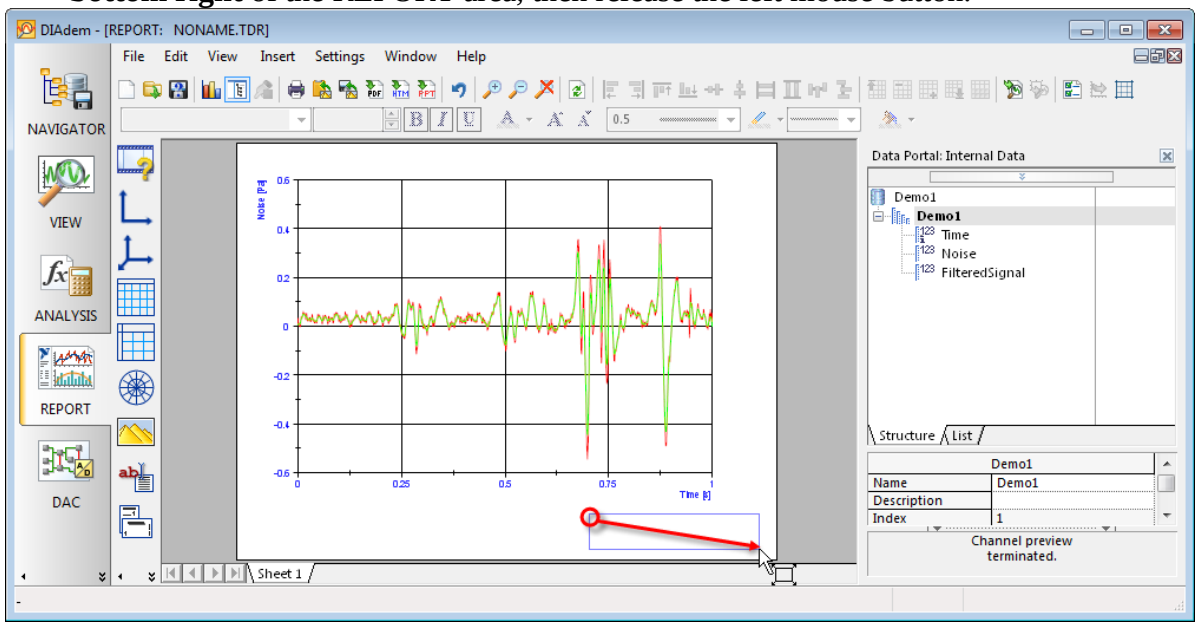
3.20 Drag the "**Demo1**" **group** from the Data Portal at the right of your screen into the new graph object. This automatically plots the "Noise" and "FilteredSignal" channels on the Y-axis vs. the "Time" channel on the X-axis.



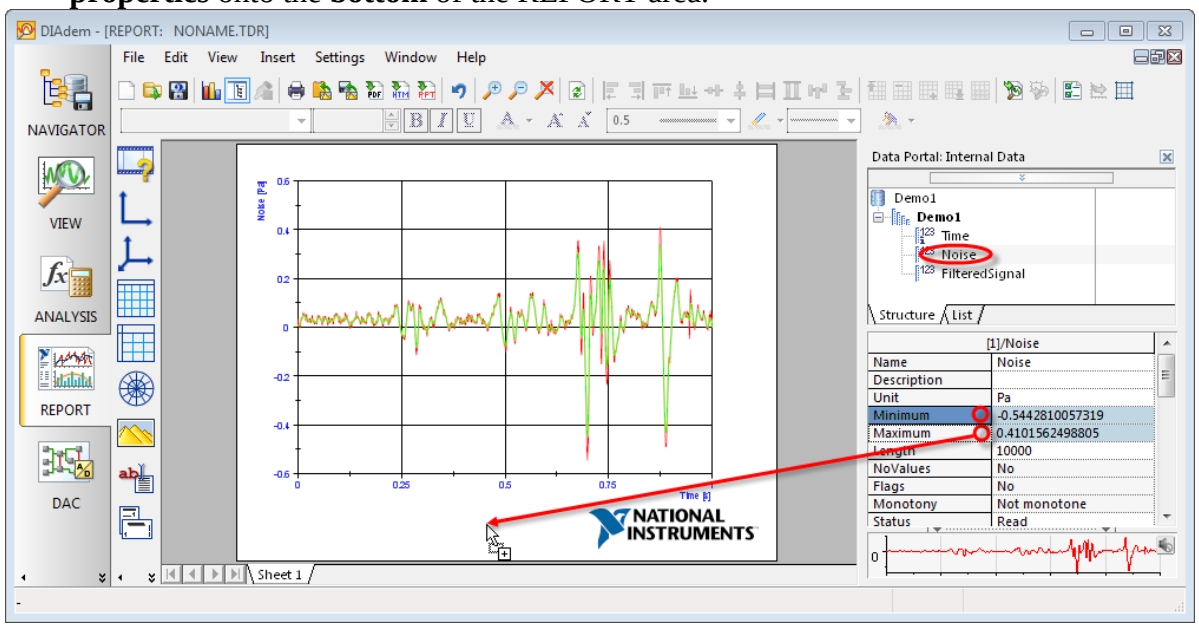
3.21 Click on the "Graphics" icon at the left of your screen, then select "Graphic 1" in order to add a company logo to the report.



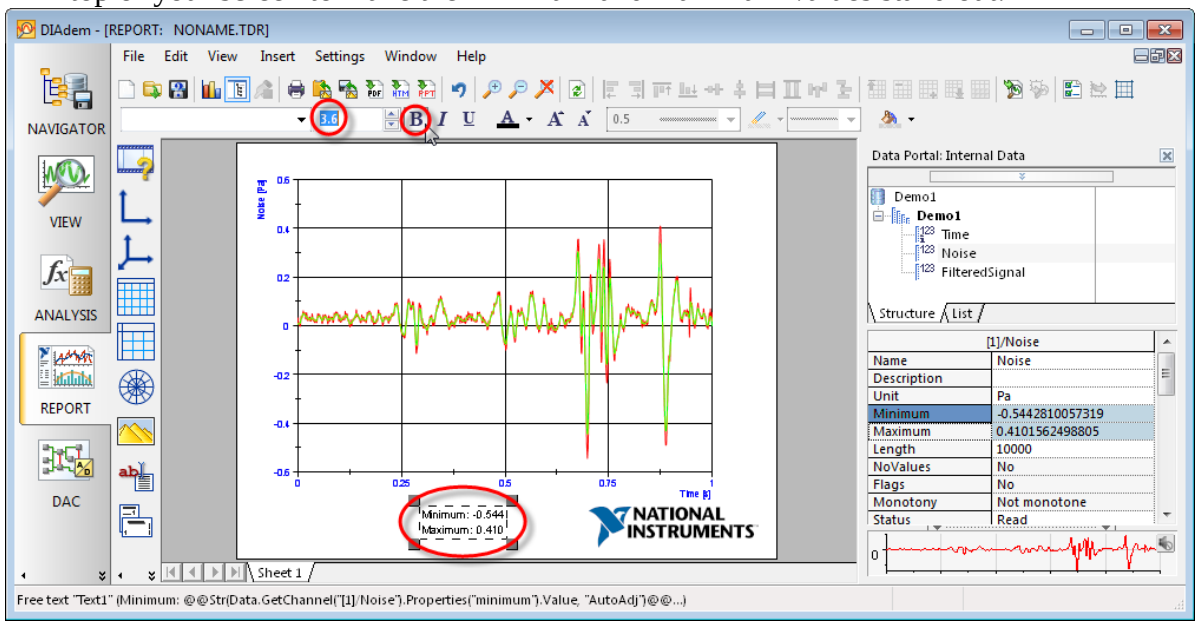
3.22 Click and **drag** your mouse where you want the **logo** to be— outline an area in the **bottom right** of the REPORT area, then release the left mouse button.



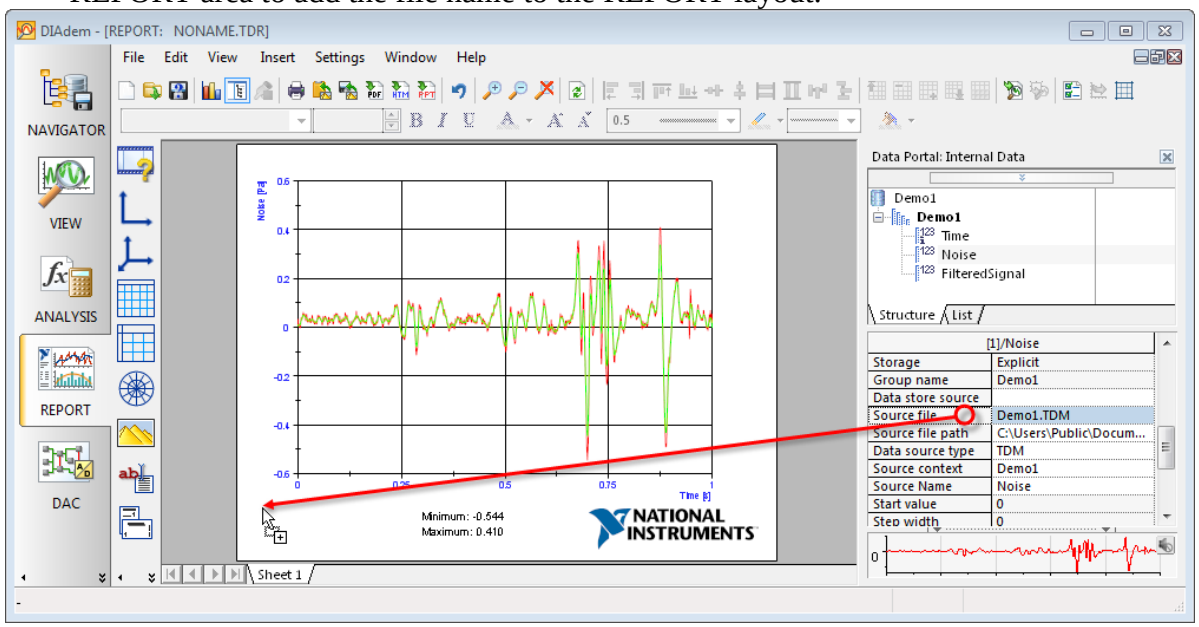
3.23 Click on the **"Noise" channel** in the Data Portal to select it, then look at its properties in the property table below it. **Click** on the "**Minimum**" property, then **hold** the **<Shift>** key down **while selecting** the "**Maximum**" property as well. Now **drag both properties** onto the **bottom** of the REPORT area.



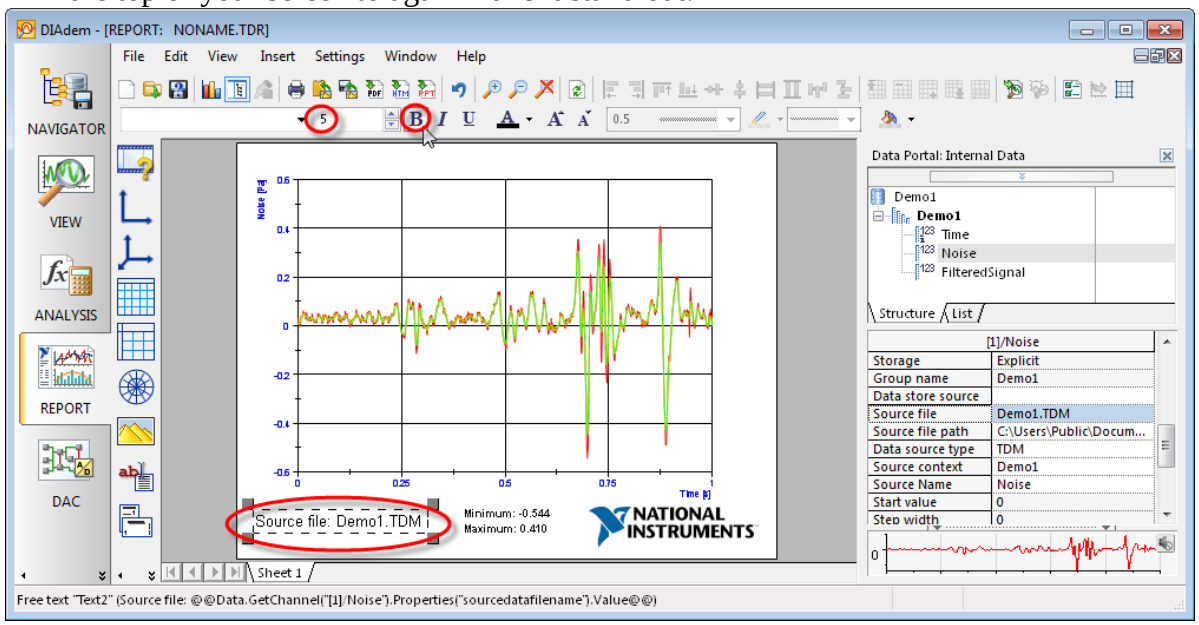
3.24 Click on the new **textbox** object that was automatically added to your REPORT area, then **change** the value of the **"Font Size"** field **to 3.6** and **click** the **"Bold"** icon at the top of your screen to make the minimum and maximum values stand out.



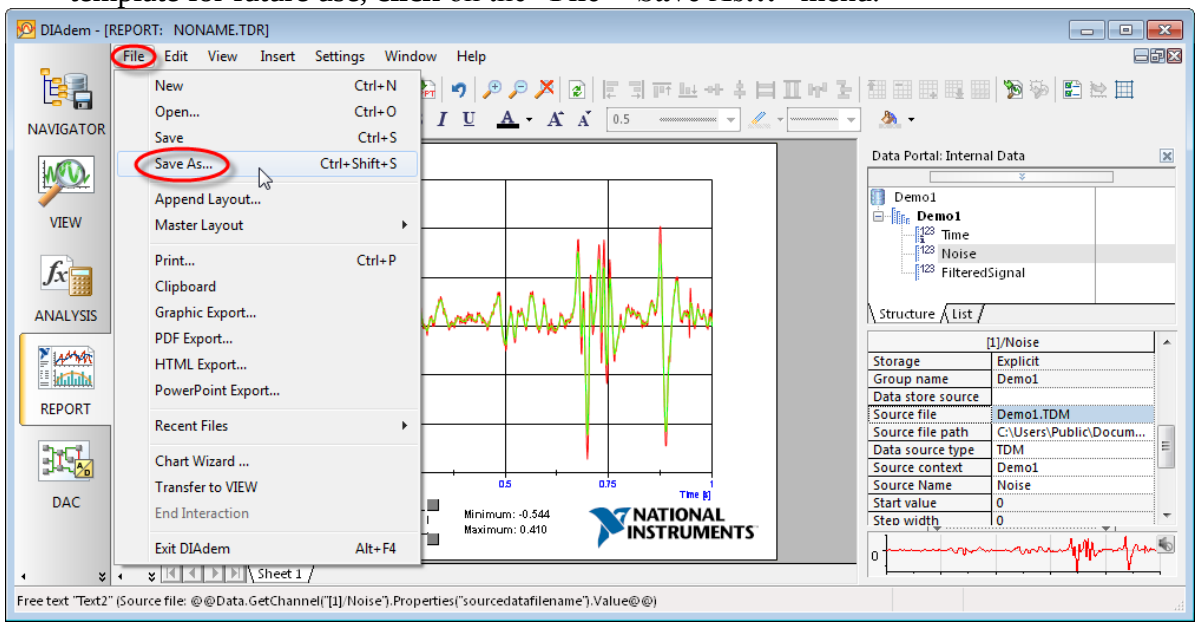
3.25 Click on the **"Source file"** property name, then **drag it** onto the **bottom left** of the REPORT area to add the file name to the REPORT layout.



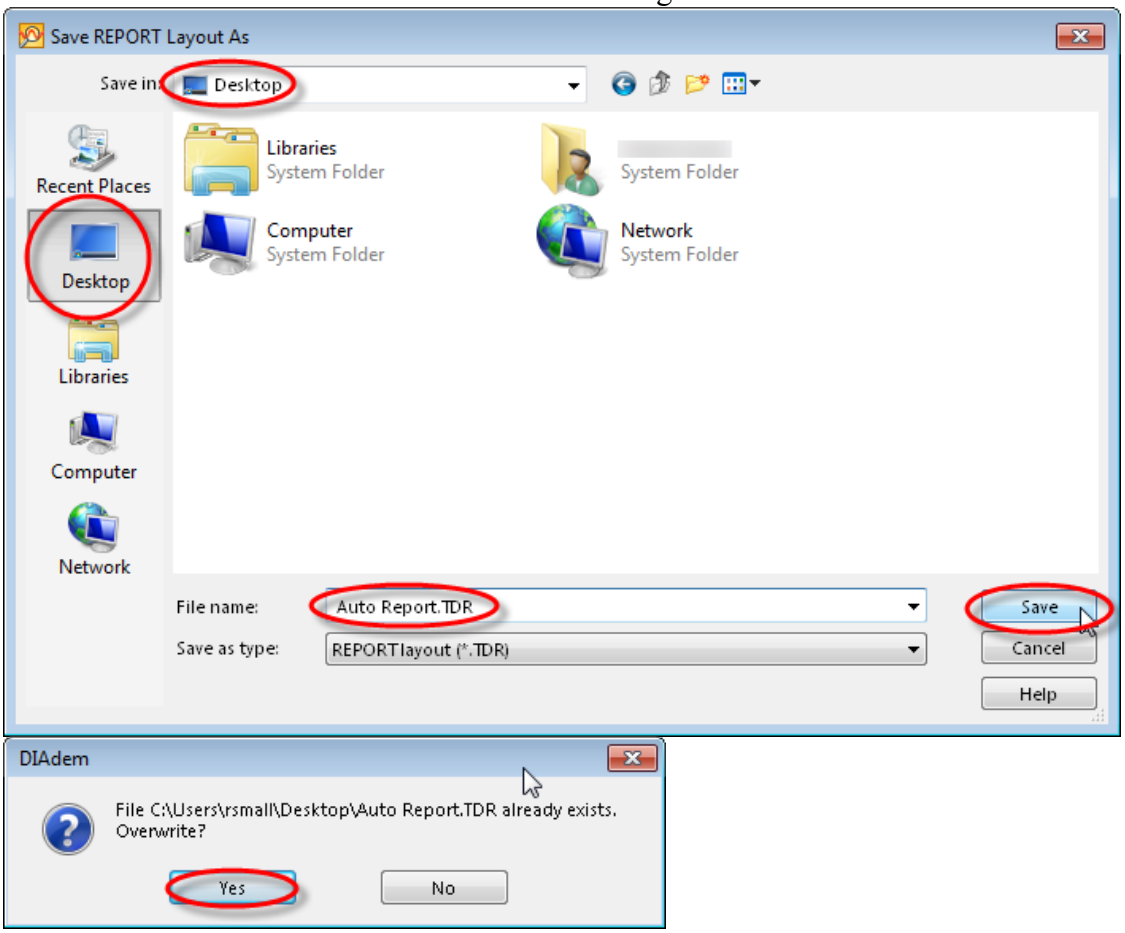
3.26 Click on the file name **textbox** object that was automatically added to your REPORT area, then **change** the value of the **"Font Size"** field **to 5** and **click** the **"Bold"** icon at the top of your screen to again make it stand out.



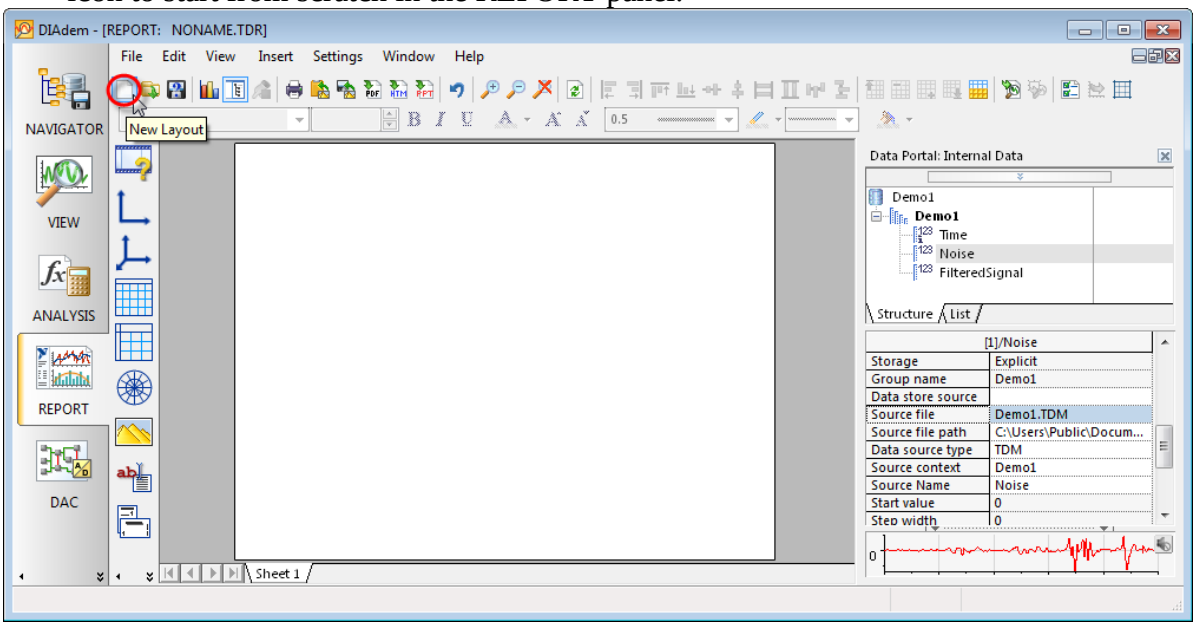
3.27 Now the report looks like you want it. What you really need is to quickly and easily create this sort of report for every new data set that comes in. To save this report template for future use, **click** on the "**File>>Save As…**" menu.



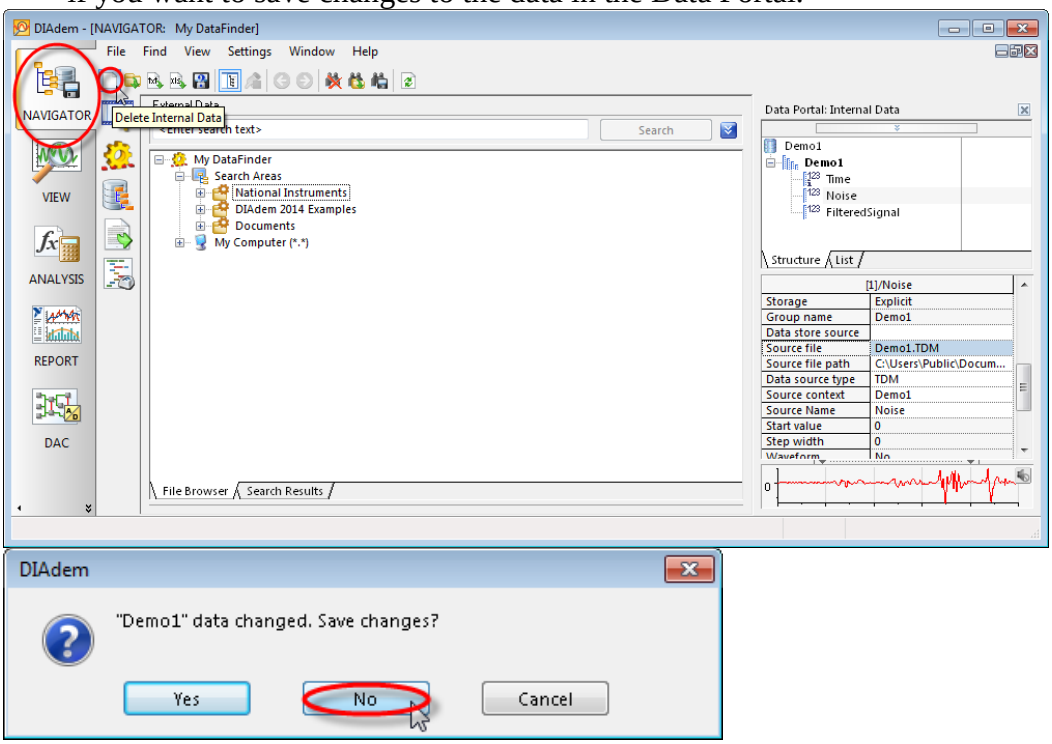
3.28 Navigate to the **Desktop, name** the **file** "**Auto Report.TDR**" and **click** the "**Save**" button. Click "Yes" if asked to confirm overwriting a file of the same name.



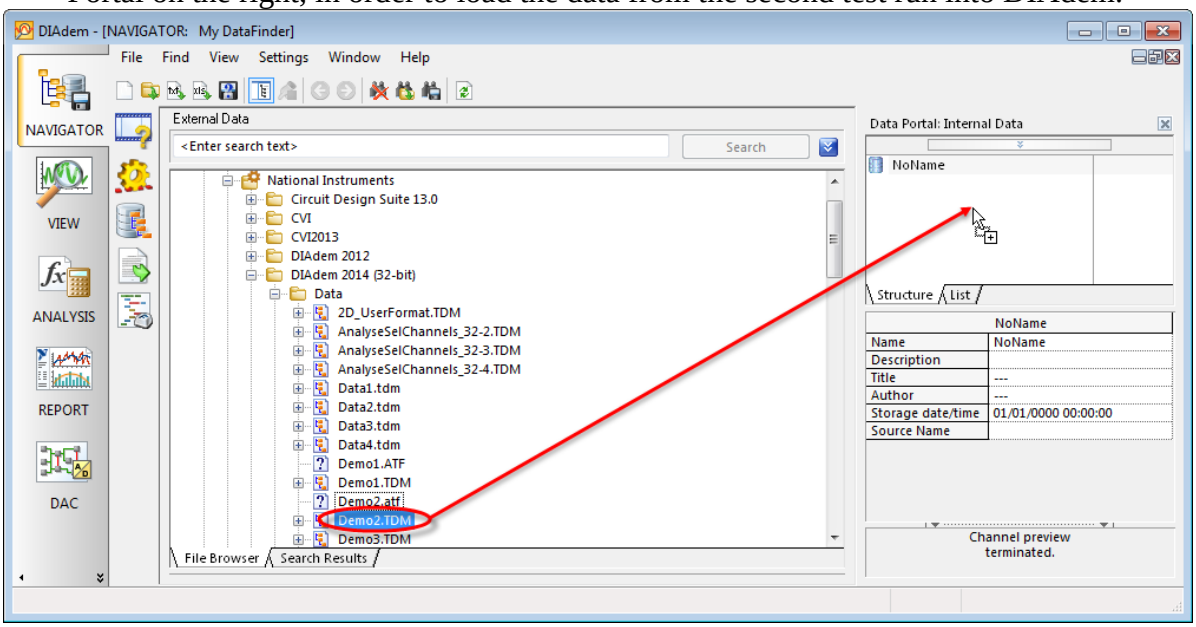
3.29 Now you will use the VBScript Recorder in DIAdem to easily retrace your analysis and reporting steps and turn them into a reporting script. First **click** on the "**New Layout**" icon to start from scratch in the REPORT panel.



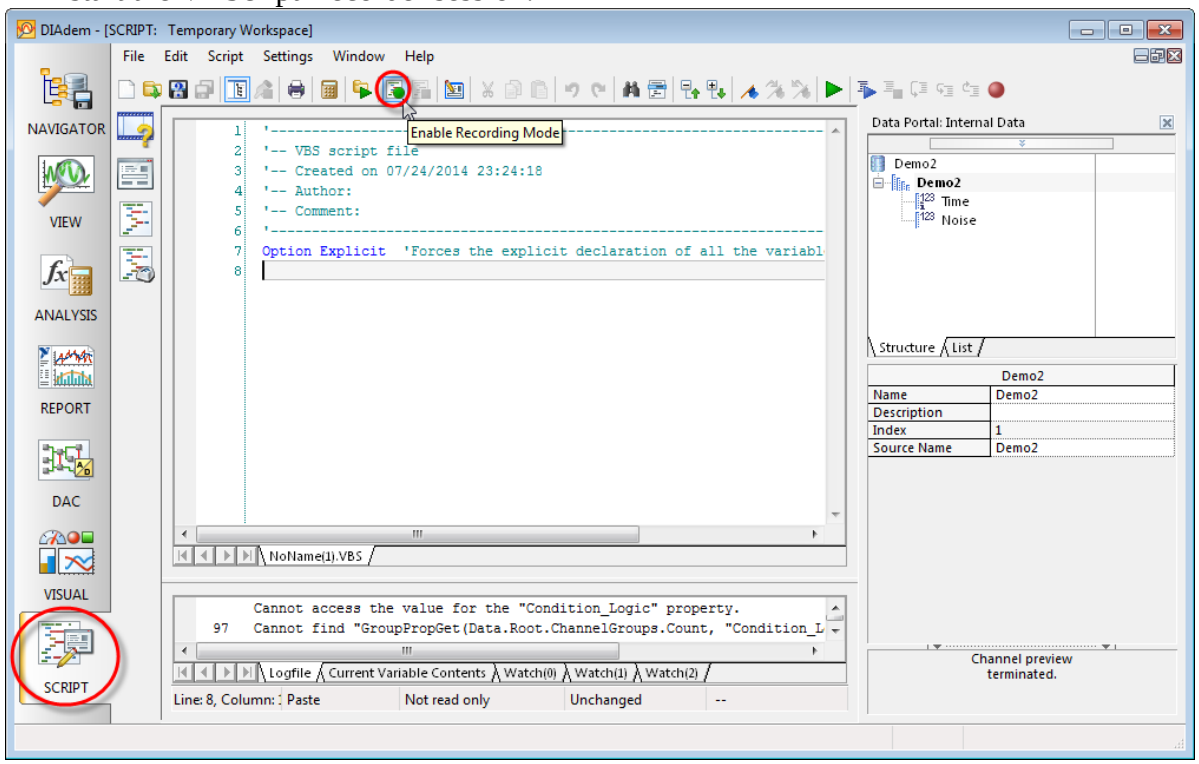
3.30 Click on the "**NAVIGATOR**" icon in order to switch to the NAVIGATOR panel, then **Click** on the "**Delete Internal Data**" icon at the top left of your screen in order to clear out the Data Portal and start with a clean slate. Click the "No" button if you are asked if you want to save changes to the data in the Data Portal.



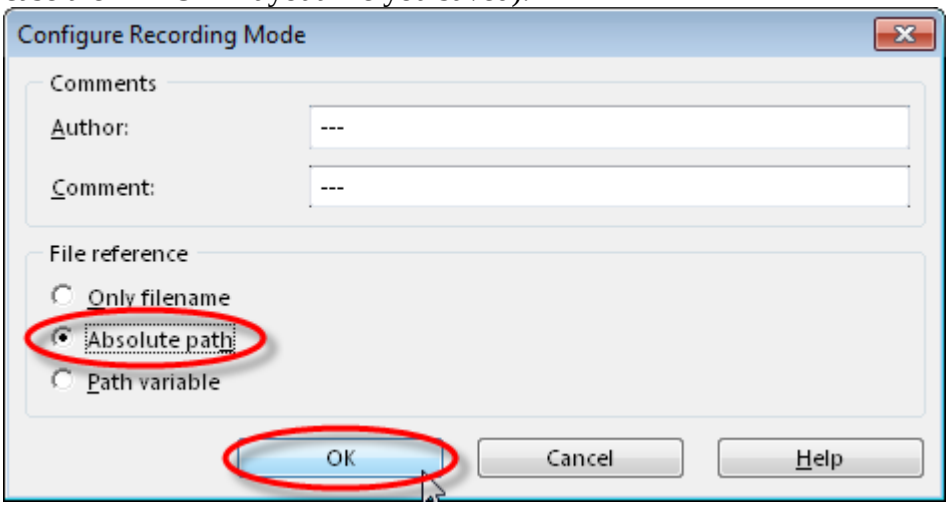
3.31 Drag the "**Demo2.TDM**" data file from the File Browser on the left into the Data Portal on the right, in order to load the data from the second test run into DIAdem.



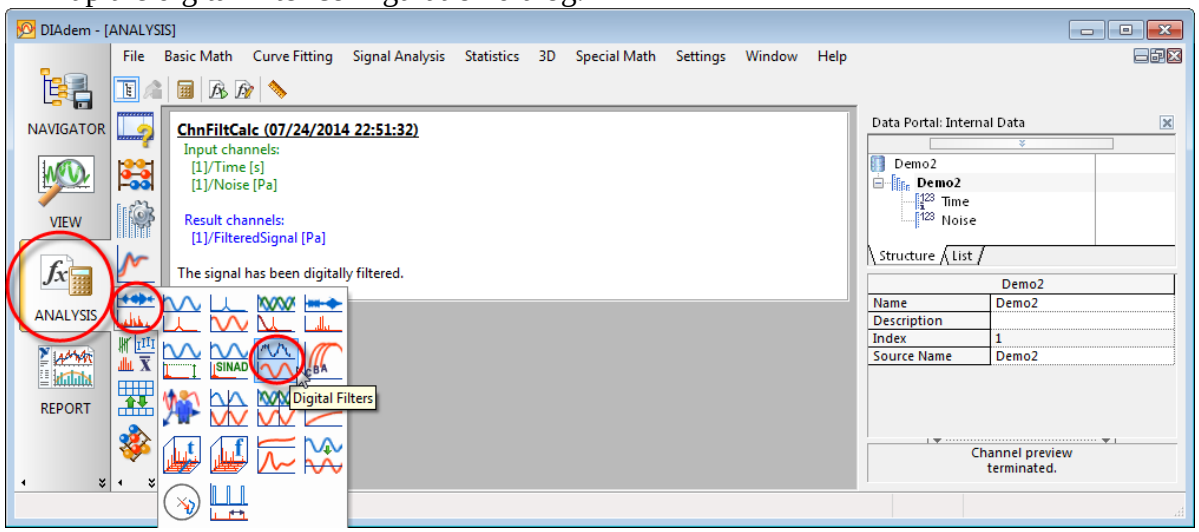
3.32 Click the "**SCRIPT**" icon at the left of your screen in order to switch to the SCRIPT panel. **Click** the "**Enable Recording Mode**" icon at the top of your screen in order to start the VBScript Recorder session.



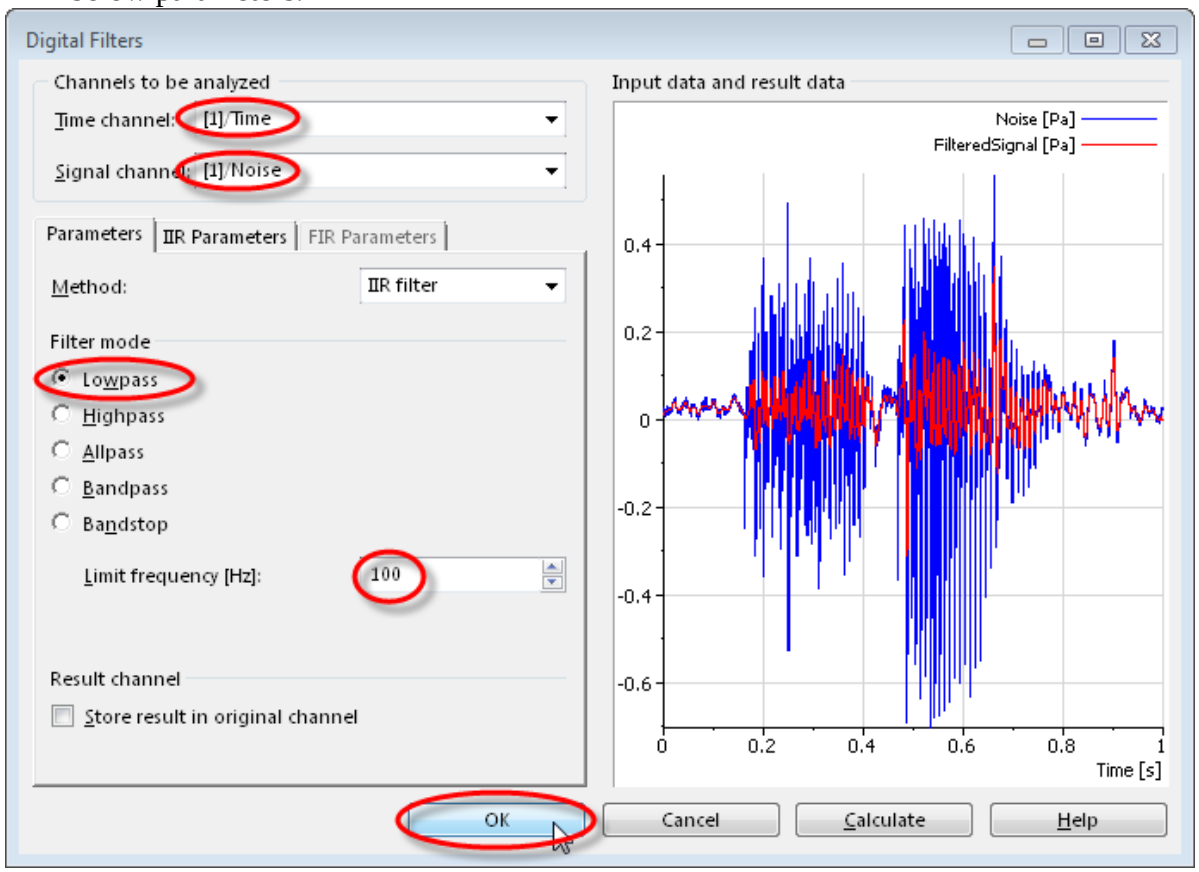
3.33 Select the **"Absolute path"** radio button and **click** the "**OK**" button. This instructs the Script Recorder to include the full file path to any resource files loaded or saved (in this case the REPORT layout file you saved).



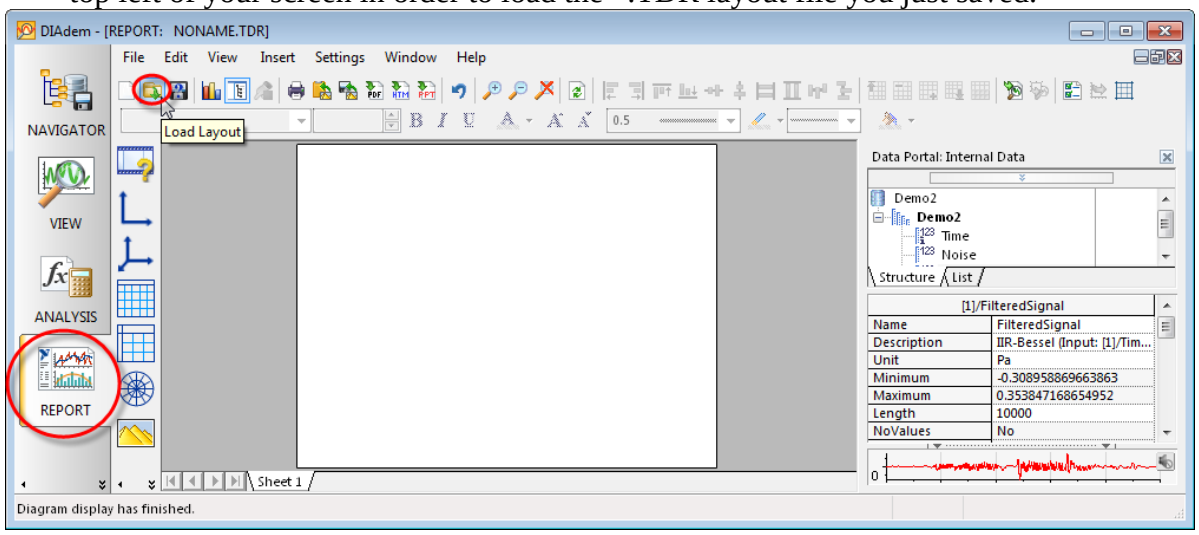
3.34 Now everything you do interactively will be automatically turned into VBScript code. **Click** on the "**ANALYSIS**" icon at the left of your screen to return to the ANALYSIS panel, **click** the "**Signal Analysis**" icon and **select** the "**Digital filters**" function to pop up the digital filter configuration dialog.



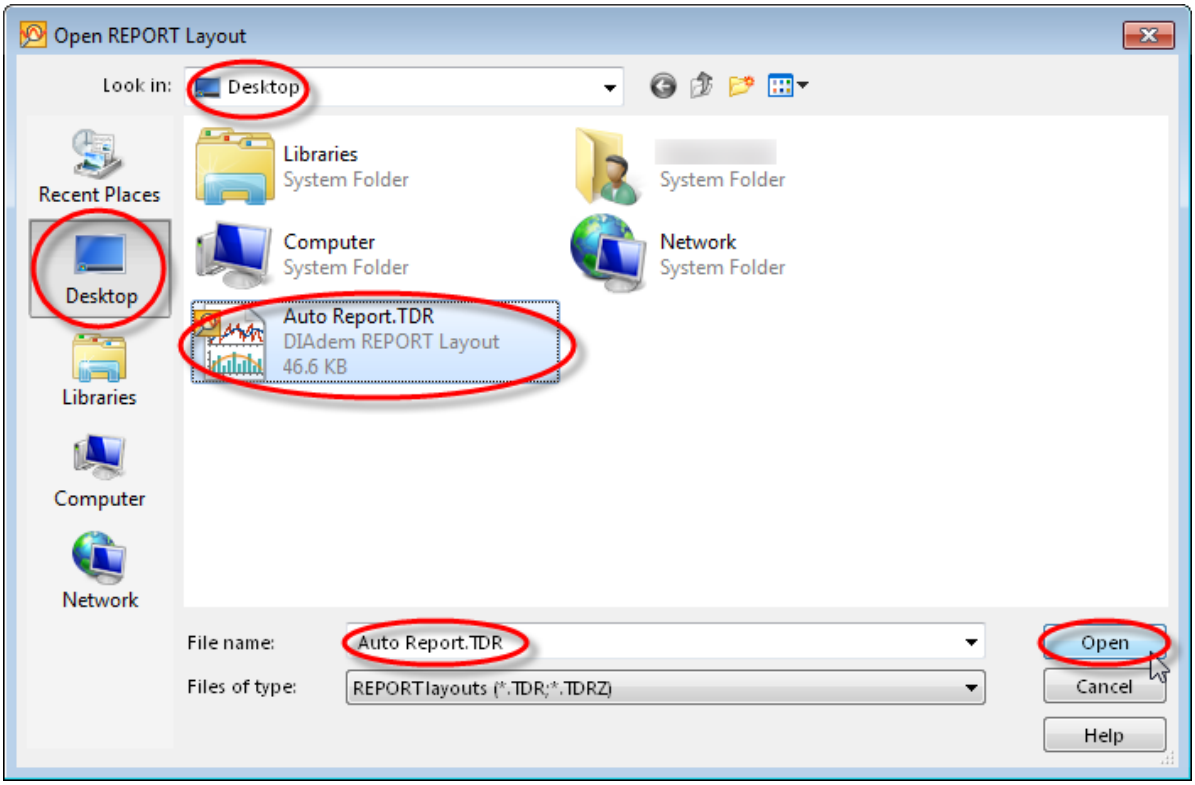
3.35 Verify that all your settings are the same from the last digital filter you ran, then **click** on the "**OK**" button to execute the digital filtering for this second data set. A new command line will now automatically appear in the VBScript you are recording which calculates a "FilteredSignal" channel from the "Time" and "Noise" channels with the below parameters.



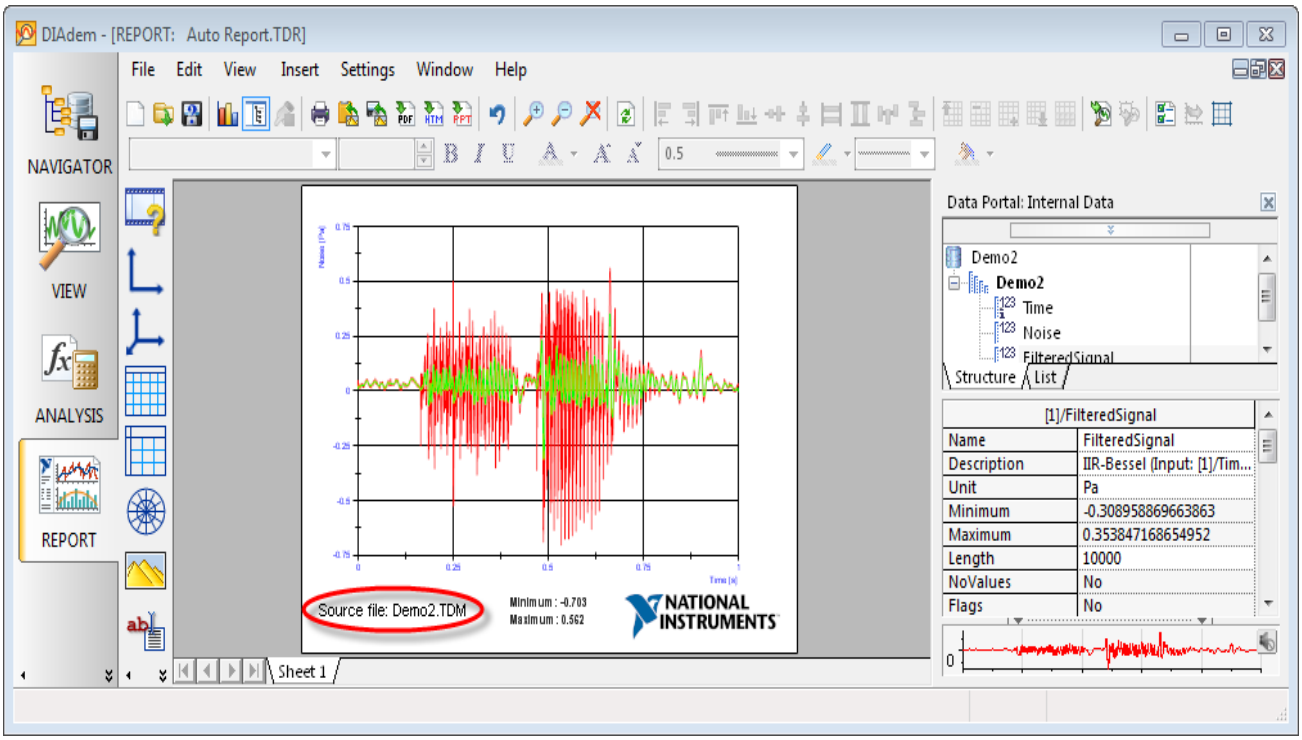
3.36 Click on the **REPORT** icon at the left of your screen in order to switch back to the REPORT panel. Now that you have created the filtered channel, all you have left to do is load the REPORT layout file you created. **Click** on the "**Load Layout**" icon at the top left of your screen in order to load the *.TDR layout file you just saved.



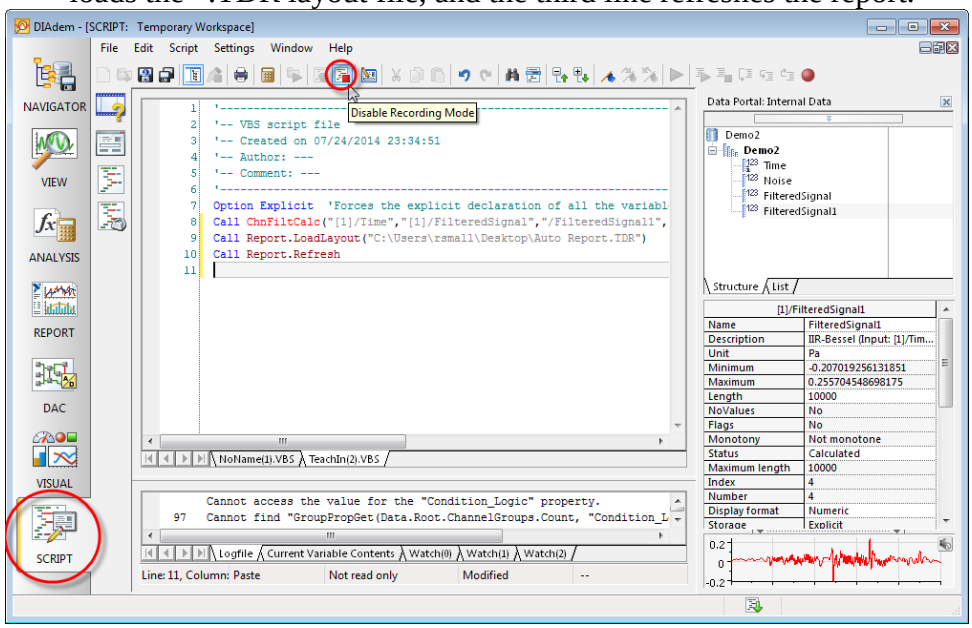
3.37 Navigate to the **Desktop, select** the "**Auto Report.TDR**" layout file you saved earlier, then **click** on the "**Open**" button to load the layout and replace the current contents of REPORT.



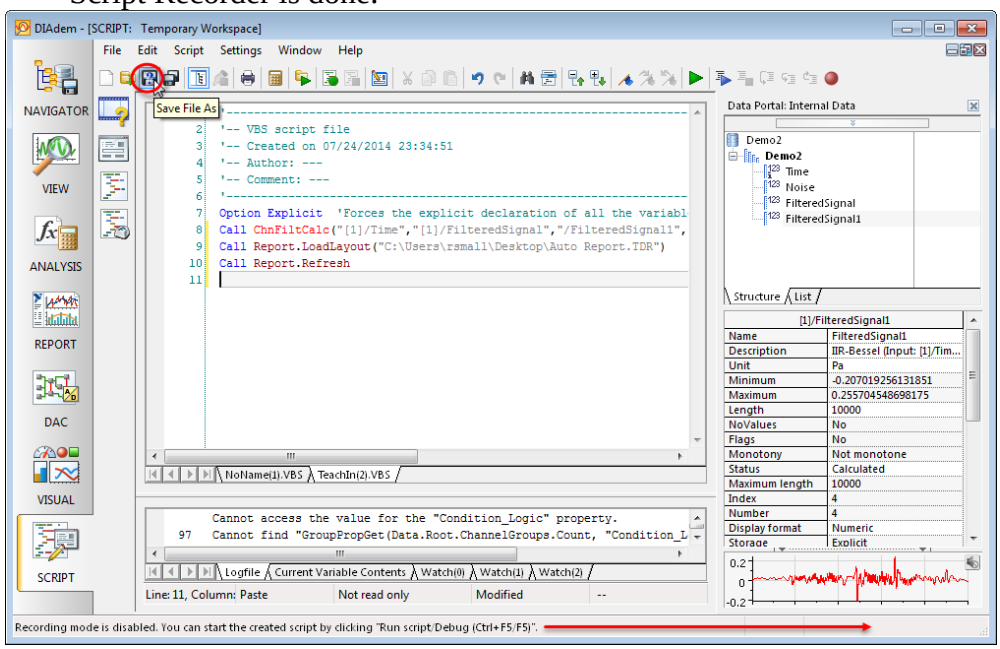
3.38 The format of the report you see now should be identical to that which you saved into the *.TDR file, but notice that the raw and filtered data traces are shaped quite differently than they were before, and the Source file, Minimum and Maximum properties are also different. This is because the *.TDR layout file stores the information that there is a graph on top with the curves “Noise” vs. “Time” and “FilteredSignal” vs. “Time”. If there is a different set of channels in the Data Portal, the curves on the graph will look different, though they will have the same color, line style, background grid, etc. Similarly, the *.TDR layout file stores that there is a textbox below the graph where the “Source file” property of the “Noise” channel is displayed and another textbox where the “Minimum” and “Maximum” properties of the “Noise” channel are displayed. If those properties are different in the Data Portal because new channels have been loaded, then different values automatically display in the textboxes.



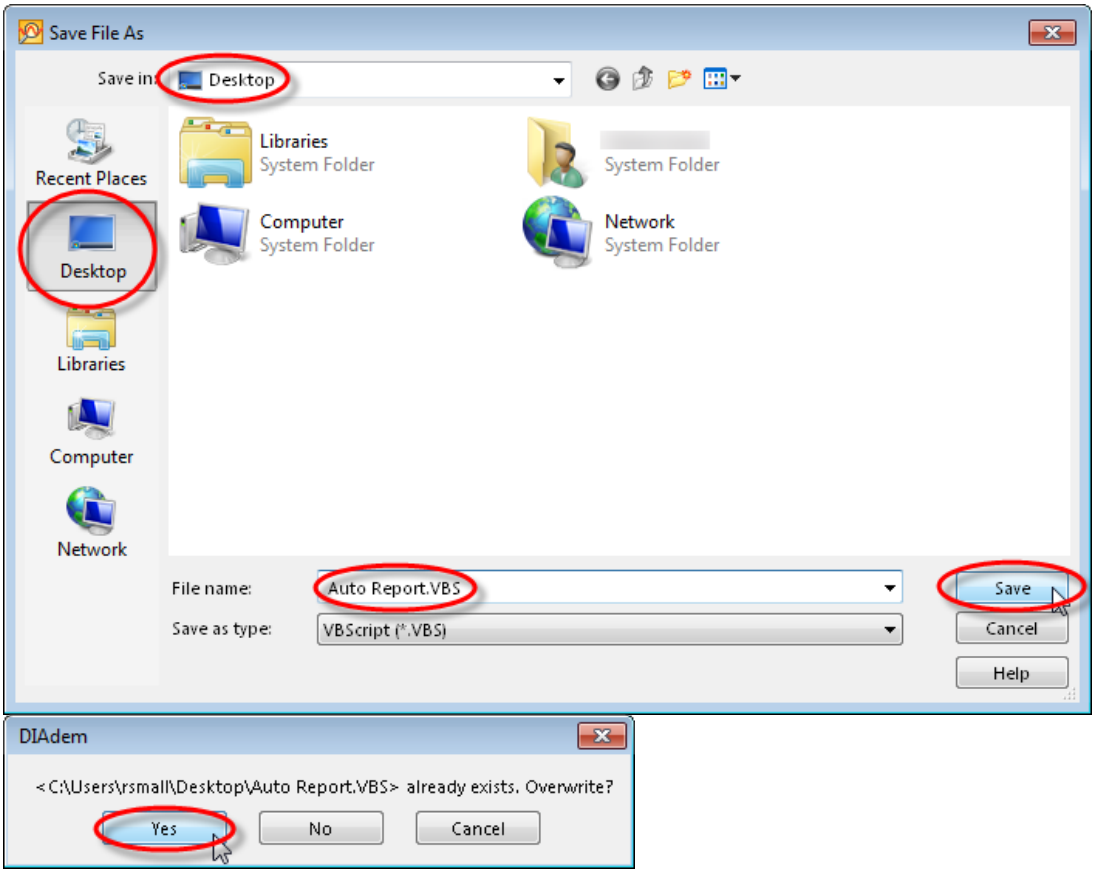
3.39 Now you are done recording your report script. **Click** on the "**SCRIPT**" icon at the left of your screen in order to switch back to the SCRIPT panel, then **click** on the "**Disable Recording Mode**" icon at the top of your screen in order to stop your VBScript Recorder session. Notice that you now have a VBScript with 3 red DIAdem commands in it— the first line calculates the "FilteredSignal" channel, the second line loads the *.TDR layout file, and the third line refreshes the report.



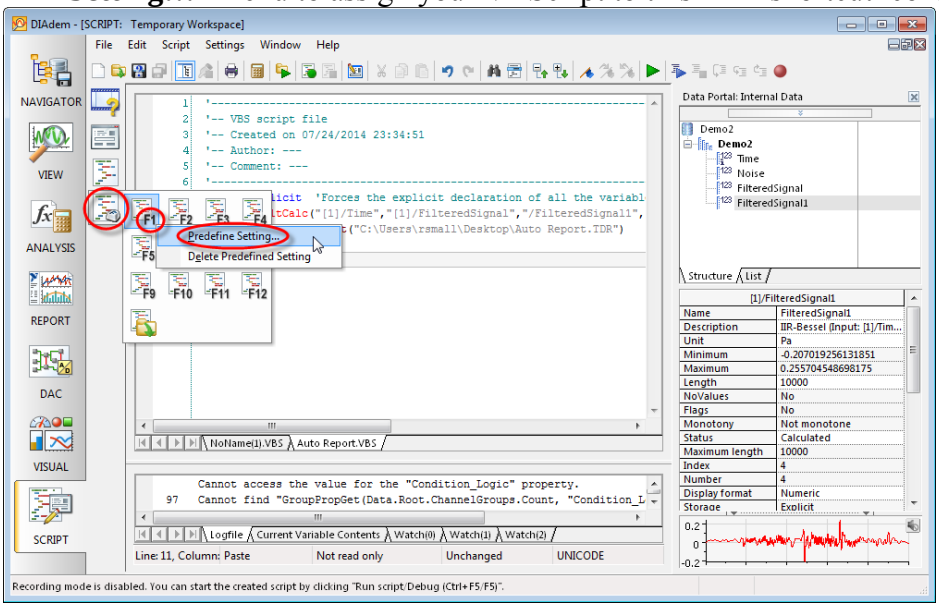
3.40 You will want to use this VBScript again, so **click** on the "**Save File As**" icon at the top left of your screen in order to save it. Notice that during the Script Recorder session a corresponding icon appears in the bottom right of your screen so that you can always tell at a glance whether the Script Recorder has been turned on— its absence means the Script Recorder is done.



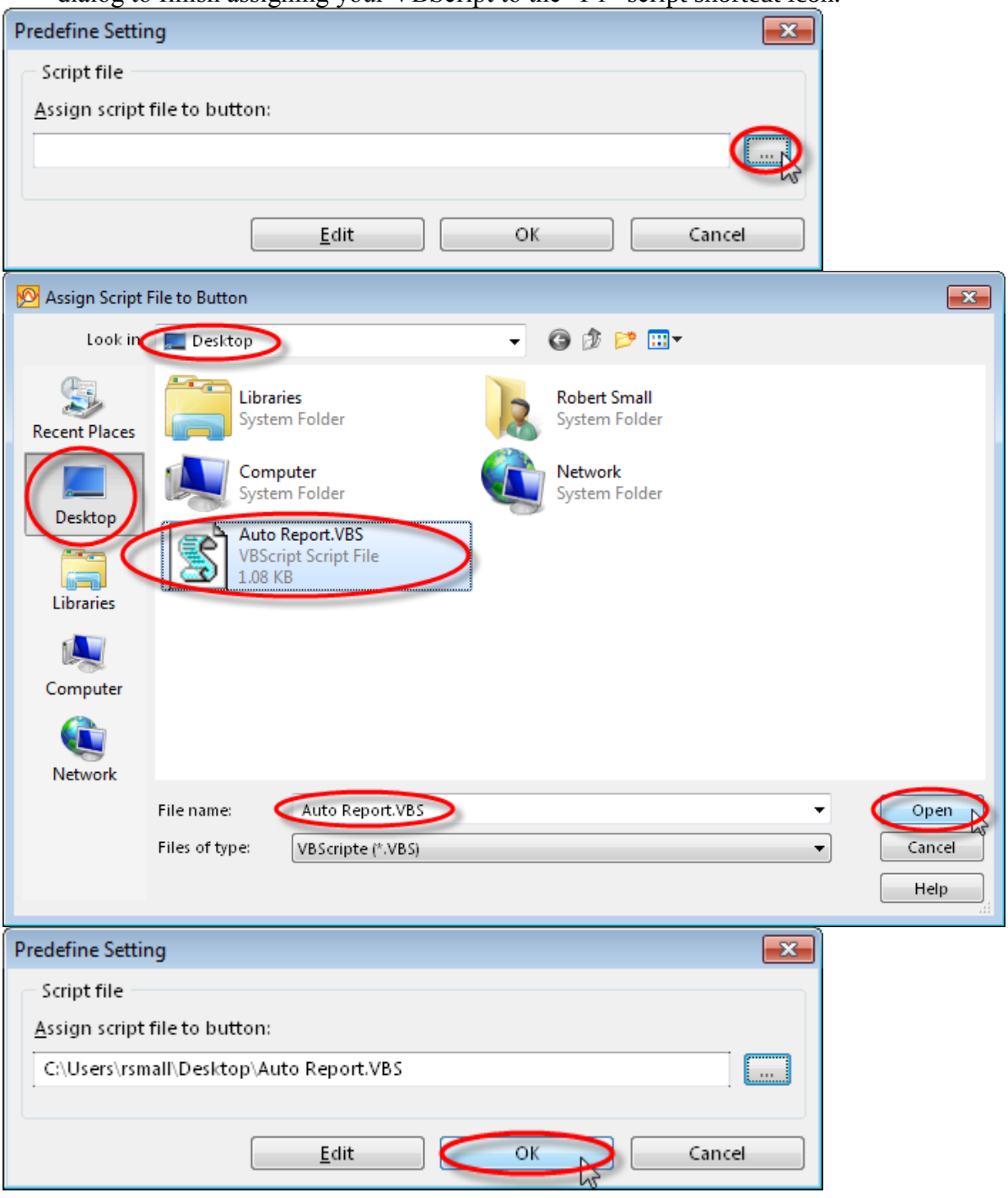
3.41 Navigate to the **Desktop, name** the **file** "**Auto Report.VBS**", then **click** on the "**Save**" button— click on the "Yes" button if asked to confirm overwriting a previous file of the same name.



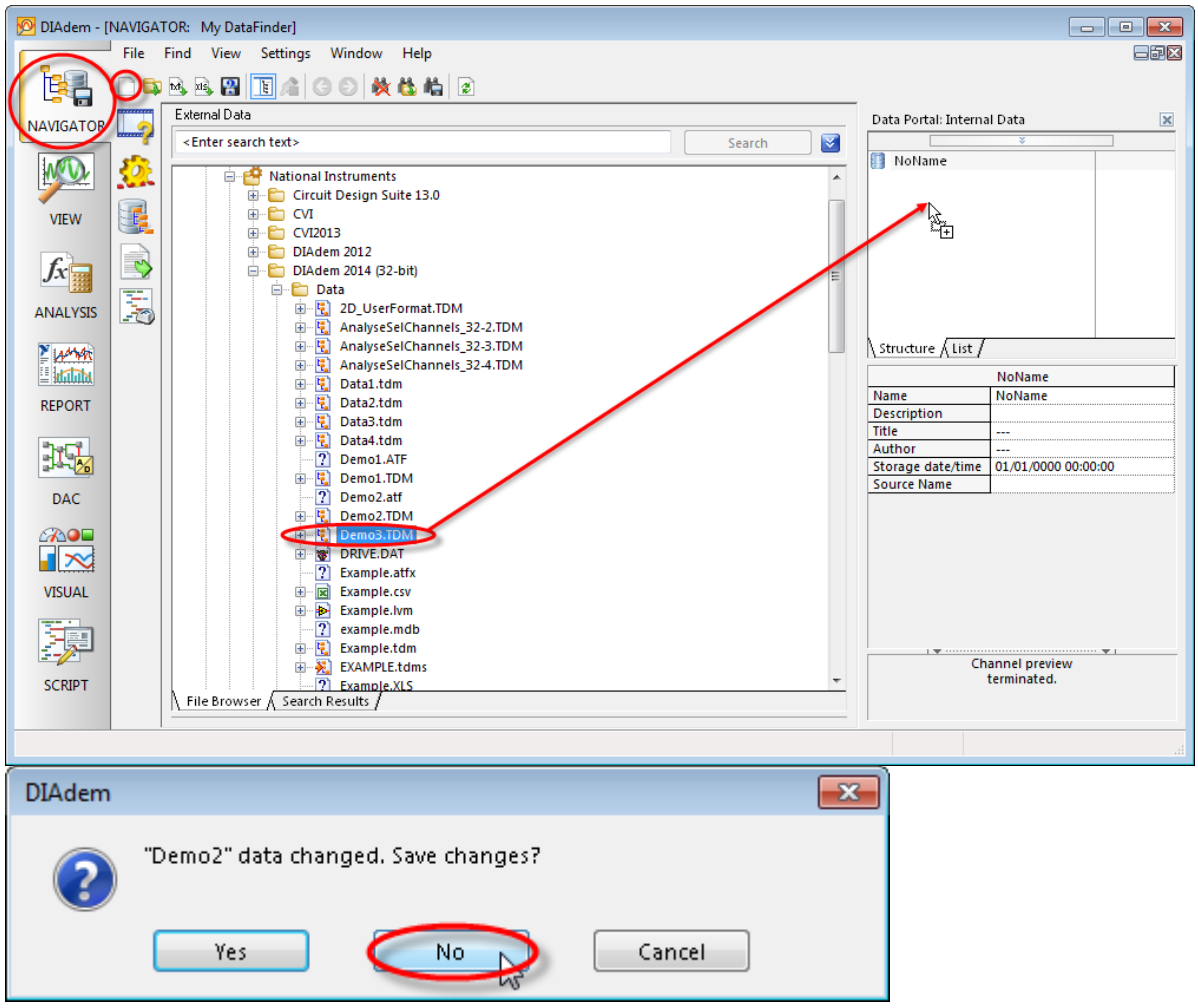
3.42 You will be using this reporting script you just created quite a lot, so you want to assign it to one of the script shortcut keys so you can run it easily from anywhere in DIAdem. **Click** on the small "**DIAdem Scripts…**" icon at the top left of your screen, then **right-click** on the "**F1**" script **icon** just to the right of it and **select** the "**Predefine Setting…**" menu to assign your VBScript to this "F1" shortcut icon.



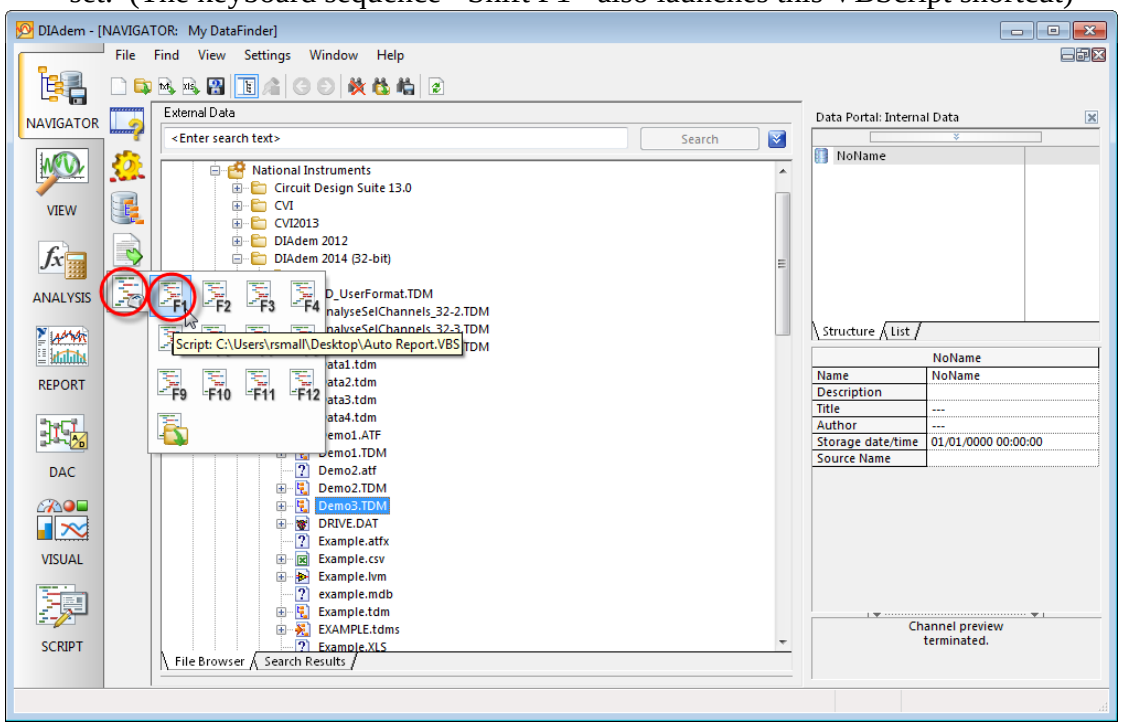
3.43 Click on the **[...]** button at the right of the dialog to launch the file selection dialog. **Navigate** to the **Desktop** and **select** the **"Auto Report.VBS**" script file you just saved, finally **click** on the "**Open**" button in this dialog and the "OK" button in the previous dialog to finish assigning your VBScript to the "F1" script shortcut icon.



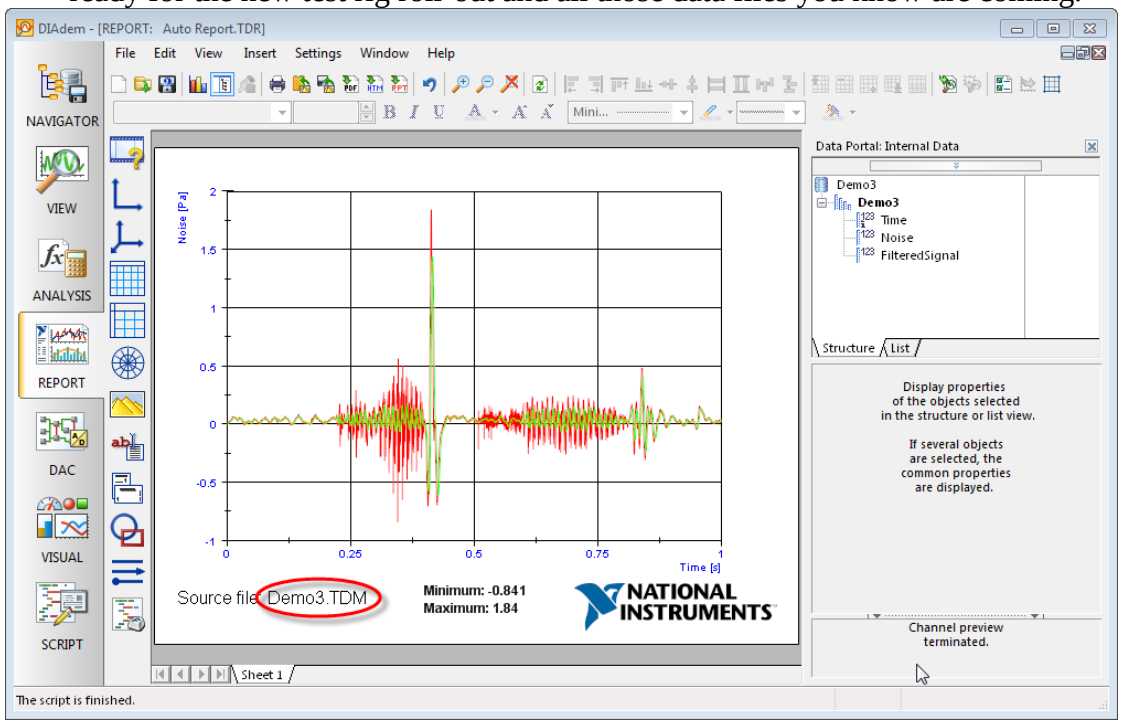
3.44 Now you can practice using your new reporting script with the third data set. **Click** on the "**NAVIGATOR**" icon in order to switch back to the NAVIGATOR panel, then **click** on the "**Delete Internal Data**" icon to delete the channels from the second data set. **Click** on the "**No**" button when asked if you want to save the changes you made to the second data set. Finally, **drag** the **"Demo3.TDM"** file **into** the **Data Portal** to load it.



3.45 Click on the "**DIAdem Scripts**" icon at the left of your screen, then **select** the **F1** "**Auto Report.VBS**" script **icon** to easily run your reporting script on this third data set. (The keyboard sequence <Shift F1> also launches this VBScript shortcut)



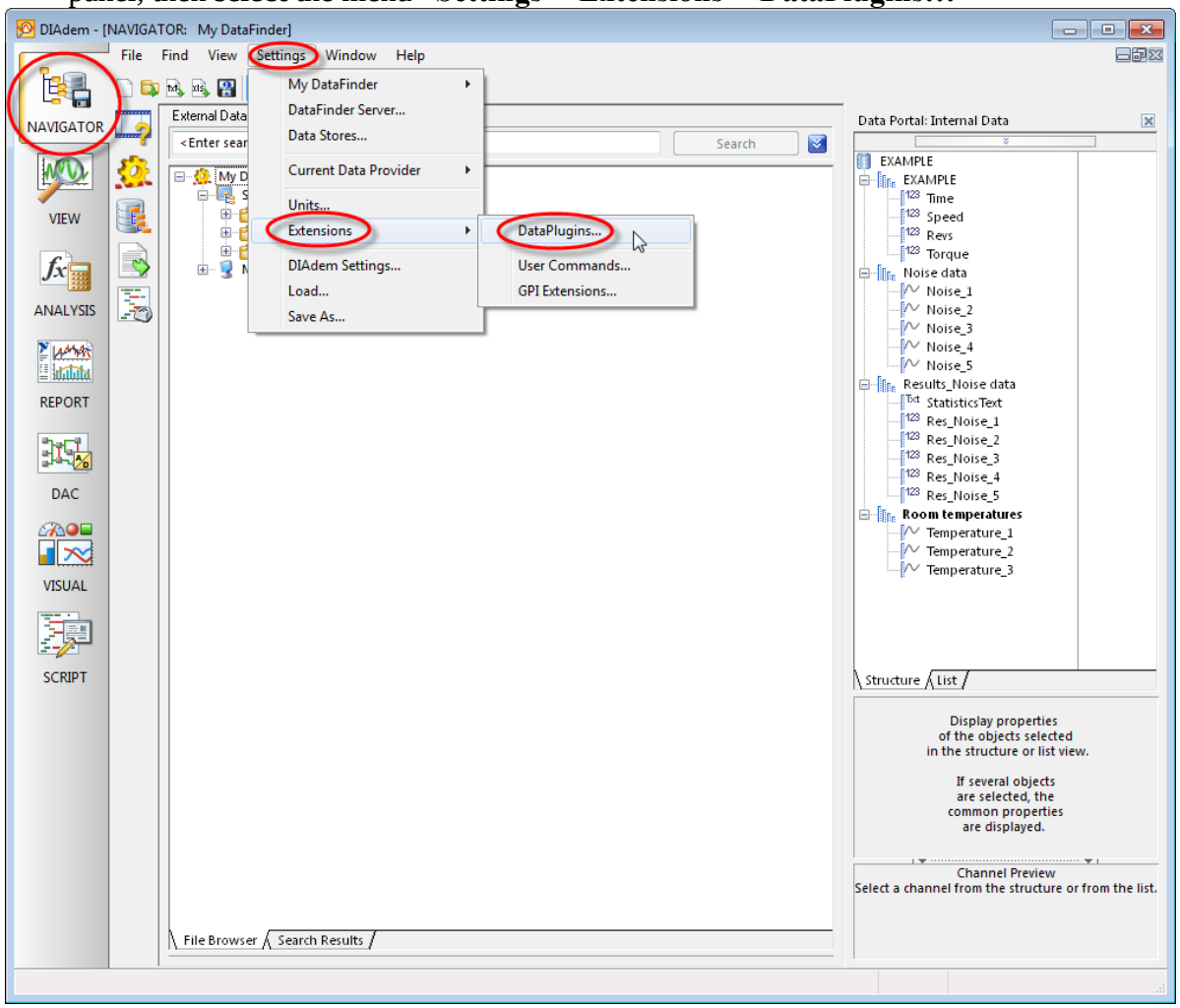
3.46 Notice that the reporting script automatically calculated the "FilteredSignal" channel and displayed the new data traces as well as the new file name and min/max values. Try repeating the last two steps with each of the "Demo#.TDM" data files and verify that you can quickly and easily generate this report, and that while the form of the report is the same every time, the detailed content is different every time. You are now ready for the new test rig roll-out and all those data files you know are coming.



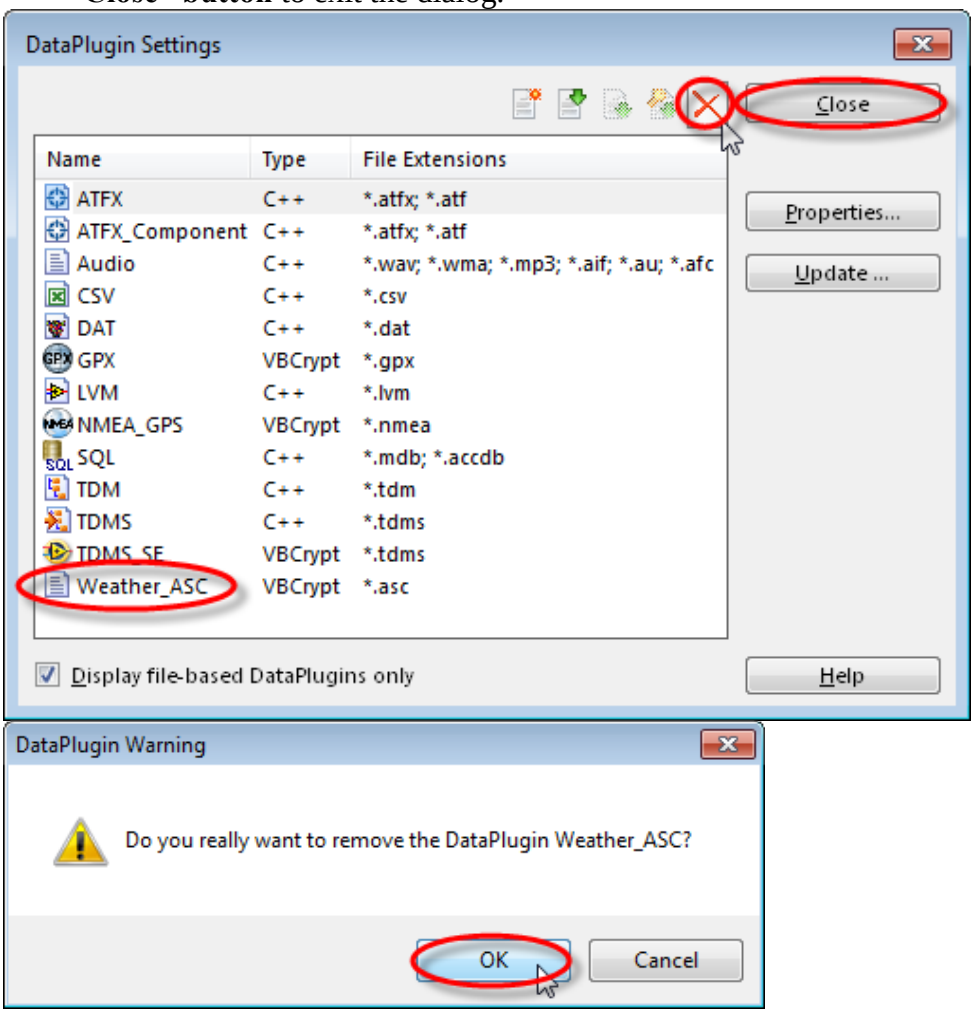
Exercise #4 ASCII DataPlugin and Interactive Analysis

Scenario: You have downloaded some ASCII weather data files from the internet, and you need to graph the measured temperatures across multiple months and find the lowest temperature for that period, in °F. First you need to teach DIAdem how to automatically find and load these ASCII files, then once the data is loaded you need to graph the temperatures from multiple data files to find the global minimum. You will use DIAdem's DataPlugin Wizard to interactively create a DataPlugin that will load these weather data files. You will then graph the temperature data in VIEW from multiple files and find the minimum temperature. Finally, you will convert the loaded temperature data channels from °C to °F using DIAdem's built-in unit management features.

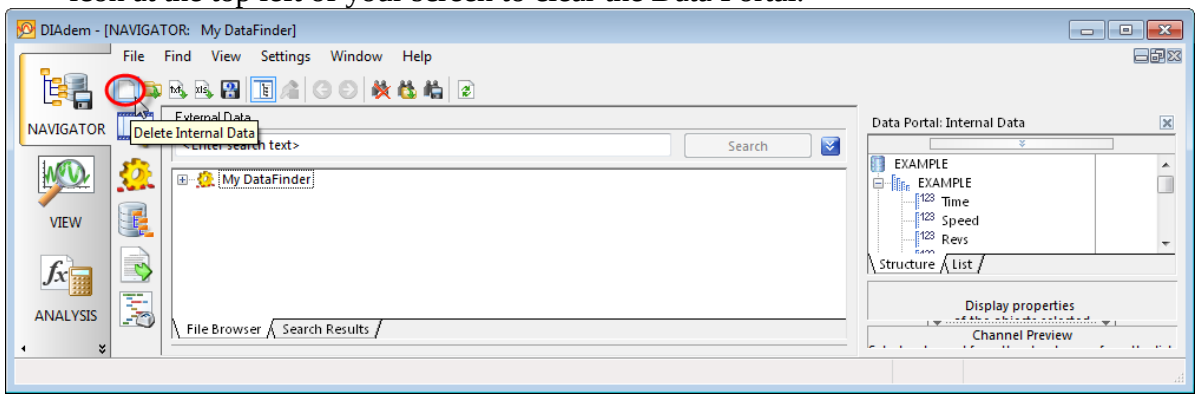
4.1 First review the DataPlugins installed on your computer. Switch to the **NAVIGATOR** panel, then **select** the menu **"Settings>>Extensions>>DataPlugins…"**



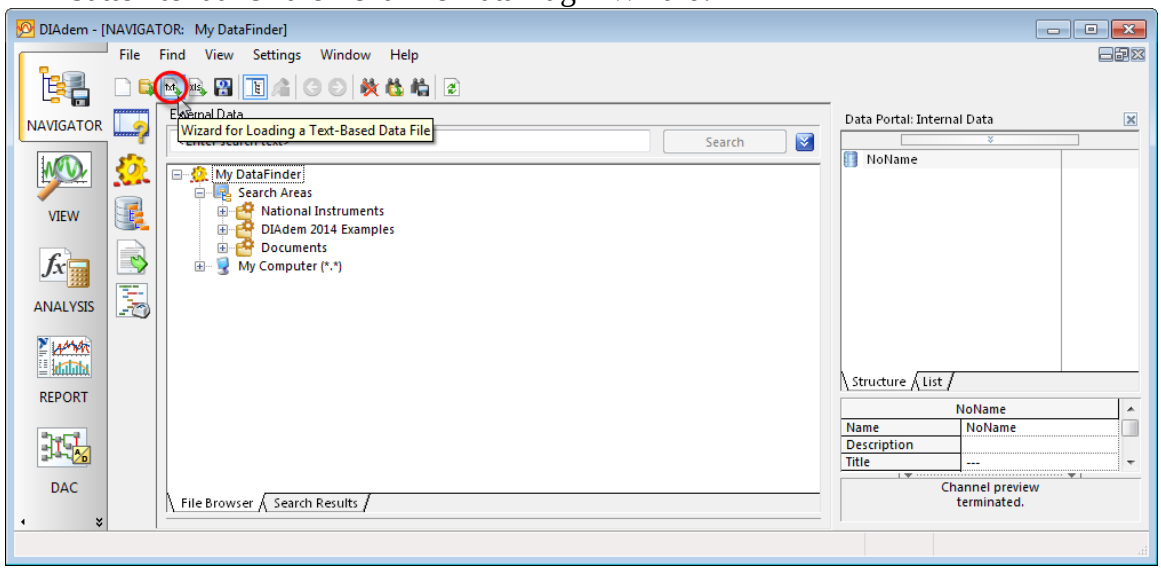
4.2 In this exercise you will be creating a DataPlugin called "Weather_ASC". If you already have a DataPlugin called "Weather_ASC" in your DataPlugin list, select it and click on the red "X" icon to delete it. If you are asked to confirm deletion of the "Weather_ASC" DataPlugin, then click the "OK" button. In any case **click on the "Close" button** to exit the dialog.



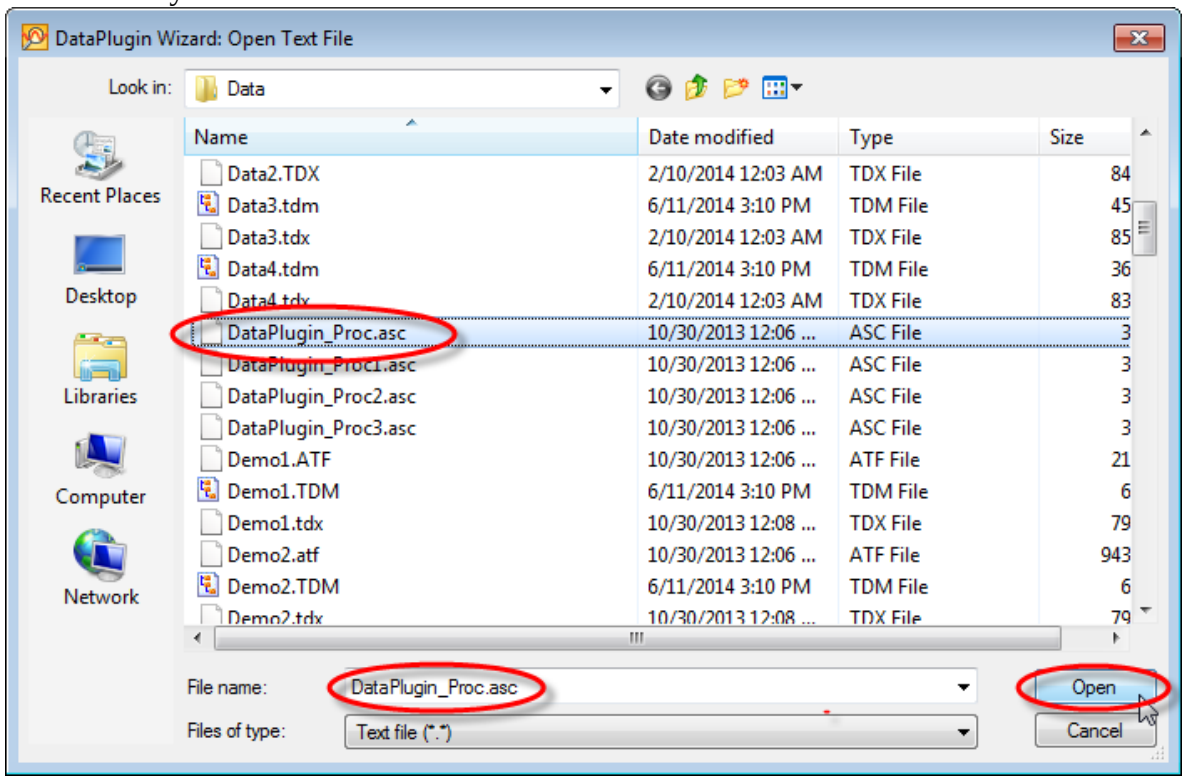
4.3 The DataPlugin Wizard will create the new DataPlugin for you, then automatically use that DataPlugin to load the data file you select. **Click on** the **"Delete internal data"** icon at the top left of your screen to clear the Data Portal.



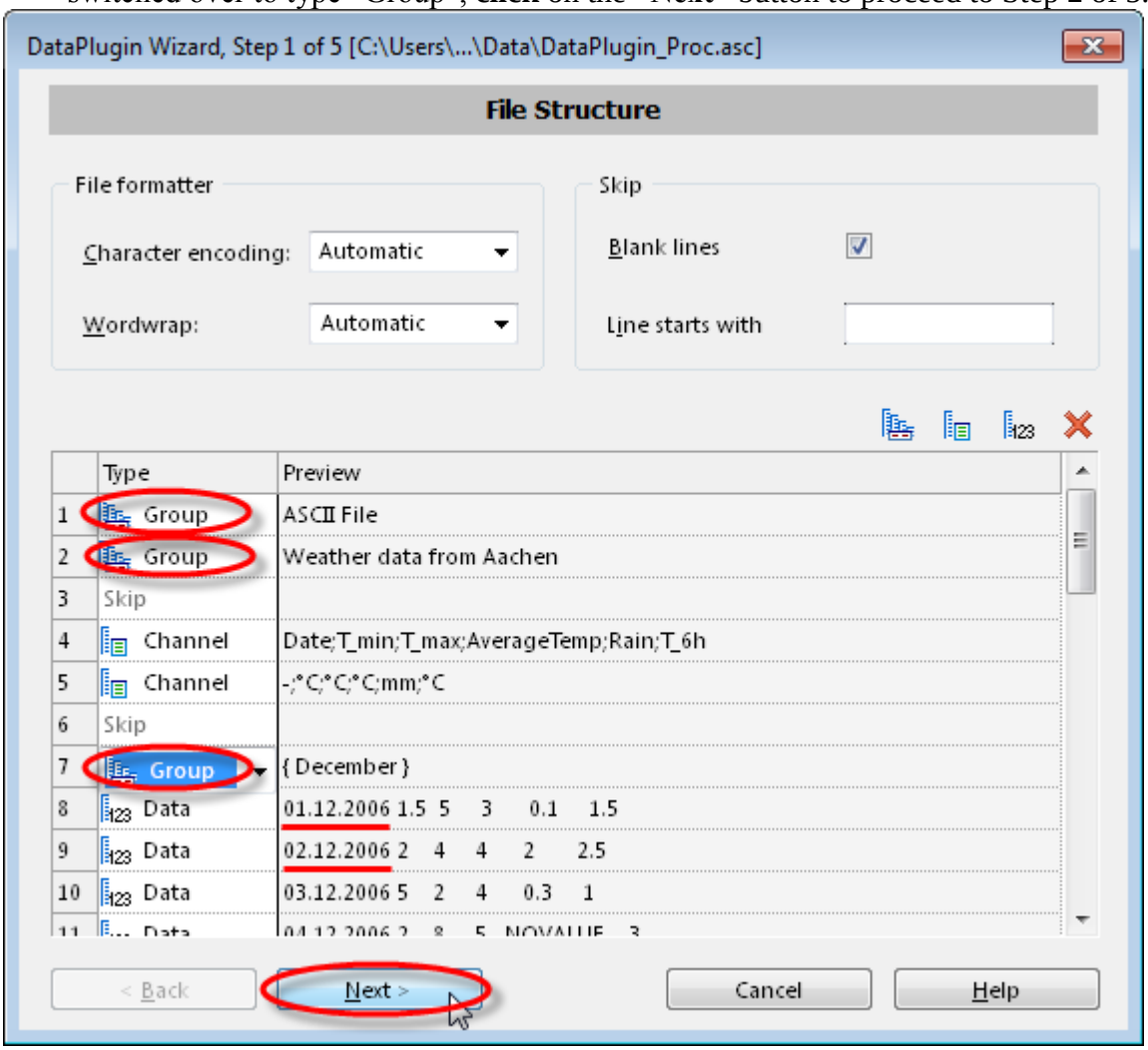
4.4 You're going to use the DataPlugin Wizard to create the new "Weather_ASC" DataPlugin for you without any programming. **Click** on the **TXT DataPlugin Wizard** button to launch the Text File DataPlugin Wizard.



4.5 The DataPlugin Wizard initially asks you to enter the path of a sample data file. **Select** the sample weather file called **"DataPlugin_Proc.asc"** in the DIAdem "Data" directory and **click** on the **"OK"** button.

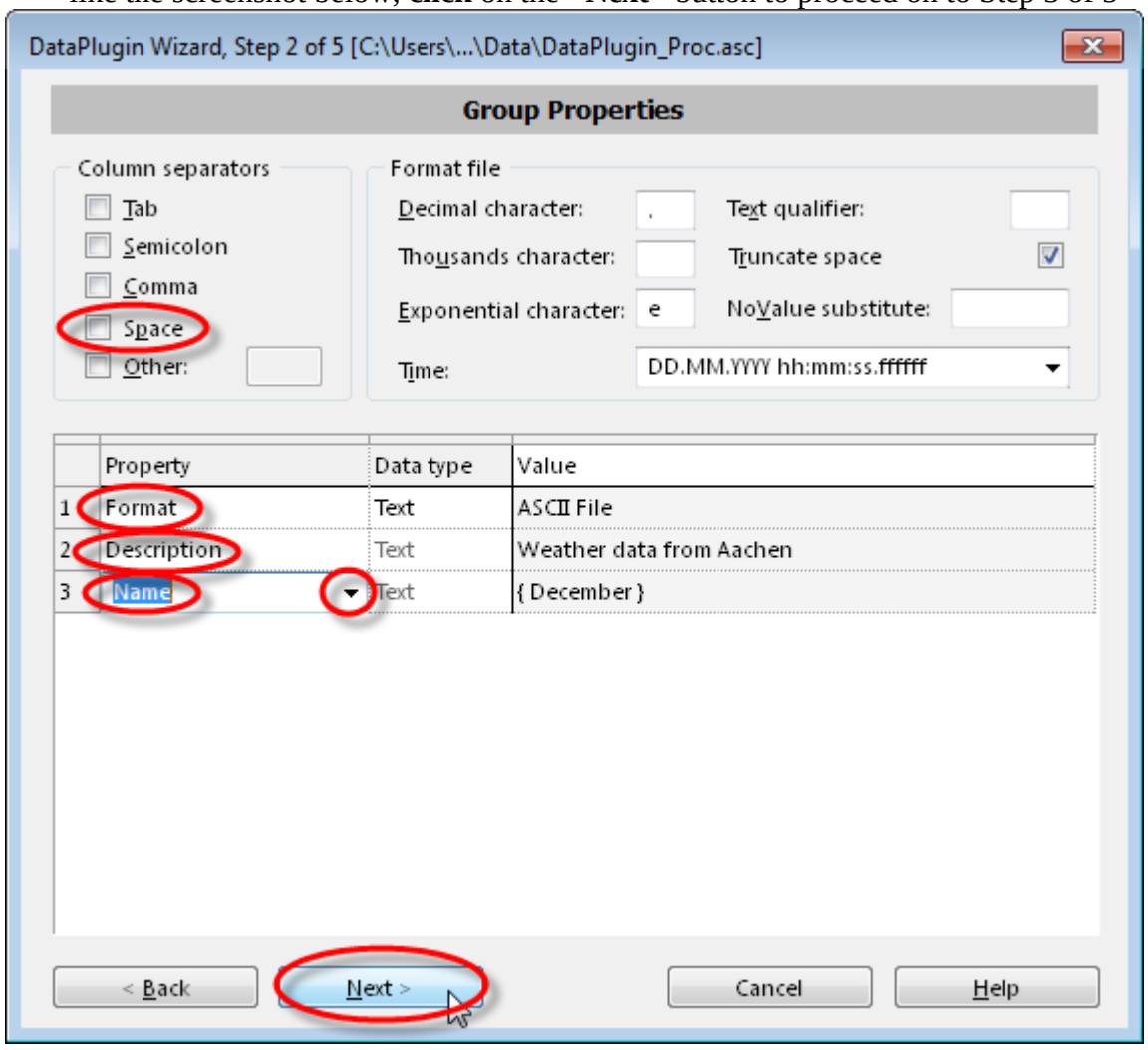


4.6 This is the 1st of 5 steps in the DataPlugin Wizard. In Step 1 you get a preview of the sample data file you selected, and your task in this step is to designate which rows contain group properties, channel properties or data, and which rows should be ignored altogether. The DataPlugin Wizard has correctly determined most of the rows for you. You will, however, need to **change** the **"Type" column** values of **lines 1, 2, 7** from "Channel" **to "Group"**, because these property values do not pertain to any one data channel but rather to the file as a whole. You change each "Type" column value by left-clicking just to the right of the "Channel" text. Once you have rows 1, 2, 7 switched over to type "Group", **click** on the **"Next"** button to proceed to Step 2 of 5.

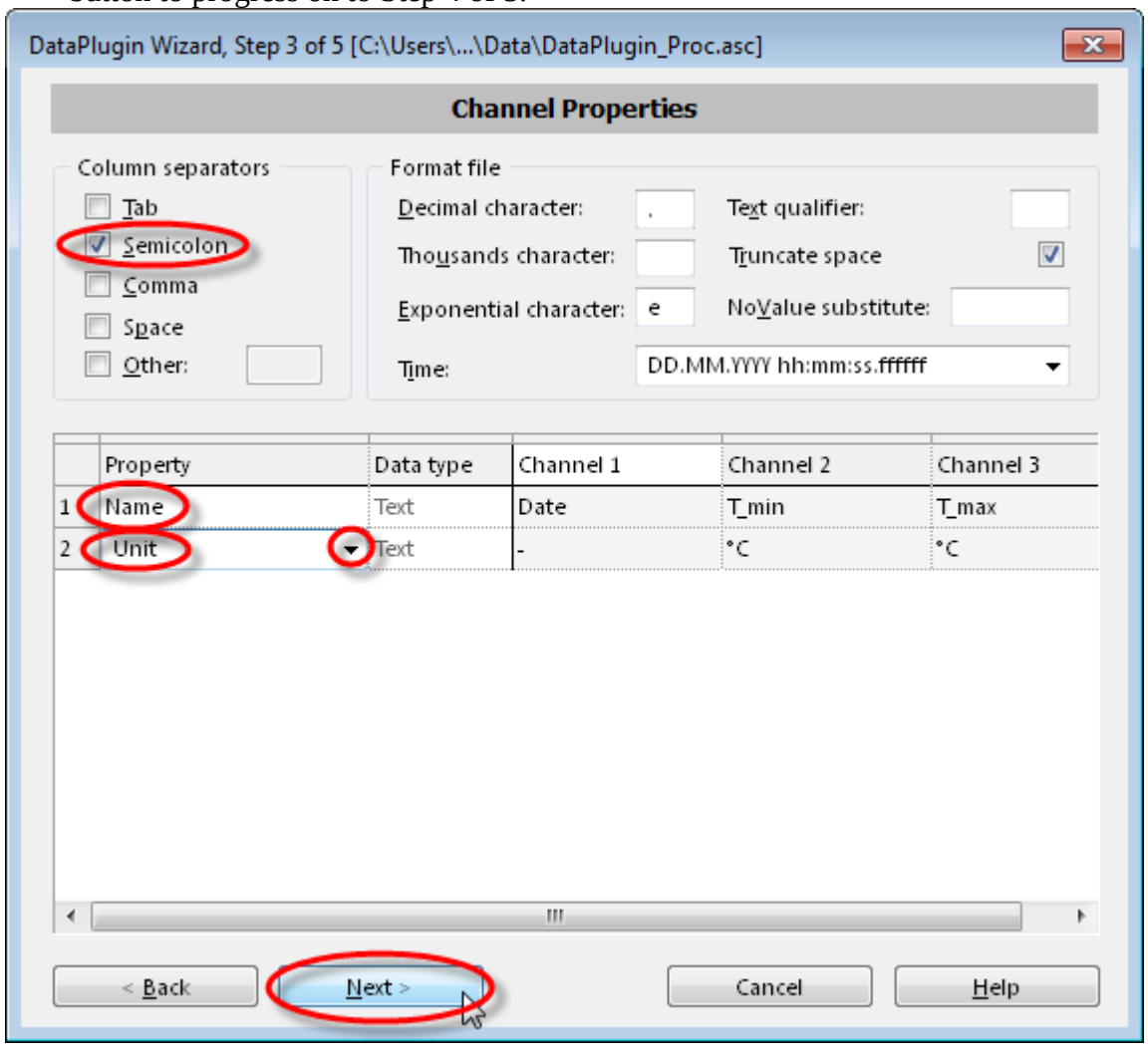


NOTE: Look at the "Preview" column in the above screenshot. These data files have standard (SI) scientific channel units (°C, mm) and a European date format which starts with the day of the month and uses a decimal between the elements (DD.MM.YYYY). You will need to remember this date/time format for "DataPlugin Wizard Step 4 of 5".

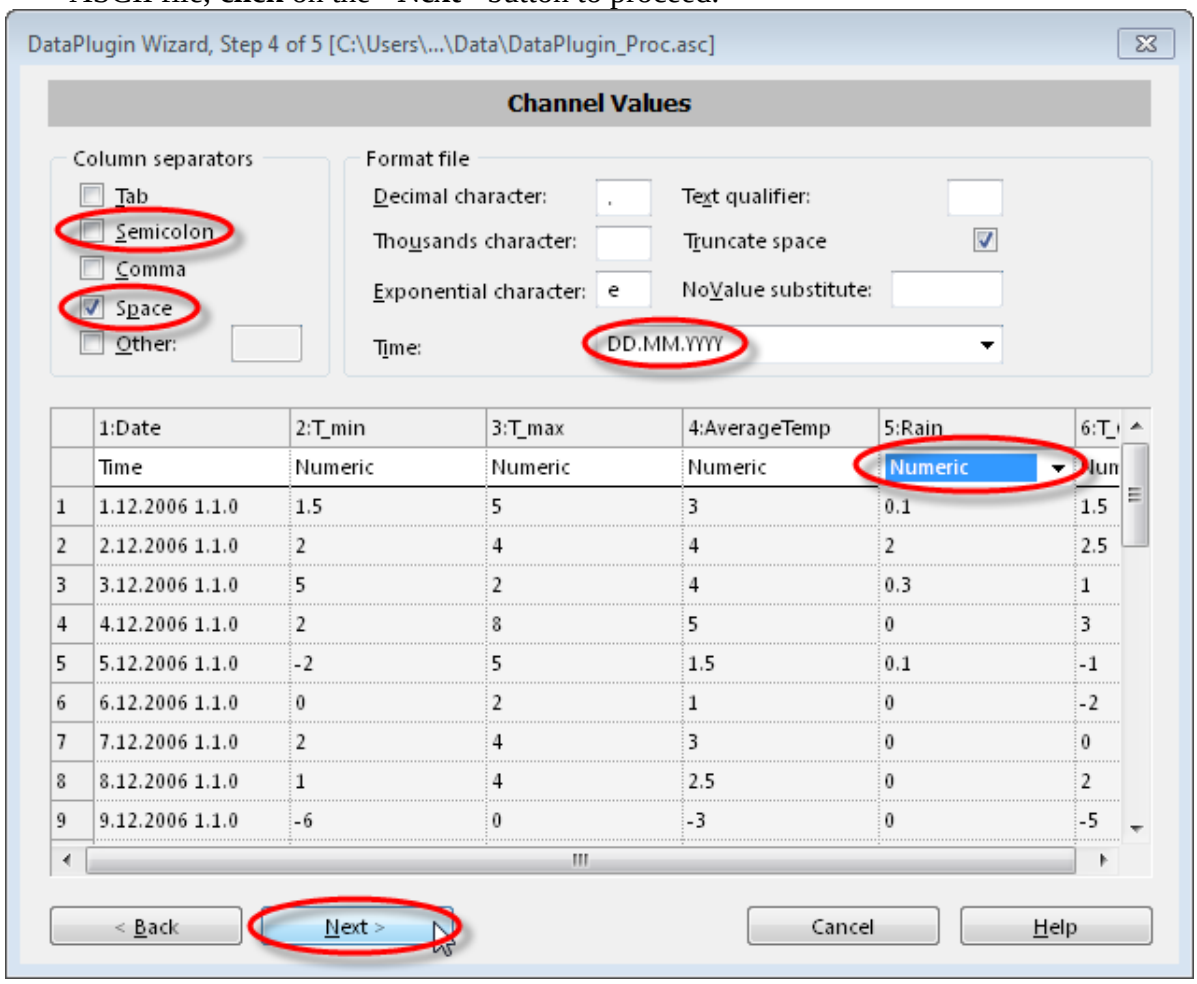
4.7 This is the 2nd of 5 steps in the DataPlugin Wizard. In Step 2 you get a list of all the rows you selected in Step 1 as containing group properties, and your task in this step is to designate how to parse and name those group property rows. By default the Wizard assumes that the row contents should be split into multiple columns with a space delimiter. In this weather file that is not the case at all, so your first task in Step 2 is to **uncheck** the **"Space"** and any other selections in the "Column separators" section. For the first property in **row 1, type** in the text **"Format"** in the "Property" column. The Wizard allows you to freely name properties at the group and channel level, and the "ASCII File" text would best fit under a property named "Format". Note that property names can only consist of letters, numbers, and the underscore character (_). For the second and third properties in **rows 2 and 3, click** on the right edge of the "Property" field, where an enumeration icon will appear so that you can **select** from a list of suggested property names. Pick the property **"Description"**, **for row 2** and **"Name" for row 3**. The month of the year will be the most useful piece of information, and the group name is the most visible property. When all three of your property rows look like the screenshot below, **click** on the **<Next>** button to proceed on to Step 3 of 5



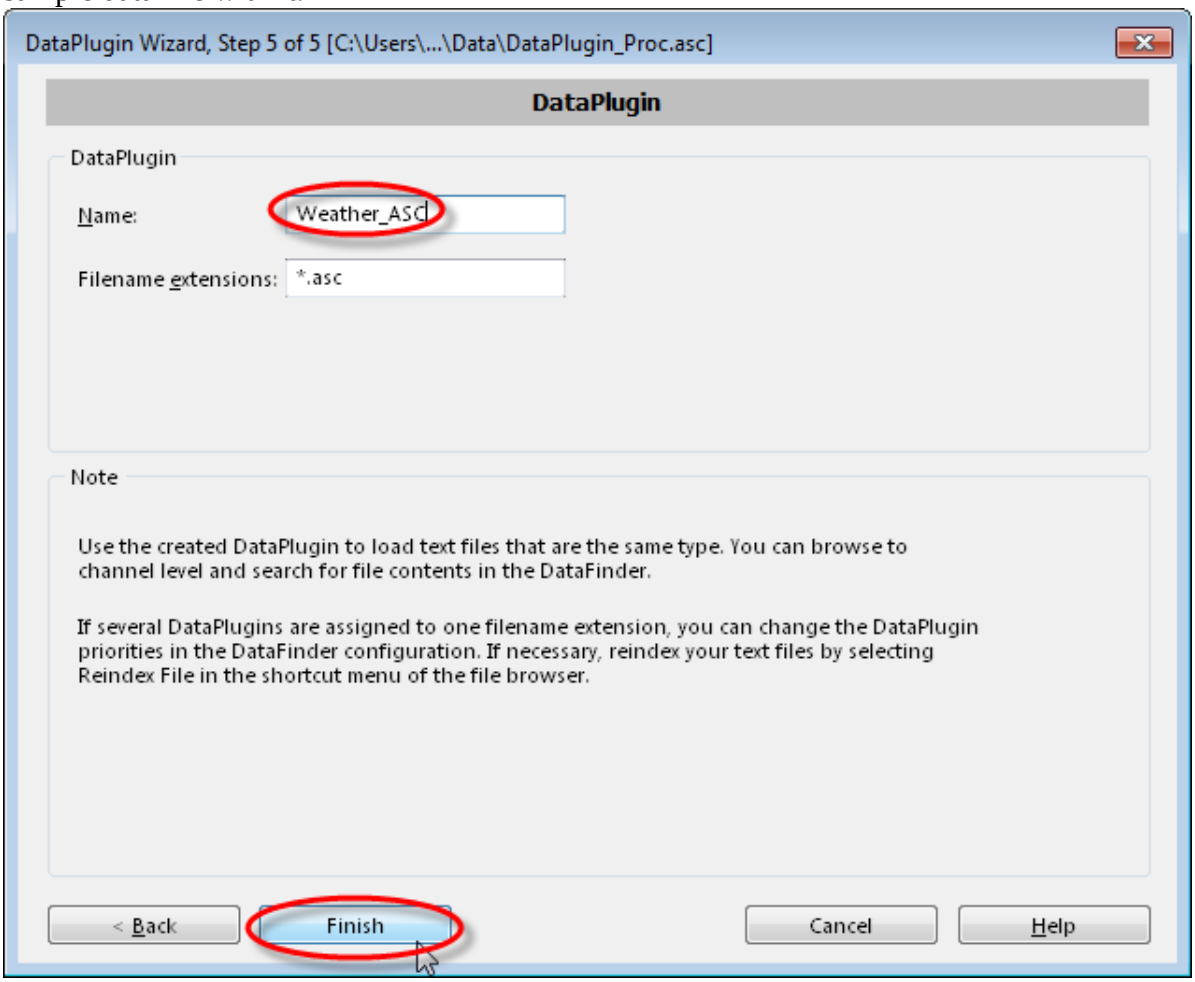
4.8 This is the 3rd of 5 steps in the DataPlugin Wizard. In Step 3 you get a list of all the rows you selected in Step 1 as containing channel properties, and your task in this step is to designate how to parse and name those channel property rows. In the previous step you turned off all column delimiters— which was correct for the group properties, but these channel properties are separated by semicolons. **Check** the **"Semicolon"** checkbox in the "Column separators" section and uncheck any others in order to use only semicolon column delimiters for these channel properties. Now that the correct column delimiters are being used, you see each channel's property values displayed in a column with that channel number as the column heading. You selected 2 channel property rows in Step 1, and the Wizard has correctly guessed the first property as the "Name" property of each channel, but the second property should be the unit, not the description. For this second property in **row 2, click** on the right edge of the "Property" field, where an enumeration icon will appear so that you can **select** from a list of suggested property names. Pick the property **"Unit",** then **click** on the **<Next>** button to progress on to Step 4 of 5.



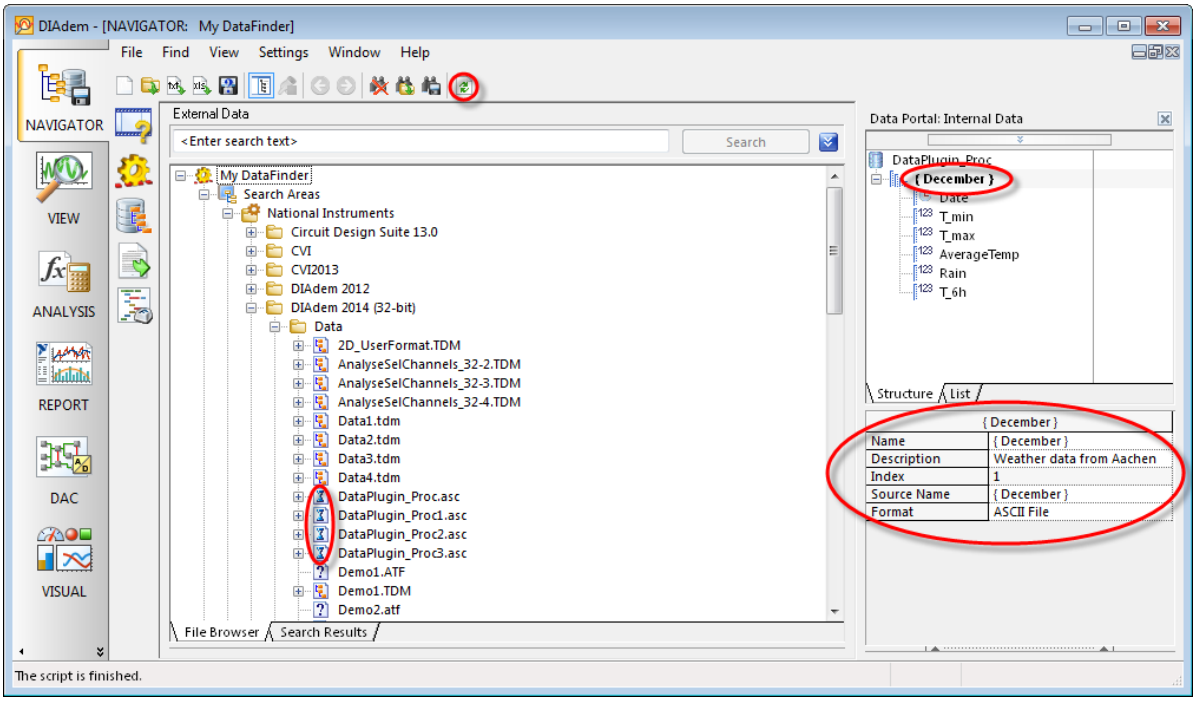
4.9 This is the 4th of 5 steps in the DataPlugin Wizard. In Step 4 you get a list of all the rows you selected in Step 1 as containing data, and your task in this step is to designate how to parse the channel data. In the previous step you turned on semicolon column delimiters for parsing the channel properties. In most ASCII files only one delimiter character is used throughout the file, but in this file the channel properties are separated with semicolon delimiters, while the data values are separated with space delimiters. The DataPlugin Wizard fortunately allows you to select different delimiter characters for group properties, channel properties, and data values. **Uncheck** the **"Semicolon"** checkbox in the "Column separators" section and **check** the **"Space"** checkbox in order to correctly parse the data values into their correct channels. Note that the Wizard has correctly guessed that the first column is a date/time column— **make sure** all the **rest of the columns are numeric**, manually changing the data type of one or more columns from text to numeric where needed. The first column has a European date/time format— **click** on the far right of the **"Time:"** format **field**, and **select** the format **"DD.MM.YYYY"**. You are now done describing how to parse the data in this ASCII file, **click** on the **<Next>** button to proceed.



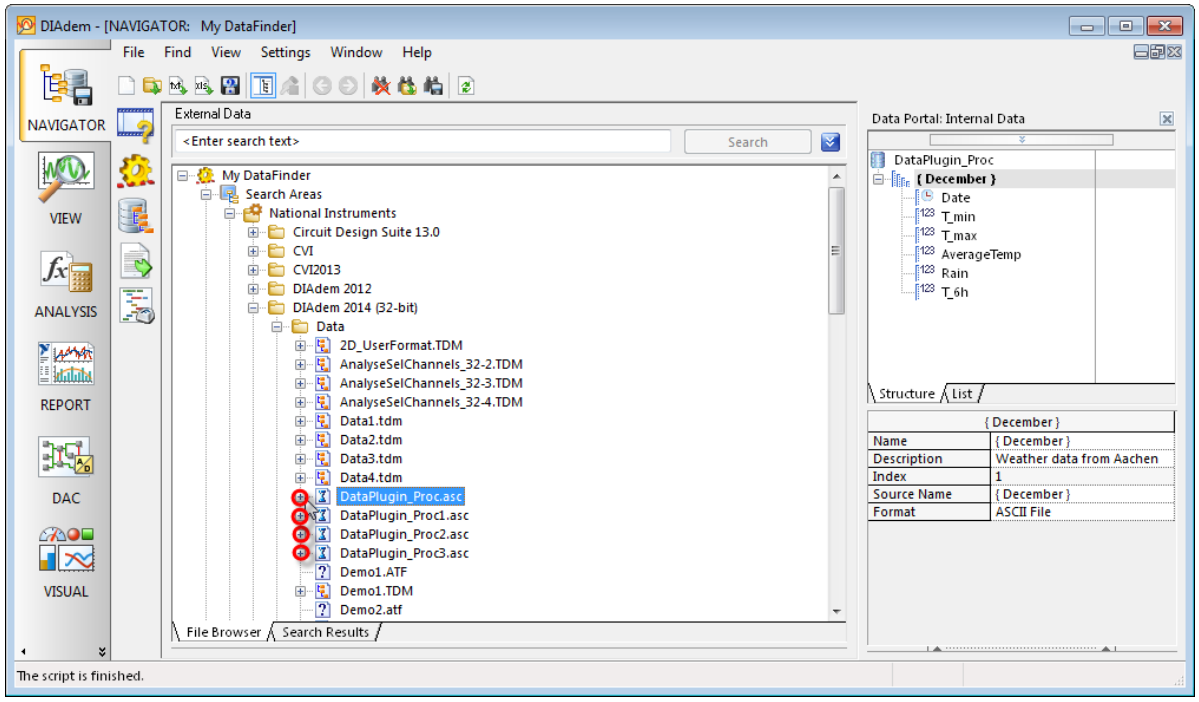
4.10 This is the 5th of 5 steps in the DataPlugin Wizard. In Step 5 you specify the name of the new DataPlugin you have been defining as well as one or more file extensions DIAdem should automatically associate it with. The Wizard has already guessed that you want to use the "*.asc" file extension of the sample weather data file you selected. **Change** the **DataPlugin Name** to **"Weather_ASC"**. Hereafter, any time you drag and drop a file with an "*.asc" file extension from the NAVIGATOR tree view into the Data Portal, DIAdem will automatically use this new "Weather_ASC" DataPlugin to load the data from that file. Additionally, any time you add a file with an "*.asc" file extension to a Search Area, DIAdem will also use the "Weather_ASC" DataPlugin to index that data file into the DataFinder data base. Now **click** on the **<Finish>** button to complete the creation of the new "Weather_ASC" DataPlugin and the loading of your sample data file with it.



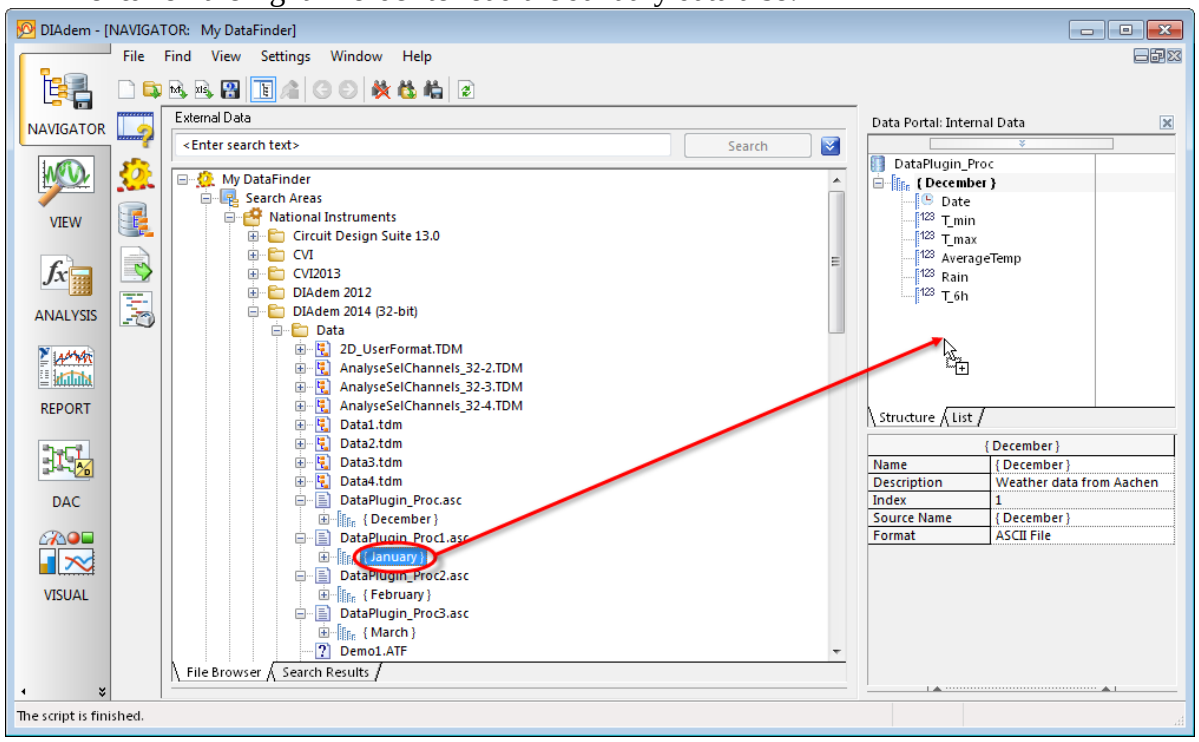
4.11 Now that the "Weather_ASC" DataPlugin has been automatically created and registered for you, DIAdem goes ahead and uses this new DataPlugin to load the sample ASCII file you used into the Data Portal. **Click** on the newly loaded group **"{ December }"** in order to select it in the Data Portal at the right of your screen. Now look at the property table at the bottom right of your screen, where you will see exactly the group properties you defined in Step 2 of 5 in the DataPlugin Wizard: "Name", "Description", and "Format". **Navigate** in the tree view to **"My DataFinder>>Search Areas>>National Instruments>>DIAdem 2014>>Data".** Notice that the 4 data files starting with the file name "DataPlugin_Proc…" now appear in the NAVIGATOR tree view under the "Data" directory. Before they did not appear because there was no DataPlugin for data files with the file extension "*.asc". If you don't see these "DataPlugin_Proc…" files yet, **click** on the **"Refresh"** icon at the top of your screen to refresh the NAVIGATOR panel and cause them to appear with a "+" icon in front of them like the other standard DIAdem data files.



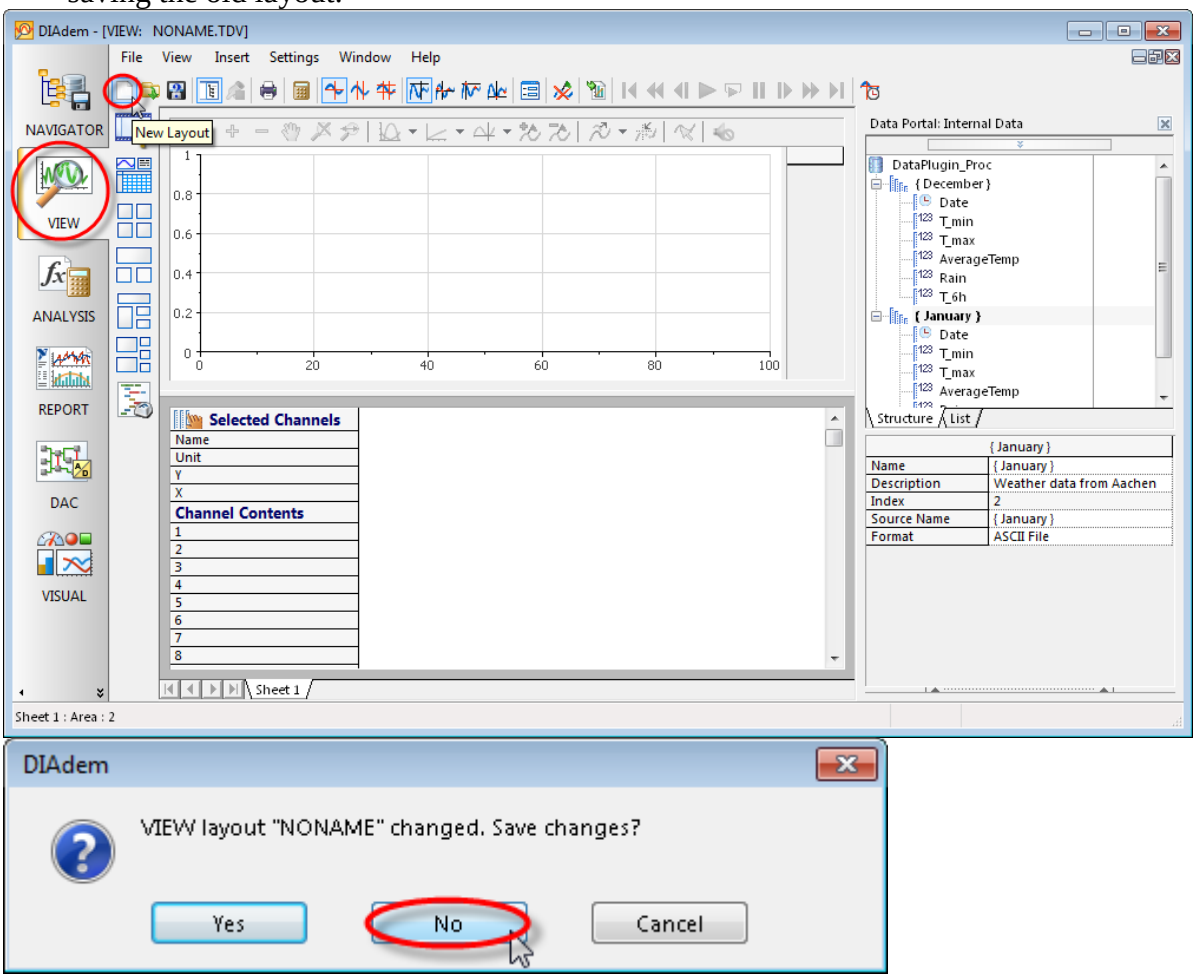
4.12 Now DIAdem has recognized the "*.asc" files as data files for which there is a DataPlugin, but it has not yet indexed them— that is why you see the hourglass icon in front of the 4 "DataPlugin_Proc…" files. **Click** on the **"+" icon** to the left of each of these **4 files**, one after the other, to open each up to the group level— this forces only those 4 files to be re-indexed.



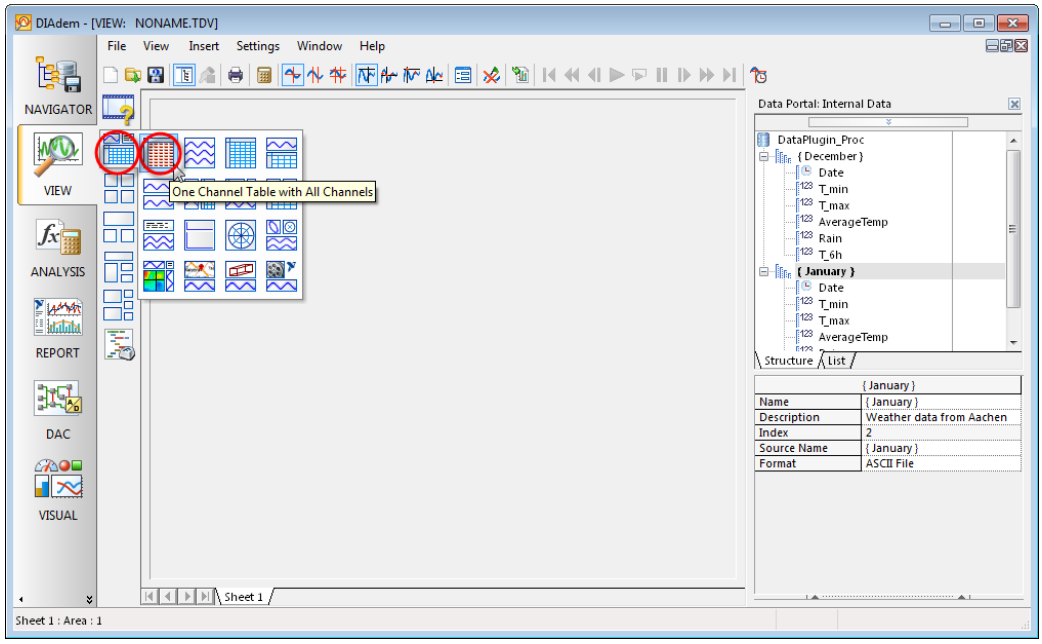
4.13 Now you can see the advantage of mapping the "{ Month }" text in each of these weather files to the group name property— it is now very easy to pick the month of data you want to load interactively from the NAVIGATOR tree view. You specifically wanted to look at the data for December and January on the same graph, since they are typically two of the coldest months of the year and probably contain the coldest day of the winter. **Drag** the **"{ January }"** group from the tree view on the left **into** the **Data Portal** on the right in order to load the January data also.



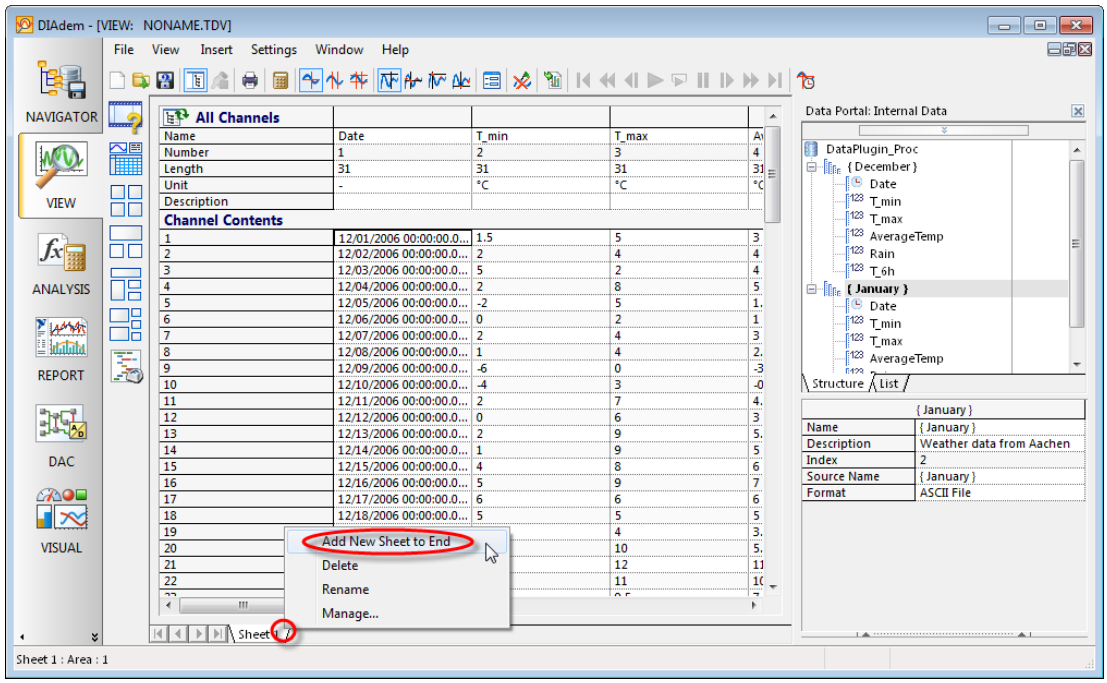
4.14 Now you have both the December and January data loaded into the Data Portal. In order to actually look at the data values, **click** on the **big VIEW icon** at the top left of your screen in order to switch to the VIEW panel in DIAdem. Your DIAdem VIEW may look different than the picture below, depending on what previous work you've already done. You want to create a custom VIEW layout to display this data, so start off by deleting the VIEW areas previously configured. **Click** on the **"New Layout"** icon at the top left of your screen in order to clear the VIEW panel and start with a blank layout. If a confirmation dialog pops up, **click** on the **"No"** button to avoid saving the old layout.



4.15 In order to add a table of channel values to this VIEW sheet, **click** on the **"Assigned Worksheet Partitions"** icon, then **click** on the **"One Channel Table with All Channels"** icon.

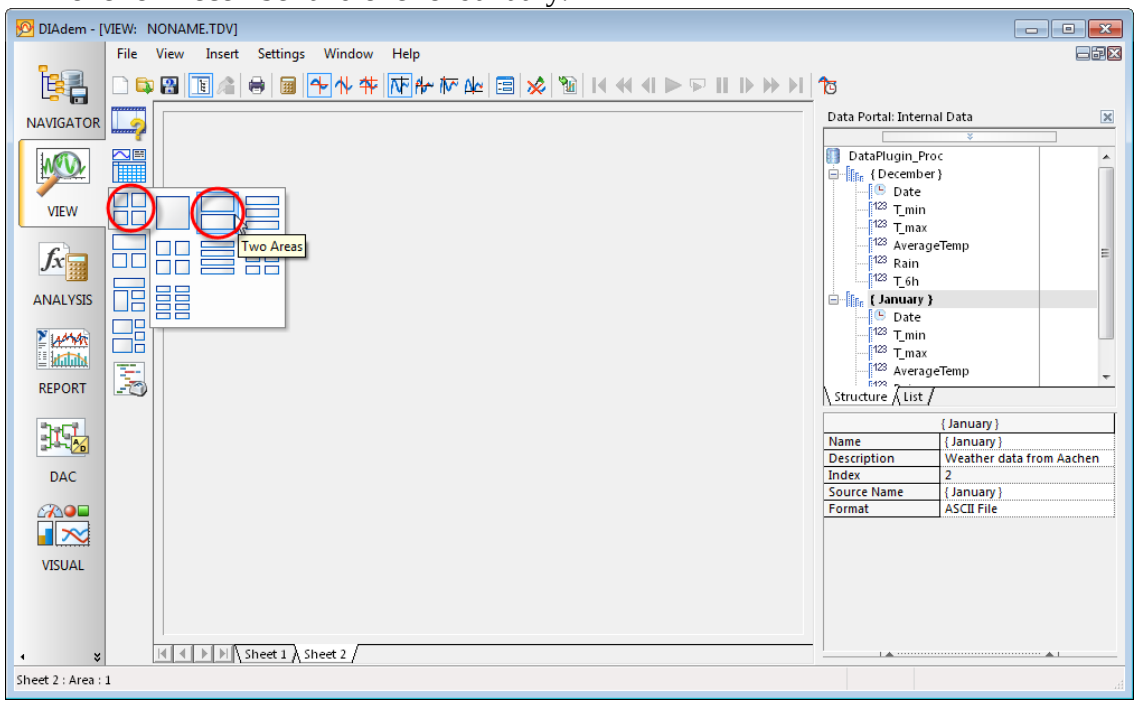


4.16 Now you can see all the values of all the channels loaded in the Data Portal in VIEW sheet 1. It will be much easier, though, to find the winter minimum temperature graphically. **Right-click** on the **"Sheet 1"** tab at the lower left of your screen and **select** the **"New"** item from the context menu in order to insert a new VIEW sheet.

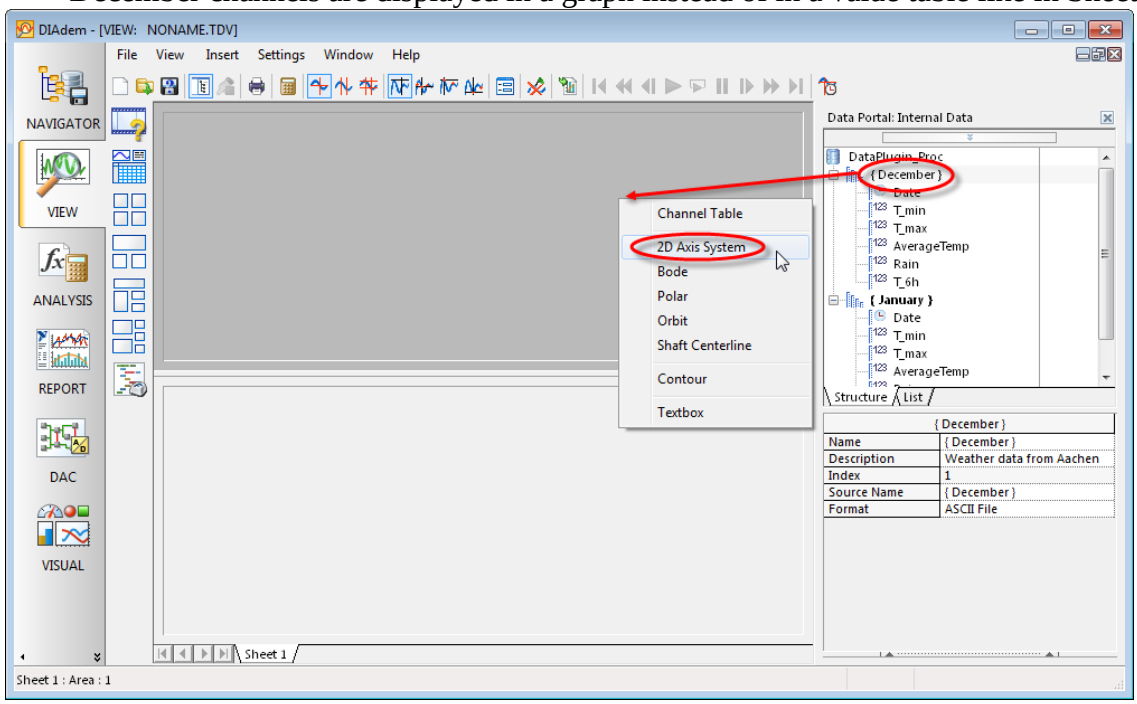


NOTE: The channel units (°C) from the ASCII file are automatically imported into the channel unit property, as seen in the above table heading.

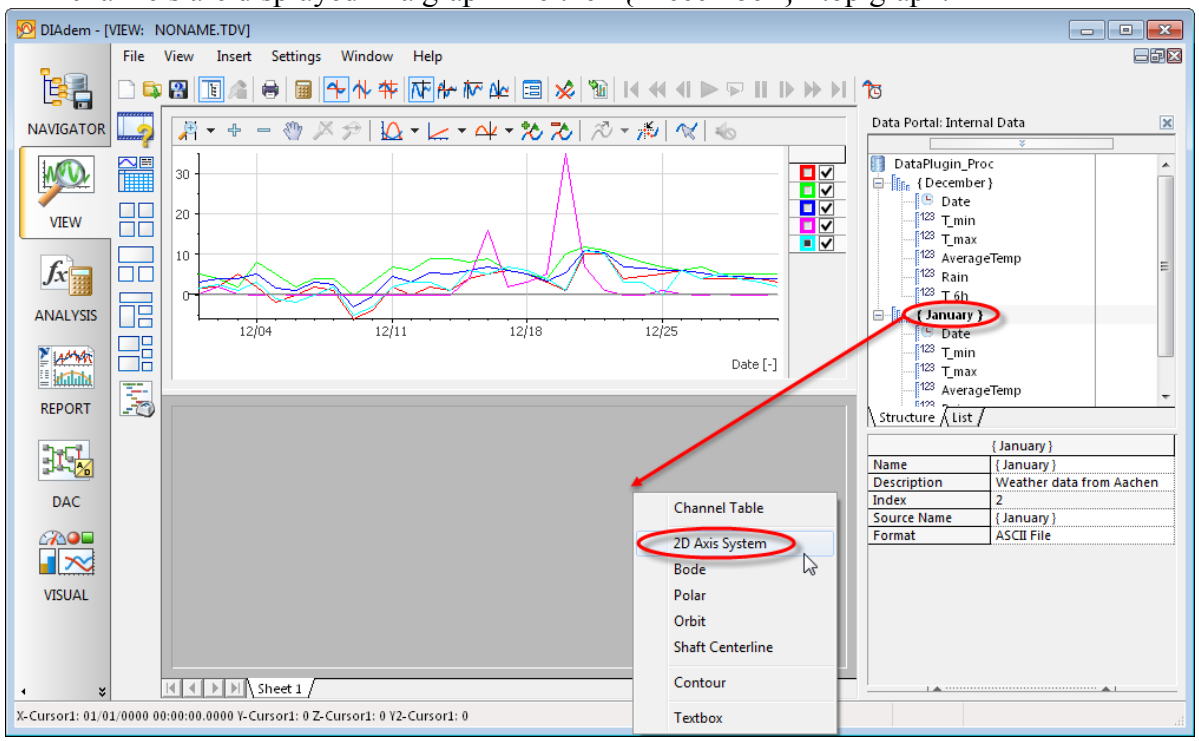
4.17 Click on the **"Regular Worksheet Partitions"** icon, then **click** on the **"Two Areas"** icon in order to automatically divide this sheet into 2 equal, vertically stacked areas, one for December and one for January.



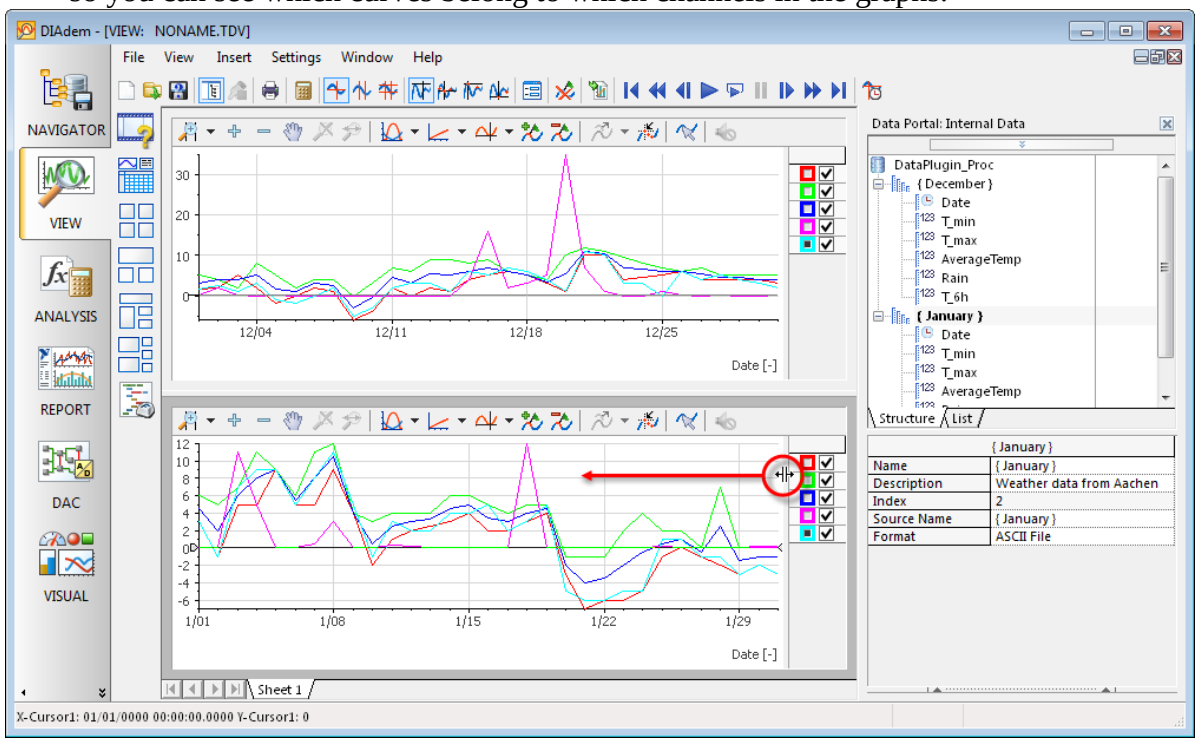
4.18 Drag the **"{ December }" group** from the Data Portal on the right **into** the **top VIEW area**, then **select "2D Axis System"** from the automatic pop-up menu, so that the December channels are displayed in a graph instead of in a value table like in Sheet 1.



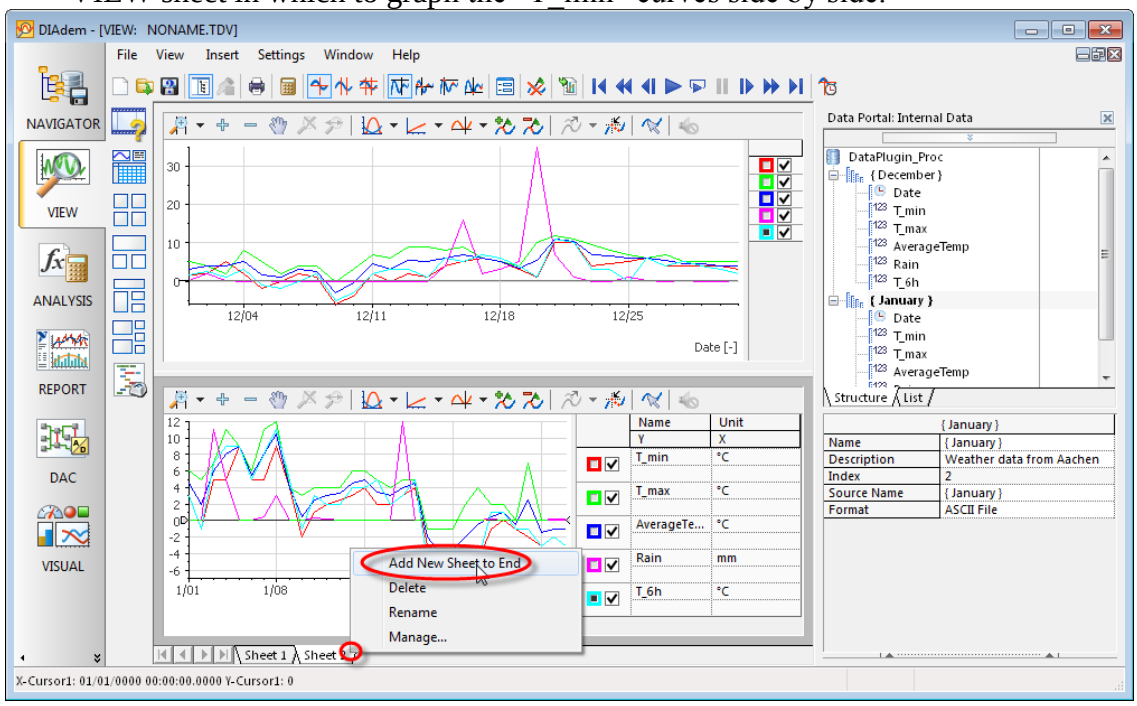
4.19 Drag the **"{ January }" group** from the Data Portal on the right **into** the **bottom VIEW area**, then **select "2D Axis System"** from the pop-up menu, so that the January channels are displayed in a graph like the "{ December }" top graph.



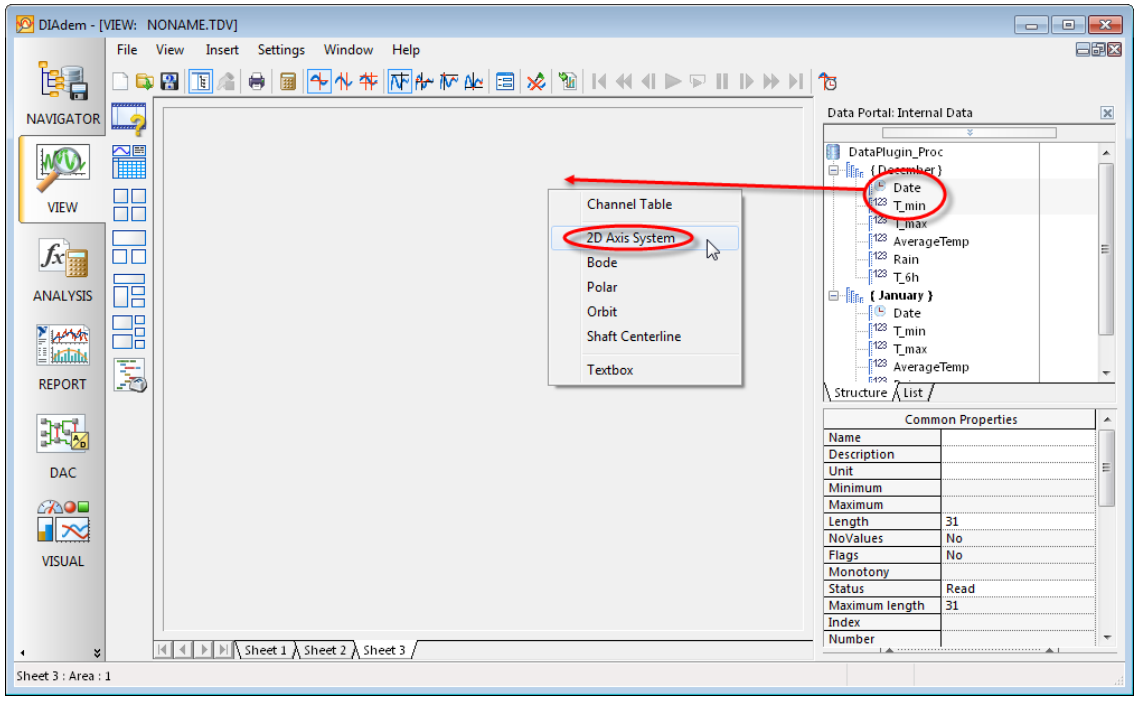
4.20 Drag the legend out from the right edge **of both** the top and the bottom VIEW **areas**, so you can see which curves belong to which channels in the graphs.



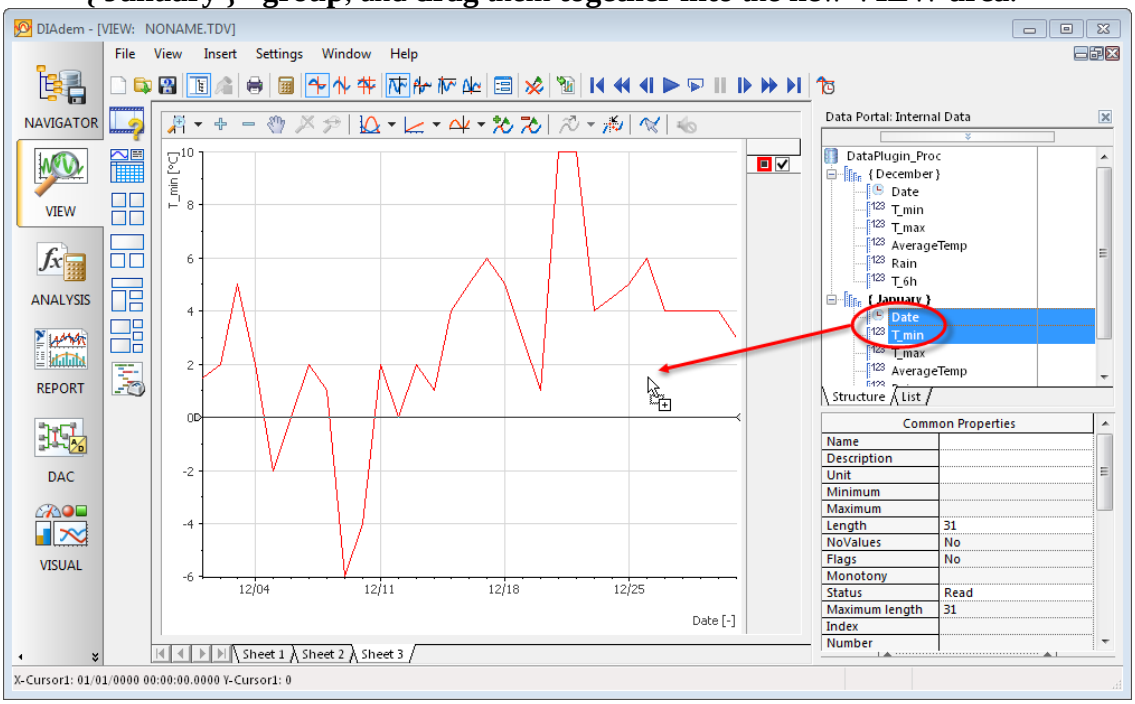
4.21 You confirm from the graph of all the data what you expected from the names of the channels— that the minimum temperature will indeed by contained in the red "T_min" curves. **Right-click** on the **"Sheet 2"** tab and **select** the **"New"** menu to add a new VIEW sheet in which to graph the "T_min" curves side by side.



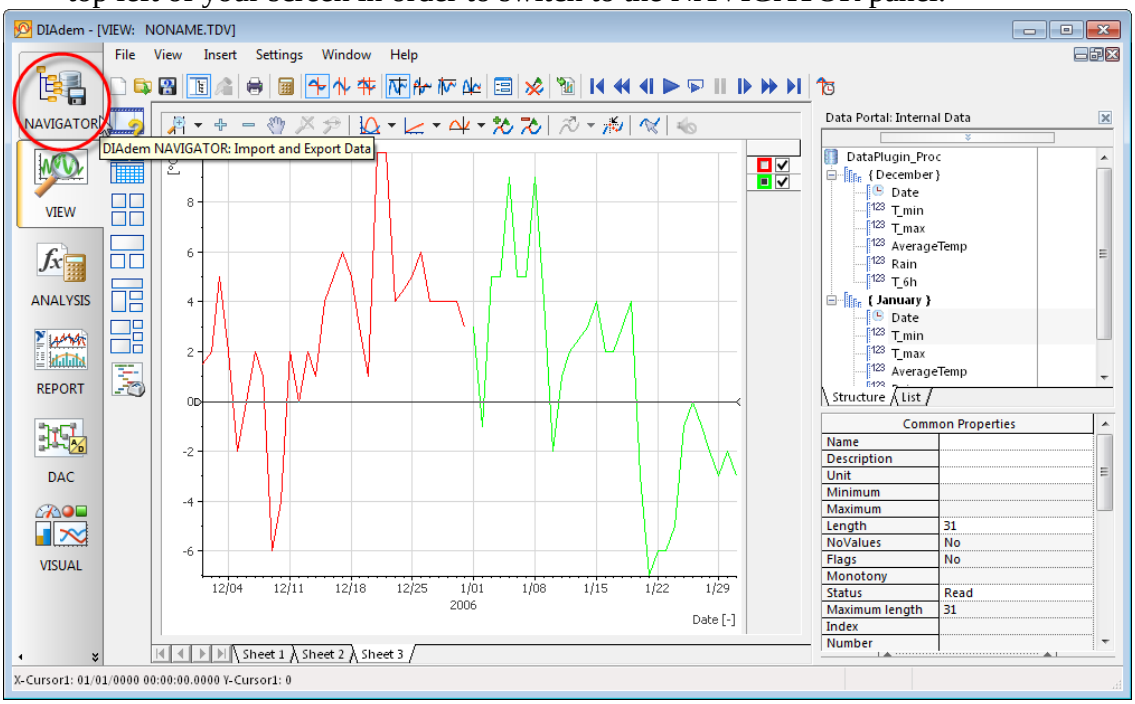
4.22 Select the **"Date"** channel, **hold** down the **<Shift>** key, then **select** the **"T_min"** channel from the **"{ December }" group** and **drag** them **together into** the **new VIEW area**— again **select "2D Axis System",** this time to graph these 2 channels as a single XY curve.



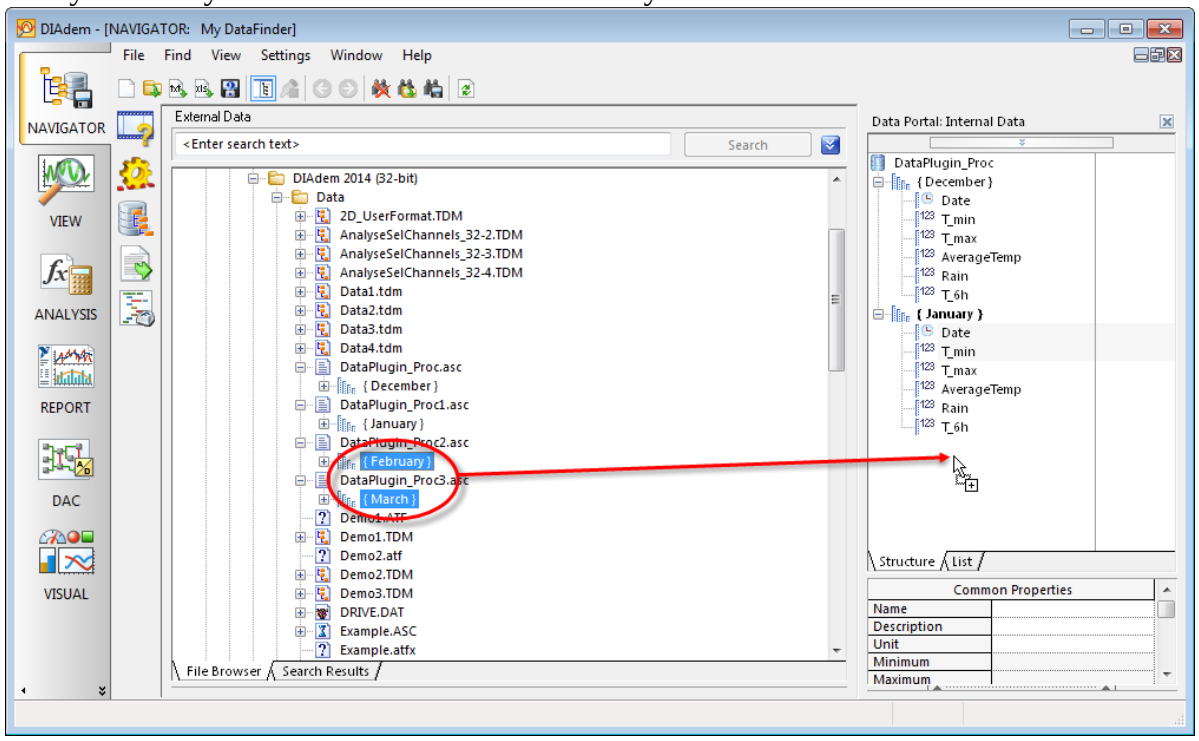
4.23 Select both the **"Date"** channel and the **"T_min"** channel again, this time from the **"{ January }" group**, and **drag** them **together into** the **new VIEW area**.



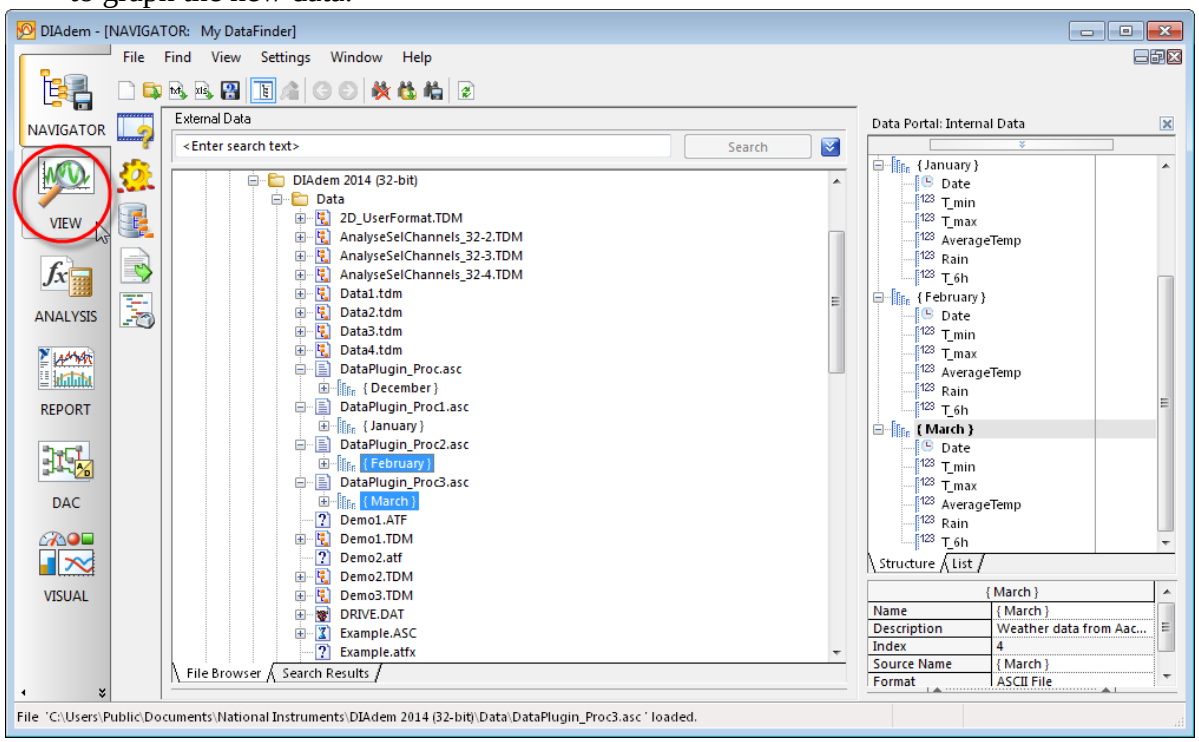
4.24 Now you see the minimum daily temperature plotted for both December and January. The minimum temperature during this whole period was -7 °C on January 21. But before you go back to your boss with this answer, you decide you'd better check the February and March data just to make sure. **Click** on the **NAVIGATOR icon** at the top left of your screen in order to switch to the NAVIGATOR panel.



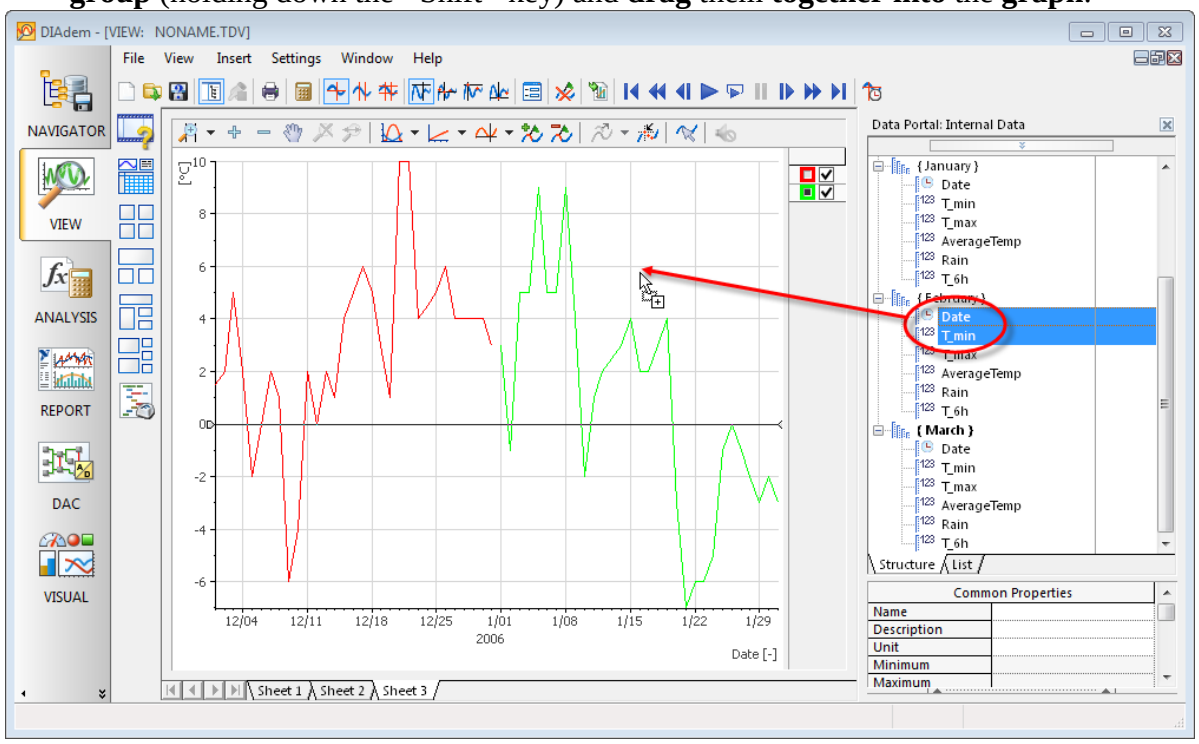
4.25 Select the **"{ February }"** data group, **hold** down the **<Ctrl>** key, **select** the final **"{ March }"** data group, then **drag** them both **into** the **Data Portal** alongside the data you already have from December and January.



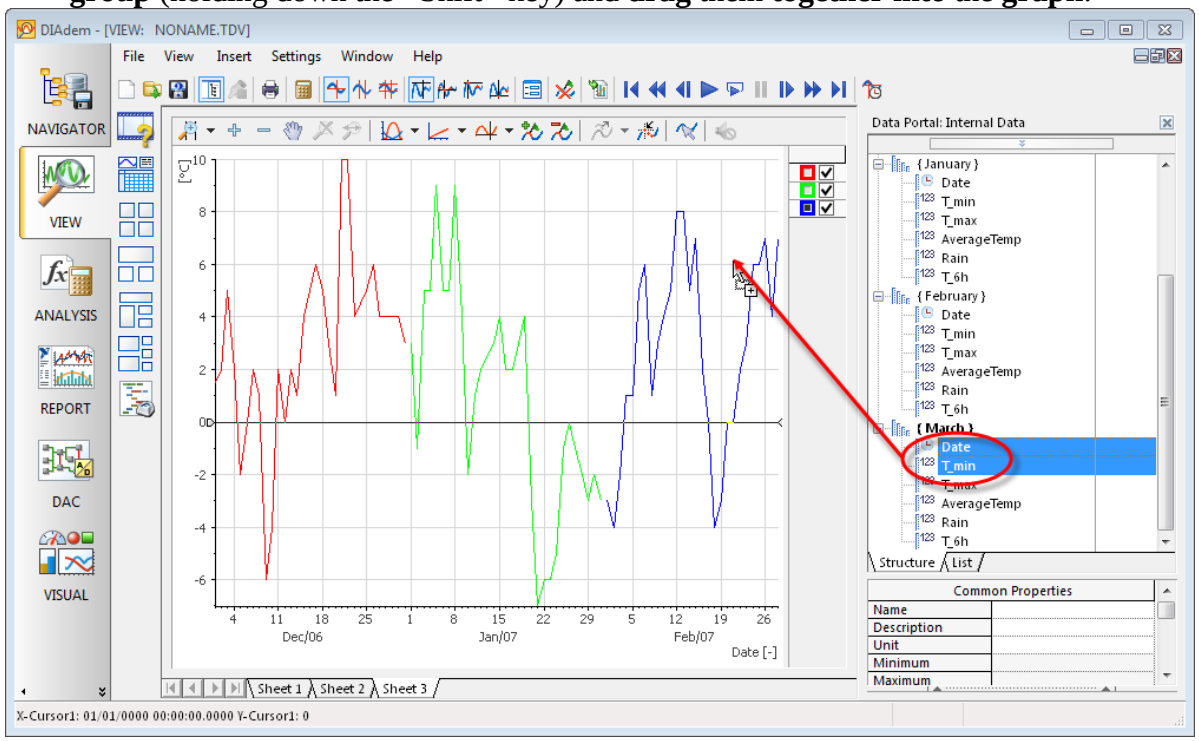
4.26 Now you have data from the coldest 4 months of the year in the Data Portal. **Click** on the big **VIEW icon** at the left of your screen in order to switch back to the VIEW panel to graph the new data.



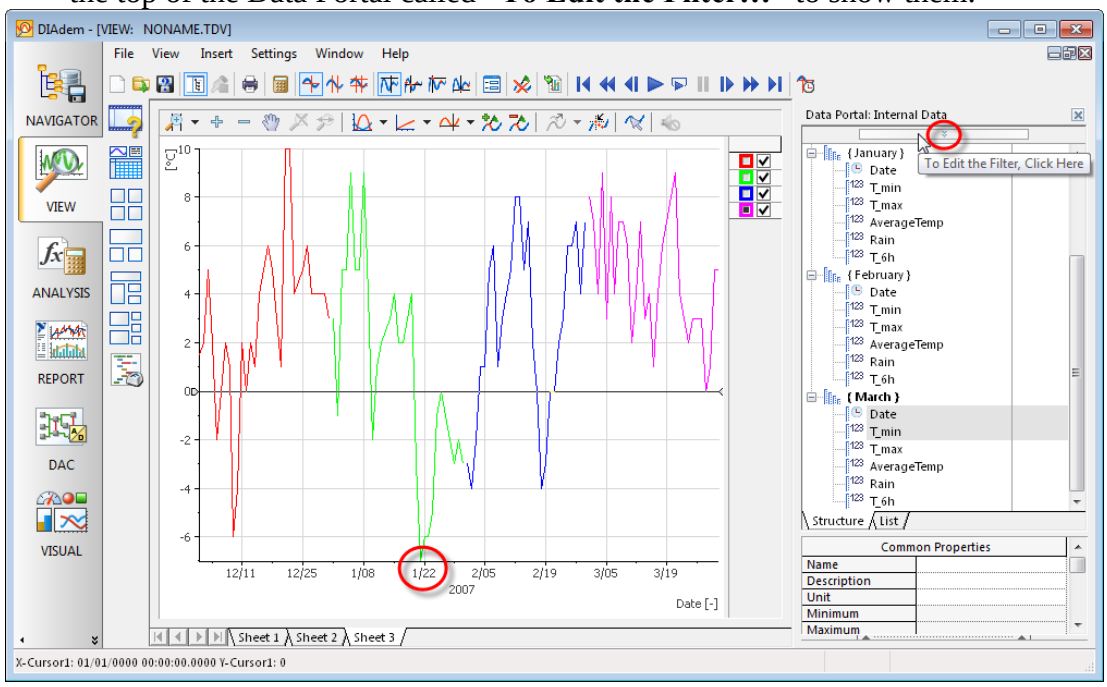
4.27 Select both the **"Date"** channel and the **"T_min"** channel from the **"{ February }" group** (holding down the <Shift> key) and **drag** them **together into** the **graph**.



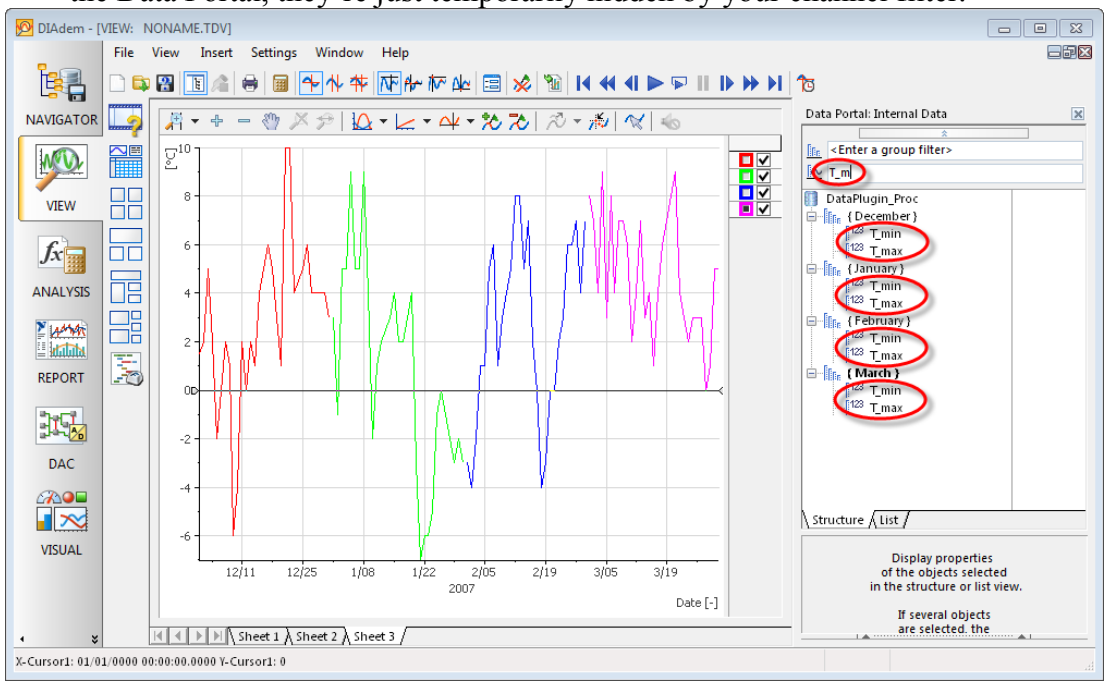
4.28 Select both the **"Date"** channel and the **"T_min"** channel from the **"{ March }" group** (holding down the <Shift> key) and **drag** them **together into** the **graph**.



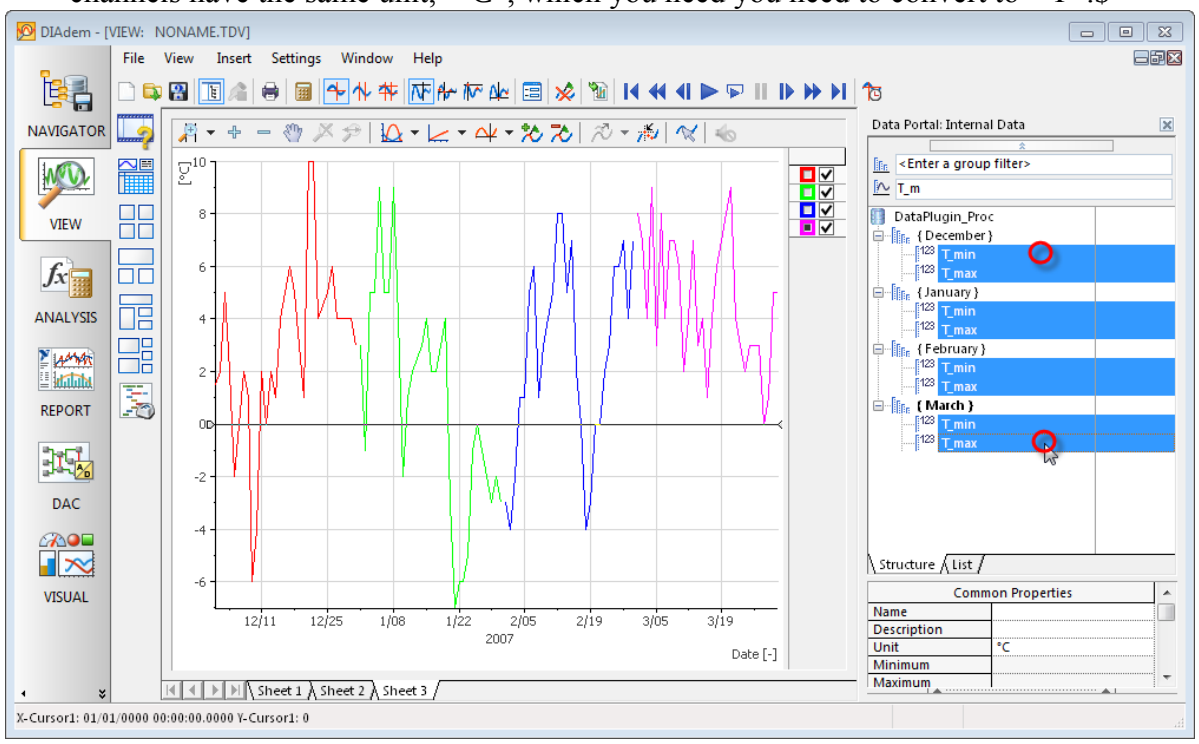
4.29 Here you have your conclusive answer. December had the closest other cold day at -6 °C, but it turns out that the low of -7 °C on January 21 is definitely the coldest day of that winter. But for the audience you're reporting this result to, you need to convert the temperature channels measured in °C to temperature measured in °F. The easiest way to select the temperature channels is to filter the Data Portal display. If you don't already see the group and channel filter fields in the Data Portal, **click** on the button at the top of the Data Portal called **"To Edit the Filter…"** to show them.



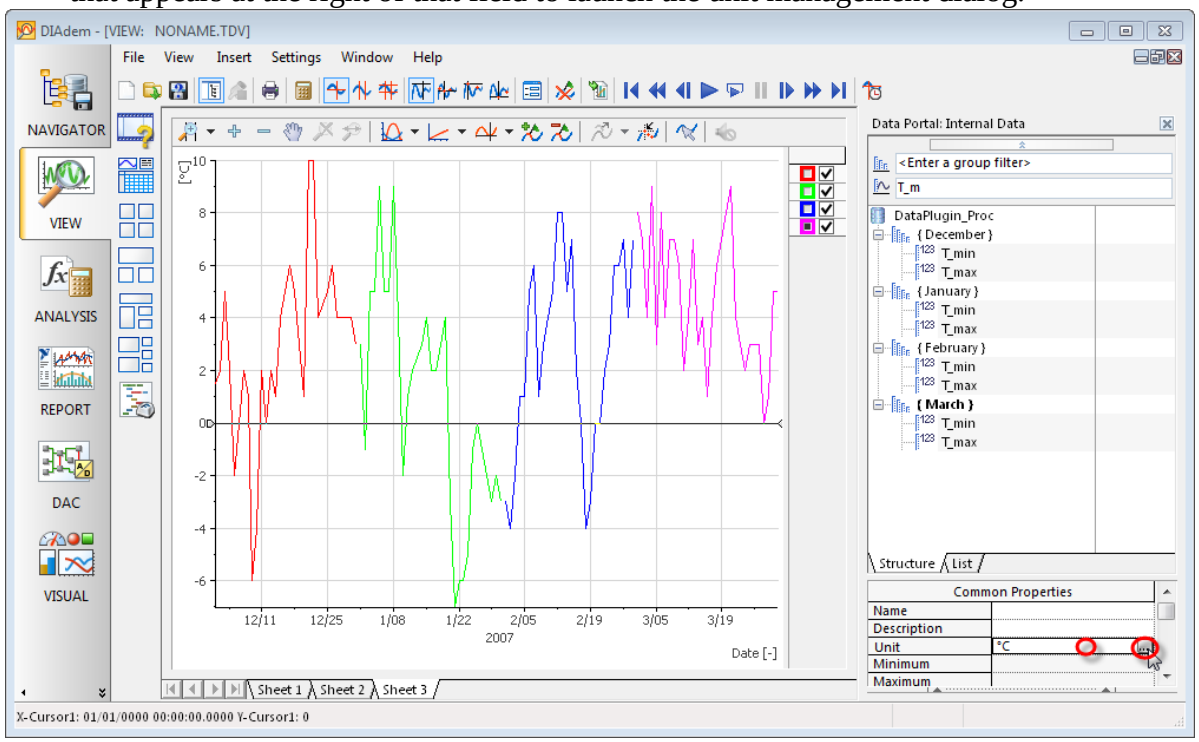
4.30 Type the text **"T_m"** into the channel filter field in the Data Portal underneath the group filter field. Notice how as you type the displayed channels become successively fewer as the filter text gets longer. The channels you no longer see are still loaded in the Data Portal, they're just temporarily hidden by your channel filter.



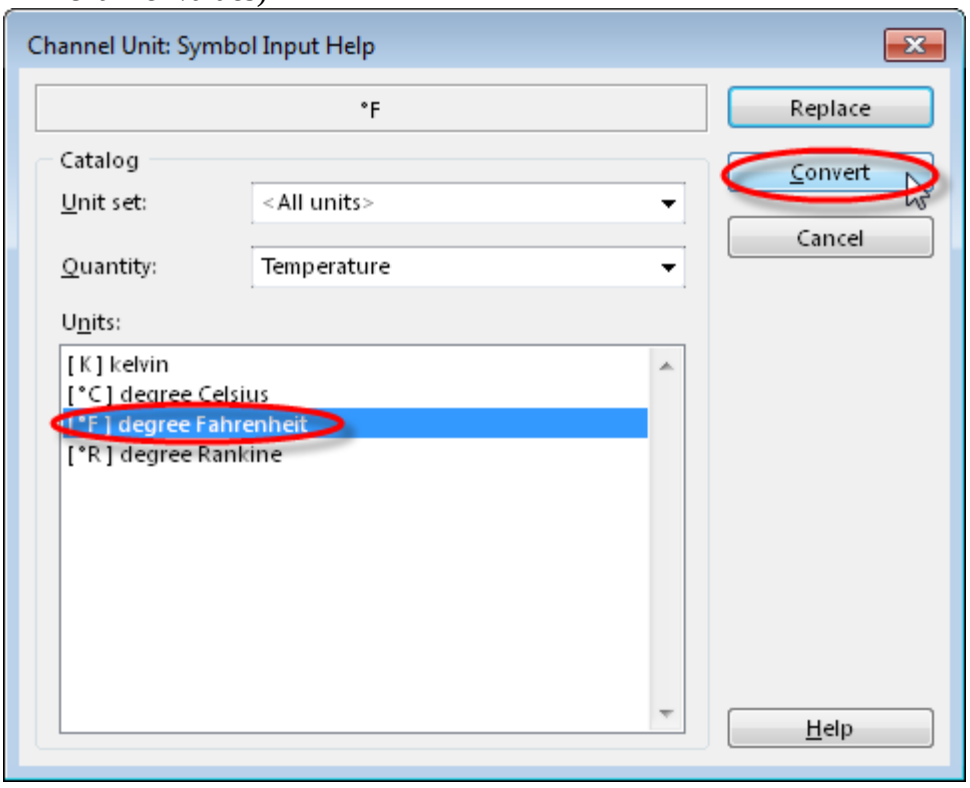
4.31 Click on the **top "T_min"** channel, **hold down** the **<Shift>** key, then **click** on the **bottom "T_max"** channel to select all these temperature channels. All of these channels have the same unit, "°C", which you need you need to convert to "°F".$



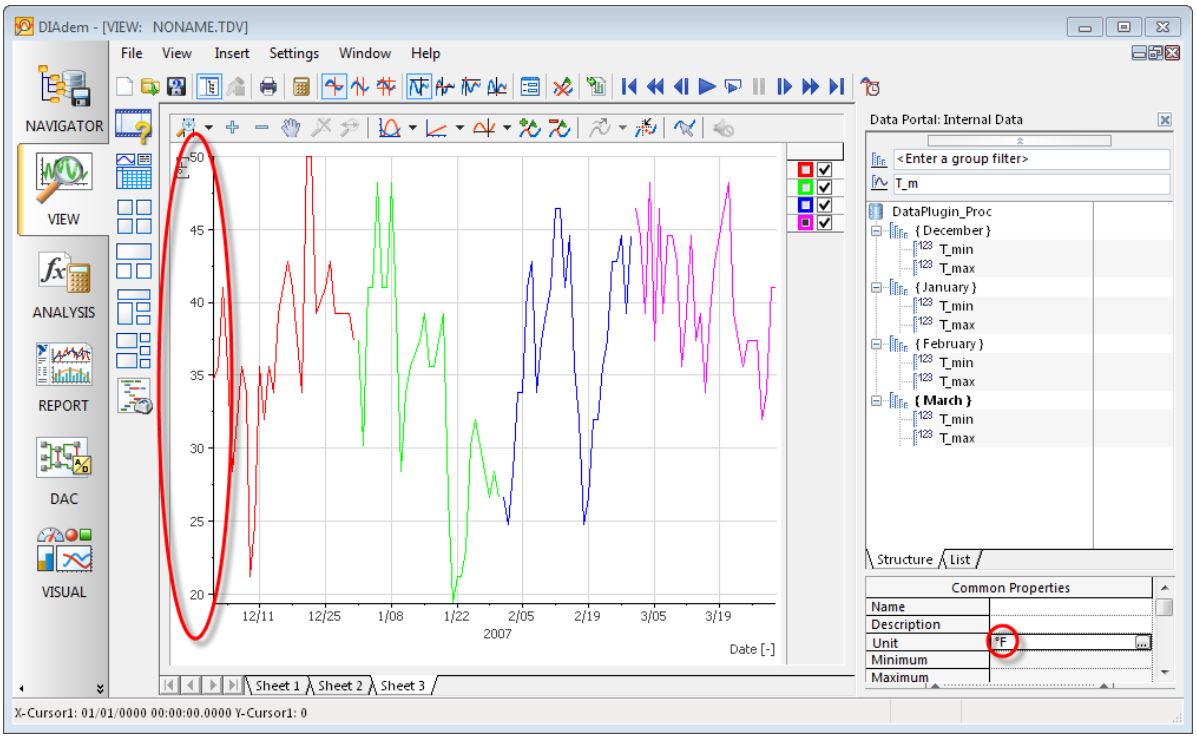
4.32 Luckily, DIAdem makes it easy to convert data from one unit to another. **Click** on the **Unit** property **field** at the bottom right of your screen, then **click** on the "**[…]" button** that appears at the right of that field to launch the unit management dialog.



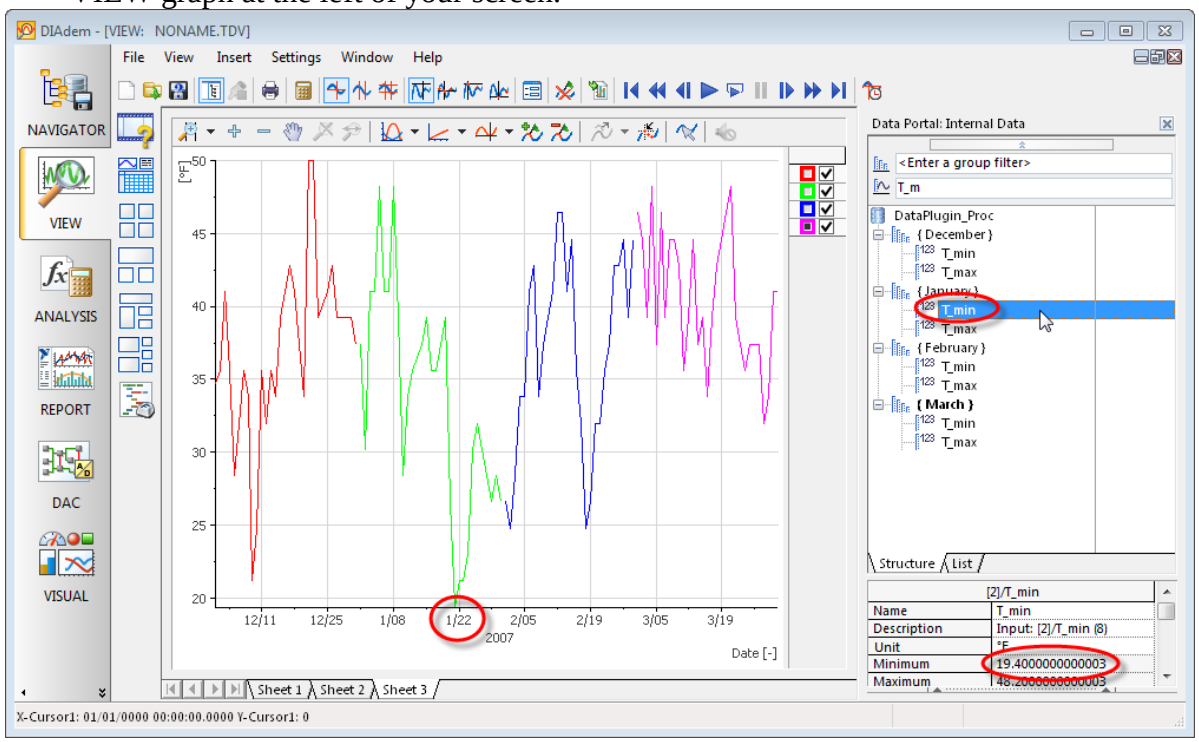
4.33 Select the **"[°F] degree Fahrenheit"** unit and **click** on the **"Convert"** button to change the unit string AND convert the channel values for all the selected channels in the Data Portal. (You MUST click on the "Convert" button or you will not convert the channel values)



4.34 Note that the unit property in the Data Portal now reads "°F" and the values graphed on the Y axis range from 20 to 50. So both the unit string and the channel values have been converted from "°C" to "°F".



4.35 Finally, **Select** the **"T_min" channel** in the second **"{ January }"** group you loaded. Now look in the Data Portal property table at the bottom right of your screen and see that the lowest temperature recorded that winter was 19.4 °F, just as it appears in the VIEW graph at the left of your screen.

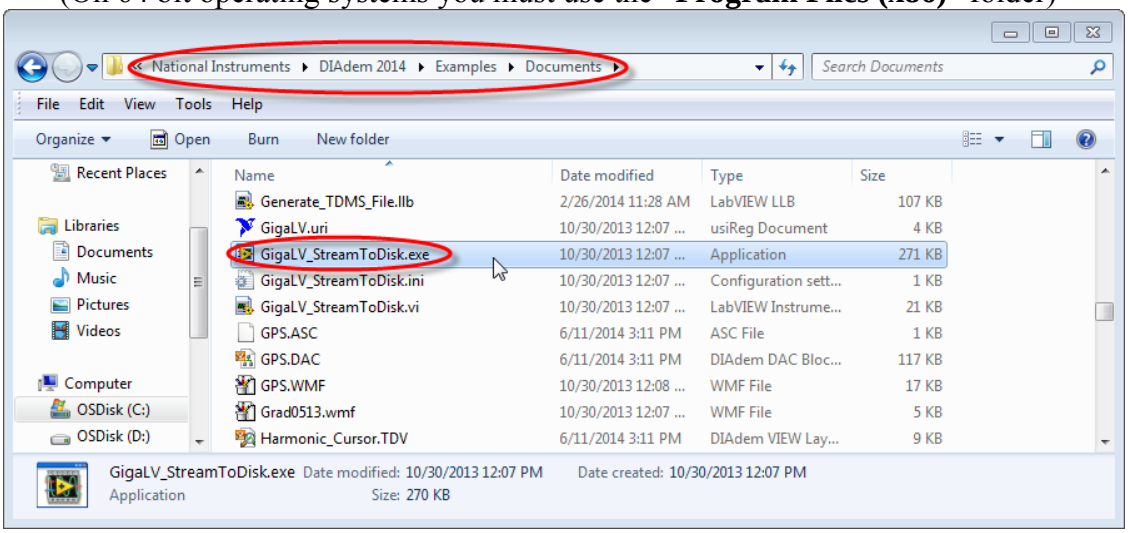


Exercise #5 Binary DataPlugin and Frequency Analysis

Scenario: Your professor has assigned you the task of processing all the data from a newly installed underwater microphone array. The real data will be coming in soon, so he wants you to establish a process for quickly analyzing the frequency content of sounds recorded at each microphone over time. He specifically requested both 3D waterfall and 2D intensity plots of the Joint-Time-Frequency-Analysis type (JTFA). He would like Windows Meta Files (WMF) of each of these graphs emailed back to him as soon as possible. The data files themselves will be in a proprietary binary format that the previous graduate student invented. Thankfully she had already created a DataPlugin for that file type so that reading the files into DIAdem should be automatic. Your advisor points you to the directory where the DataPlugin file is, as well as a LabVIEW program which creates one of these binary files with simulated test pattern data to get you started.

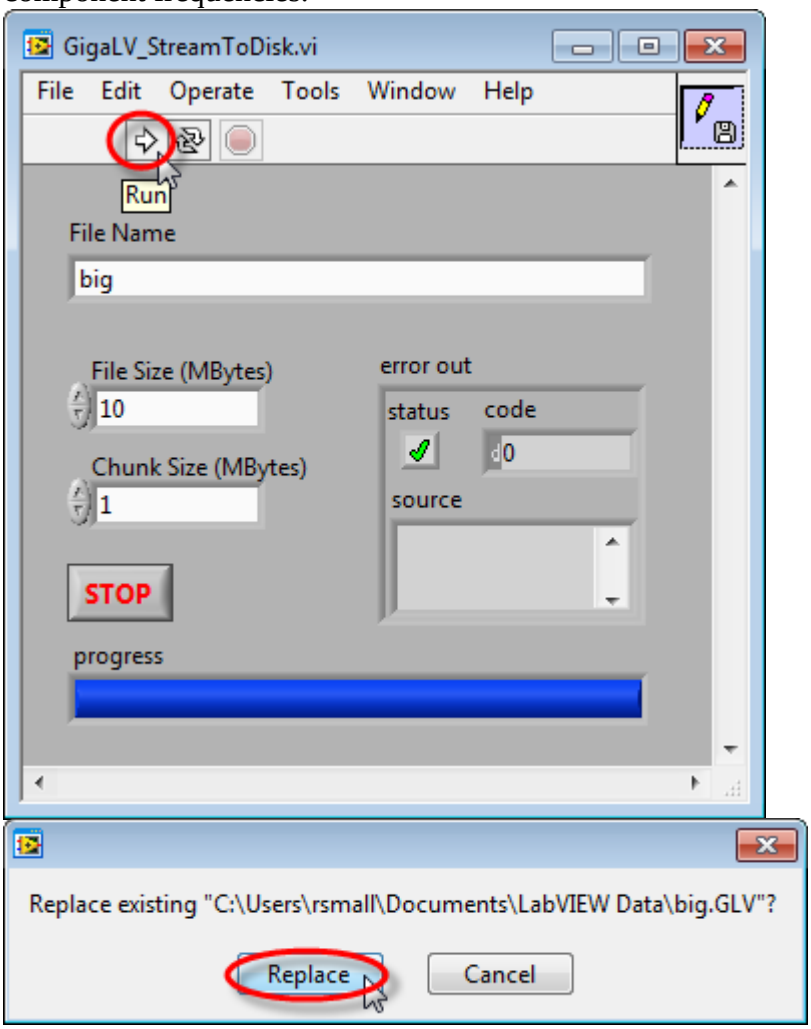
5.1 Your first task is to Launch Windows Explorer and run the LabVIEW program that creates the test file. If you took all the defaults when installing DIAdem, you will find the LabVIEW example in the following folder on your hard drive: **"C:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"** If, on the other hand, you are in an official National Instruments seminar, look in **"D:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"** The LabVIEW program you need to launch is called "GigaLV_StreamToDisk.exe". **Double-click** the **"GigaLV_StreamToDisk.exe"** application to launch it.

(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)



NOTE: DIAdem automatically installs the LabVIEW run-time engine— this is why you do not need to have LabVIEW installed in order to run this compiled LabVIEW application. If you have a recent version of LabVIEW installed and want to look at the source code for this example, you can double-click on the "GigaLV_StreamToDisk.vi", from which the executable was compiled

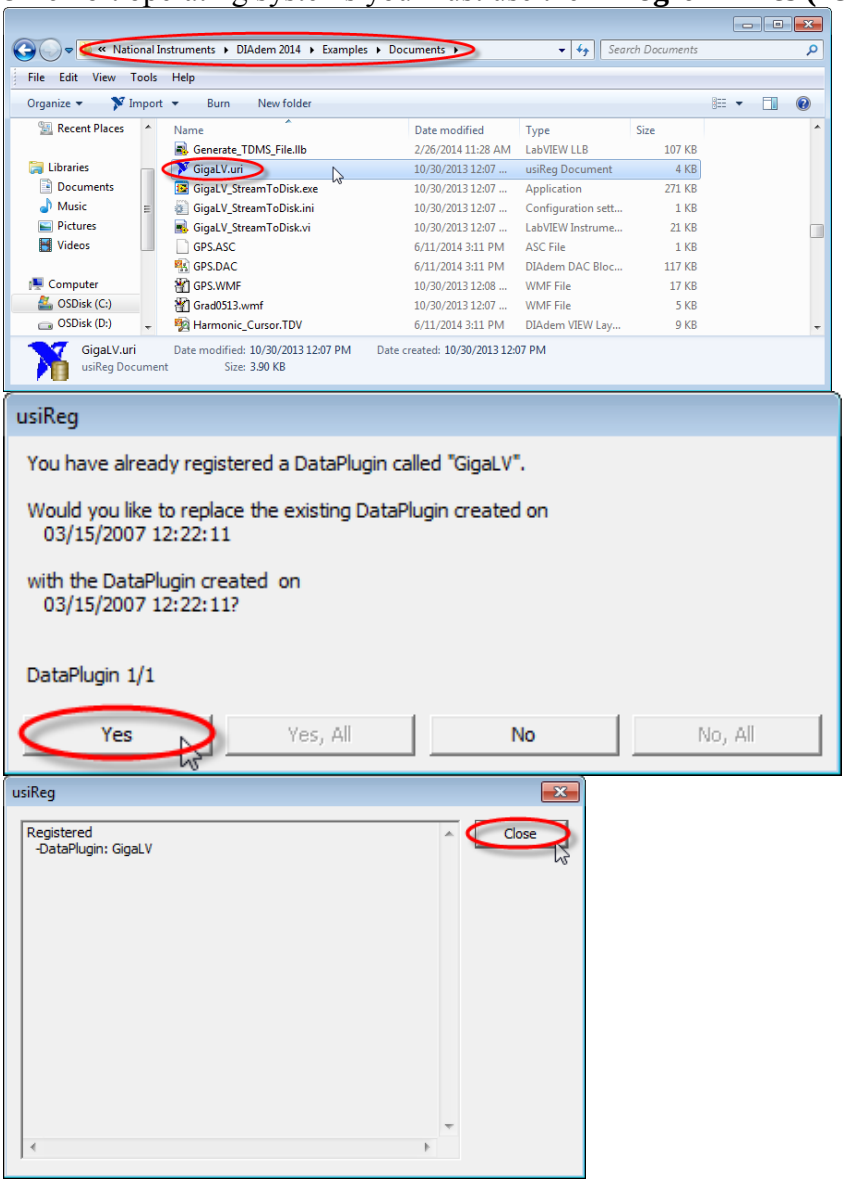
5.2 The LabVIEW application runs automatically as soon as it is loaded, by default creating a file called "big.GLV" in your "My Documents\LabVIEW Data" directory. **Click** on the **"Replace"** button if asked to confirm overwriting a previous "big.GLV" file. If you wish, you can run the VI a couple of more times with different "File Name", "File Size" and/or "Chunk Size" parameters. Any files you create will automatically be placed in the "My Documents\LabVIEW Data" directory. Each streamed binary file contains one channel of simulated acoustic data with multiple component frequencies.



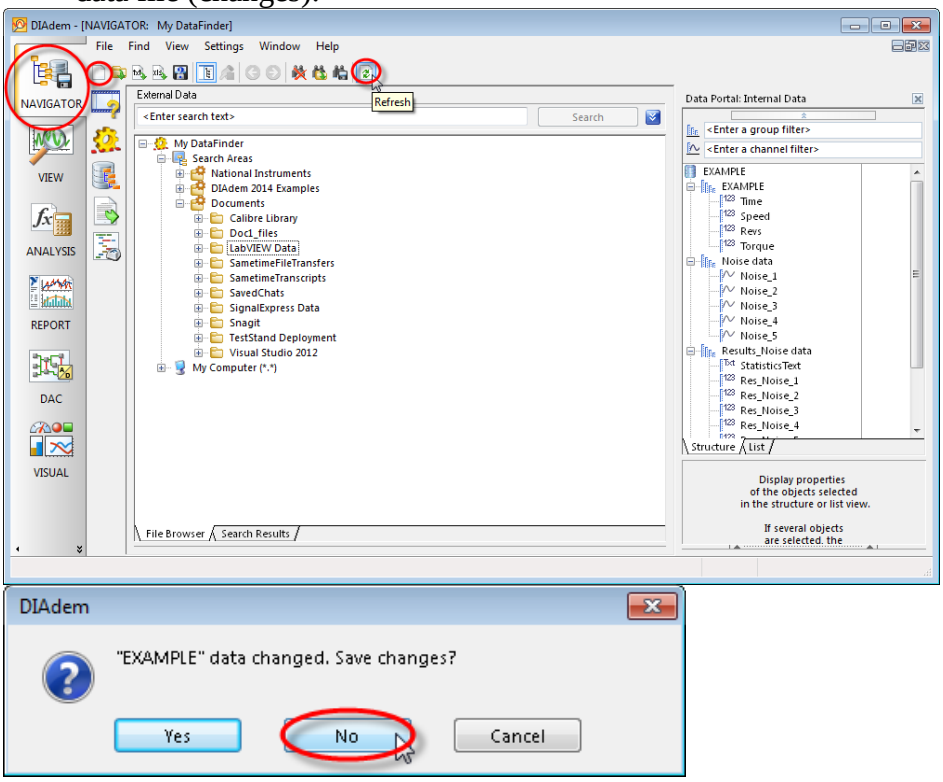
NOTE: If you cannot get this application to run, you will not be able to work through the rest of Exercise 5— the "*.GLV" file this application creates is required in the remaining steps. If that is the case, try re-runing the DIAdem 2014 installer and choose to install the LabVIEW Runtime Engine option, then retry opening the "GigaLV_StreamToDisk.exe" file.

5.3 The "big.GLV" binary file is not in a file format that DIAdem natively understands. Fortunately, a DataPlugin exists which extends DIAdem's list of native file formats to include the "GLV" binary file format. Return to Windows Explorer, which should still be dialed to the same directory as the step before last. **Double-click** on the **"GigaLV.uri"** file to register the "GigaLV" DataPlugin with your DIAdem. **Click** the **"Yes"** button if you are asked to confirm replacing an existing version of the "GigaLV" DataPlugin with the version in the "GigaLV.uri" file you just registered. Once the "GigaLV" DataPlugin has been registered, you receive a notification dialog. **Click** the **"Close"** button on the notification dialog.

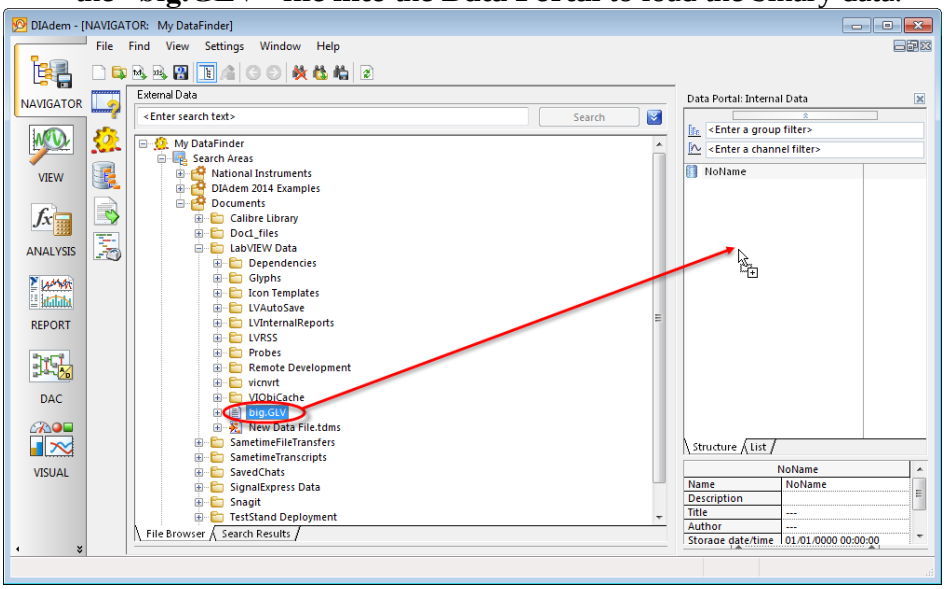
(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)



5.4 Return to DIAdem and **switch** to the **NAVIGATOR** panel. **Click** on the **"Refresh"** icon and then also the **"Delete Internal Data"** icon at the top of your screen to refresh the tree view and then also delete any data channels that may still be in your Data Portal. **Click** the **"No"** button if you are asked whether you want to save the previous data file (changes).

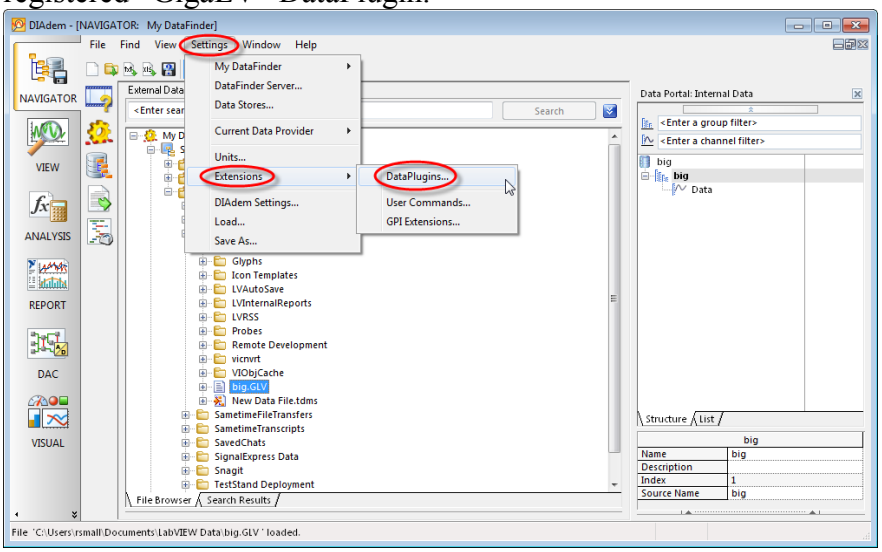


5.5 **Navigate** in the tree view to **"My Documents\LabVIEW Data\big.GLV"**, then **drag** the **"big.GLV"** file **into** the **Data Portal** to load the binary data.

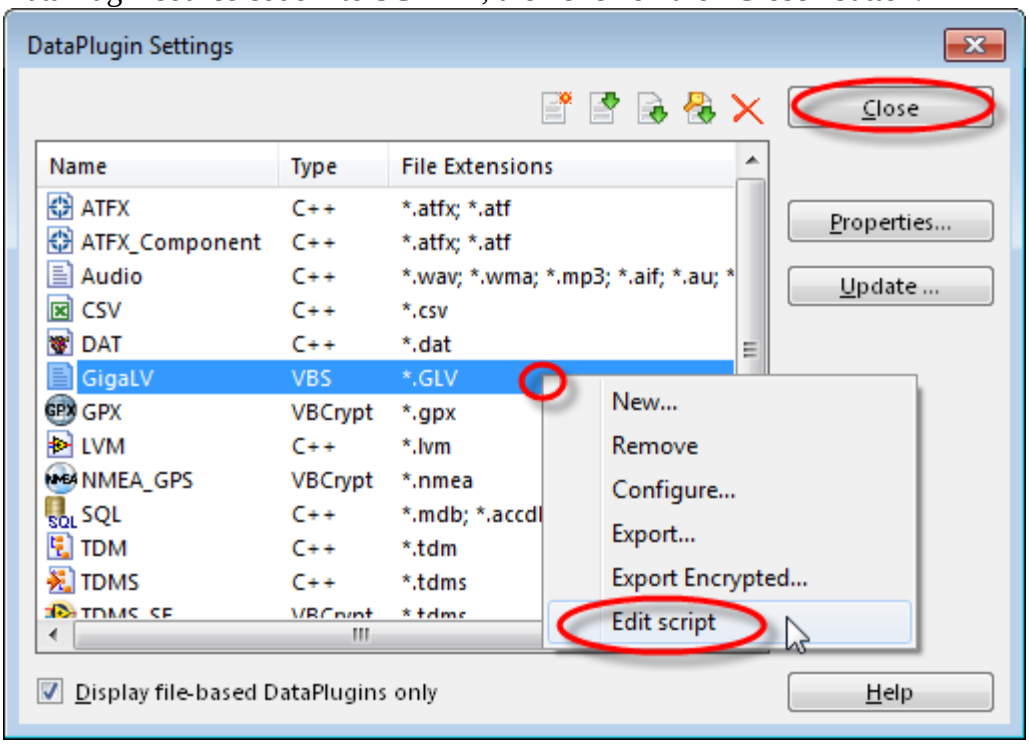


NOTE: Your "big.GLV" file may still have a question mark icon (?) next to it. You can right-click on it and choose the "Reindex File" context menu to force the file to index.

5.6 The "GigaLV" DataPlugin you just registered enabled DIAdem to read this external binary file format. You're curious how much work that other graduate student put into creating the DataPlugin and decide to take a look at the code behind it. **Select** the **"Settings>> Extensions>>DataPlugins"** menu in order to find and open up the registered "GigaLV" DataPlugin.



5.7 This dialog lists all the DataPlugins registered in your DIAdem and which file extensions they can open. With the exception of the "GigaLV" DataPlugin, all of the below DataPlugins were registered during DIAdem's initial installation. **Right-click** the **"GigaLV"** DataPlugin in the list and **select** the **"Edit script"** button to load the DataPlugin source code into SCRIPT, then click on the **"Close"** button.

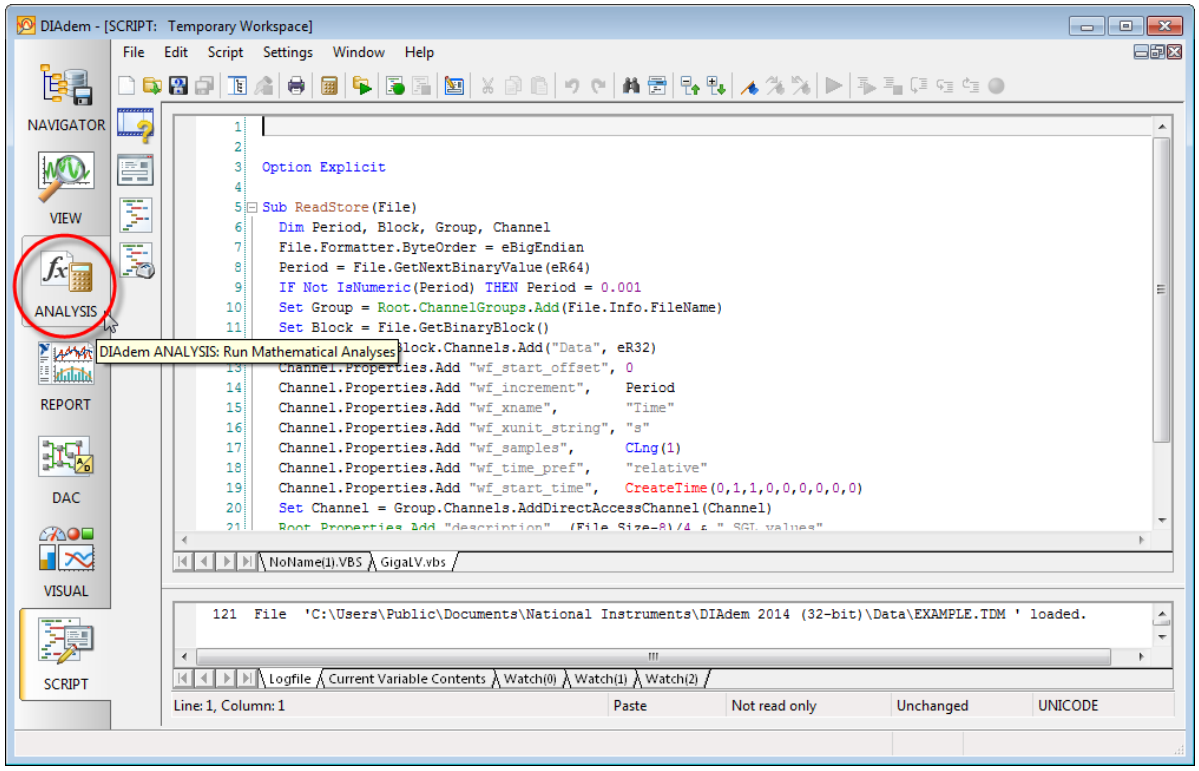


5.8 Now DIAdem has placed you in the SCRIPT panel and loaded the VBScript code of the "GigaLV" DataPlugin. You're surprised that it's only 20 lines of code, and many of its features are pretty easy to pick out.

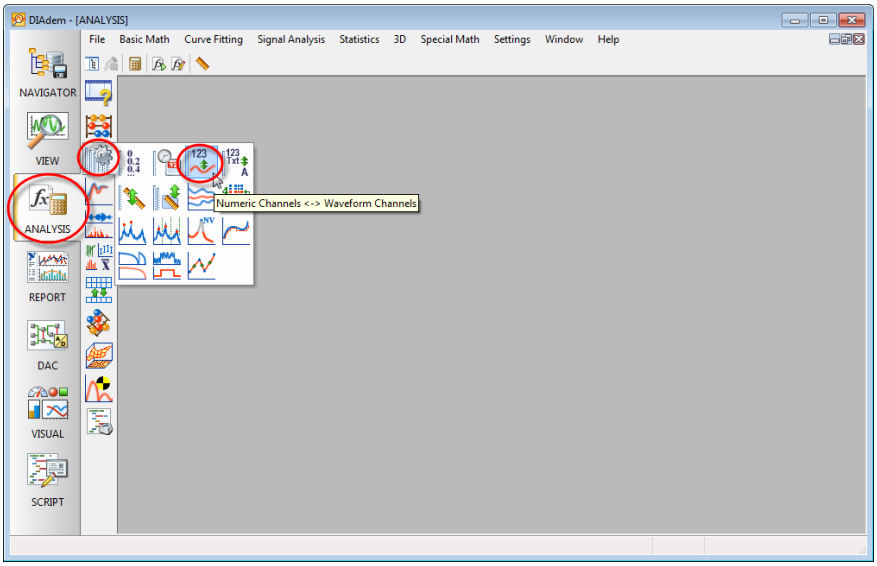
In line 7 the expected binary byte order is set to "Big Endian"
In line 8 the time between values is loaded as a DBL
In line 12 the rest of the values in the file are configured to be read as SGLs

Most of the rest of the code assigns property values to the root, group, and channel levels, including the channel waveform properties in lines 13 through 19. Notice that this DataPlugin does NOT read in the individual SGL values of the "Data" channel, it just configures HOW to read those values. The actual binary parsing of the channel values happens in the DataPlugin engine in optimized C code. This means that the DataPlugin VBScript code is often very simple and compact.

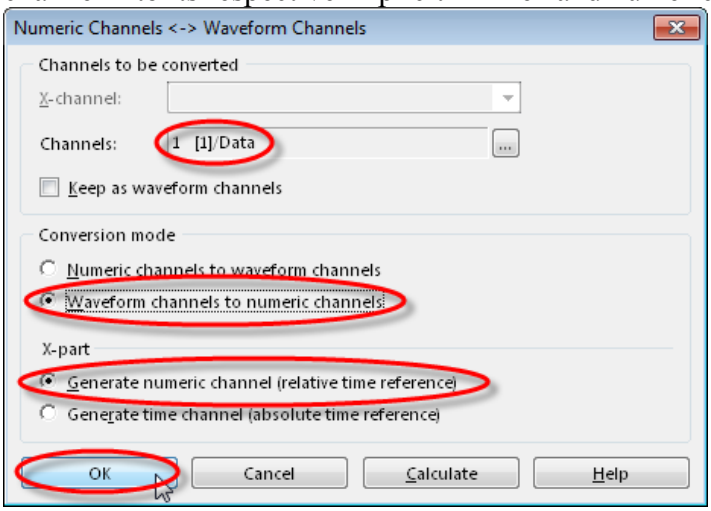
In most cases having a waveform "Data" channel is preferable, but for the case of 3D graphing and time interval FFTs it will actually be easier to work with a "Time" and "Data" pair of channels. **Click** on the **ANALYSIS panel** to split the waveform "Data" channel this DataPlugin loaded into the corresponding pair of implicit "Time" channel and numeric "Data" channel.



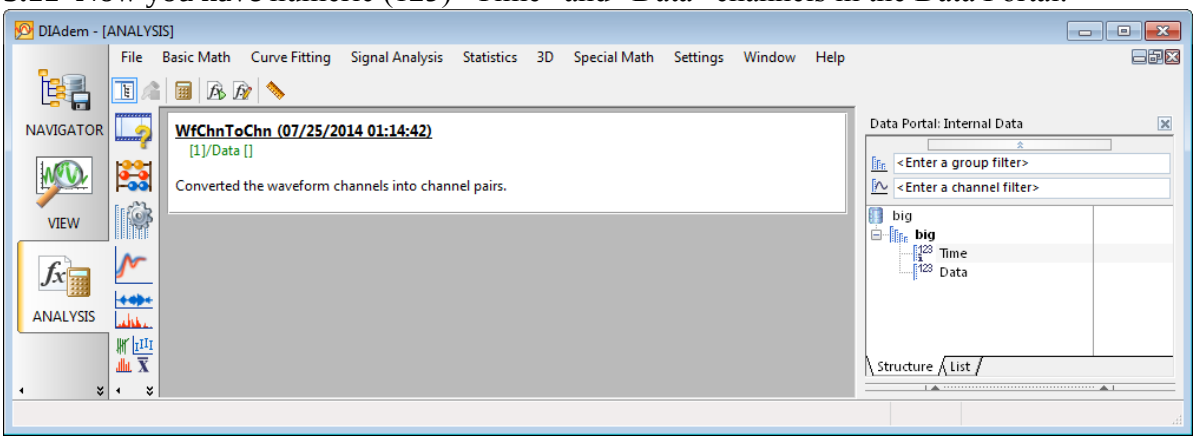
5.9 **Click** on the **"Channel Functions"** palette (cog icon), then **click** on the **"Numeric Channels ⇔ Waveform Channels"** function icon.



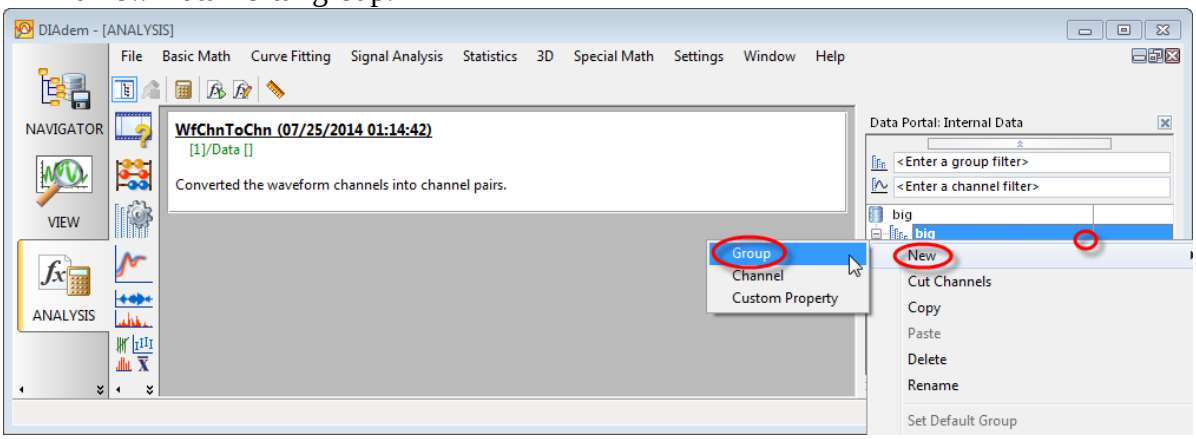
5.10 **Select "Data"** in the "Channels:" field and the **"Waveform channels to numeric channels"** radio button, then **click** on the **"OK"** button to split the waveform "Data" channel into its respective implicit "Time" and numeric "Data" channels.



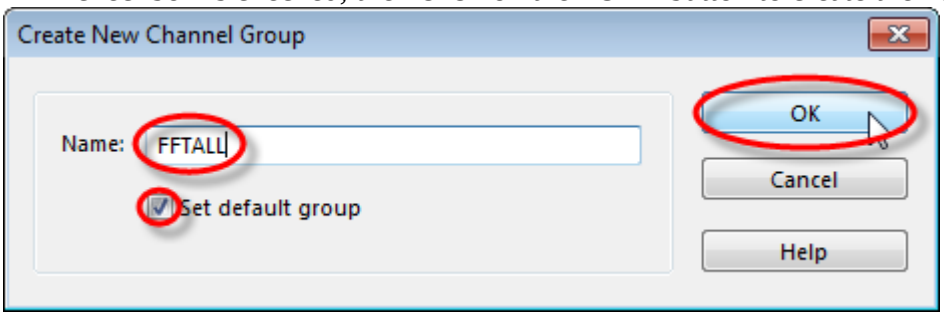
5.11 Now you have numeric (123) "Time" and "Data" channels in the Data Portal.



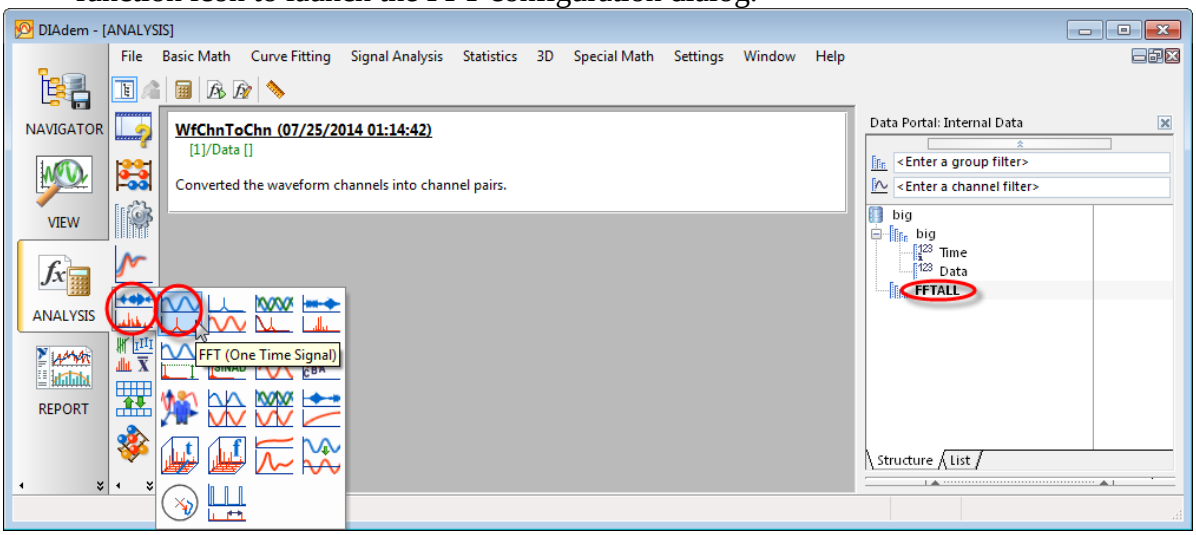
5.12 Your next step will be to run an FFT calculation, and it will be convenient for the FFT channels to land in their own group in the Data Portal. **Right-click** on the existing **"big"** group in the Data Portal and **select** the **"New>>Group"** context menu to create a new Data Portal group.



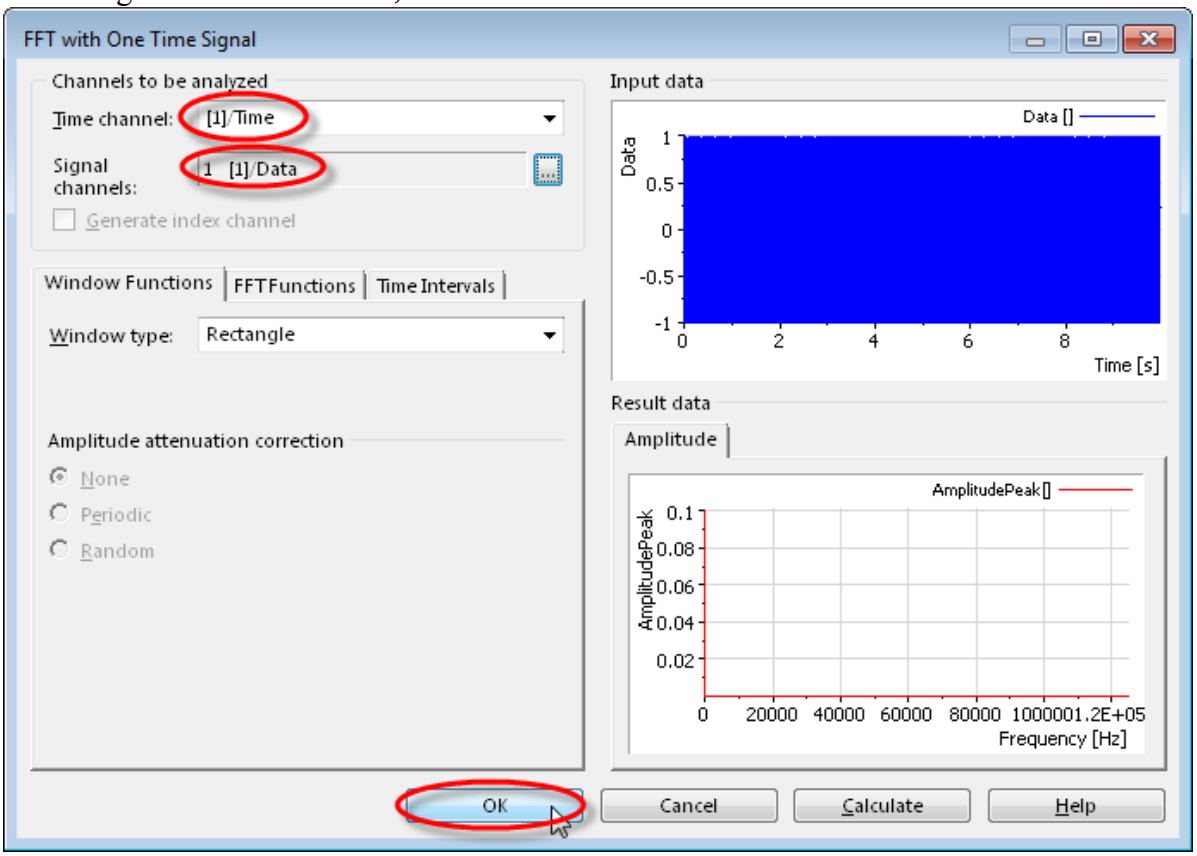
5.13 **Type** in **"FFT ALL"** in the "Name:" field, make sure the "Set default group" checkbox is checked, then **click** on the **"OK"** button to create the new group.



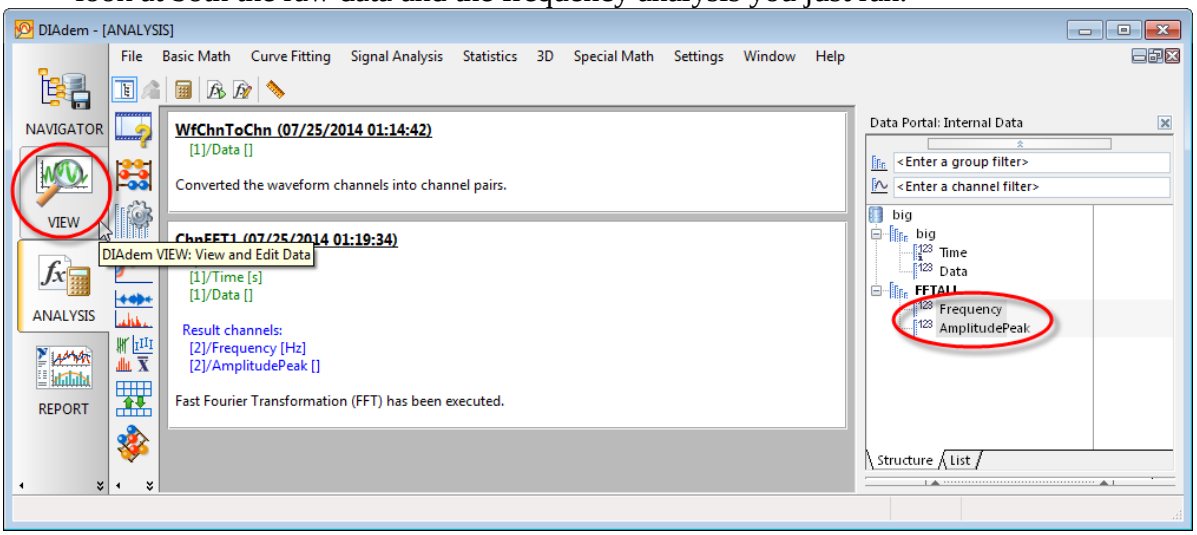
5.14 **Click** on the **"Signal Analysis"** palette, then **click** on the **"FFT (One Time Signal)"** function icon to launch the FFT configuration dialog.



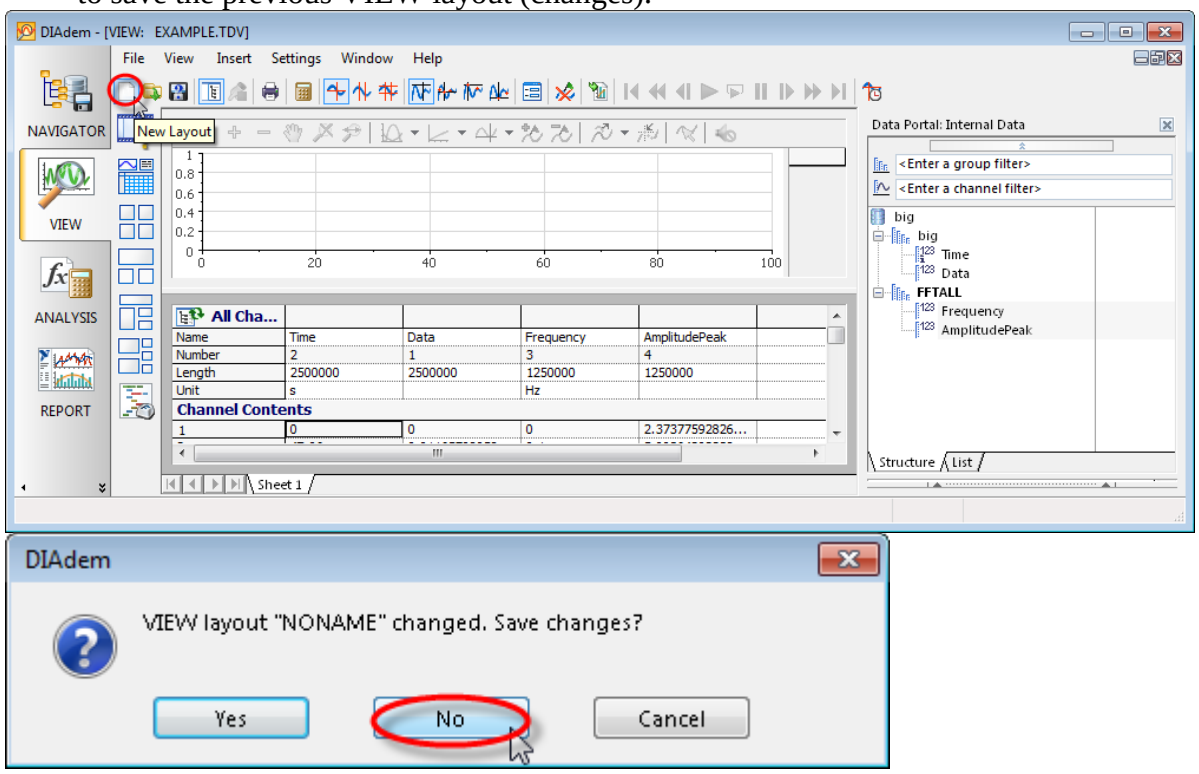
5.15 Make sure the **"Time"** and **"Data"** channels are **selected** in the "Time channel:" and "Signal channels:" fields, then **click** on the **"OK"** button to run the FFT.



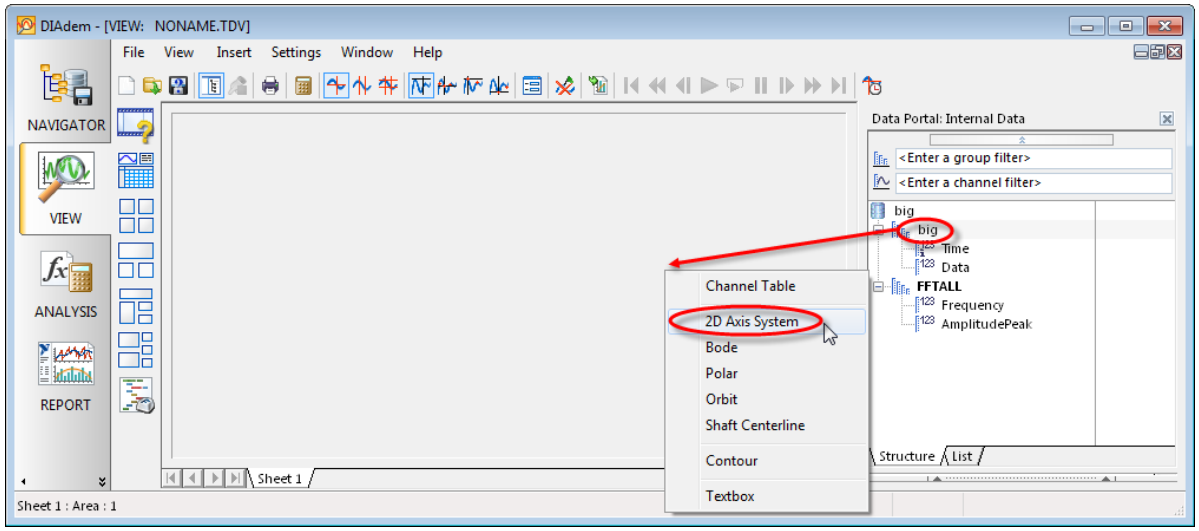
5.16 Now you have new "Frequency" and "AmplitudePeak" channels in the Data Portal containing the results of the Fourier Transform calculation. **Click** on the large **"VIEW"** tab at the left of your screen in order to switch over to the VIEW panel and look at both the raw data and the frequency analysis you just ran.



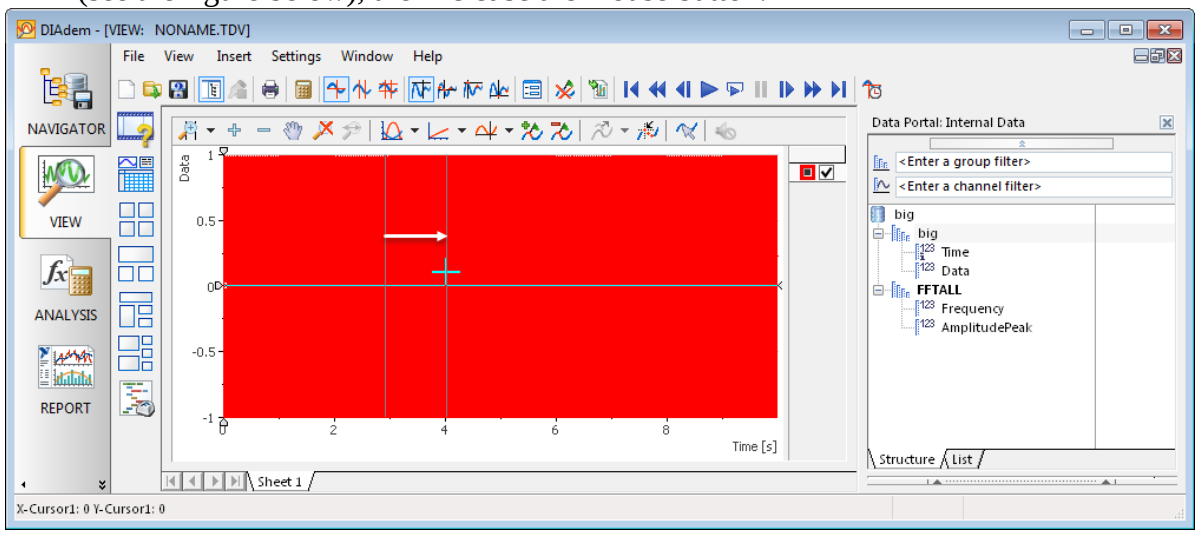
5.17 **Click** on the **"New Layout"** icon at the top left of your screen to clear the VIEW panel of any existing areas. **Click** the **"No"** button if you are asked whether you want to save the previous VIEW layout (changes).



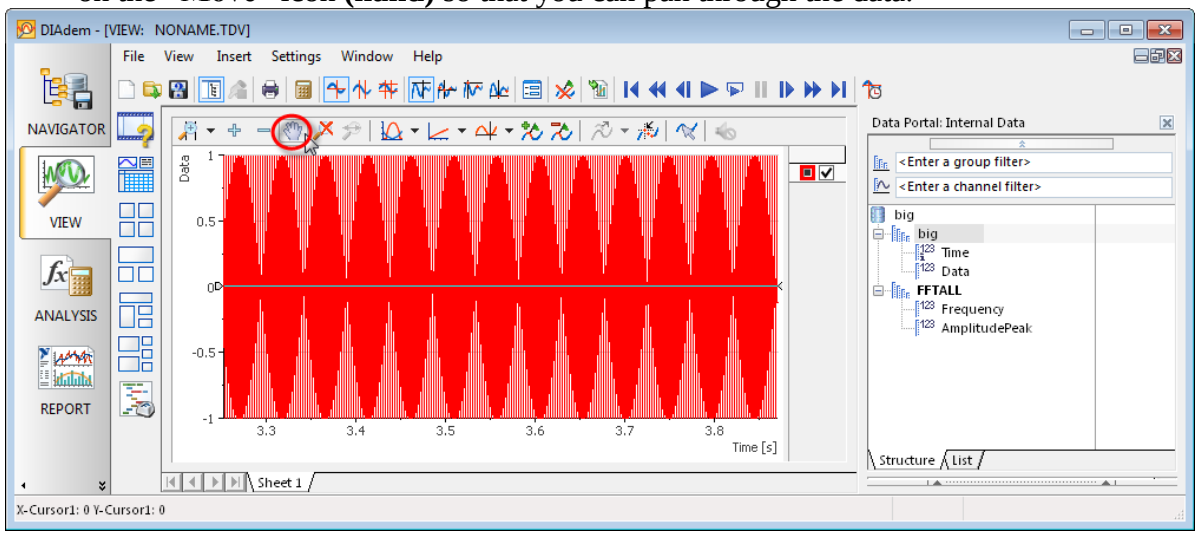
5.18 **Drag** the **"big" group** from the Data Portal on the right **into** the empty **VIEW** area, then **select** the **"2D Axis System"** display option in order to graph the raw time series data.



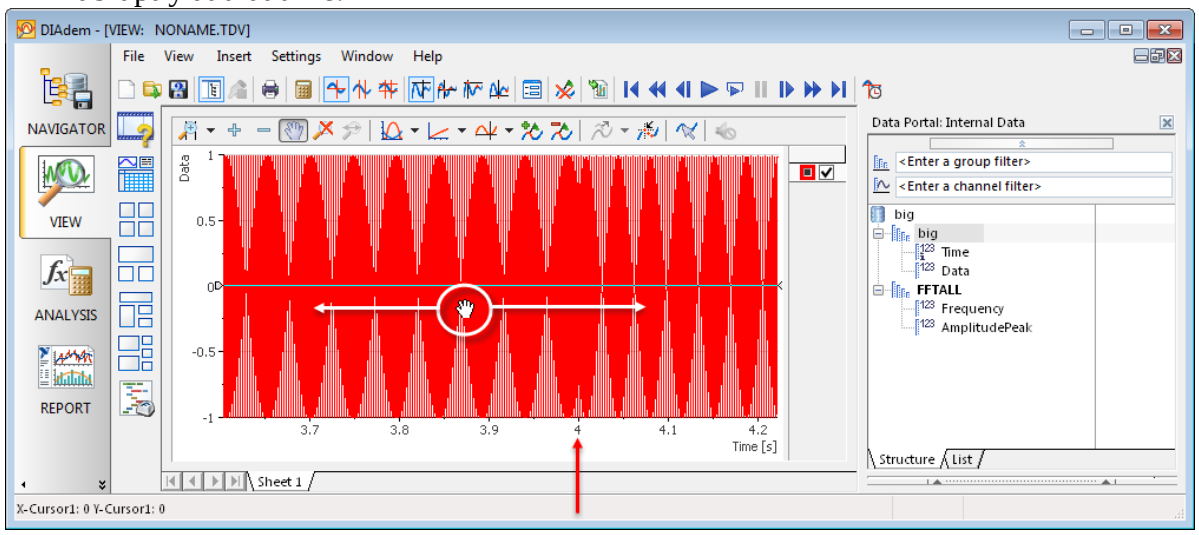
5.19 The signal is oscillating so quickly over a horizontal time window of 10 seconds between vertical values -1 and +1 that it looks like a solid band of color— you need to zoom in some. There are several ways of zooming in DIAdem VIEW, but the following is the easiest way, and you'll only learn about it here (Easter Egg alert). Place your mouse on the part of the signal you want to zoom into, then **right-click** (RIGHT-click) and hold the right mouse button down while you **drag** the mouse to the **right** to outline a time region a little smaller than a somewhere near the 4 second mark (see the figure below), then **release** the mouse button.



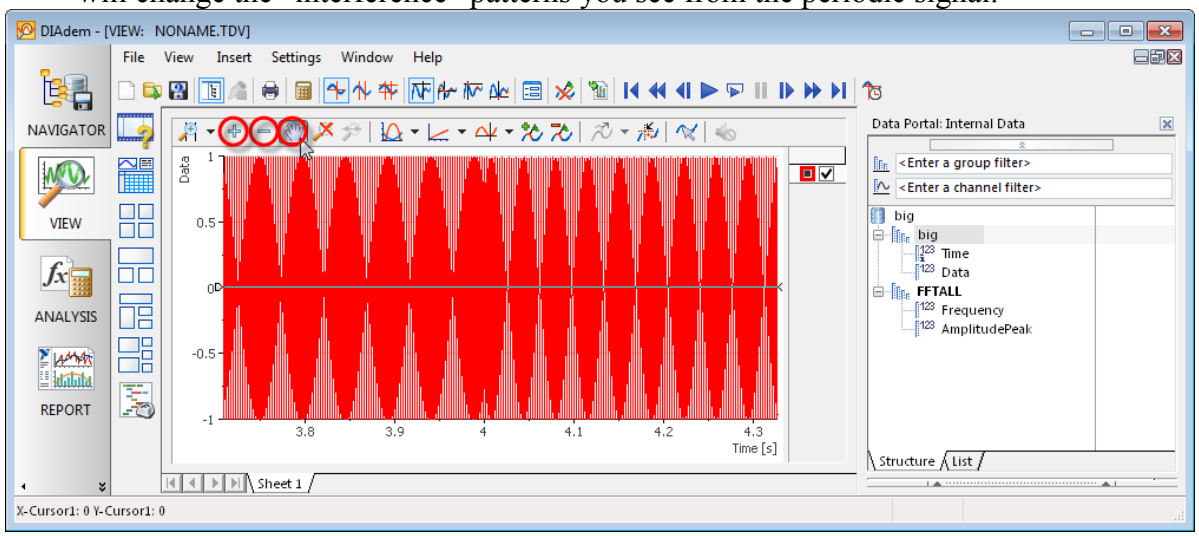
5.20 You're still not zoomed all the way in, but you should now be able to see that the signal is going up and down very quickly. The pattern you see below depends strongly on the width of the zoom region you selected, so yours may look quite different. **Click** on the **"Move"** icon **(hand)** so that you can pan through the data.



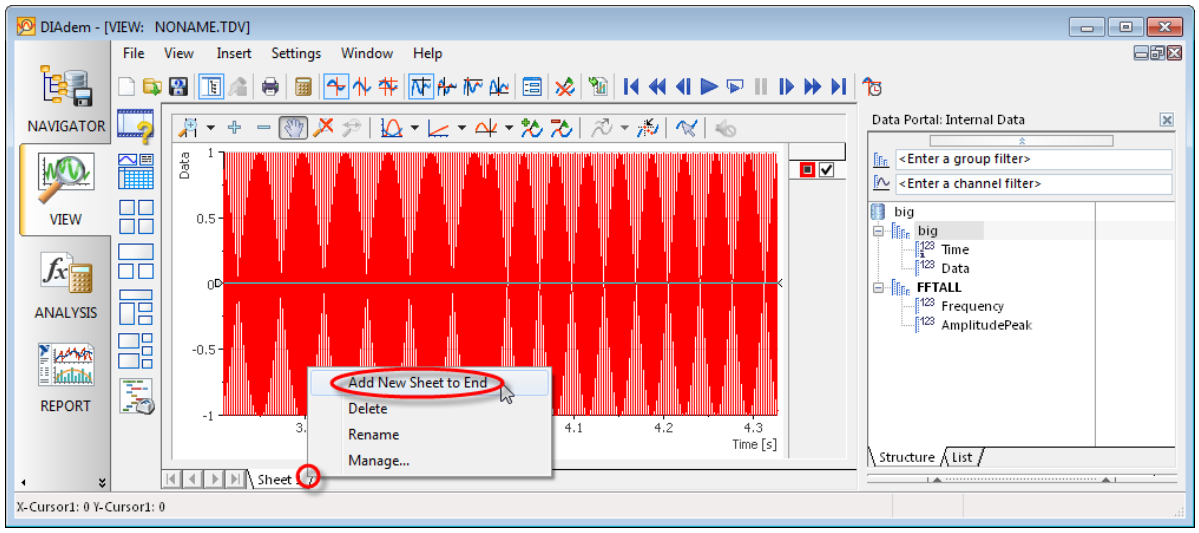
5.21 Now when you hold your mouse over the data, it appears as the same "hand" icon that you just clicked on— this enables you to "grab" the data and pan left or right through the data set, tracking your mouse movement. **Click** on the **graph, hold** the mouse button down, and **drag** your mouse **left / right** as needed to center the 4 second mark on the X axis in the middle of your screen. The sharp change in the interference-like pattern at 4 seconds indicates that the dominant frequency of the signal changed abruptly at that time.



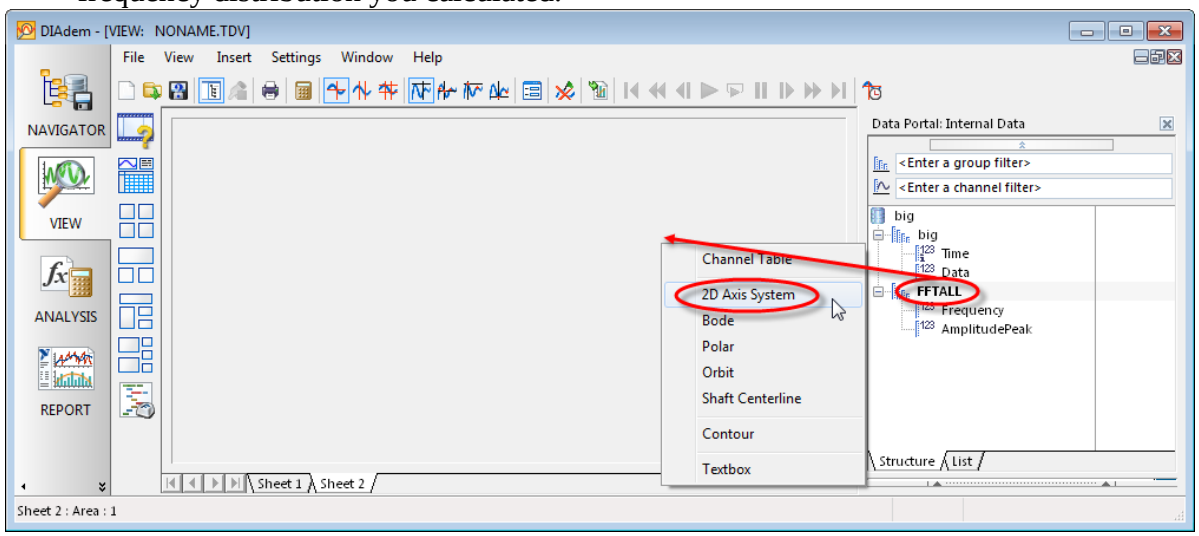
5.22 First **Click** on the **"Move"** icon **(hand)** again to disengage the panning mode. Depending on the region of the X axis you selected a few steps back, you may not see a dramatic shift at the 4 second mark. In that case **click** on the **"+" / "-"** icons to incrementally zoom into / out of the data set (or use the mouse scroll wheel)— this will change the "interference" patterns you see from the periodic signal.



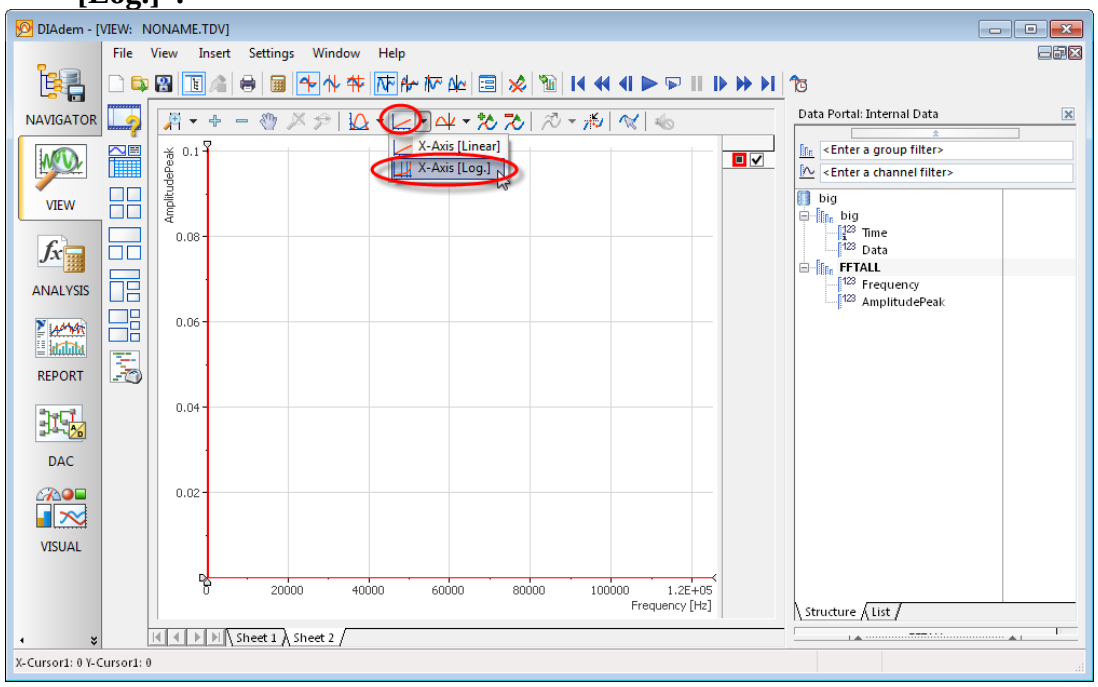
5.23 You've now seen one clear frequency transition at time = 4s. The next step is to plot the FFT frequency analysis you've already calculated to see all the frequency content in the raw data. You may want to come back to this time series graph later, so you decide to create a new Sheet in DIAdem VIEW to graph the FFT results on. **Right-click** on the existing **"Sheet 1"** tab at the bottom of the screen and **select** the **"Add New Sheet to End"** context menu.



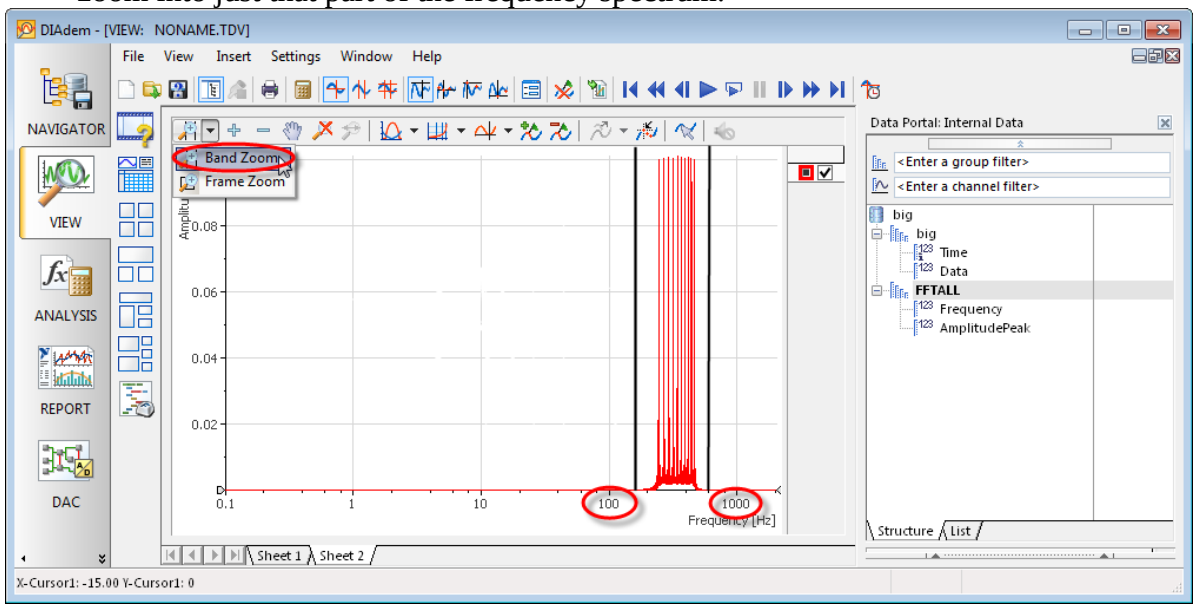
5.24 **Drag** the **"FFT ALL" group** from the Data Portal on the right **into** the new "Sheet 2" you just created in **VIEW**. **Select** the **"2D Axis System"** display option to graph the frequency distribution you calculated.



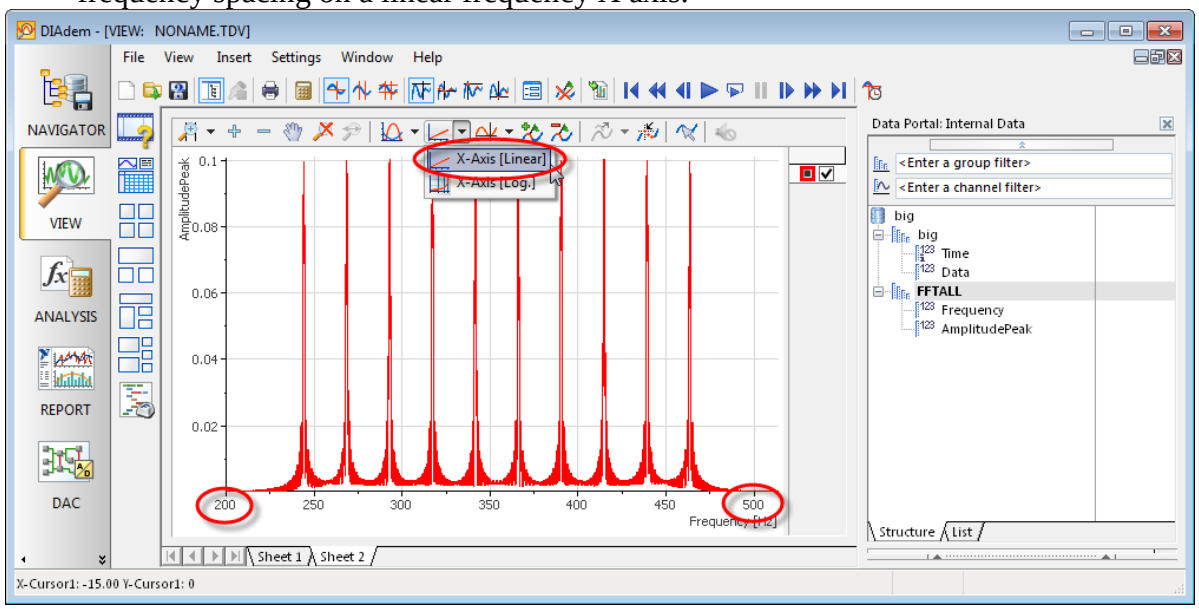
5.25 It looks like the dominant components are at low frequencies. In general, though, it's often convenient to look at wide frequency FFT results on a Log(frequency) X axis. **Click** on the **X axis scaling icon** at the top middle of your screen and **select "X-Axis [Log.]".**



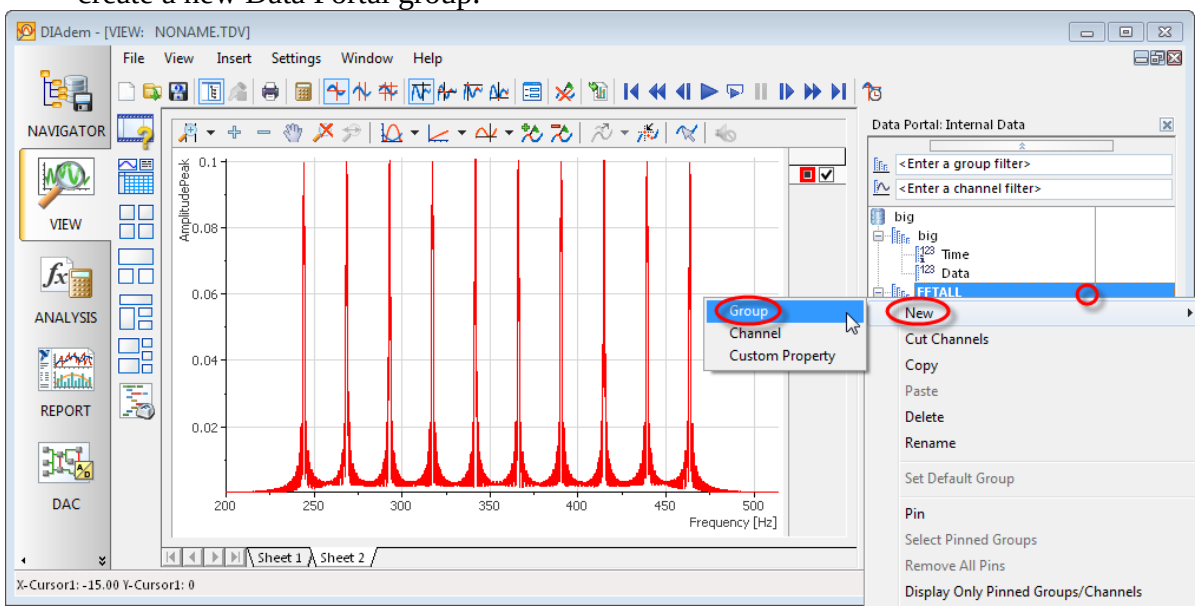
5.26 Now you can see the entire frequency spectrum from 0.1 Hz to 100 kHz spread evenly left to right on your X axis, and you immediately notice that there is a cluster of peaks between 100 Hz and 1000 Hz. **Click** on the **"Band Zoom"** icon at the top left of your screen and then **select** the frequency **region surrounding** these **peaks** in order to zoom into just that part of the frequency spectrum.



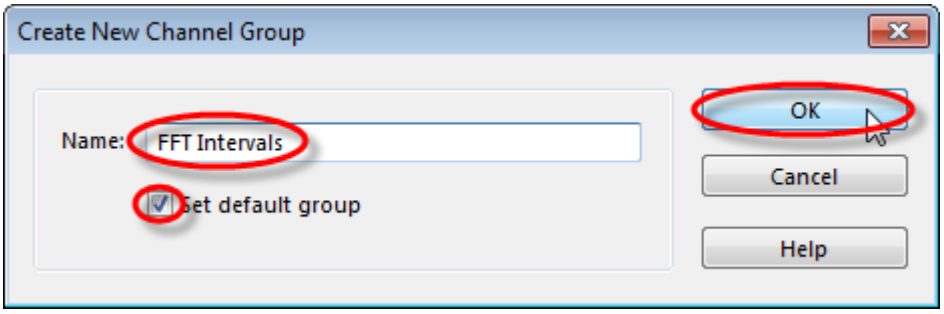
5.27 Now you see that the data set contains a series of 10 well-defined frequency components ranging from slightly over 200 Hz to slightly under 500 Hz that look like they might be evenly spaced in frequency. **Click** on the **X axis scaling icon** at the top middle of your screen and **select "X-Axis [Linear]"** in order to more easily check the frequency spacing on a linear frequency X axis.



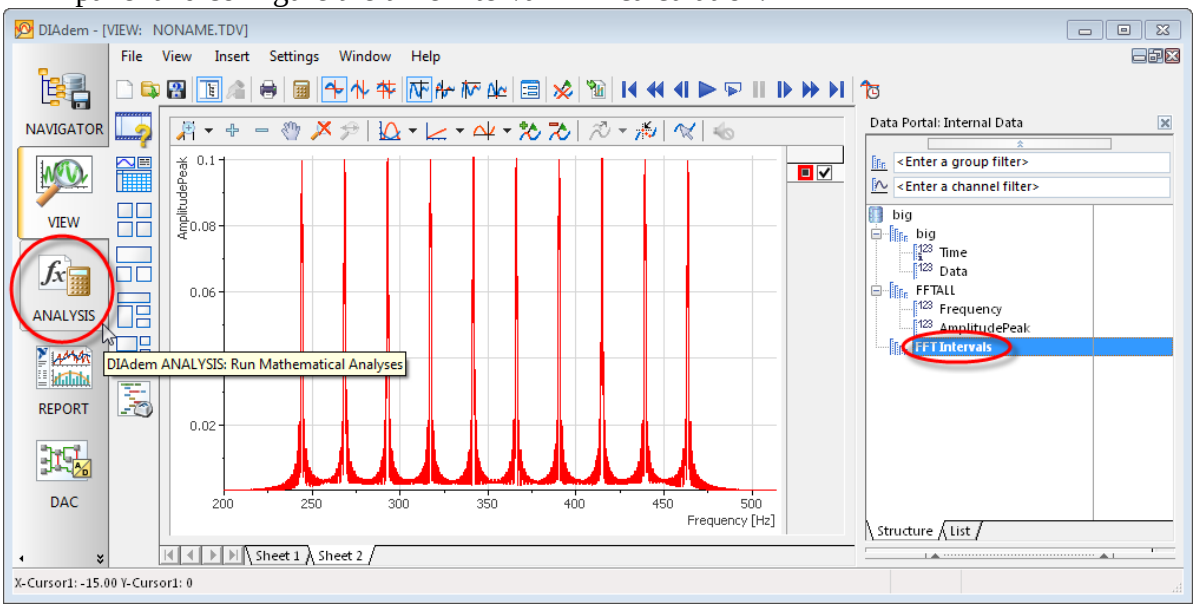
5.28 Your professor specifically asked you to determine when these various frequencies were active during this 10 second data run. Instead of calculating one FFT over the full 10 seconds of data, you should now break the signal into N time segments and calculate an FFT from each of them. This will give you a frequency breakdown at progressive snapshots of time from the beginning of the data run to the end of the data run. DIAdem calls this an interval FFT calculation, and it will generate a new FFT channel for each of the N time intervals. It will be convenient later when you graph those results to have them in their own Data Portal group. **Right-click** on the existing **"FFT ALL"** group in the Data Portal and **select** the **"New>>Group"** context menu to create a new Data Portal group.



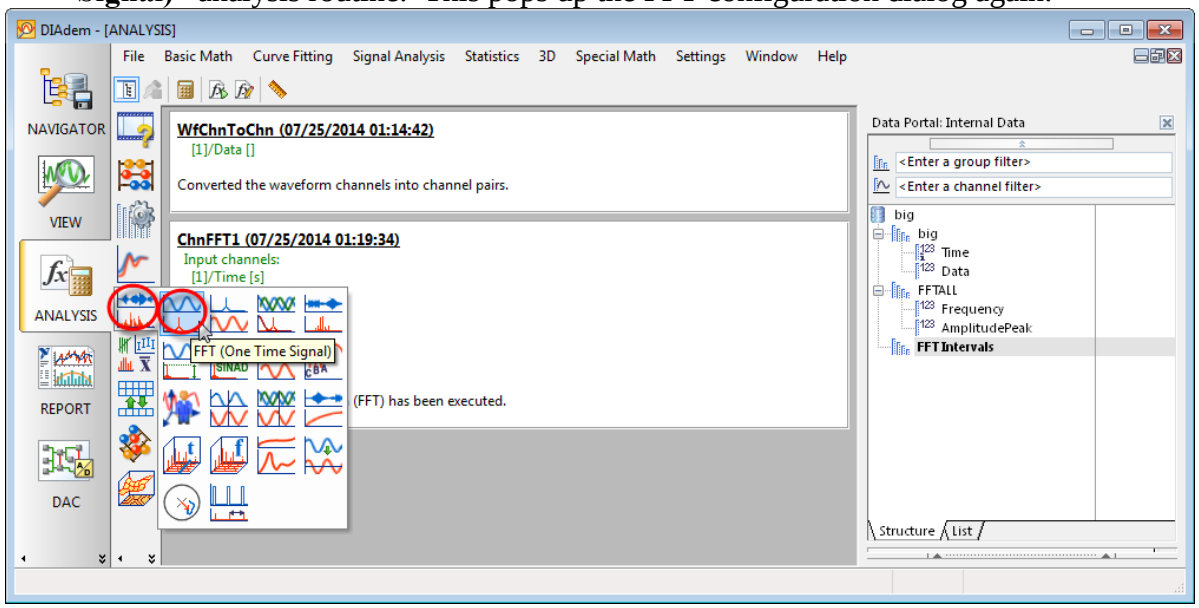
5.29 **Name** your new group **"FFT Intervals"**, verify that the **"Set default group"** checkbox is **checked**, and then **click** on the **"OK"** button to finish creating the group in the Data Portal.



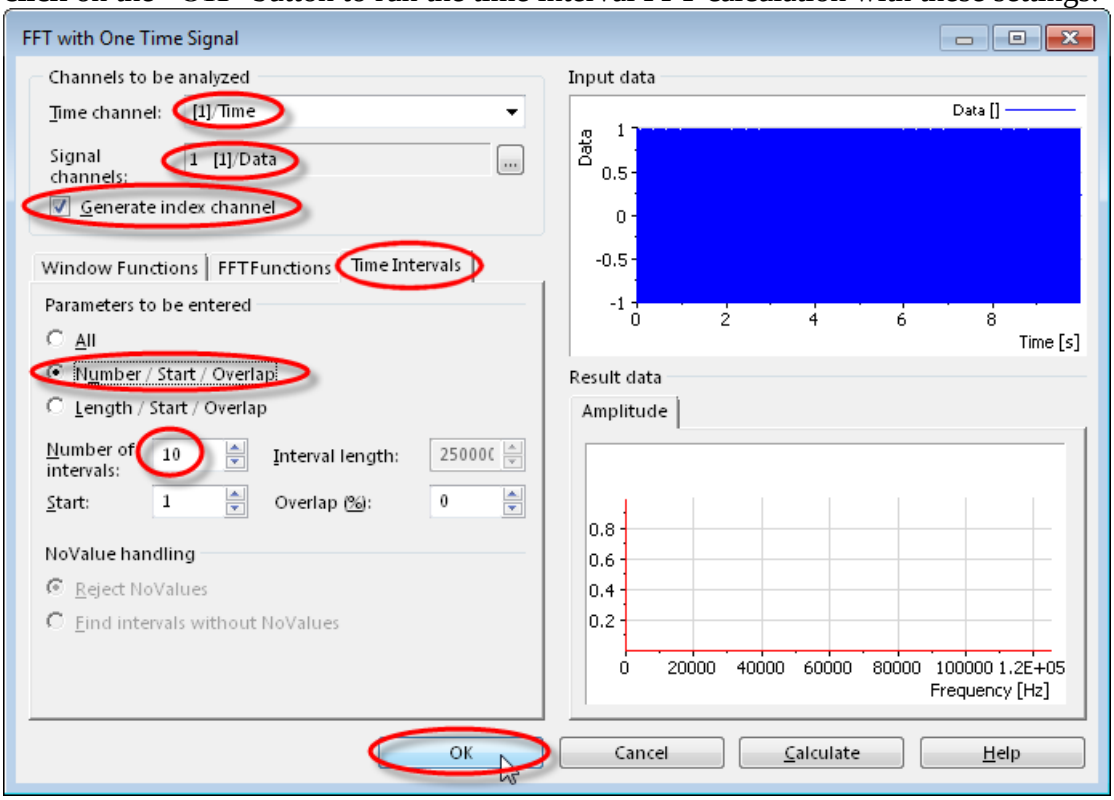
5.30 Now you are ready to run the time interval FFT calculation. **Click** on the large **"ANALYSIS"** tab at the left of your screen in order to switch to the ANALYSIS panel and configure the time interval FFT calculation.



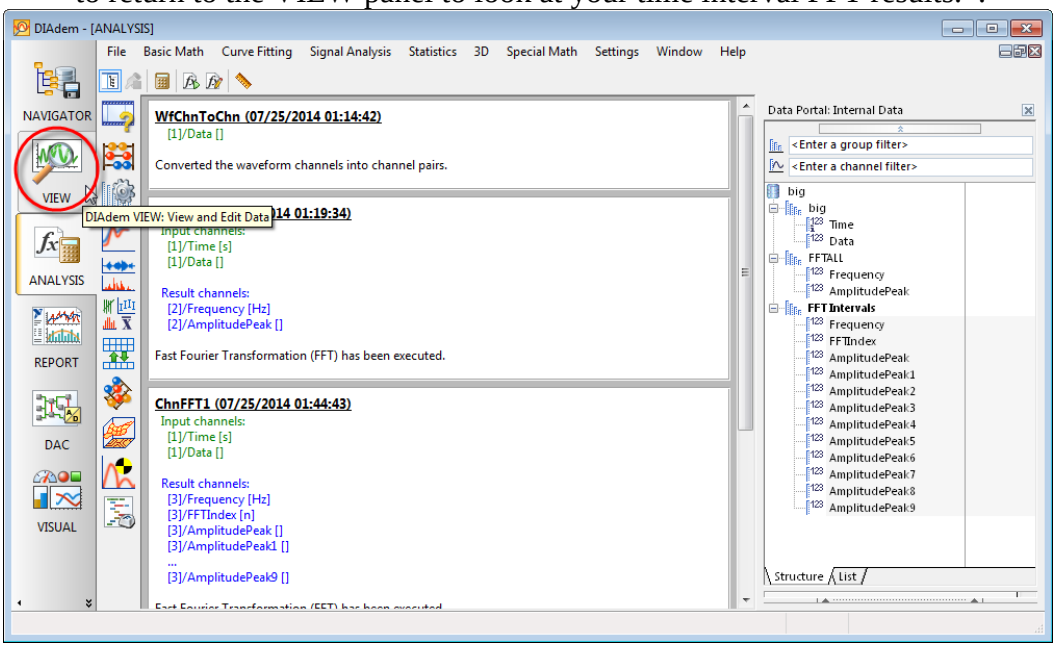
5.31 **Click** on the **"Signal Analysis"** palette, and then **click** on the **"FFT (One Time Signal)"** analysis routine. This pops up the FFT configuration dialog again.



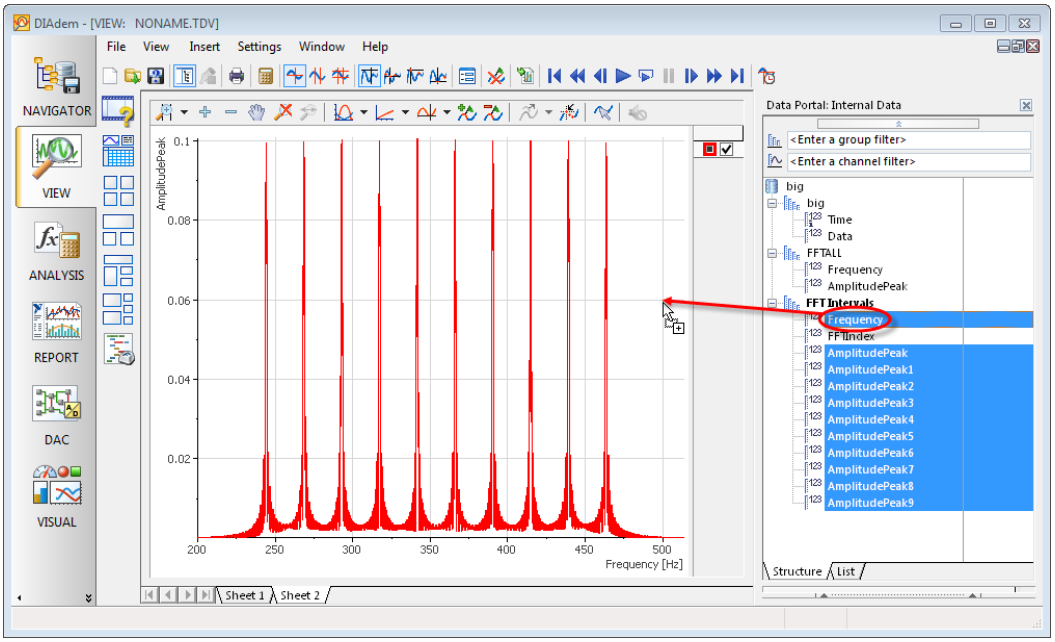
5.32 Verify again that the **"Time"** and **"Data"** channels are **selected** in the "Time channel:" and "Signal channels:" fields. This time you will need to set a few parameters differently in order to calculate N separate FFTs, each over a time segment of the data set. **Click** on the last tab called **"Time Intervals"** to make these changes. **Select** the **"Number / Start / Overlap"** radio button, and then **set** the **"Number of intervals" to 10**. This will result in 10 FFTs calculated over the 10 second long data set, one for the interval 0s – 1s, another for the interval 1s – 2s, up to the last interval 9s – 10s. Finally, **check** the **"Generate index channel**" checkbox (important!) and **click** on the **"OK"** button to run the time interval FFT calculation with these settings.



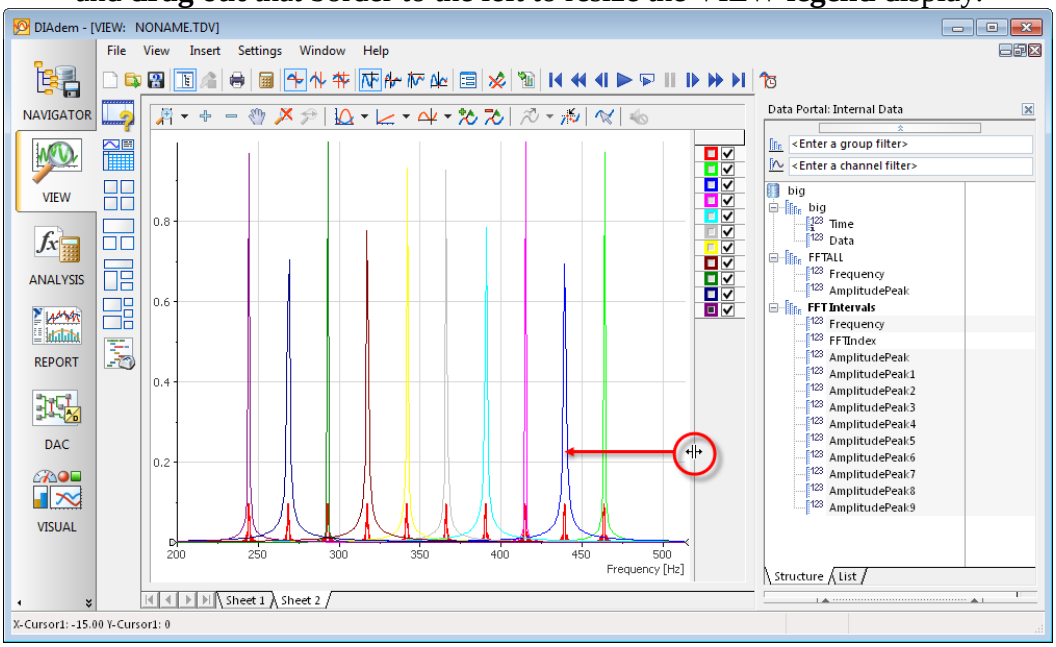
5.33 As expected, your new Data Portal group now contains 10 new FFT channels, one for each second of acquired data from 0s to 9s. If for some reason you do not see a "Frequency" channel, an "FFTIndex" channel, and 10 channels named "AmplitudePeak" through "AmplitudePeak9", select all the channels in the FFT Intervals group, right-click one of them and select the "Delete" context menu, then repeat Steps 5.28 through this one. **Click** on the **"VIEW"** tab at the left of your screen to return to the VIEW panel to look at your time interval FFT results. .



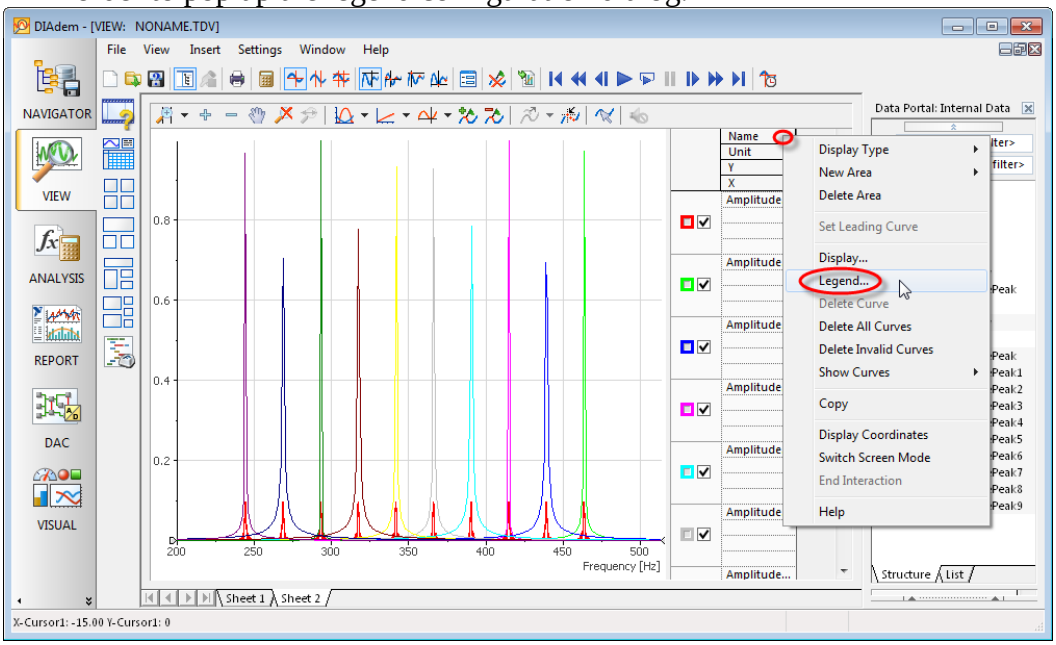
5.34 **Select** the **"Frequency"** channel and all the **"Amplitude#" channels** in the Data Portal, **while holding** down the **"Ctrl" key** on your keyboard, then **drag** this channel selection **onto** the existing FFT **graph** to see the FFT interval results overlaid on top of the FFT of the whole data set.



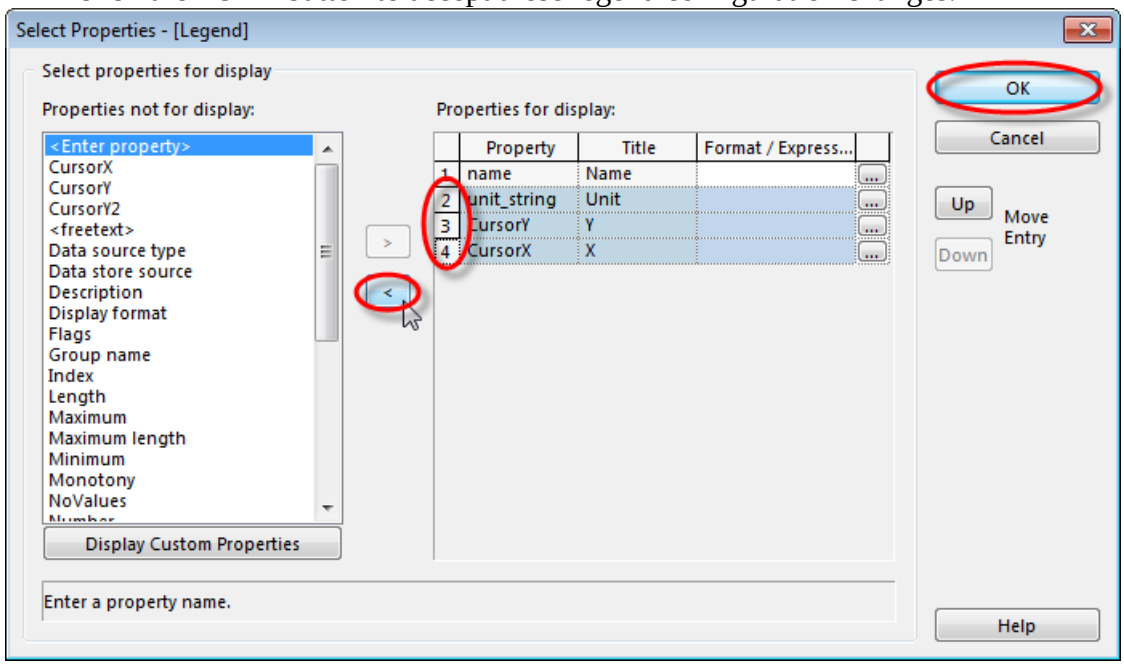
5.35 You can clearly see that there is a one-to-one correlation between each interval FFT and one of the FFT peaks over the whole data set, the question is which frequency peaks occurred at which times. To clarify the issue, place your mouse over the right hand border of the graph until the mouse icon changes to 2 vertical lines, then click and **drag out** that border to the left to resize the VIEW **legend** display.



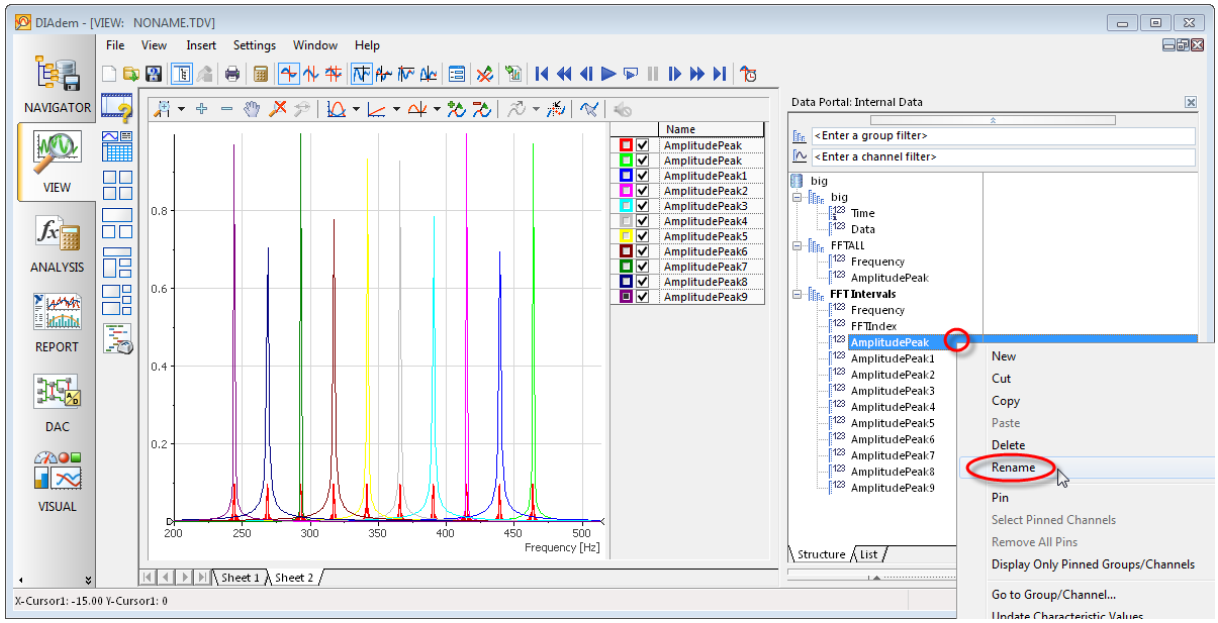
5.36 By default the VIEW legend shows 4 channel properties, one of which is the channel name. The other properties are actually obscuring the important suffix of each channel name. Fortunately, you can customize which properties display in the legend. **Right-click** on the "Name" field in the **legend** and select the **"Legend…"** context menu in order to pop up the legend configuration dialog.



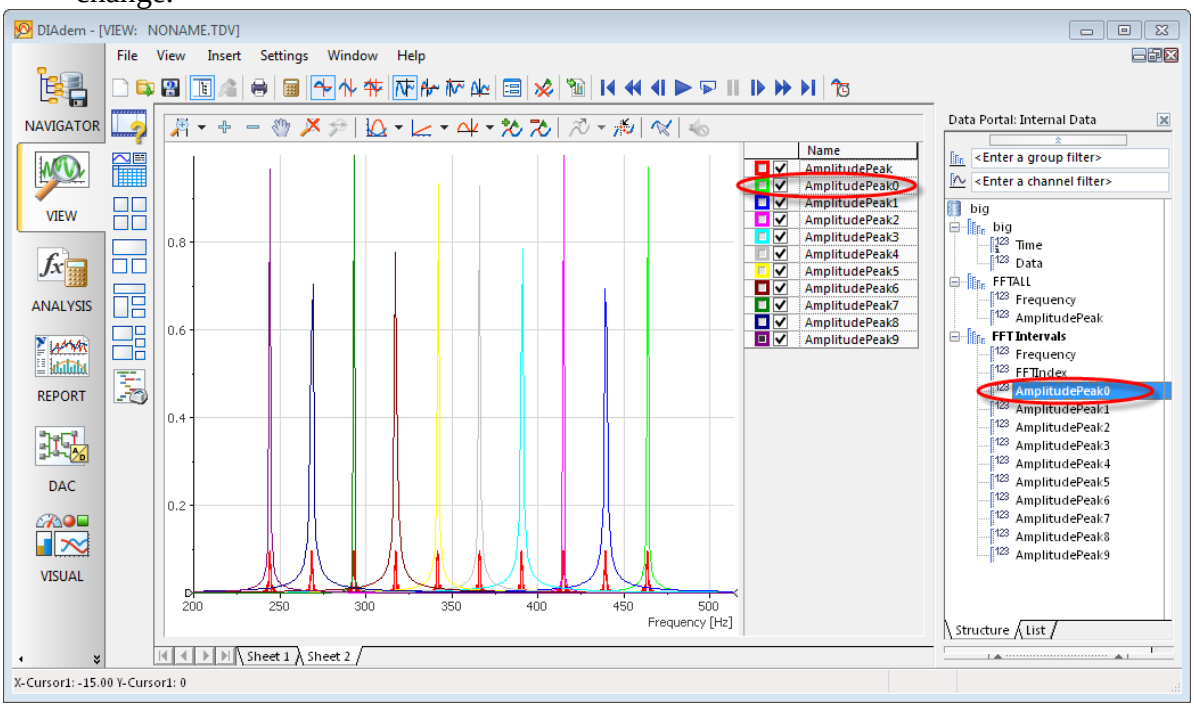
5.37 **Select** all **3** property **rows** below the "name" property in the middle of this dialog, then **click** on the **"<"** button to remove these 3 properties from the legend display. Finally **click** the **"OK"** button to accept these legend configuration changes.



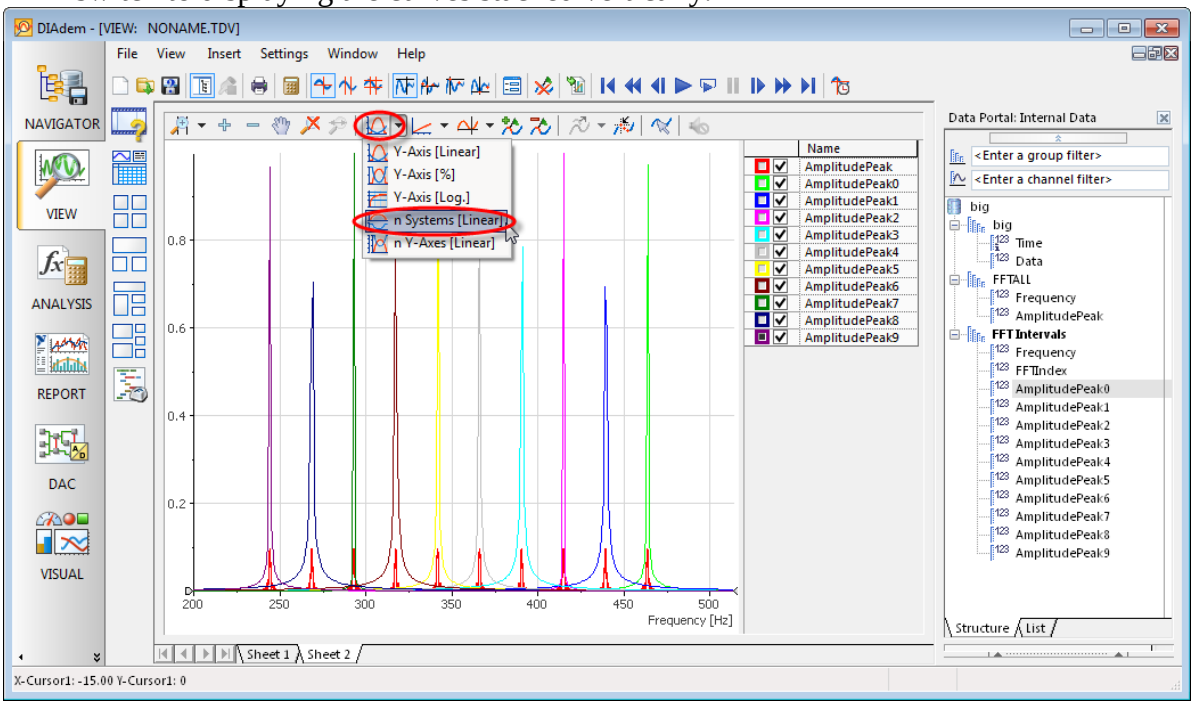
5.38 Now the only remaining confusion is that the original (red) FFT curve is named the same thing ("Amplitude") as the first (green) interval FFT curve. You can freely rename channels in the Data Portal, though. For clarity, you decide to rename that first FFT interval channel to "AmplitudePeak0". **Right-click** on the first interval FFT channel **"AmplitudePeak"** in the Data Portal at the right of your screen, then **select** the **"Rename"** context menu.



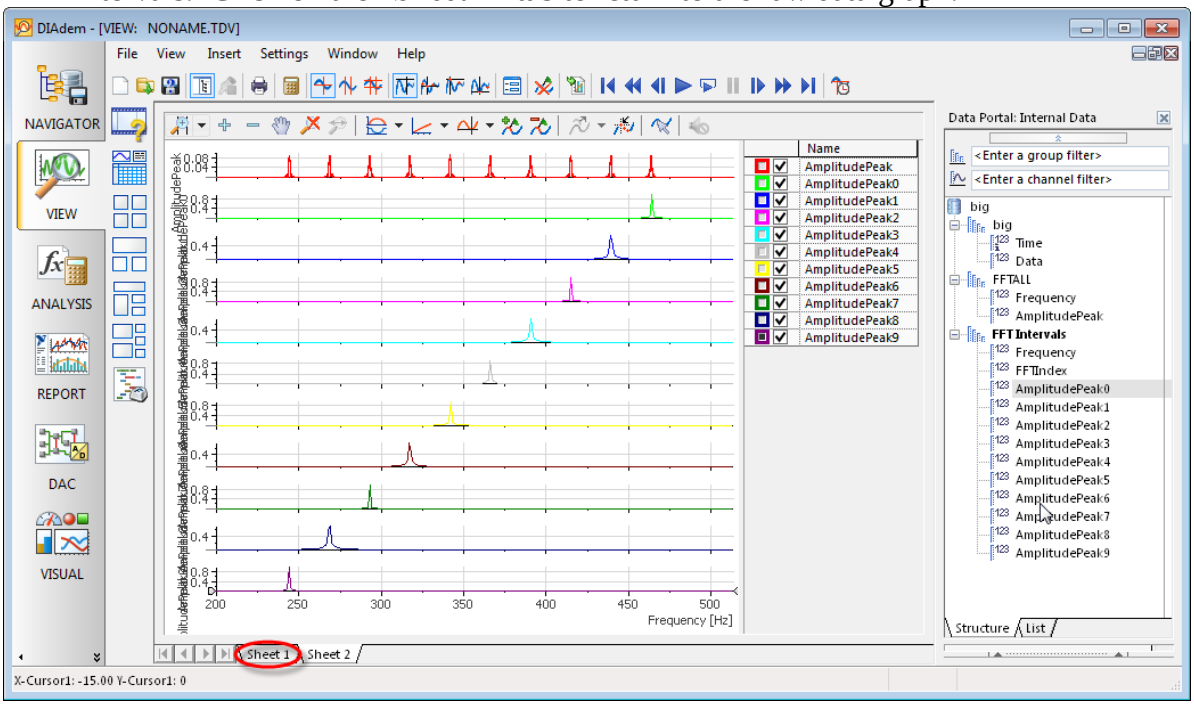
5.39 Now the "AmplitudePeak" channel in the "FFT Intervals" group appears highlighted and is ready to be renamed. Hit the "End" button or the right arrow key to move the cursor to the end of the current channel name, and type "0" to **rename** the channel **"AmplitudePeak0"**. **Hit** the **<Enter>** key on your keyboard to accept this name change.



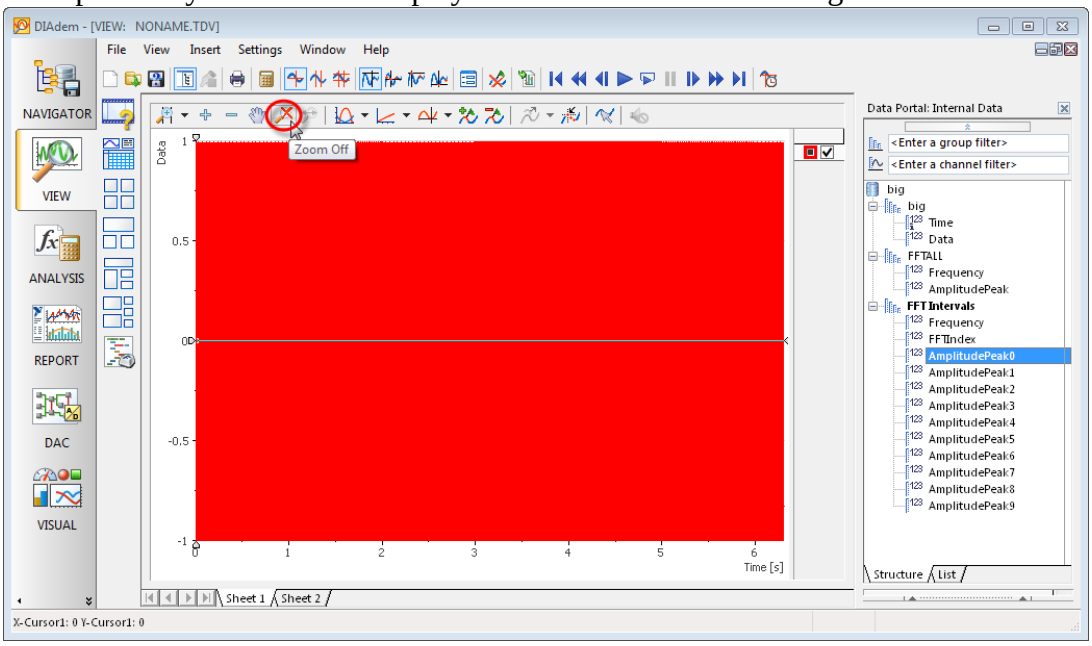
5.40 Notice that the VIEW legend updates the green curve name to be "AmplitudePeak0". What you really want to see is the progression of these interval FFTs over time. You can easily achieve a preliminary look at this in VIEW by switching the Y axis display to show the curves stacked on top of each other. **Click** on the **"Y-Axis [Linear]"** icon at the top middle of your screen, and then select the option **"n Systems [Linear]"** to switch to displaying the curves stacked vertically.



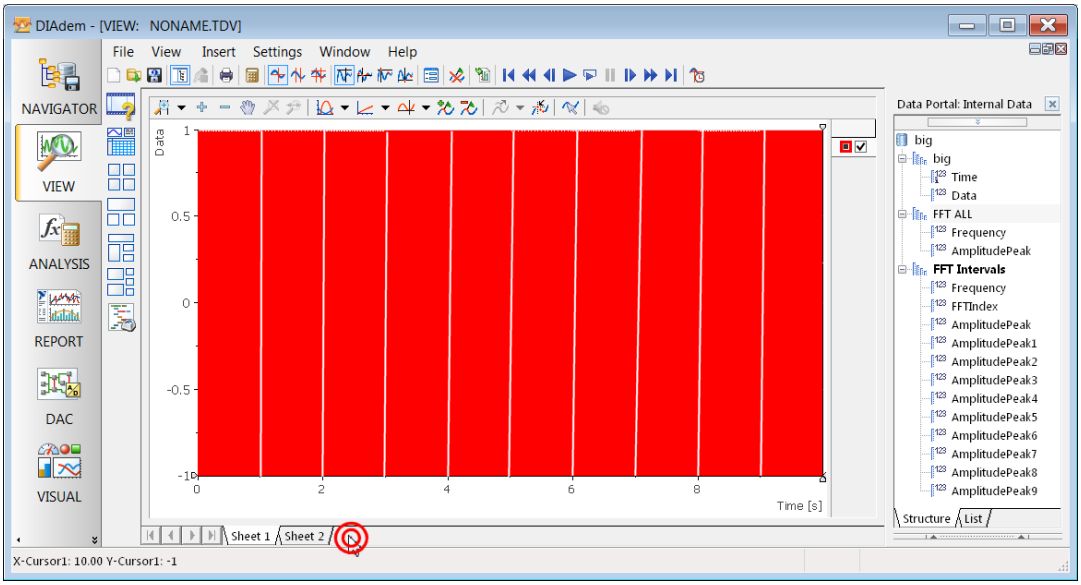
5.41 Here you see the first indication of when each of the red FFT peaks occurred during the course of the 10 second data acquisition. The highest frequency green "AmplitudePeak0" FFT peak, stacked near the top of the graph, occurred during the initial second of the data set, while the lowest frequency purple "AmplitudePeak9" FFT peak, stacked at the bottom of the graph, occurred in the last second of the data set. In fact, it looks like this simulated test pattern created by the LabVIEW program shifted to a slightly lower frequency after each second of the data set. Because the FFT intervals are displayed top to bottom in this graph, there is an implicit time axis starting at 0s at the top of the graph and proceeding down to 10s at the bottom of the graph. You will need to explicitly assign a time value for each of these FFT interval curves in order to create the waterfall and intensity Joint-Time-Frequency-Analysis (JTFA) plots that your advisor requested. You decide to take another look at the raw time series data to make sure you do the time value assignment correctly for the FFT intervals. **Click** on the **"Sheet 1"** tab to return to the raw data graph.



5.42 You want to see the whole time range at once, so **click** on the **"Zoom Off"** icon near the top left of your screen to display the data set with no zooming.

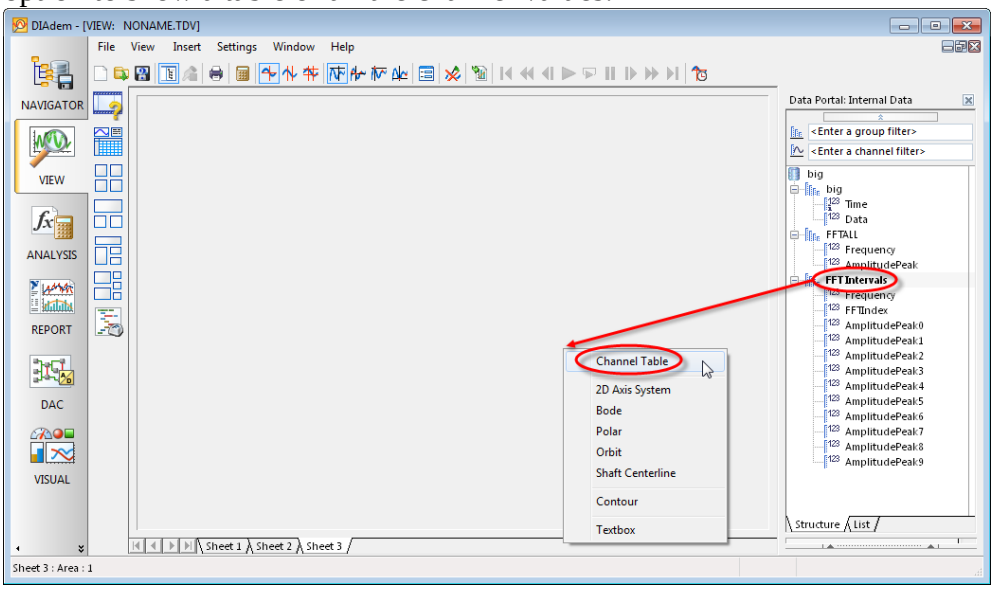


5.43 Here you see again that the raw data was acquired between time values 0s and 10s. The first interval FFT was calculated on data points between time 0s and 1s, while the last interval FFT was calculated on data points between 9s and 10s. Each resulting interval FFT curve represents the frequency content of the whole time segment, so the average time value for the initial FFT interval is 0.5s, while the average time value for the last FFT interval is 9.5s. You need to match up the FFTIndex channel values with these time intervals— the easiest way to do that will be in a VIEW table in a new sheet. **Double-click** to the right of the **"Sheet 2"** tab at the bottom of the screen to create a new sheet.

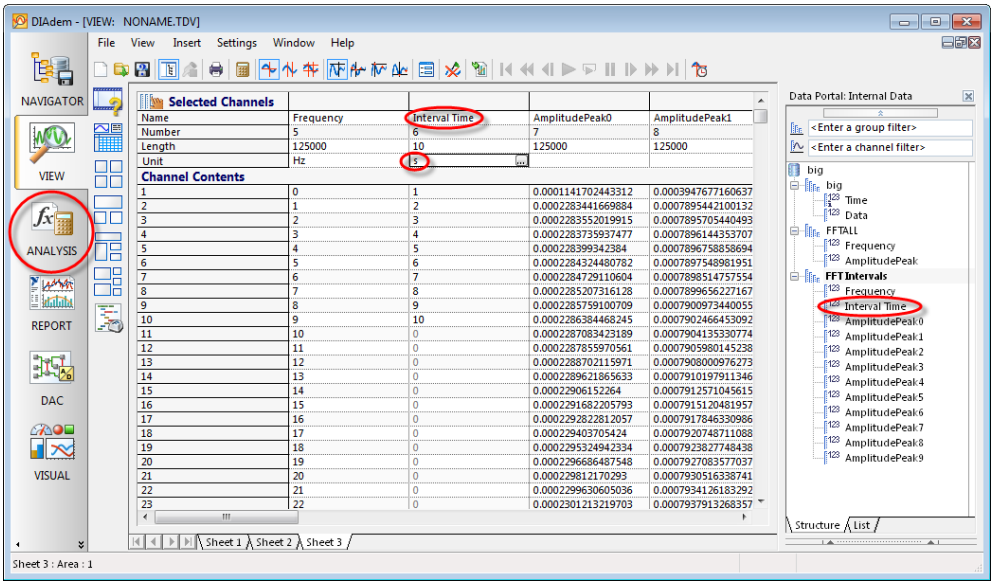


NOTE: The vertical white lines you see above will NOT appear on your screen— they have been artificially painted on in order to show the data points used for each of the 10 FFT intervals you calculated.

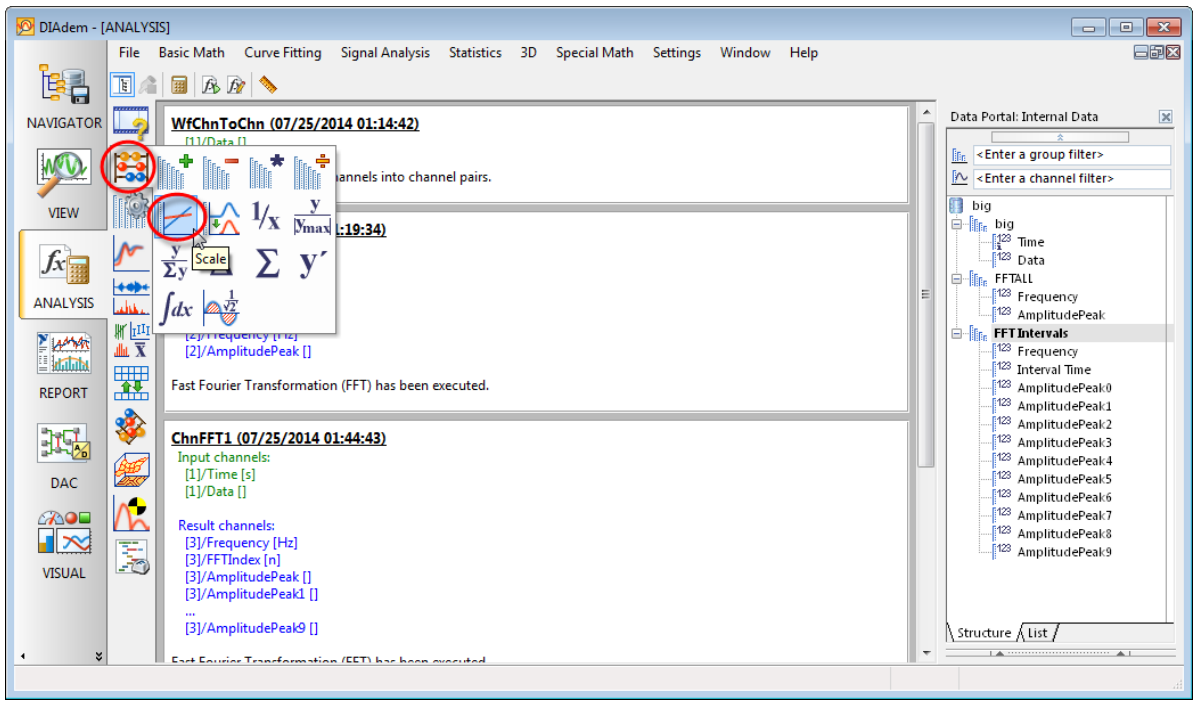
5.44 **Drag** the **"FFT Intervals" group** from the Data Portal on the right **into** the new "Sheet 3" you just created in **VIEW**. This time **select** the **"Channel Table"** display option to show a table of all the channel values.



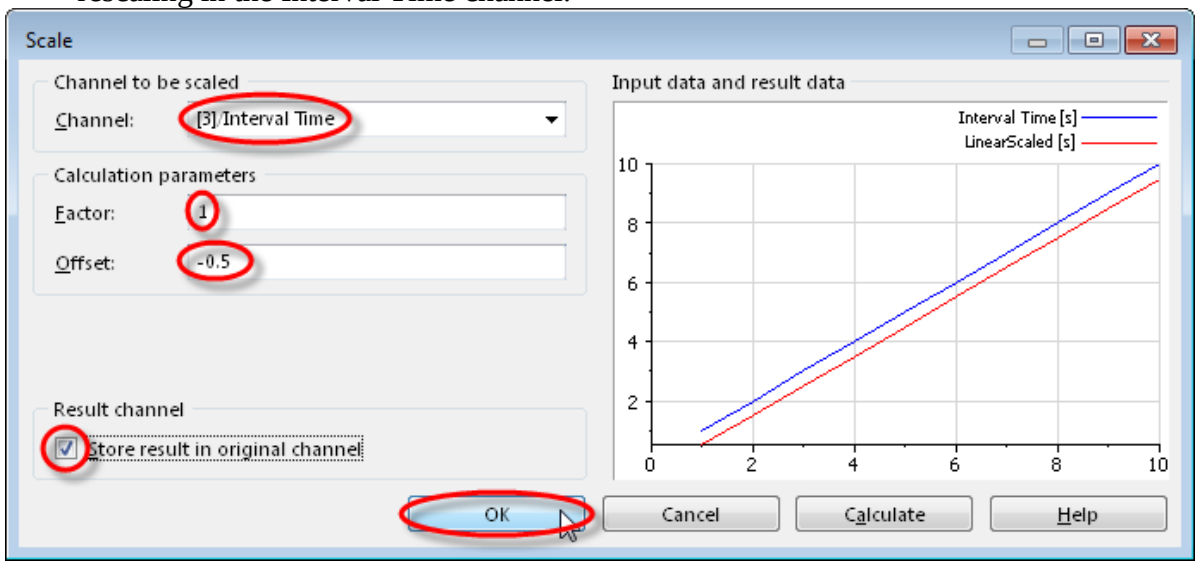
5.45 The second channel, "FFTIndex", was created by the interval FFT calculation— it has 10 values, one for each of the 10 time intervals you selected in the FFT dialog. But what you want this channel to be are the average interval time values. **Click** on the **"Name"** field in that second channel's table header and **type** in the new channel name **"Interval Time"**. Now **click** on the **"Unit"** field in that second channel's table header and **type** in **"s"**. Note that the name of the "FFTIndex" channel in the Data Portal changes automatically to the new "Interval Time" name you just gave it. As you saw a few steps ago, the time values in the "Interval Times" channel should run from 0.5 to 9.5. **Click** on the **"ANALYSIS"** tab at the left to switch to the ANALYSIS panel in order to subtract 0.5 from each of these channel values.



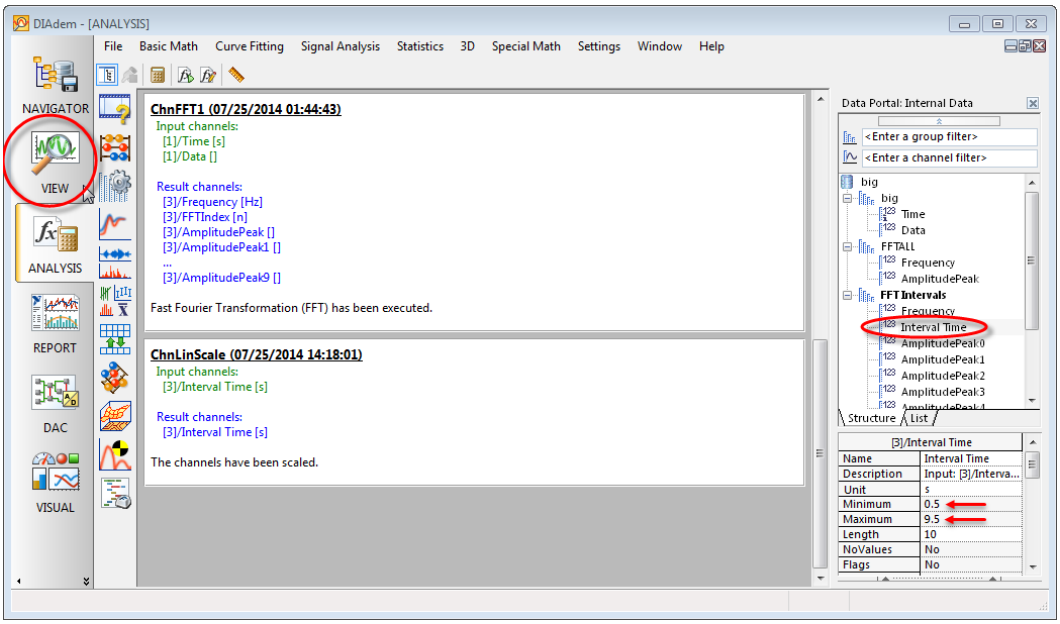
5.46 **Click** on the **"Basic Mathematics"** palette and then select the **"Scale"** function to rescale the index channel to correspond to the time interval values by subtracting 0.5 from each channel value.



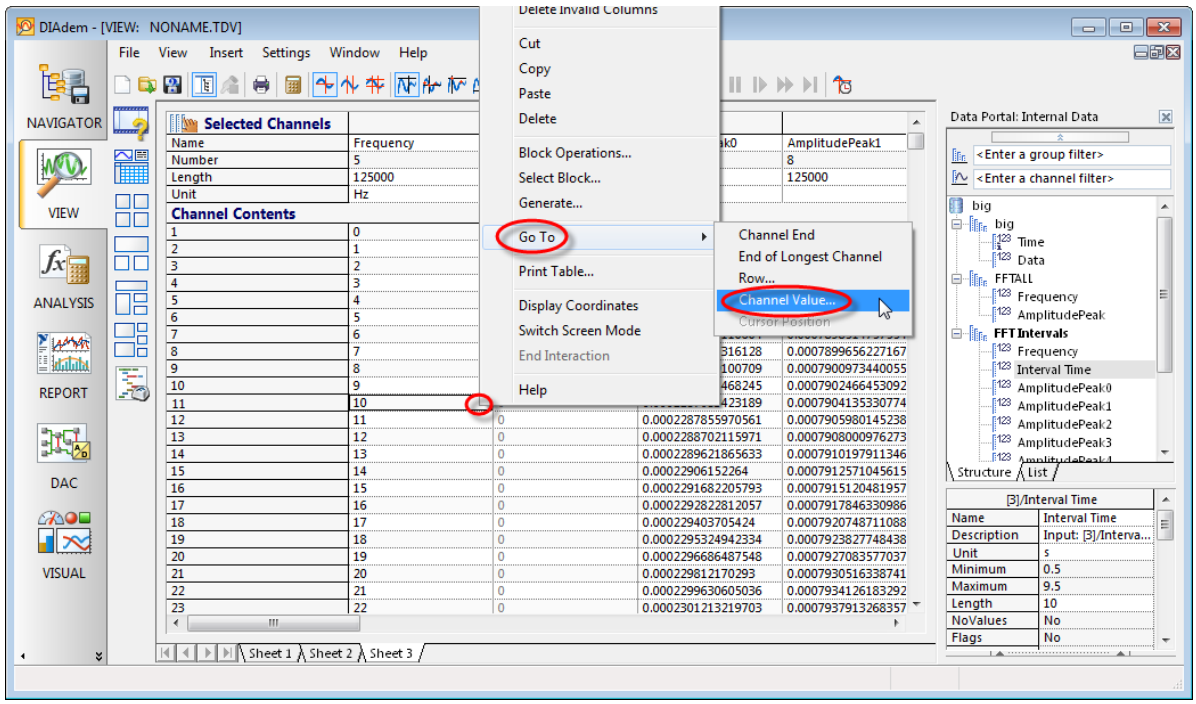
5.47 **Select** the "**Interval Time"** channel you just renamed in the "Channel:" field, then enter **"-0.5"** for the "Offset:" field, verify that the "Factor:" field is set to 1, then **check** the **"Store result in original channels"** checkbox (important!). The channel preview at the right of the dialog should show the red output shifted down from the blue starting values by the -0.5 offset you selected. **Click** on **"OK"** to execute this rescaling in the Interval Time channel.



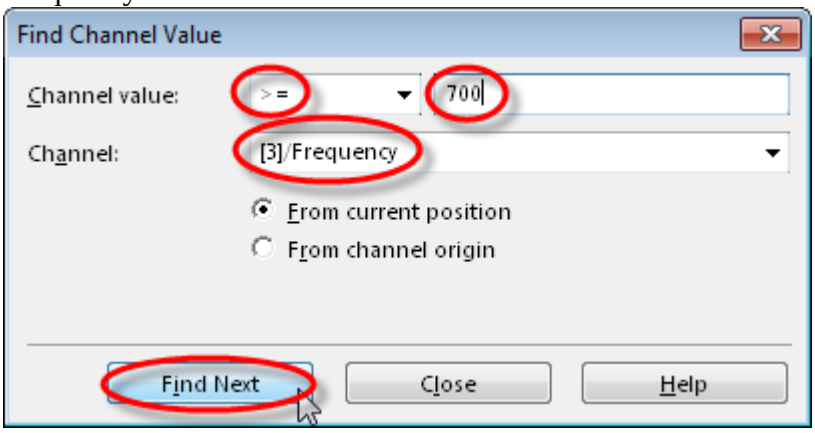
5.48 Make sure you have no new "LinearScaled" channel at the bottom of the "FFT Intervals" group. Also verify that the "Minimum" and "Maximum" properties of the "Interval Time" channel, as shown in the Data Portal property table at the bottom right of your screen, show the correctly scaled values 0.5 and 9.5. **Click** on the **"VIEW"** tab at the left to switch back to VIEW and look at the new data values.



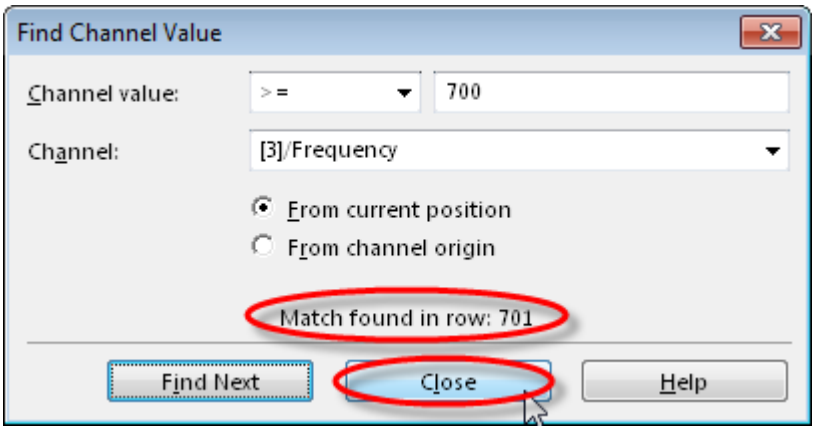
5.49 Now you can see that the Interval Time values run from 0.5 to 9.5, as desired. It looks like the Frequency channel also marches up by exactly 1 Hz per row, which would mean it ranges all the way up to 125 kHz, given the 125000 length in its table header. That's way, WAY too much frequency range. You know from the FFT over the whole time series data that the maximum frequency content was under 500Hz. The JTFA graphs will display faster if you trim the size of the Frequency channel down to, say, 0Hz to 700Hz. **Right-click** on one of the **Frequency** channel values, then **select "Go To>>Channel Value…"** from the context menu.



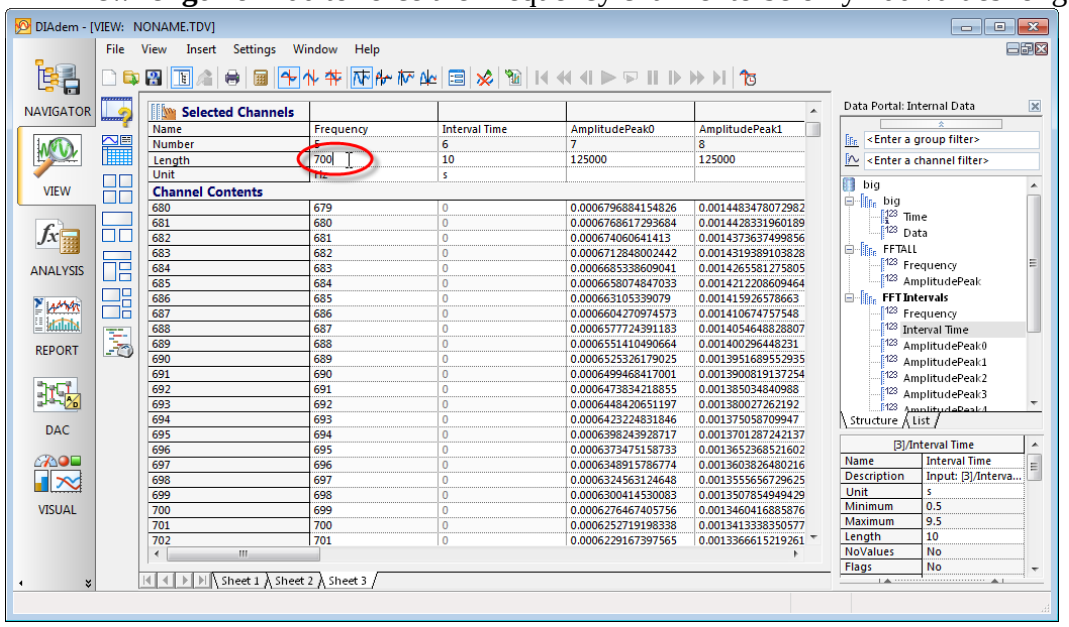
5.50 Ensure that the channel is "Frequency" and the operator is >= in the dialog, then **enter** 700 for the search value threshold and **click** on the **"Find Next"** button to find the first Frequency value >= 700Hz.



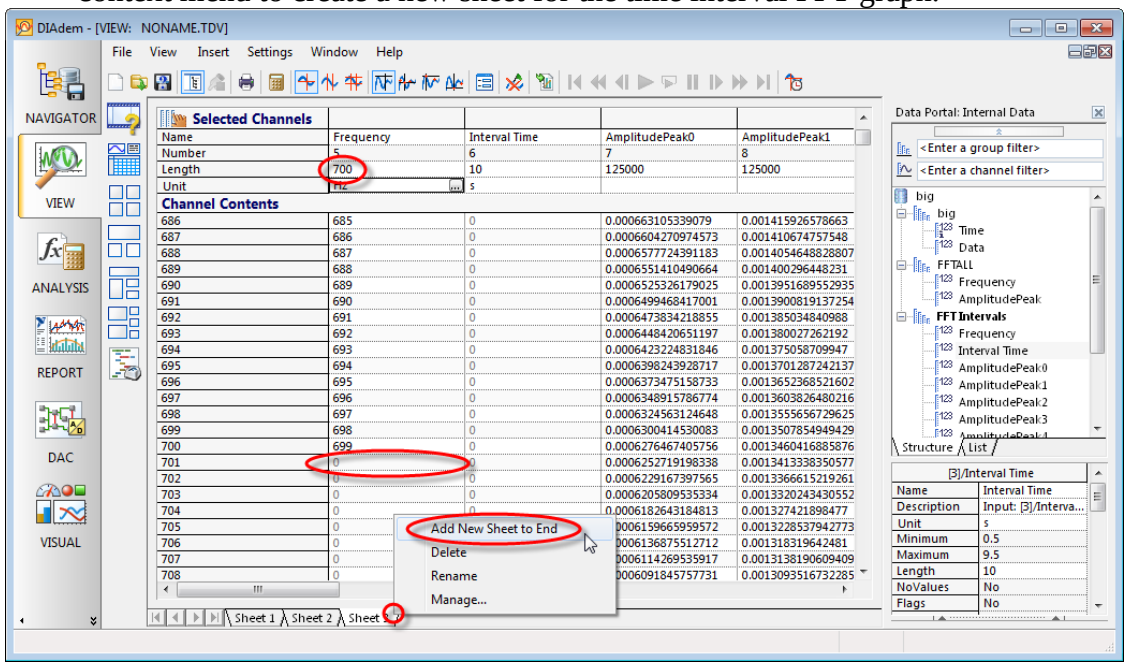
5.51 You have now located that the Frequency channel crosses the 700 Hz threshold at channel row = 701. **Click** on the **"Close"** button to exit the dialog.



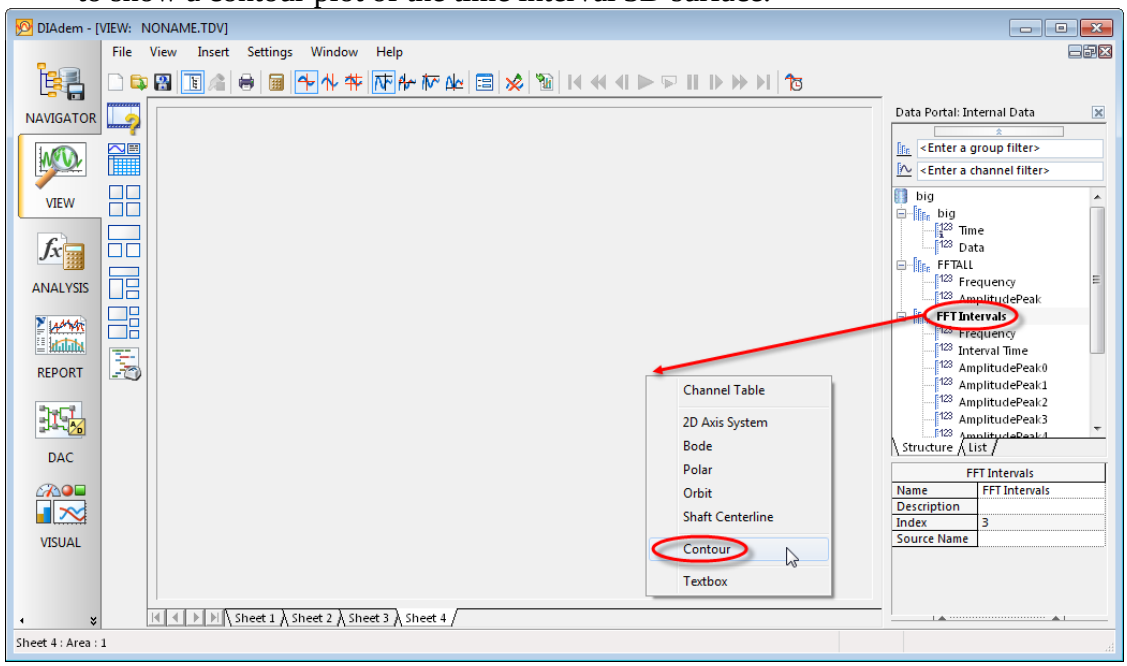
5.52 **Double-click** on the **"Length"** value of the **Frequency column header** and **enter** in a **new length** of **700** to force the Frequency channel to be only 700 values long.



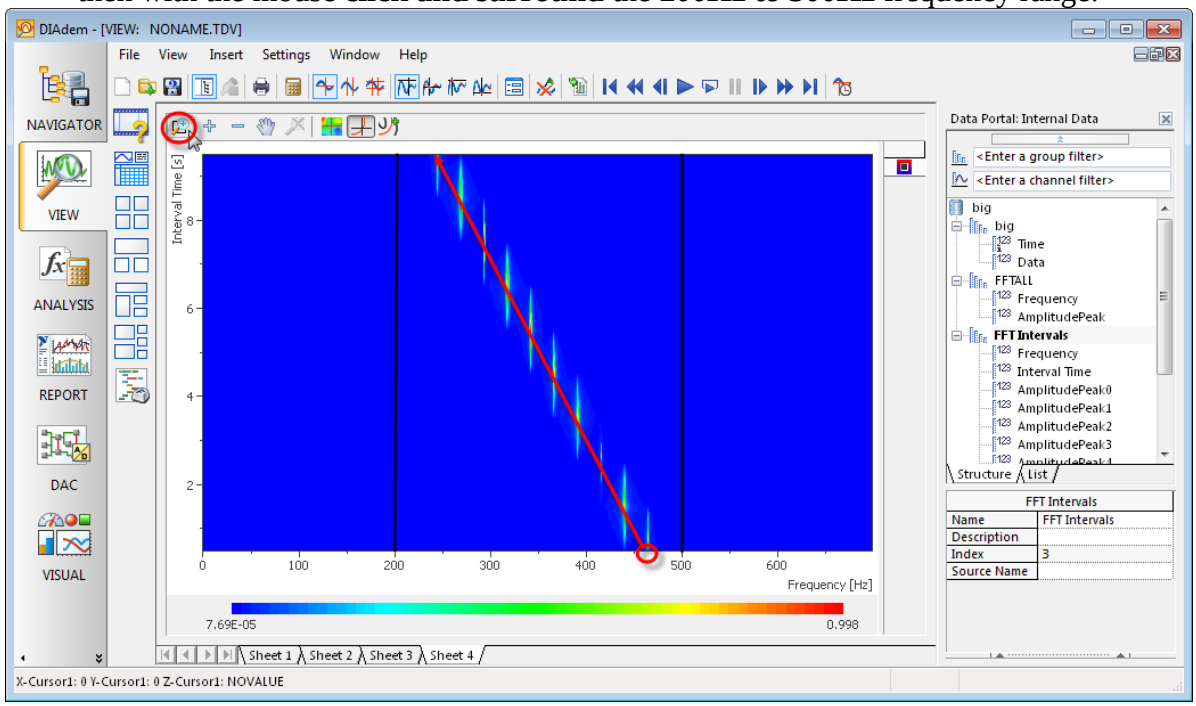
5.53 The Frequency channel should now end at 699Hz, which is the 700th value. This will force any graphs of the time interval FFT results to range only between 0Hz and 700Hz. You are now ready to plot the first JTFA graph. **Right-click** on the current **"Sheet 3"** tab at the bottom of the screen and **select** the **"Add New Sheet to End"** context menu to create a new sheet for the time interval FFT graph.



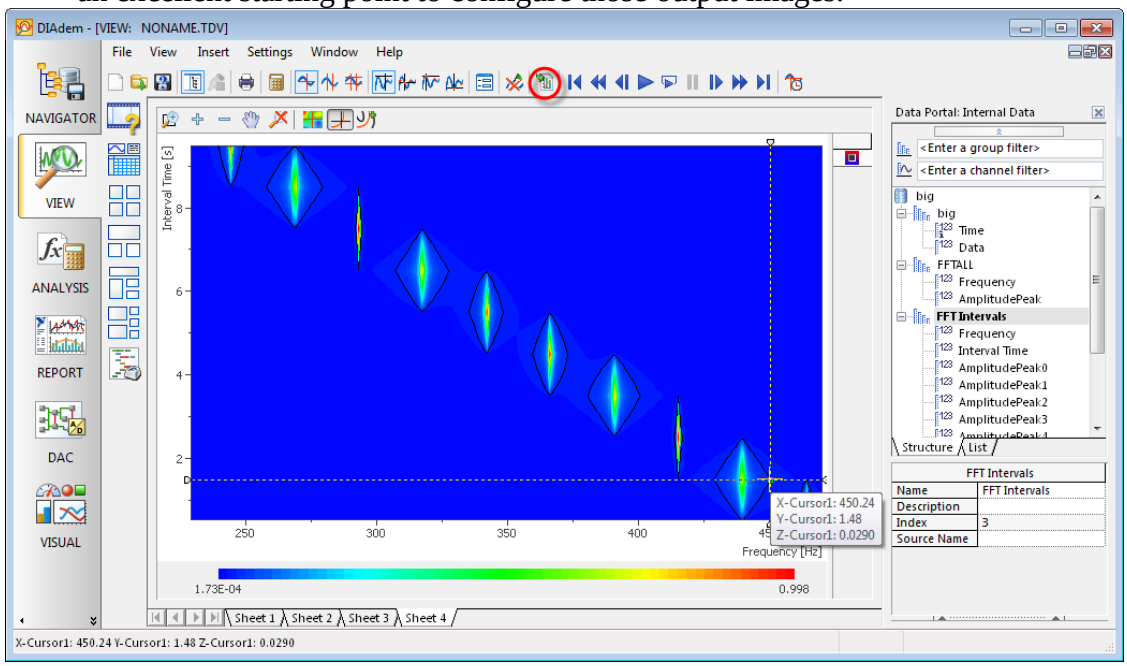
5.54 **Drag** the **"FFT Intervals" group** from the Data Portal on the right **into** the new "Sheet 4" you just created in **VIEW**. This time **select** the **"Contour"** display option to show a contour plot of the time interval 3D surface.



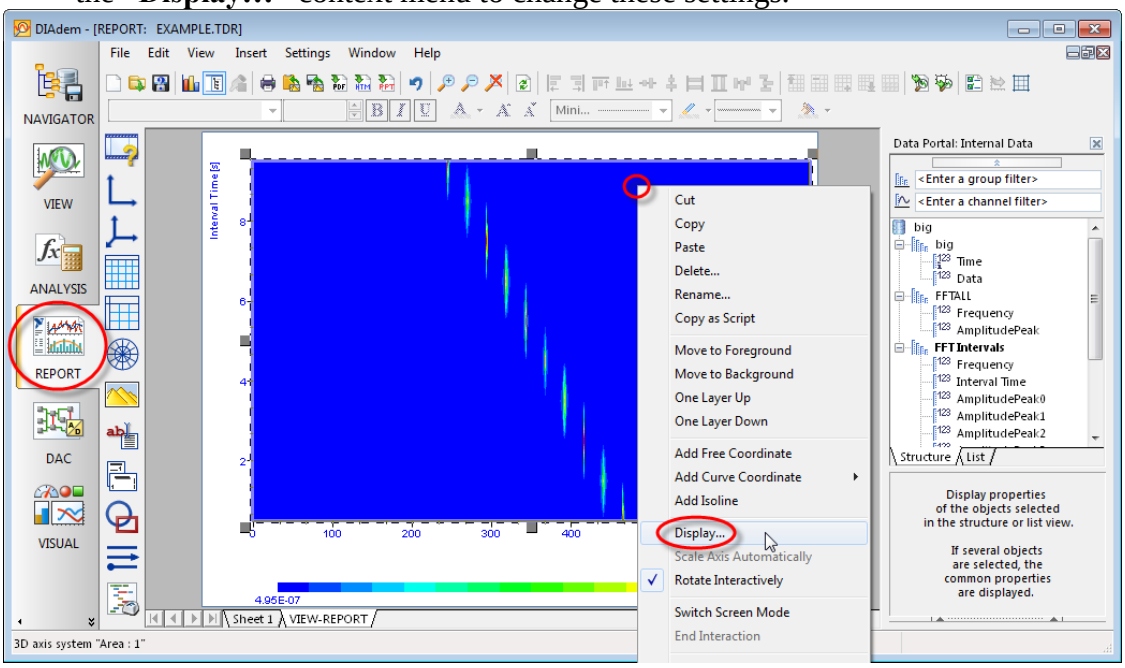
5.55 As before in the stacked 2D plot, you see that the frequency content moves steadily lower with time, starting just under 500Hz at time = 0s and ending just over 200Hz at time = 10s. Note that the Time axis increases upward now. The nice thing about this contour plot in VIEW is that you can easily zoom into a region of interest just by surrounding it with the mouse. **Click** on the **"Frame Zoom"** icon at the top left and then with the mouse **click and surround** the **200Hz to 500Hz** frequency range.



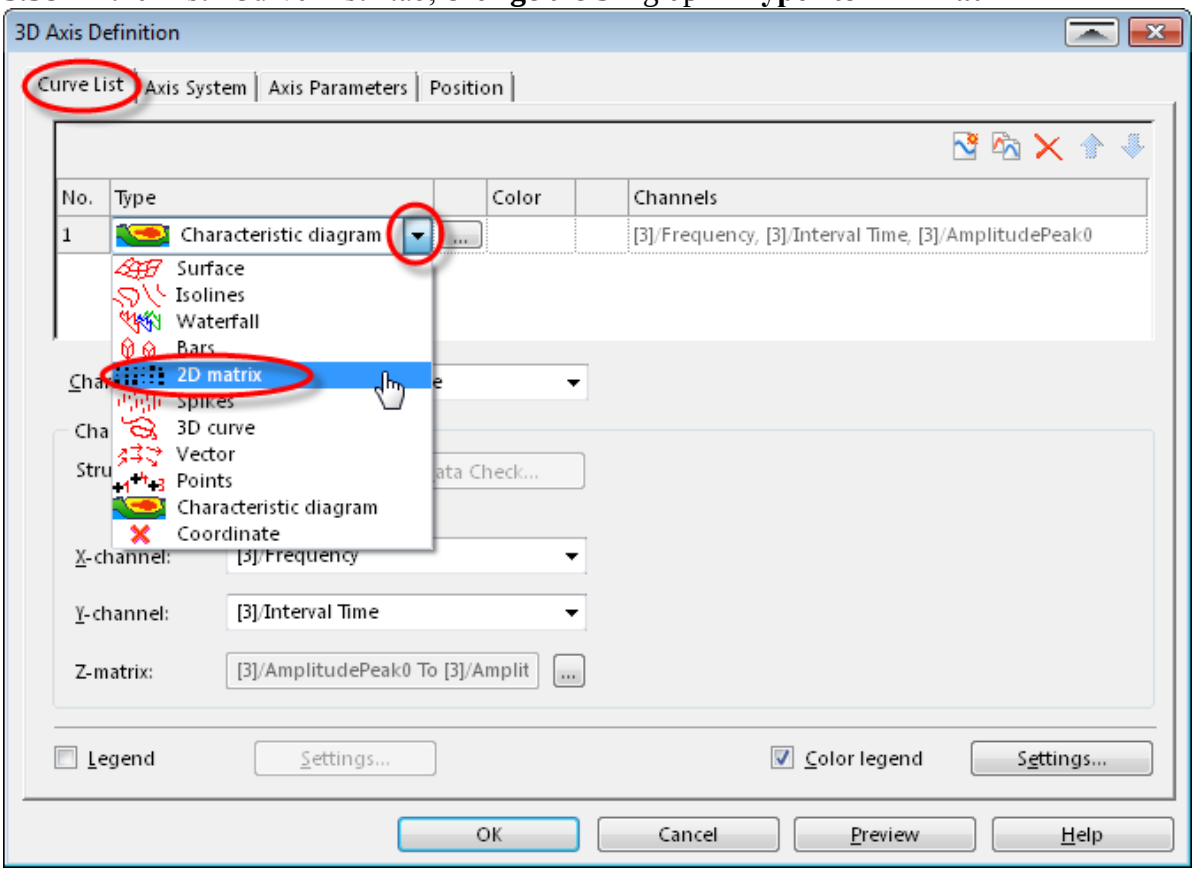
5.56 Another nice interactive feature of the contour plot in VIEW is that you can move the crosshair cursor around with the left mouse button and get exact XYZ coordinate values and dynamic isolines corresponding to any point of interest. You need to configure the exact display of this graph and export it to WMF image files for your advisor, though, and this is only available in REPORT. **Click** on the "**Transfer to REPORT**" icon at the top of your screen to move this graph to REPORT to serve as an excellent starting point to configure those output images.



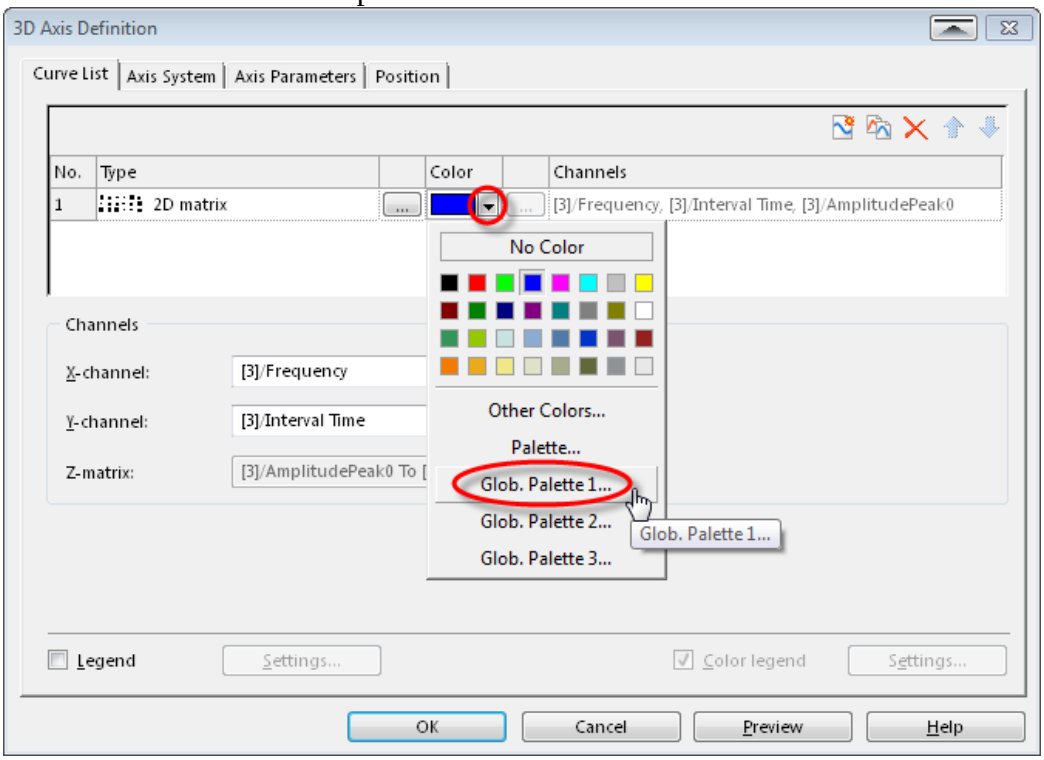
5.57 The contour plot transferred from VIEW unzoomed, so you need to zoom in again—this time you'll use explicit start and stop values for each axis to achieve a precise zoom window. You also have a better 3D display option in REPORT than in VIEW that will avoid unnecessary 3D interpolation. **Right-click** on the 3D surface and **select** the **"Display…"** context menu to change these settings.



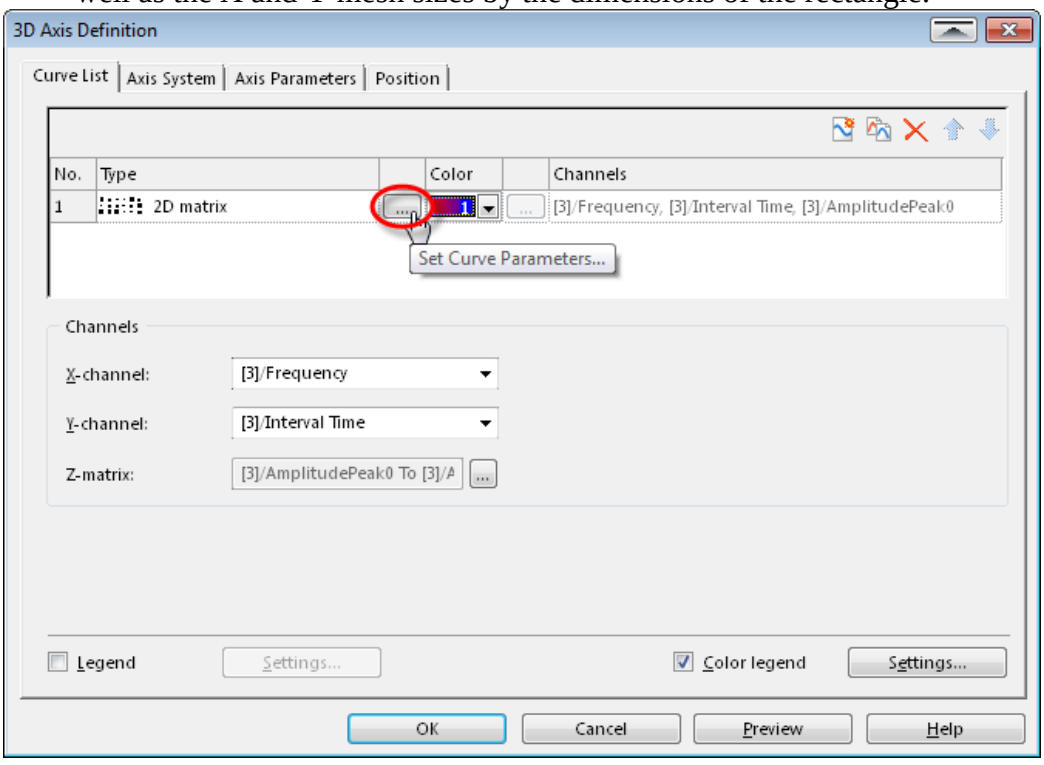
5.58 In the first "Curve List" tab, **change** the 3D graph **"Type"** to **"2D matrix"**



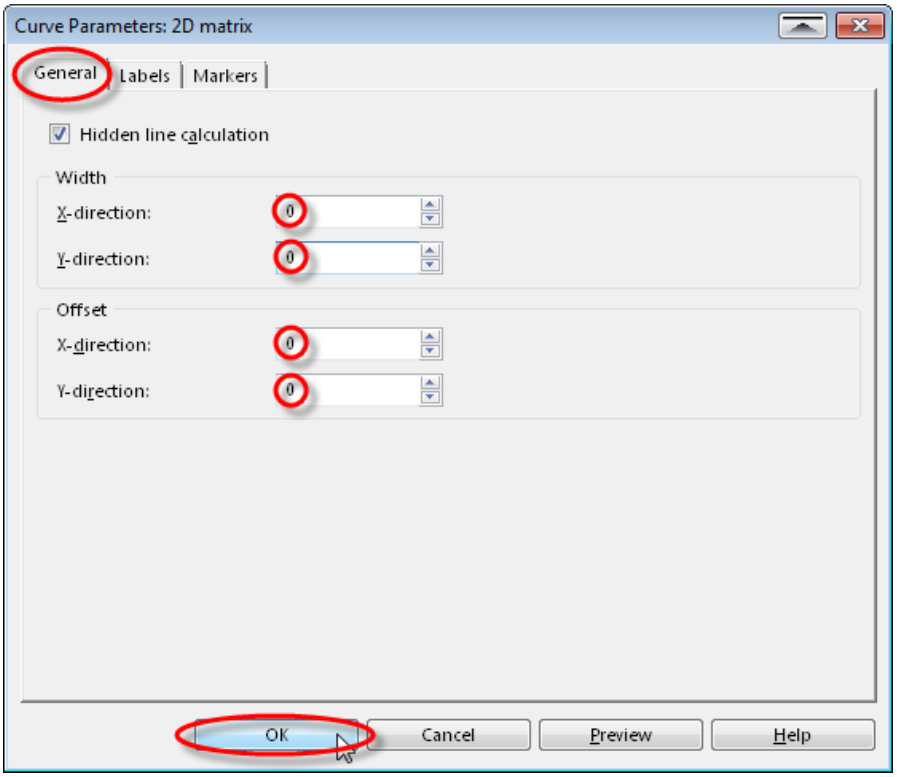
5.59 The new "2D matrix" display type defaults to the color blue. **Change** the **color to** the **"Glob. Palette 1..."** option so that the color will scale with the Z axis value.



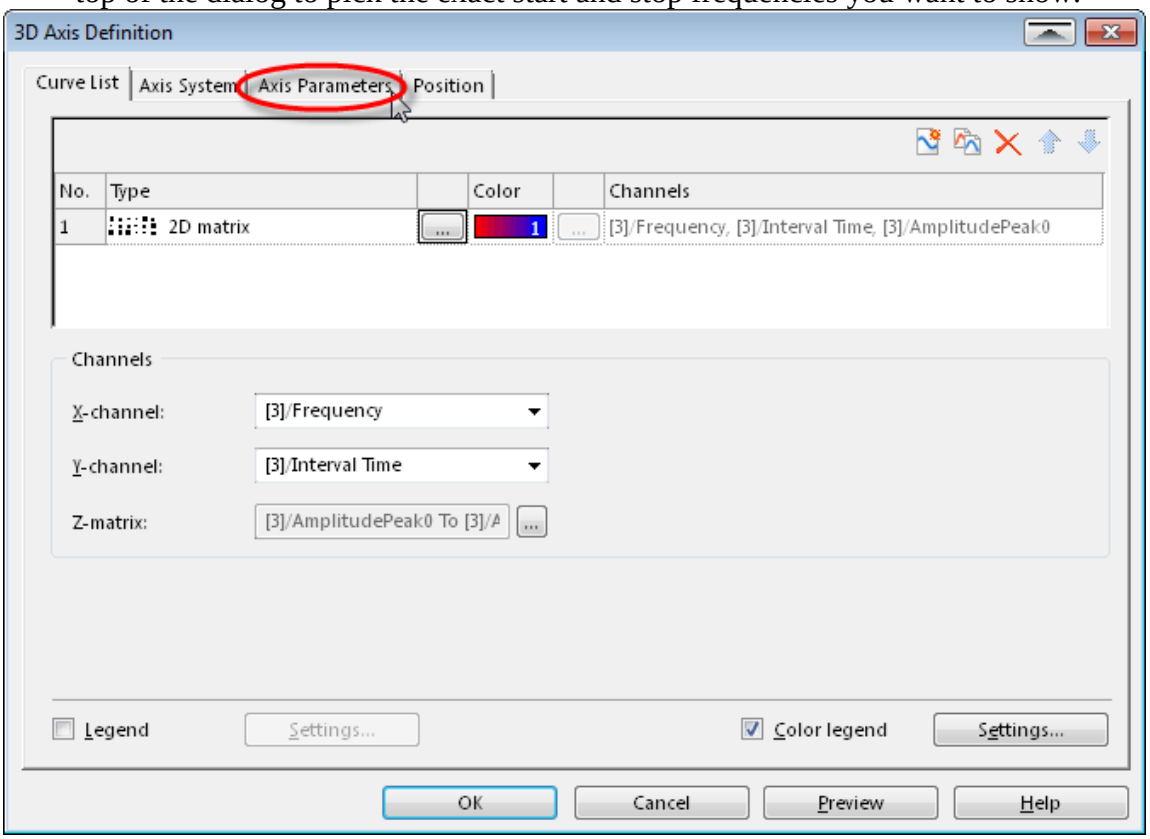
5.60 One more tweak of this new "2D matrix" display mode is needed. **Click** on the **[…]** icon to pull up the matrix spacing on both X and Y axes. The "2D matrix" display will show a checkerboard of colored rectangles that shows both the Z value via the color as well as the X and Y mesh sizes by the dimensions of the rectangle.



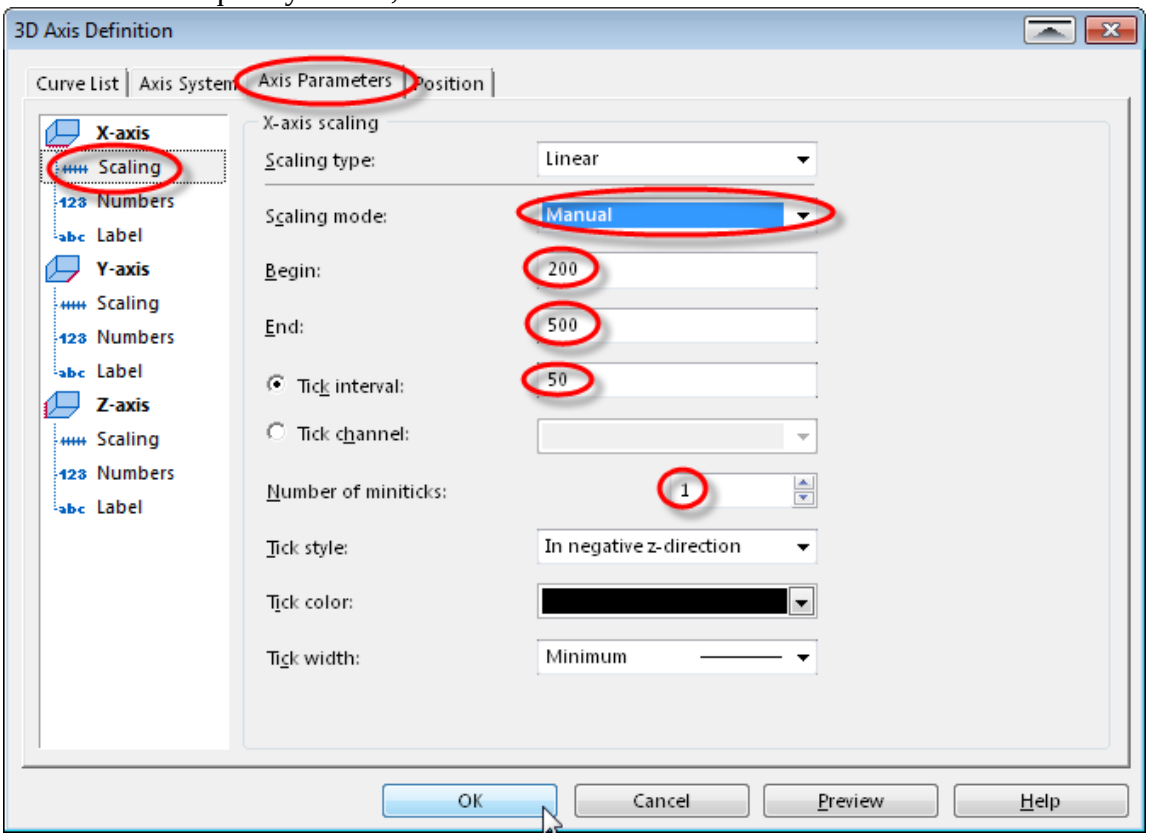
5.61 **Set all** the "Width" and "Offset" **fields** to **0**, which will cause the rectangles of the checkerboard to touch each other. **Click** on the **"OK"** button to accept the changes.



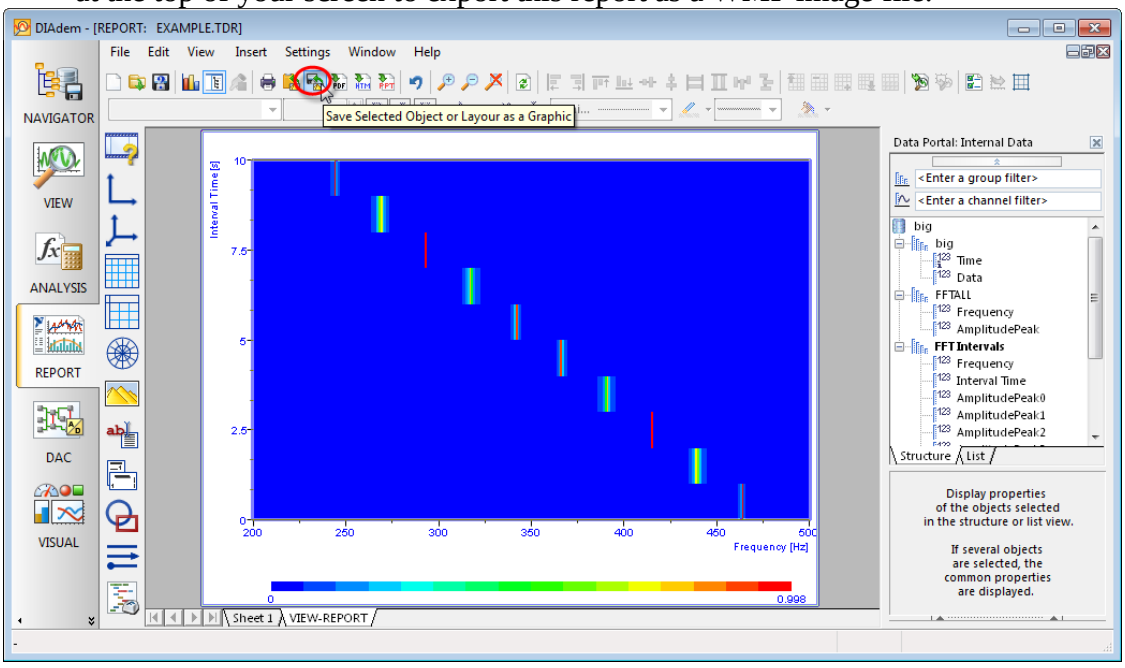
5.62 Finally, to change the frequency axis scaling, **select** the **"Axis Parameters" tab** at the top of the dialog to pick the exact start and stop frequencies you want to show.



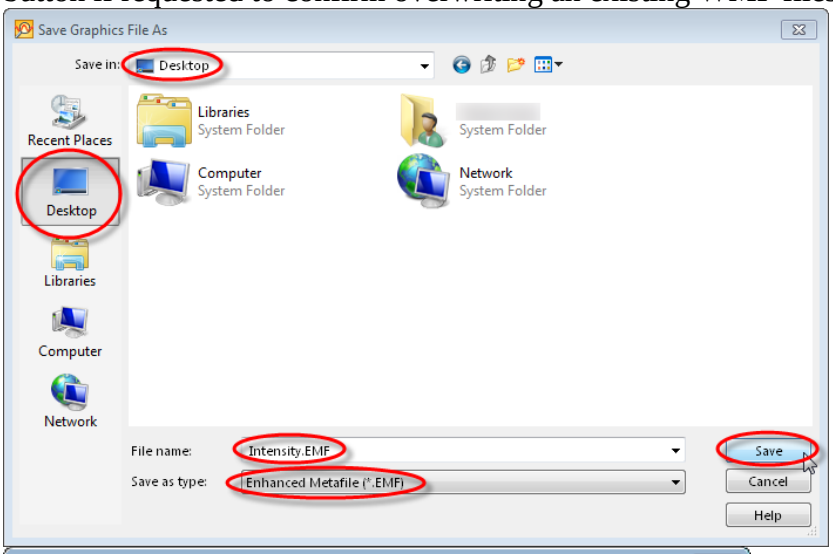
5.63 **Select** the **"X-axis Scaling"** node at the top left of the dialog, then **change** the **"Scaling mode"** dropdown to **"Manual"** and set the **"Begin"** frequency **to 200**, the **"End"** frequency **to 500**, and the **"Tick Interval" to 50** and **click** on **"OK"**.



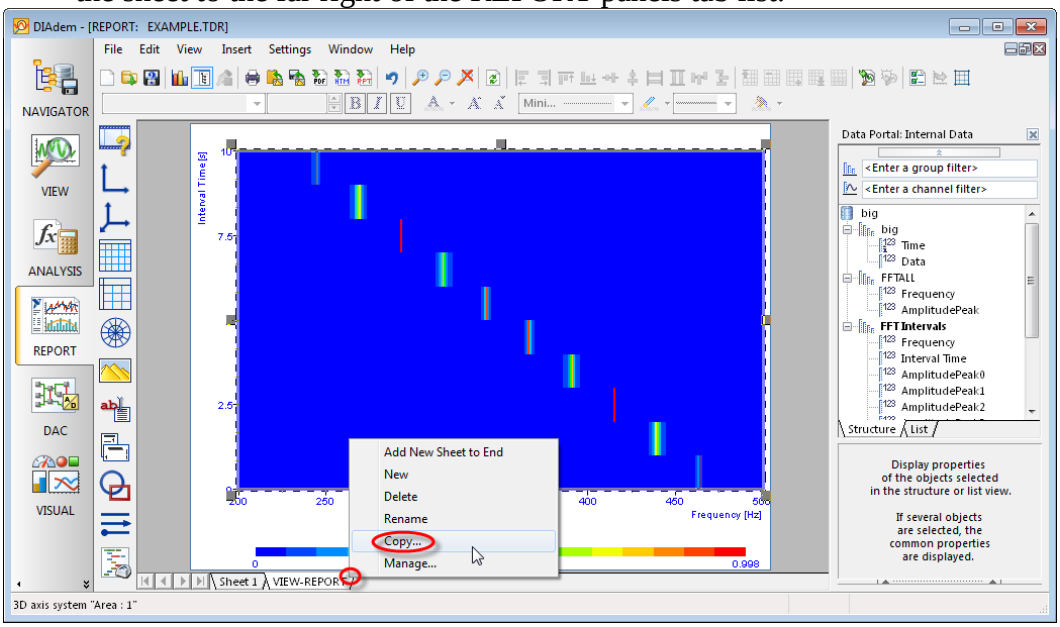
5.64 There, all ready for export. **Click** on the **"Save Selected Object as a Graphic"** icon at the top of your screen to export this report as a WMF image file.

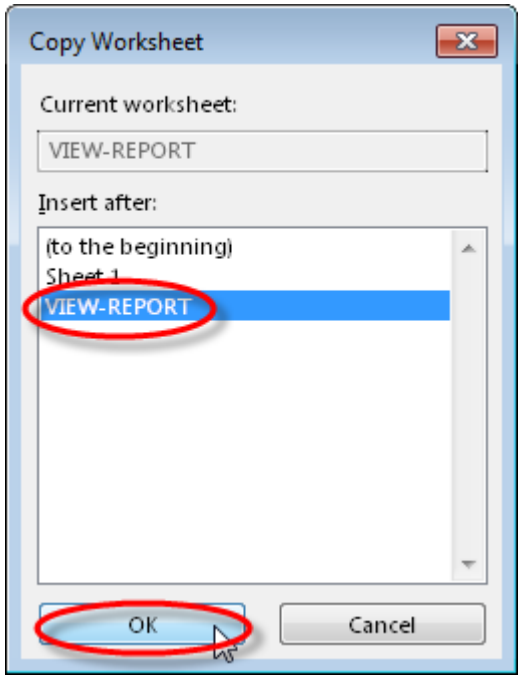


5.65 **Select** the **"Save as type"** to be **"Enhanced metafiles (*.EMF)"**, navigate to the Desktop, then **name** the **image** file **"Intensity.EMF"** and **click** on the **"Save"** button to create the new WMF file that your professor requested. In the next dialog **click** on the **"OK"** button to accept the default output ratio (1024 x 768). **Click** on the **"Yes"** button if requested to confirm overwriting an existing WMF files.

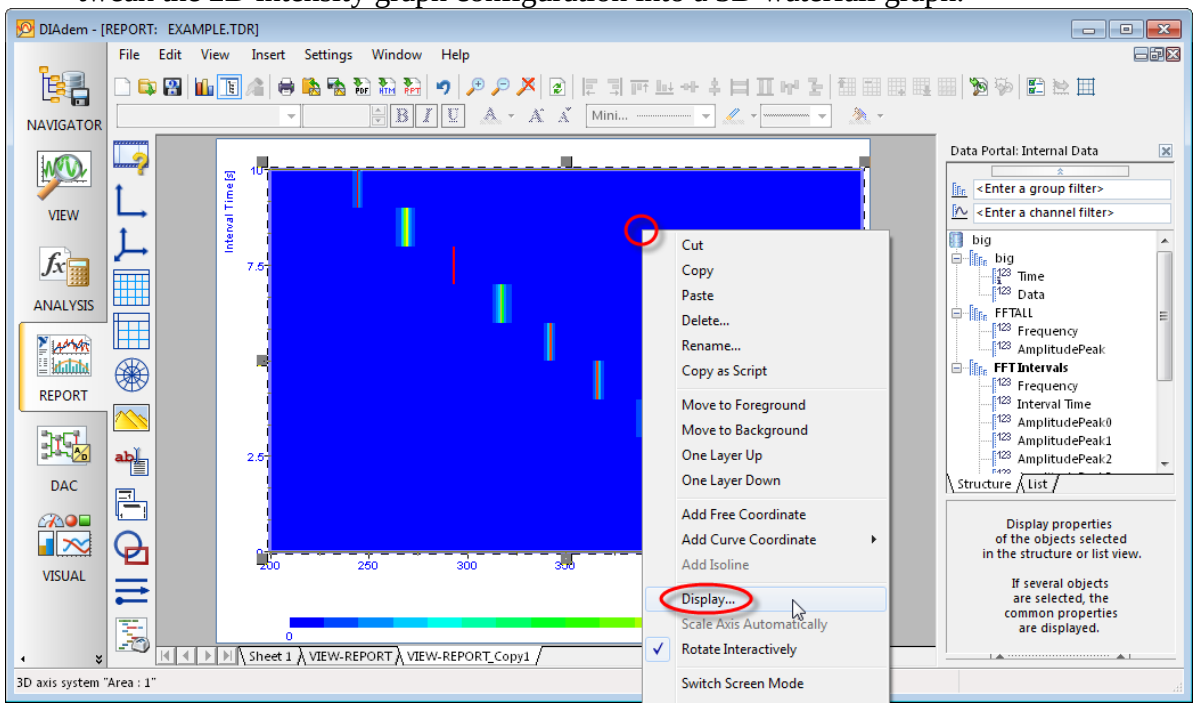


5.66 The easiest way to create the other graph your professor wanted, the 3D waterfall, is to copy this 2D intensity graph to a new sheet and tweak its configuration. **Right-click** on the "VIEW-REPORT" **tab** at the bottom of your screen, then **select** the **"Copy…"** context **menu** to create a new REPORT sheet. In the pop-up "Copy worksheet" dialog, **select** the last **"VIEW-REPORT"** sheet and **click** on the **"OK"** button to copy the sheet to the far right of the REPORT panels tab list.

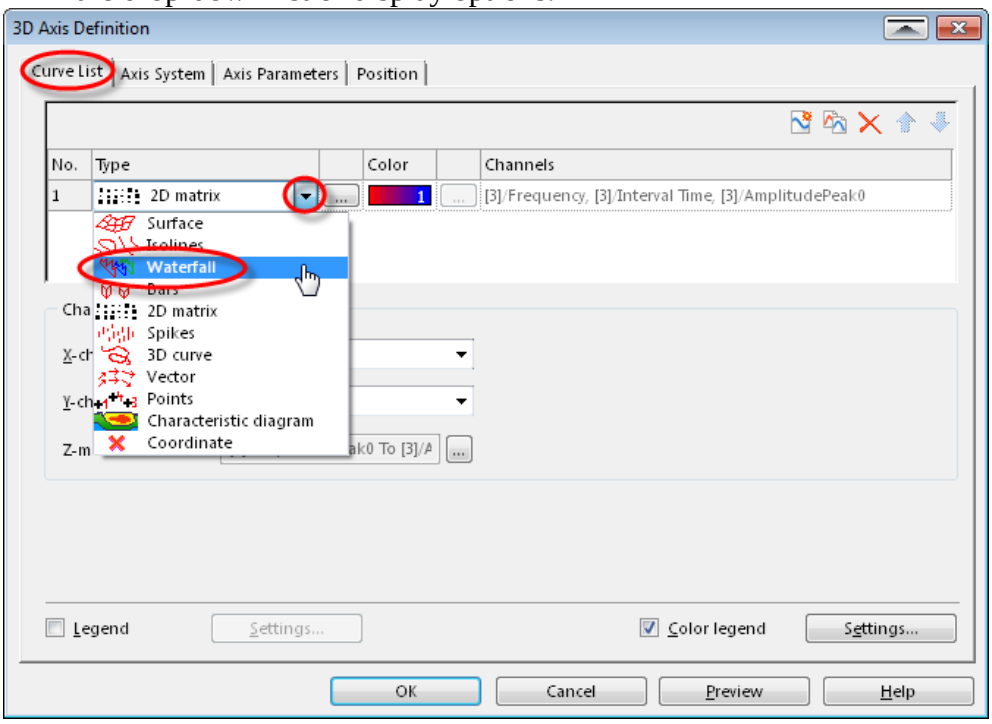




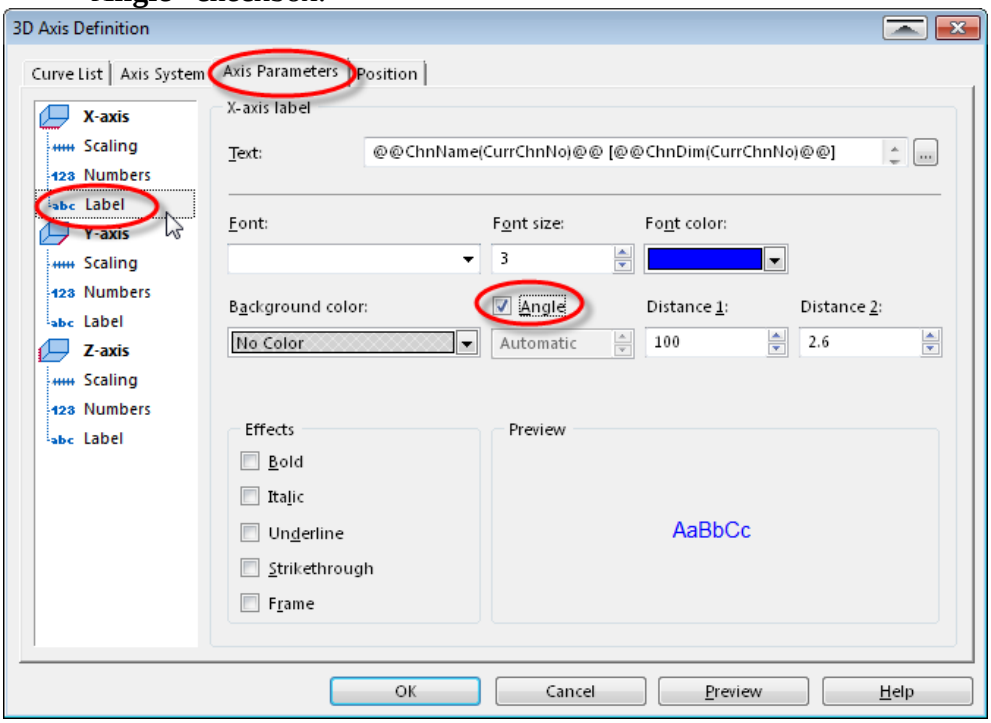
5.67 **Right-click** on the newly inserted **graph** and **select** the **"Display…"** context **menu** to tweak the 2D intensity graph configuration into a 3D waterfall graph.



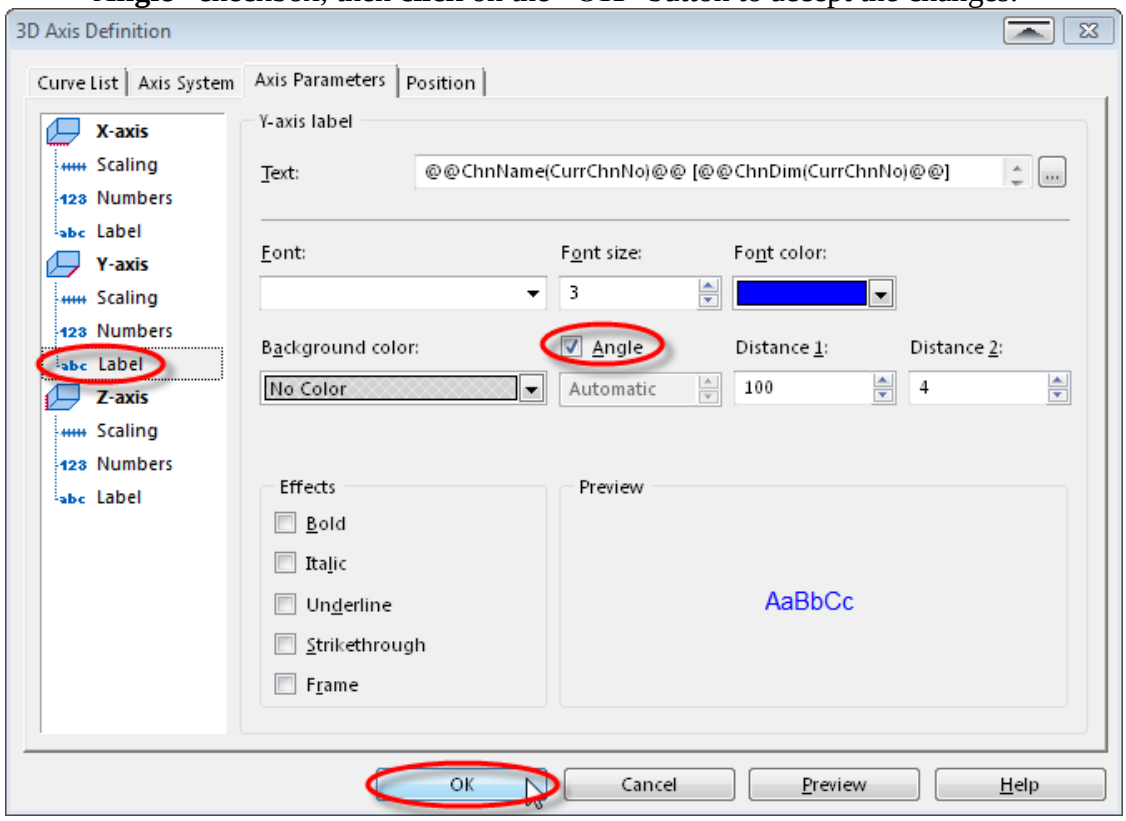
5.68 There are only two tweaks needed— the main one is to change the display type to waterfall. **Click** on the current **"2D matrix"** display type and **select** "**Waterfall"** from the drop-down list of display options.



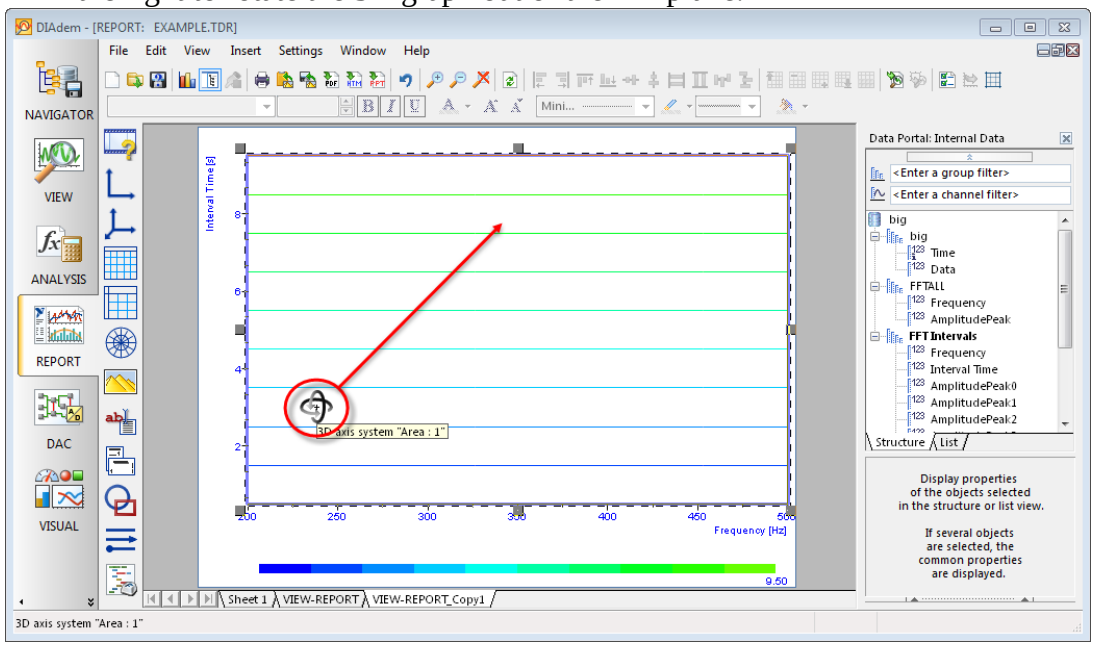
5.69 The other tweak needed is to set the X and Y axis labels to position themselves automatically. **Switch** from the "Curve List" tab **to** the **"Axis Parameters"** tab of the dialog. Now **select** the **"X-axis Label"** node at the left of the dialog and **check** the **"Angle"** checkbox.



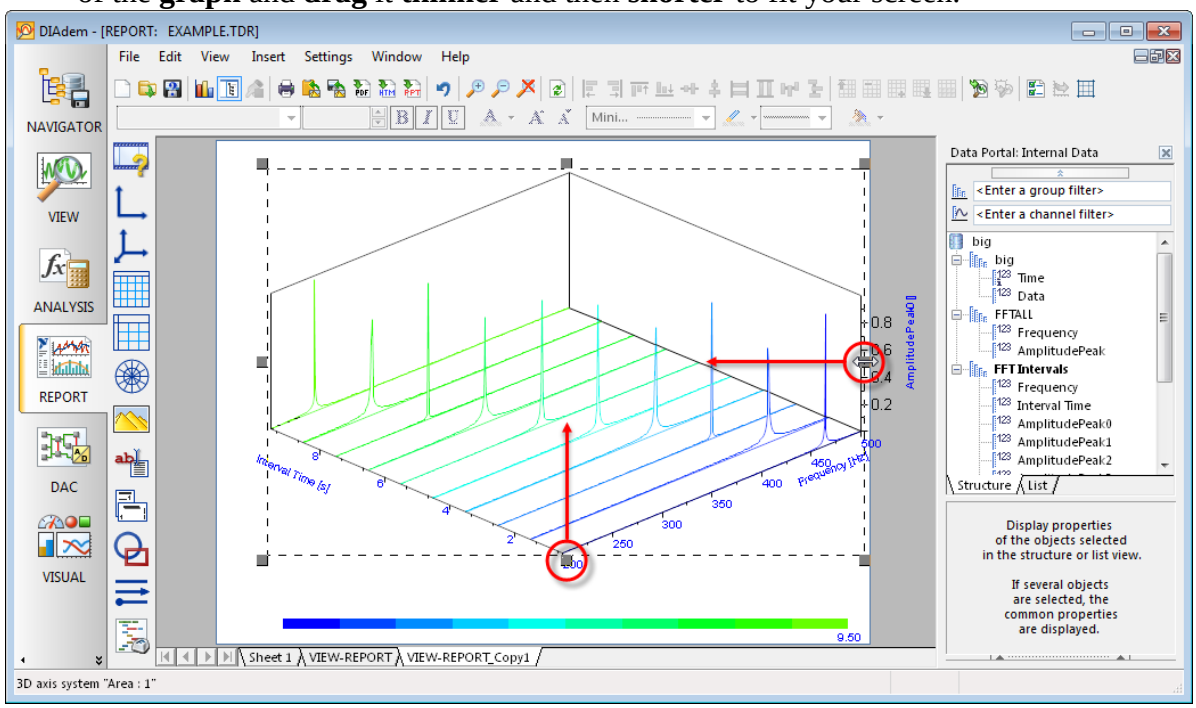
5.70 Finally, **select** the **"Y-axis Label"** node at the left of the dialog and **check** the **"Angle"** checkbox, then **click** on the **"OK"** button to accept the changes.



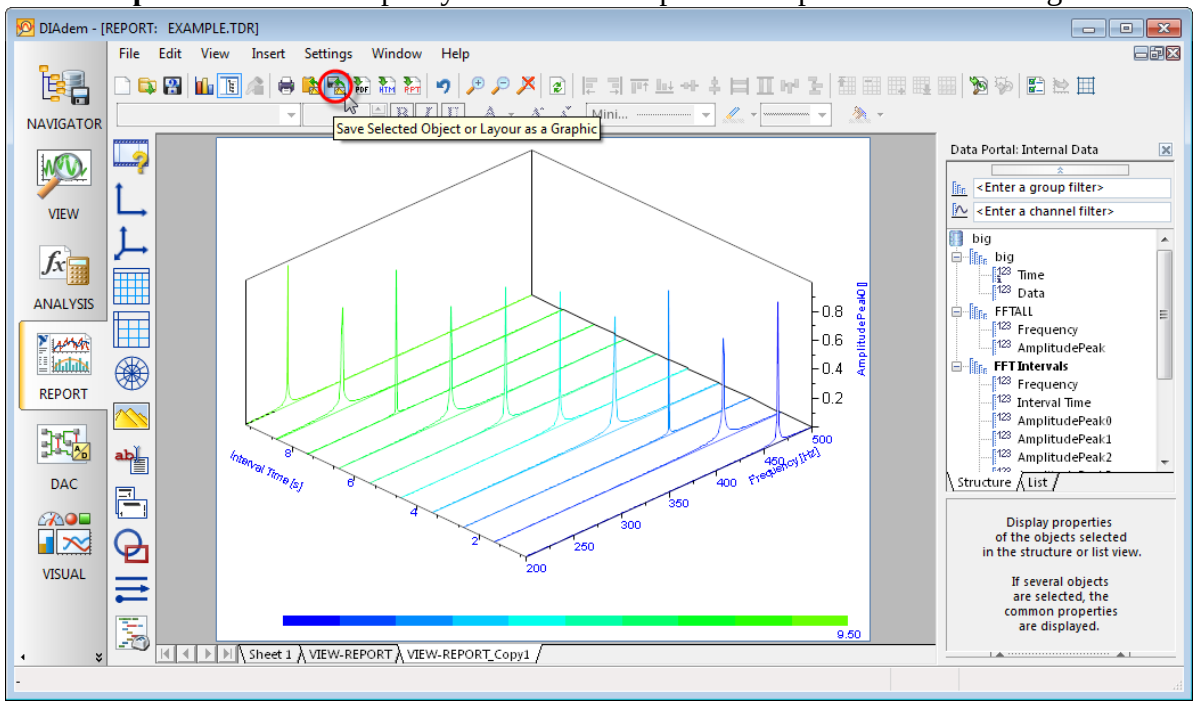
5.71 Now you have a 3D waterfall graph, but you're still staring at it top-down, so that all the 3D waterfall curves look like flat lines. **Click** on the **graph** so that your mouse icon changes to a **rotation icon**, then **click**, **hold** and **drag** the graph **up** and slightly to the right to rotate the 3D graph out of the XY plane.



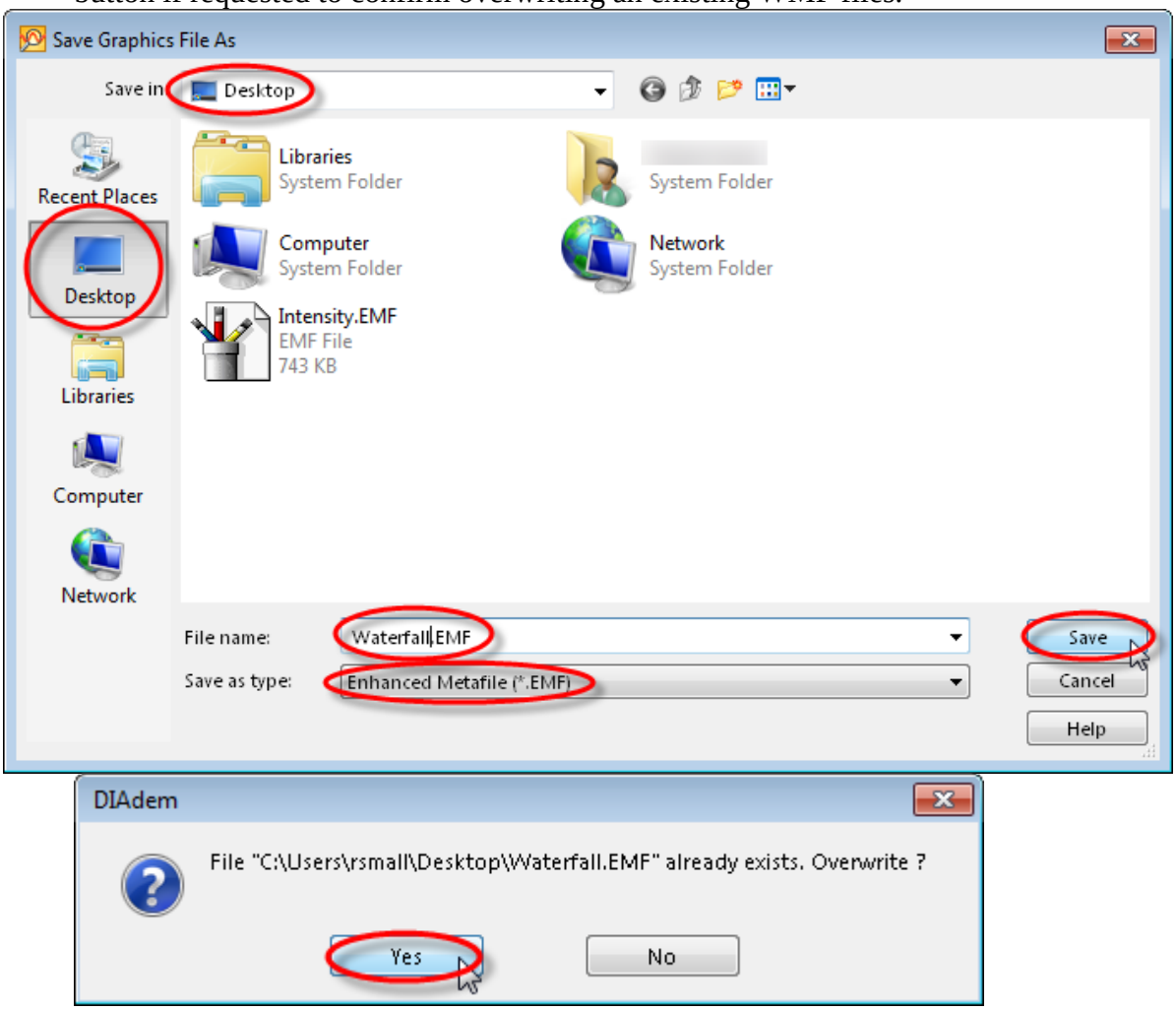
5.72 Here is the 3D waterfall display your professor requested, but chances are the graph needs to be resized smaller to fit on your screen better. **Grab** the **square** at the **edge** of the **graph** and **drag** it **thinner** and then **shorter** to fit your screen.



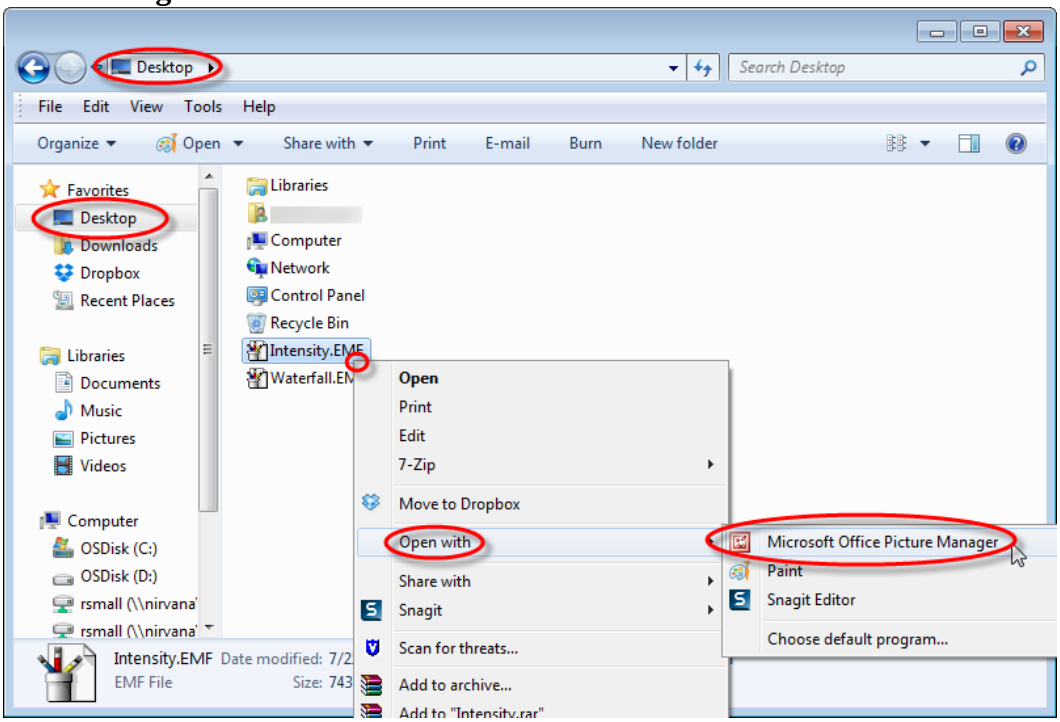
5.73 There, all ready for export. **Click** on the **"Save Selected Object or Layout as a Graphic"** icon at the top of your screen to export this report as a WMF image file.



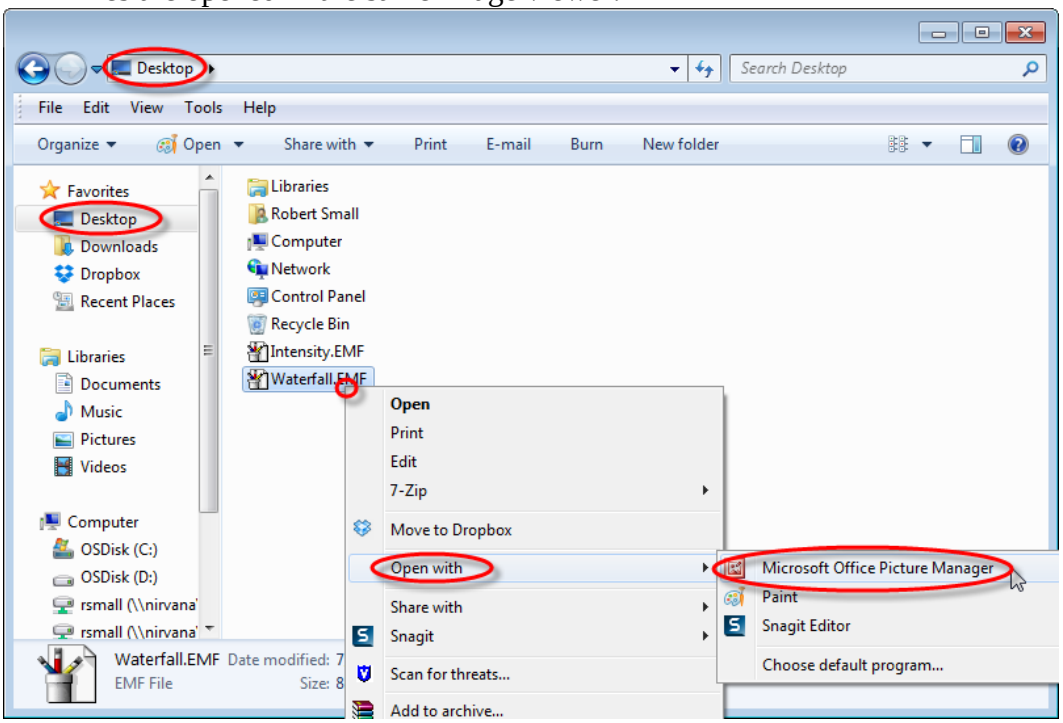
5.74 **Select** the **"Save as type"** to be **"Enhanced metafiles (*.EMF)"**, navigate to the Desktop, then **name** the **image** file **"Waterfall.EMF"** and **click** on the **"Save"** button to create the new WMF file that your professor requested. In the next dialog **click** on the **"OK"** button to accept the default output ratio (1024 x 768). **Click** on the **"Yes"** button if requested to confirm overwriting an existing WMF files.



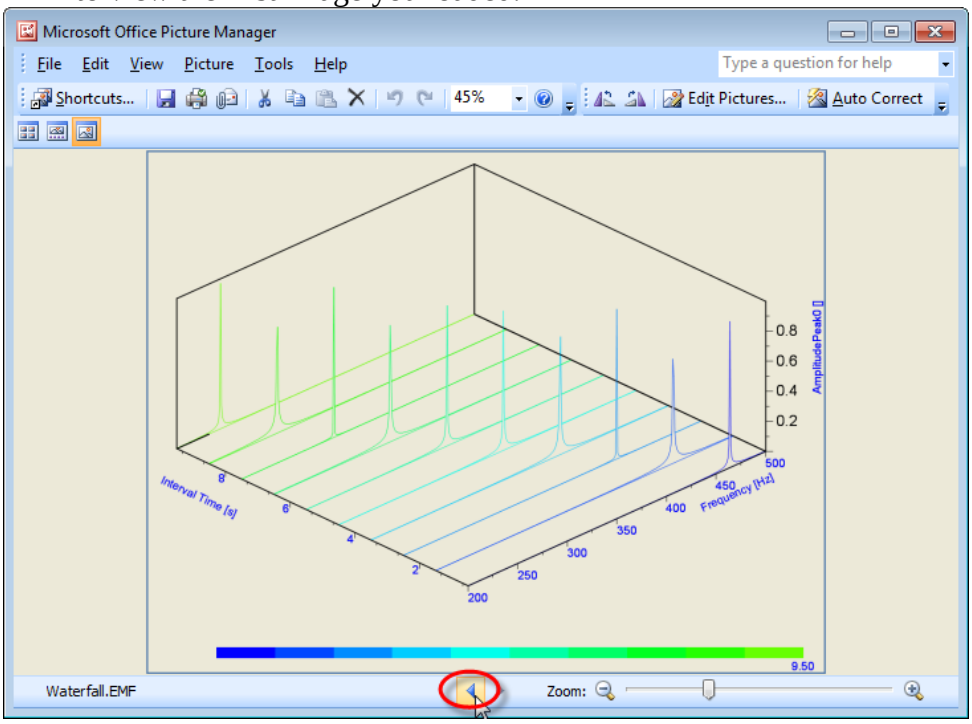
5.75 Finally open up **Windows Explorer**, **navigate** to the **Desktop**, then **right-click** on the **"Intensity.EMF"** image file and **select** the **"Open With>>Microsoft Office Picture Manager"** context menu.



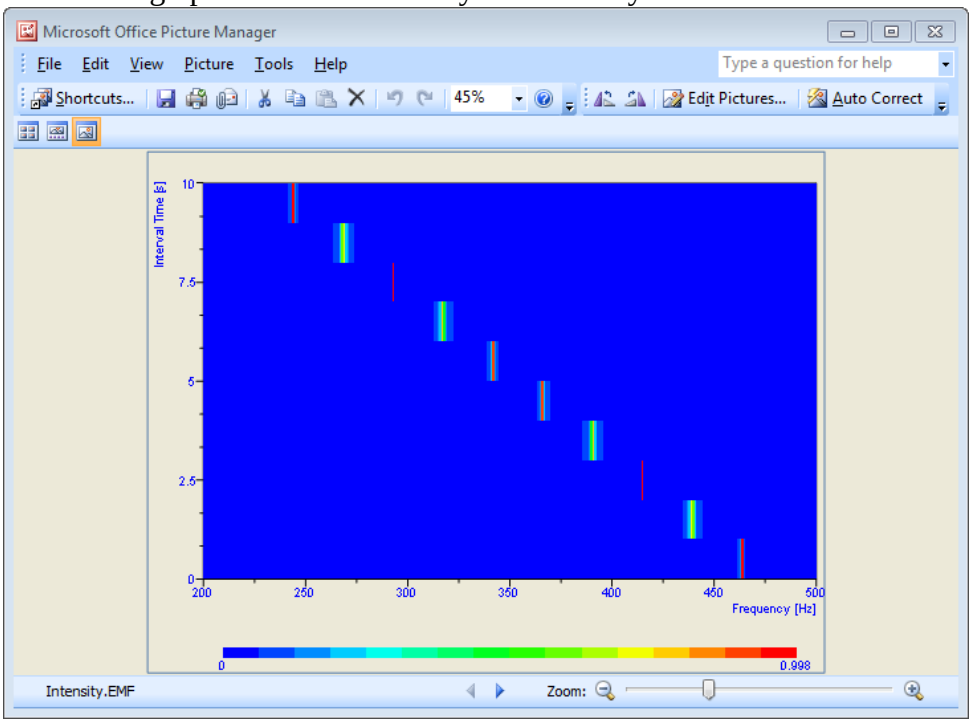
5.76 Again in Windows Explorer **right-click** this time on the **"Waterfall.EMF"** image file and **select** the **"Open With>>Microsoft Office Picture Manager"** so that both these files are opened in the same image viewer.



5.77 Now look at the files you opened in the Microsoft Office Picture Manager—the most recently loaded image is the EMF image of a 3D waterfall plot that your professor requested. **Click** on the **"Previous (left arrow)"** icon at the bottom left of your screen to view the first image you loaded.



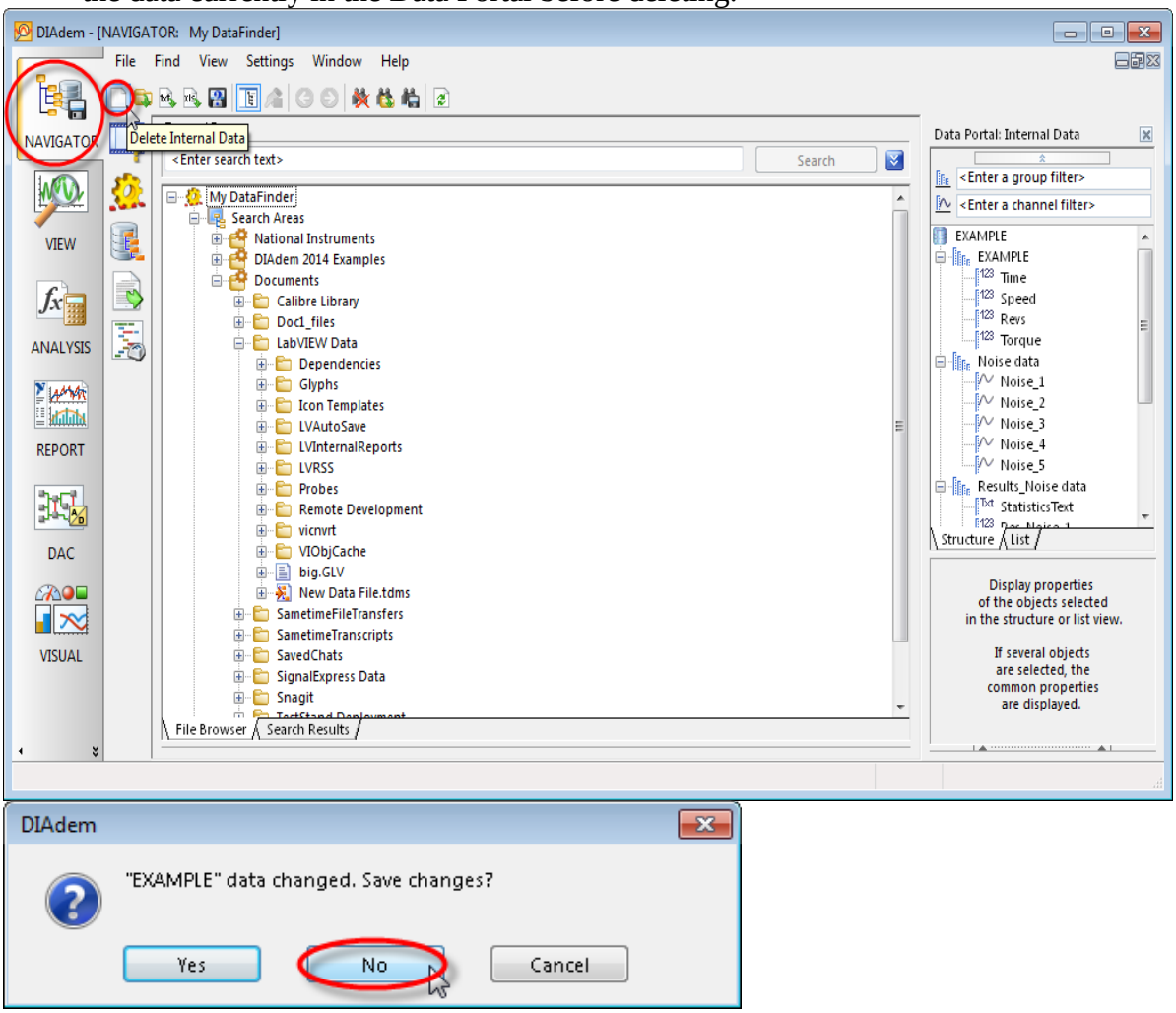
5.78 Here is the EMF image of a 2D intensity plot that your professor requested—Your 2 EMF graph files are now ready to email to your advisor.



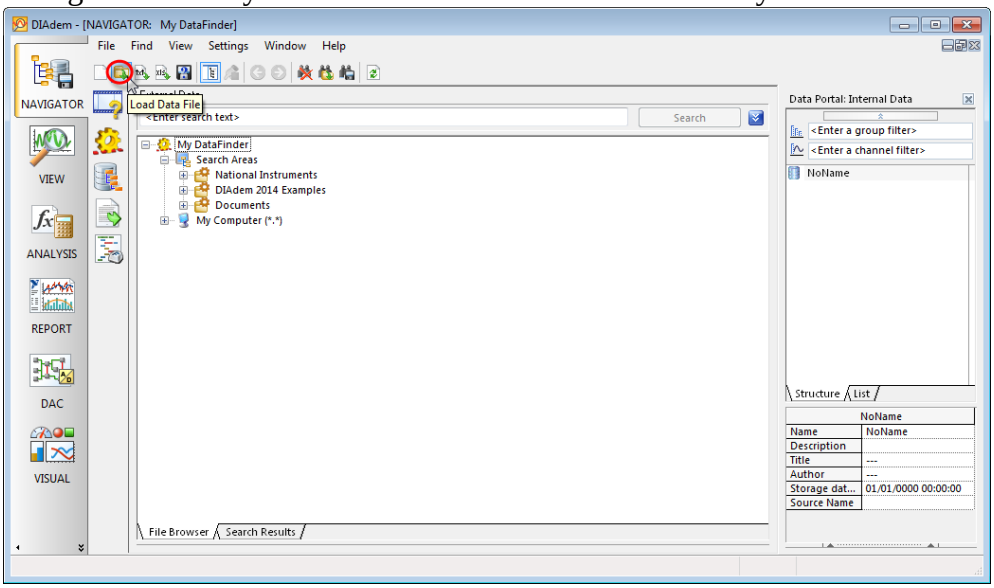
Exercise #6 Synchronizing Data with Video

Scenario: You are a newly hired engineer in an automobile safety lab and have been told to take a look at the results of a recent crash test. You are told that this lab uses DIAdem to analyze the crash data and synchronize the data and high speed video captured during the crash test. Supposedly this is pretty easy to do, since your new mentor on the job promptly went on vacation for 3 days and told you to "Check it out while I'm gone!". The only detail he left in his email was to "let me know if the resultant head acceleration exceeded 205 m/s^2 at the point that the dummy head struck the headrest".

6.1 After working your way through all the self-training material on DIAdem that you can find at your lab, you decide to give it your best try. **Click** on the **NAVIGATOR** tab at the top left of your screen to switch to the NAVIGATOR panel, then **click** on the **"Delete Internal Data"** icon at the top left of your screen to delete any data currently loaded in DIAdem. Click on the "**No**" button if asked if you want to save changes to the data currently in the Data Portal before deleting.

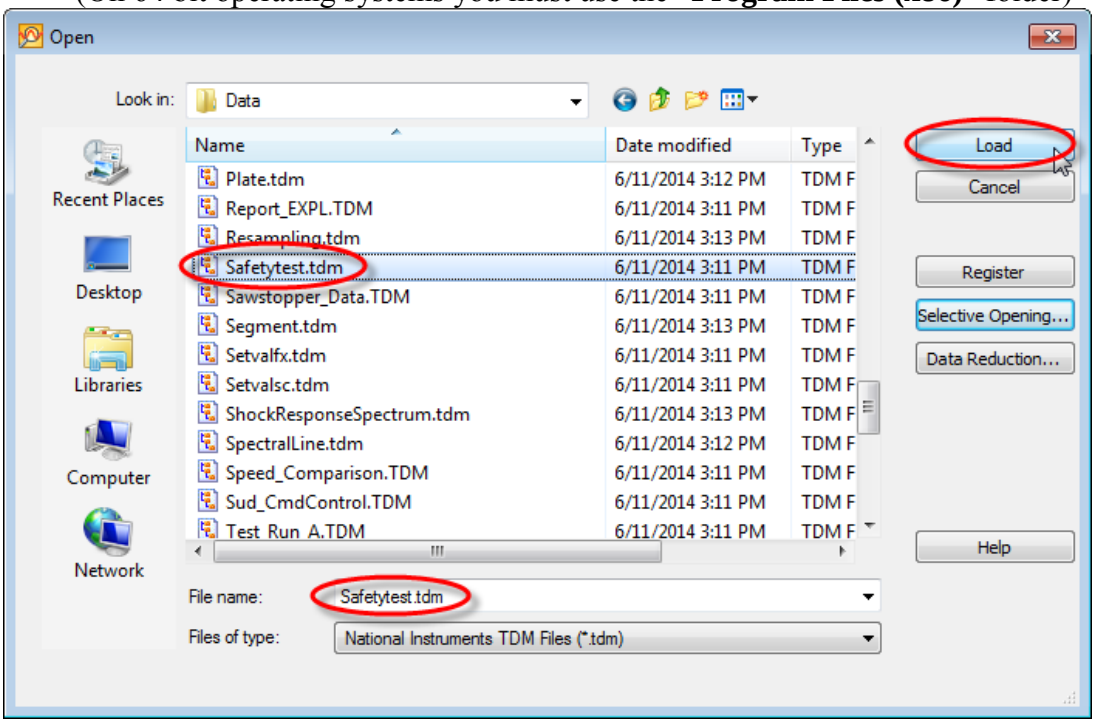


6.2 **Click** on the **"Load Data File"** icon at the top left of your screen to pop up a file dialog with which you can find and load the crash data set your mentor indicated.



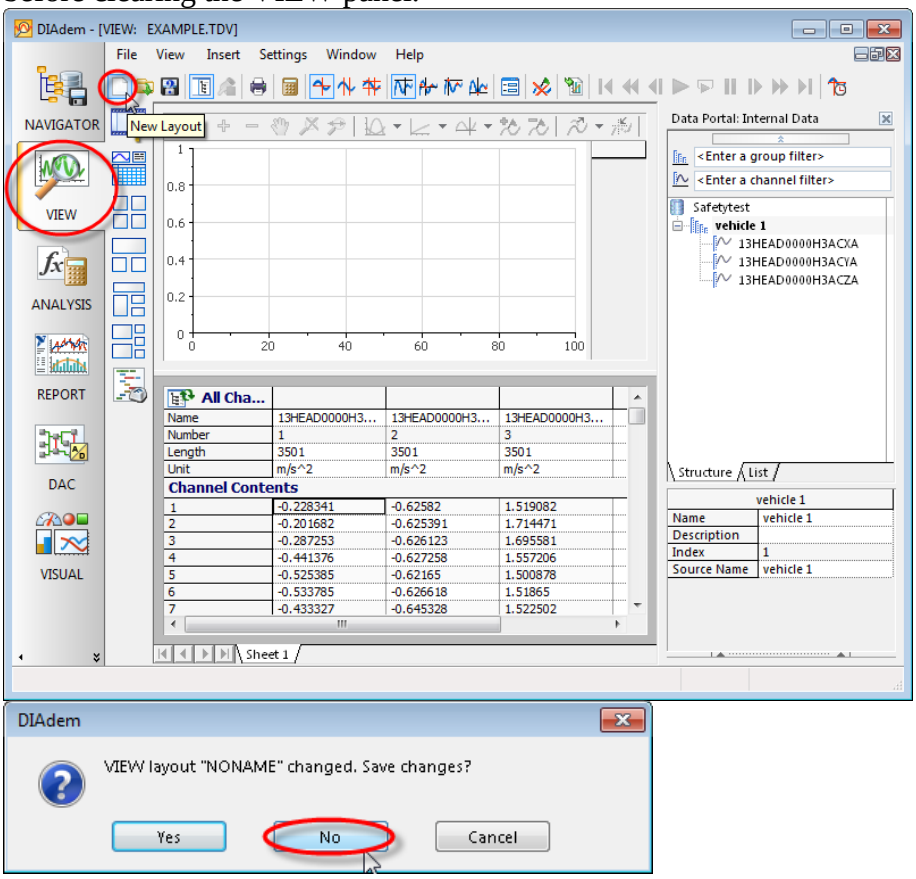
6.3 **Select** the **"SafetyTest.tdm"** file from the DIAdem Examples\Data folder.
If you took all the defaults when installing DIAdem, the Examples\Data folder is at "**C:\Program Files\National Instruments\DIAdem 2014\Examples\Data"**
If, on the other hand, you are in an official National Instruments seminar, look in **"D:\Program Files\National Instruments\DIAdem 2014\Examples\Data"**
Now **click** on the **"Load"** button to load this data file.

(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)

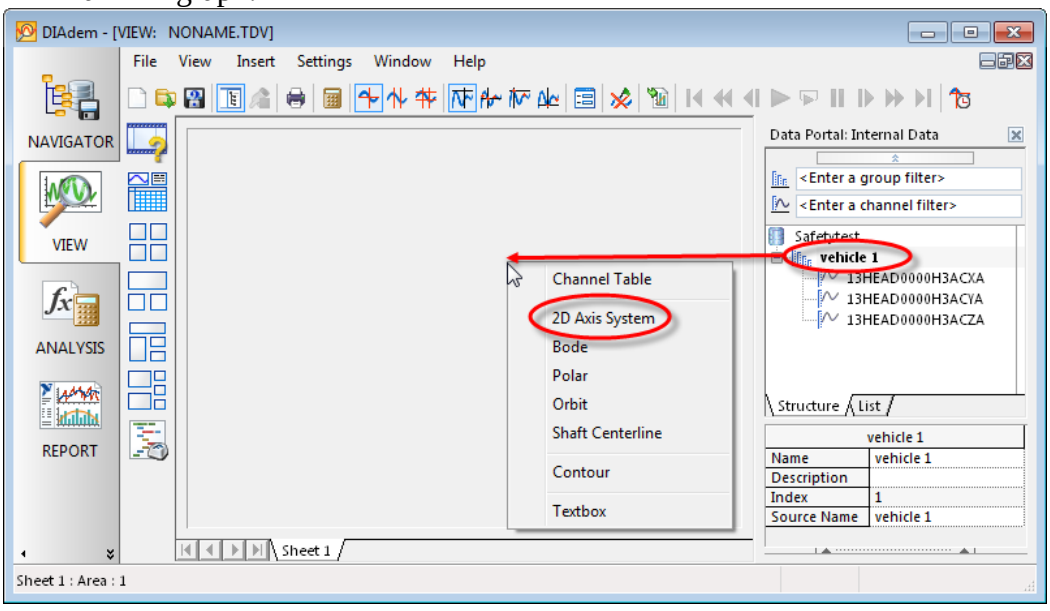


NOTE: By default DIAdem looks for data files in a different "Data" folder. If you don't see the "SafetyTest.tdm" file, double-check that you are really looking in the folder "…Program Files\National Instruments\DIAdem 2014\Examples\Data".

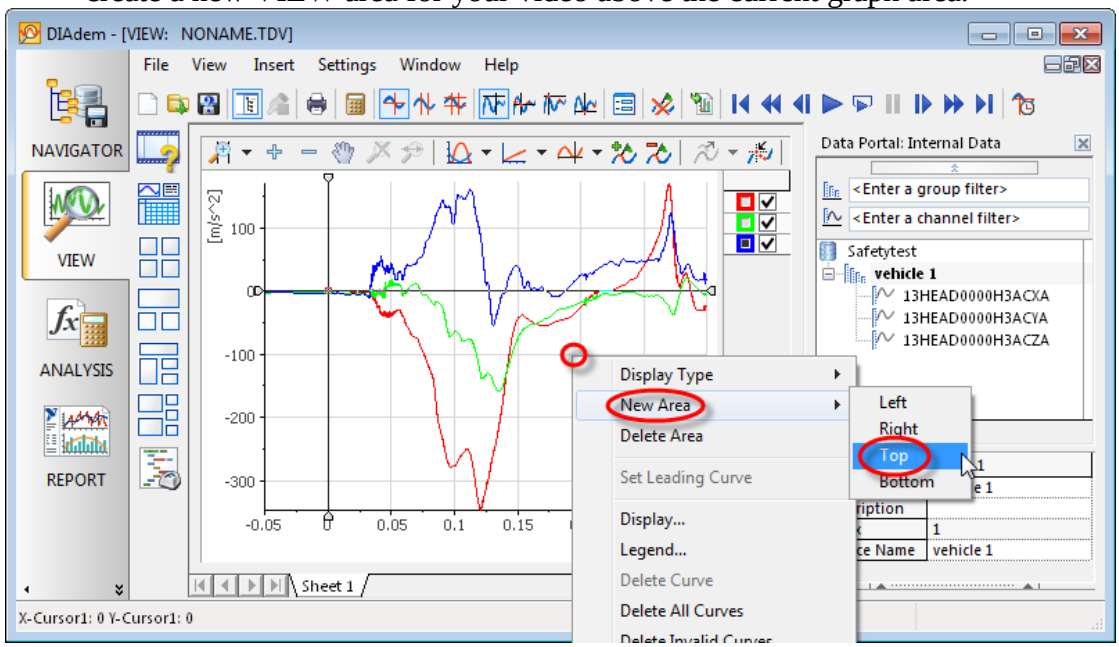
6.4 Now the data is loaded into the Data Portal at the right— 3 head acceleration channels. You remember that video synchronization happens in the VIEW panel, so you **click** on the **"VIEW"** tab at the far left of your screen to switch to the VIEW panel. **Click** on the **"New Layout"** icon at the top left of your screen to start a new VIEW layout from scratch. Select "No" if asked to save your previous VIEW layout before clearing the VIEW panel.



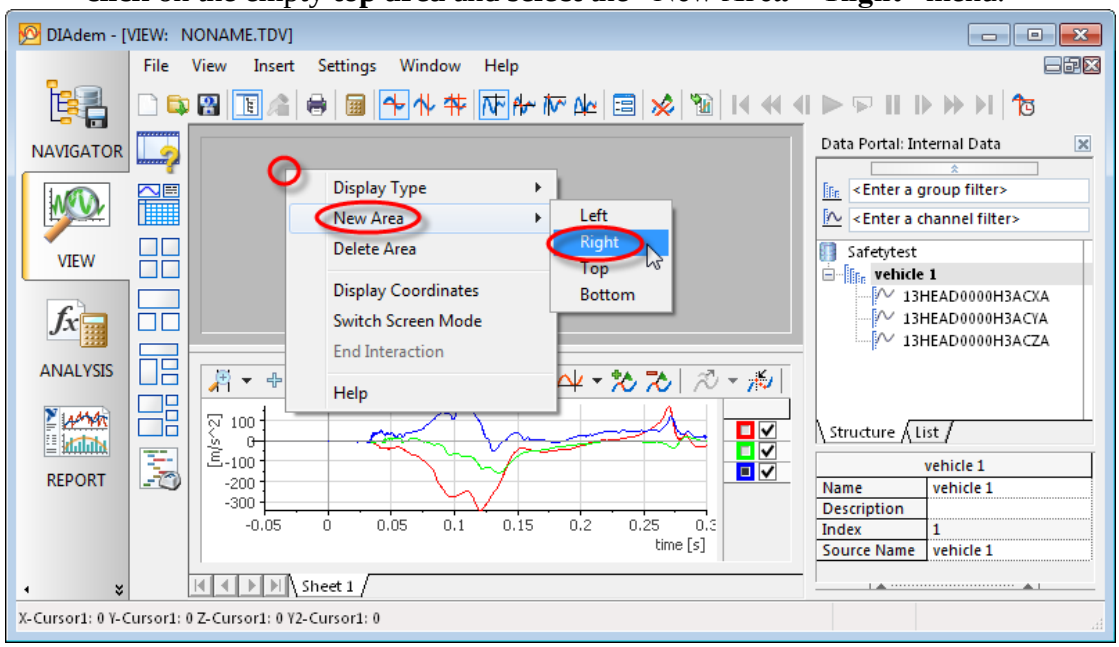
6.5 **Drag** the **"vehicle 1"** group from the Data Portal on the right of your screen **into** the empty **VIEW** area, then **select** the **"2D Axis System"** display type to plot the data on an XY graph.



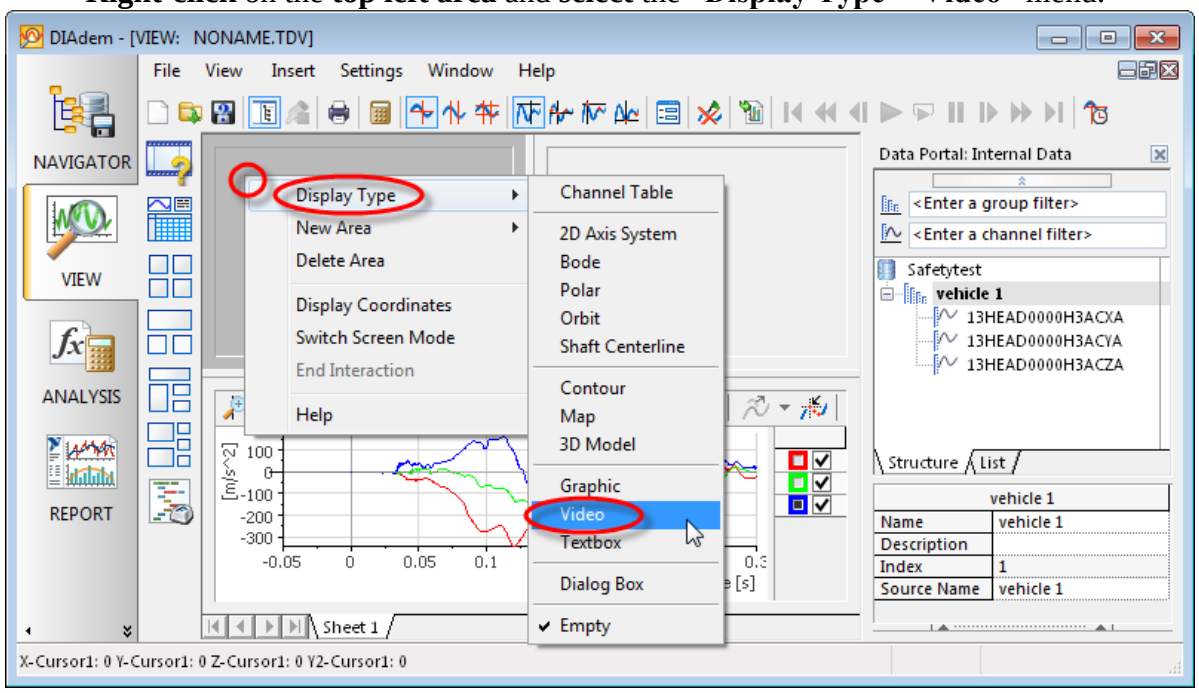
6.6 Here you see the head acceleration curves along the three axes (X, Y, Z) over the duration of the crash. You want to display a high speed video taken of this crash synchronized with the actual head acceleration data you've already graphed. **Right-click** on the white space of the **graph** and **select** the **"New Area>>Top"** menu to create a new VIEW area for your video above the current graph area.



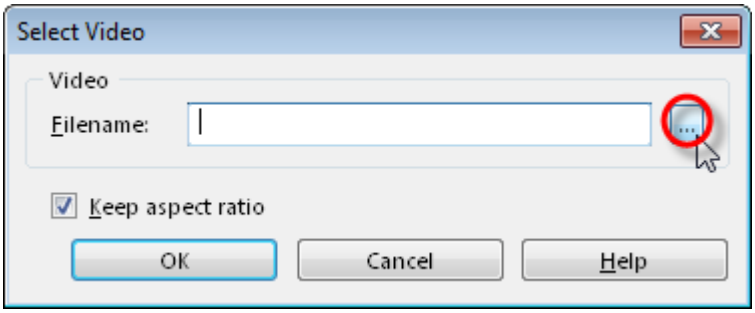
6.7 You need to create one more VIEW area for a static image of the test setup. **Right-click** on the empty **top area** and **select** the **"New Area>>Right"** menu.



6.8 Now you need to assign the video and graphics types to the two new VIEW areas. **Right-click** on the **top left area** and **select** the **"Display Type>>Video"** menu.

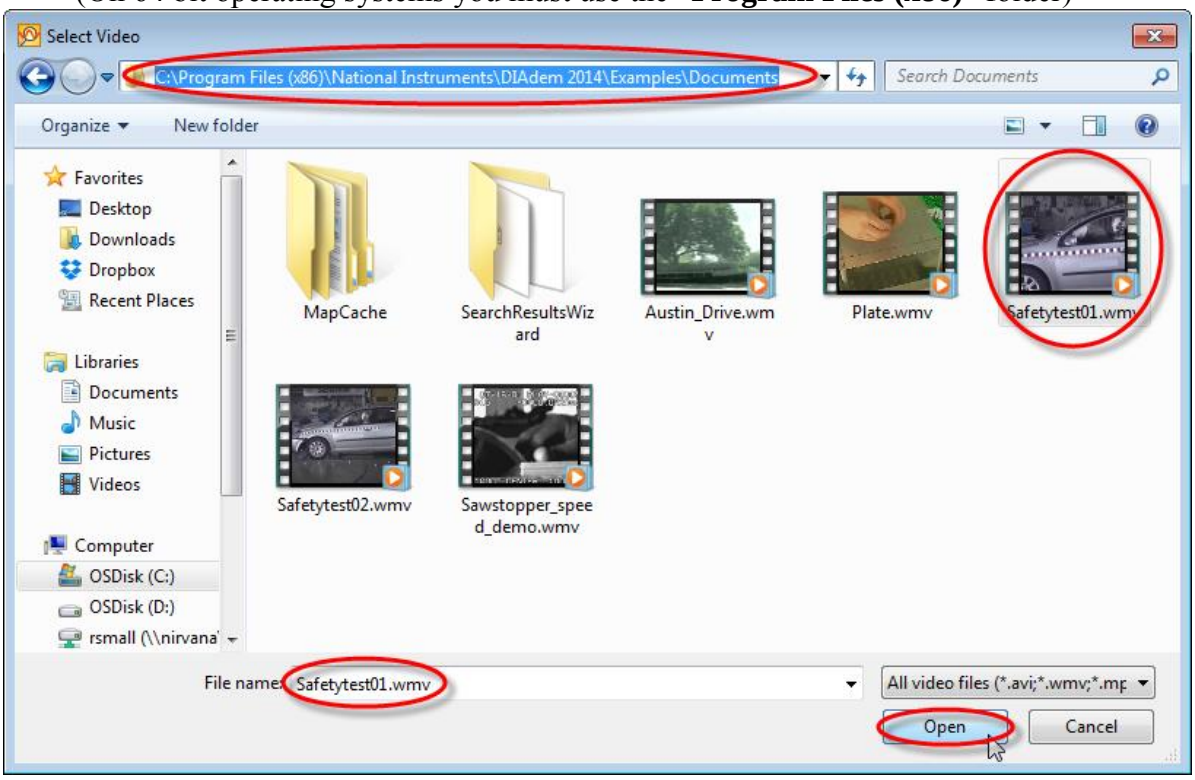


6.9 In the "Select Video" dialog that pops up, **click** the **"[…]"** button to browse for a video file.



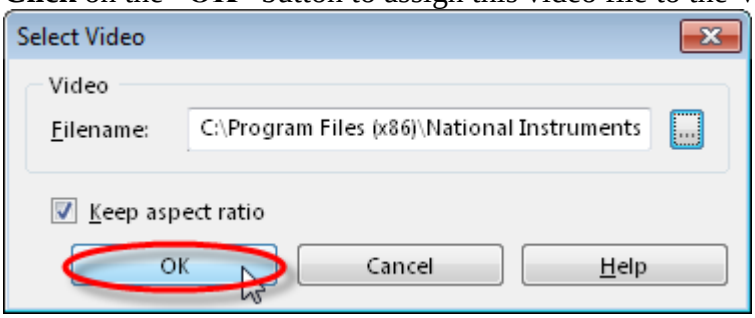
6.10 **Select** the **"Safetytest01.AVI"** file from the DIAdem Examples\Documents folder. If you took all the defaults when installing DIAdem, Examples\Documents is at "**C:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"** If, on the other hand, you are in an official National Instruments seminar, look in **"D:\Program Files\National Instruments\DIAdem 2014\Examples\Documents** Now **click** on the "**Open**" button to load this selected file path.

(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)

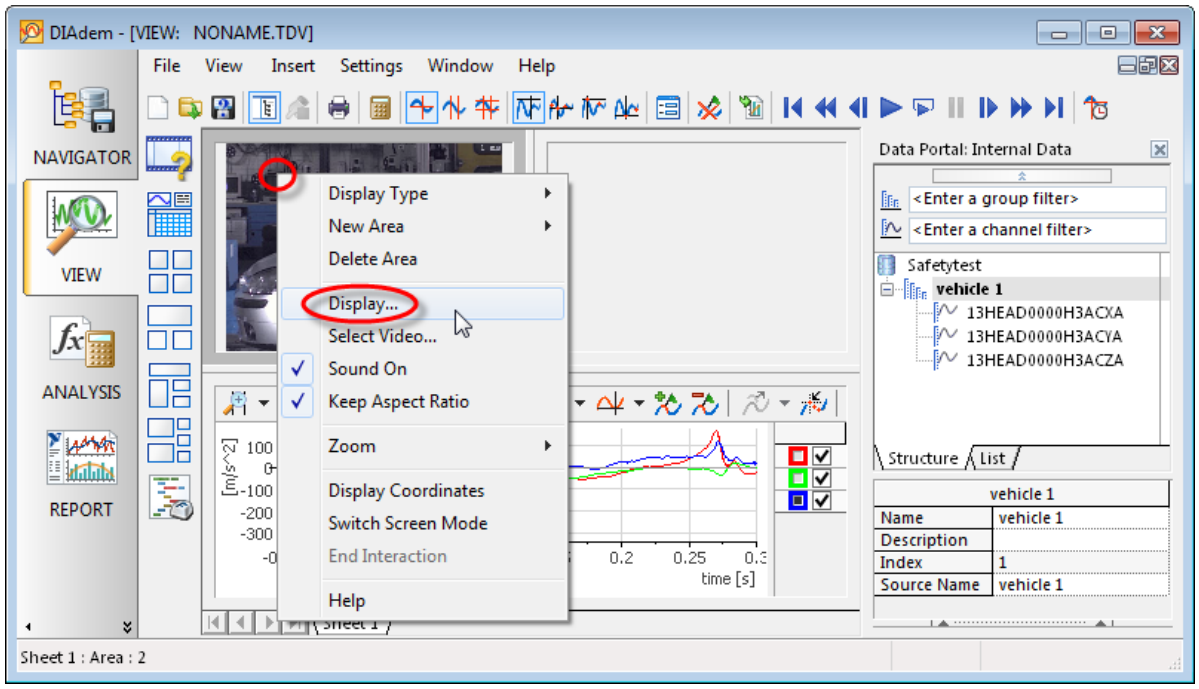


NOTE: By default DIAdem looks for data files in a different "Documents" folder. If you don't see the "Safetytest01.AVI" file, double-check that you are really looking in "…Program Files\National Instruments\DIAdem 2014\Examples\Documents".

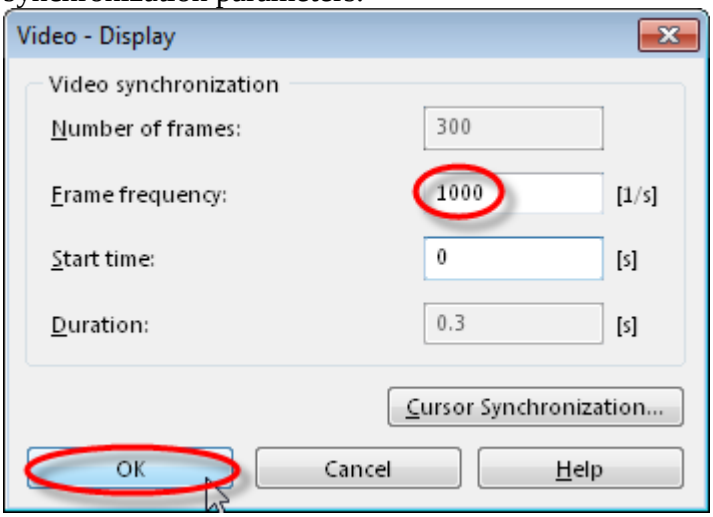
6.11 **Click** on the **"OK"** button to assign this video file to the VIEW area.



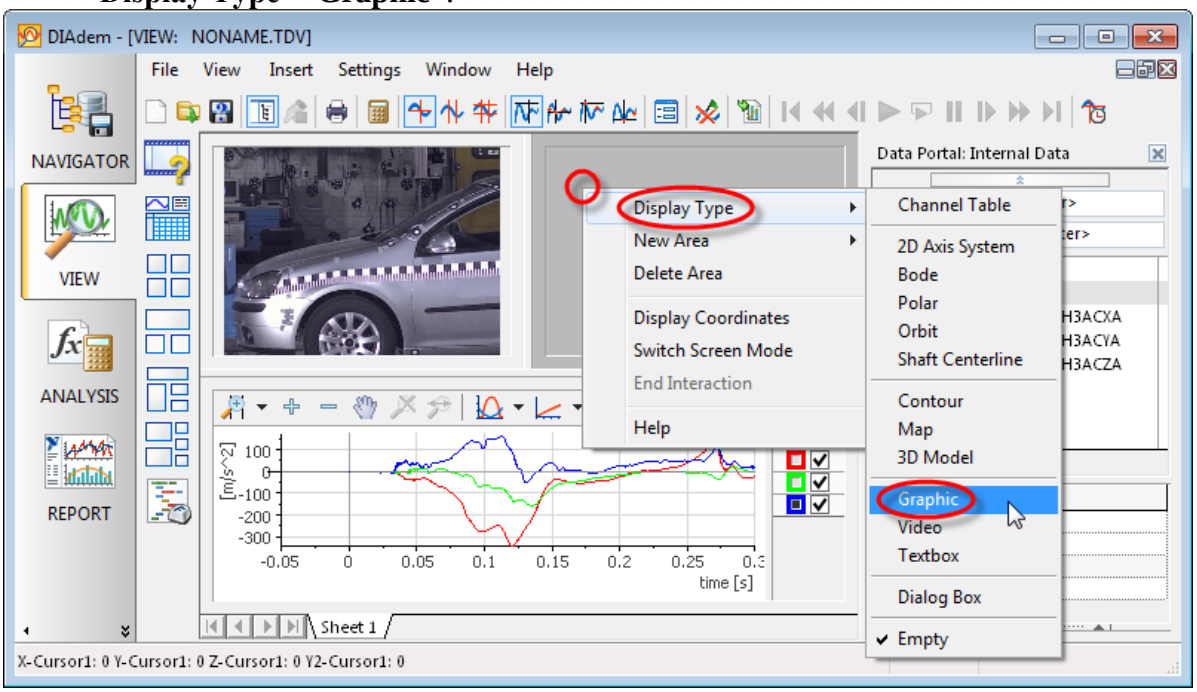
6.12 In order for the video to display correctly synchronized with the time axis of the graph in the bottom VIEW area, the correct start time and frame rate for the video must be entered. **Right-click** on the **video** and **select** the **"Display…"** menu in order to enter this information.



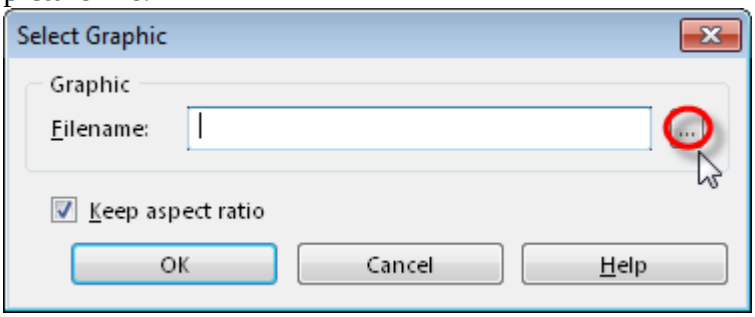
6.13 You know that the frame rate of your high speed camera is 1000 and that the camera starts recording based on a digital trigger that already corresponds to time zero on the acceleration data channels. **Set** the **"Frame frequency"** to **1000** frames per second and **leave** the **"Start time"** set to **0**. **Click** on the **"OK"** button to accept these synchronization parameters.



6.14 You need to add one last element to your layout. In the empty space to the right of the video you want to add a static picture of the original crash setup before the crash. **Right-click** in the **blank** upper right VIEW **area** and select the context menu **"Display Type>>Graphic"**.

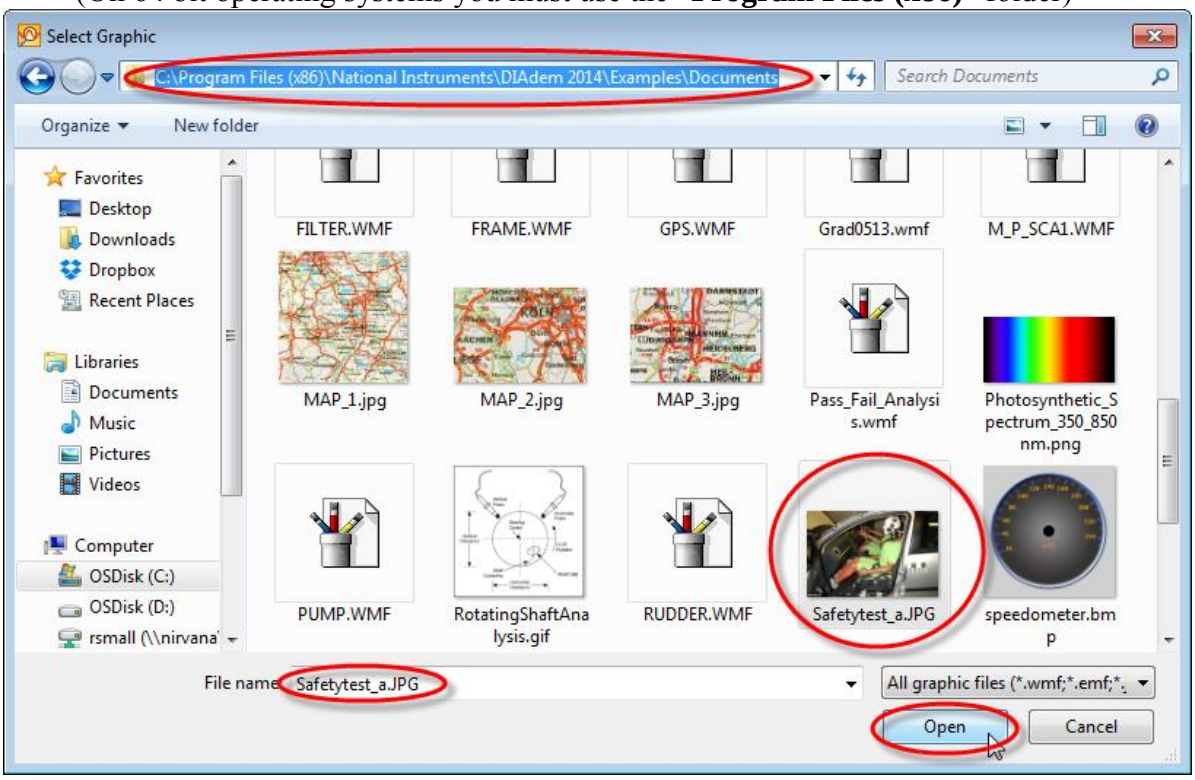


6.15 In the Select Graphic dialog that pops up, **click** the **"[…]"** button to browse for a picture file.



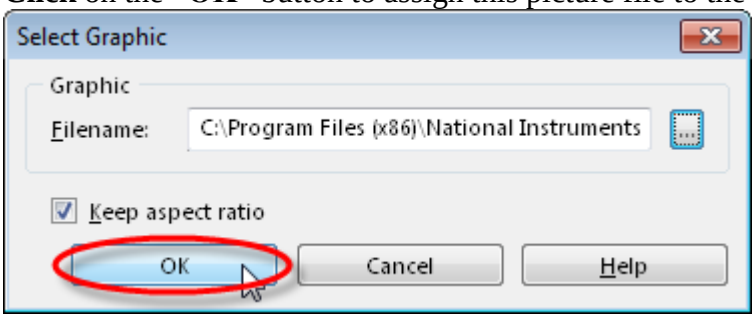
6.16 **Select** the **"Safetytest_a.JPG"** file from the DIAdem Examples\Documents folder. If you took all the defaults when installing DIAdem, Examples\Documents is at "**C:\Program Files\National Instruments\DIAdem 2014\Examples\Documents"** If, on the other hand, you are in an official National Instruments seminar, look in **"D:\Program Files\National Instruments\DIAdem 2014\Examples\Documents** Now **click** on the "**Open**" button to load this selected file path.

(On 64 bit operating systems you must use the "**Program Files (x86)**" folder)

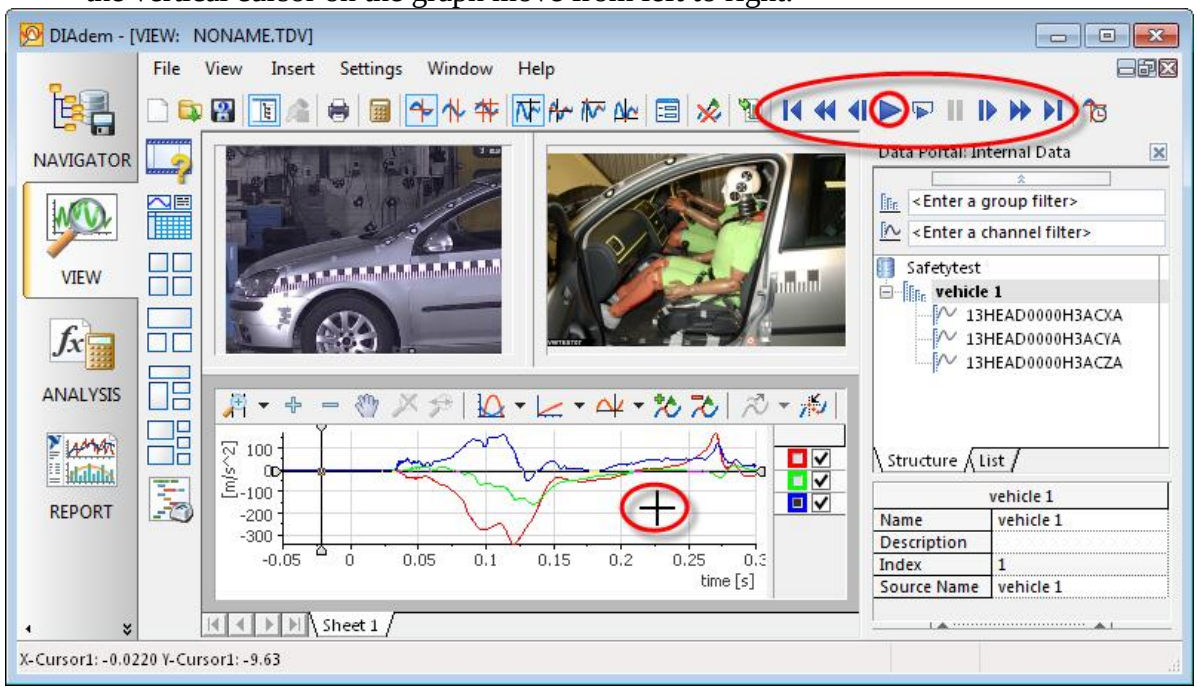


NOTE: By default DIAdem looks for graphic files in a different "Documents" folder. If you don't see the "Safetytest_a.JPG" file, double-check that you are really looking in "Program Files\National Instruments\DIAdem 2014\Examples\Documents".

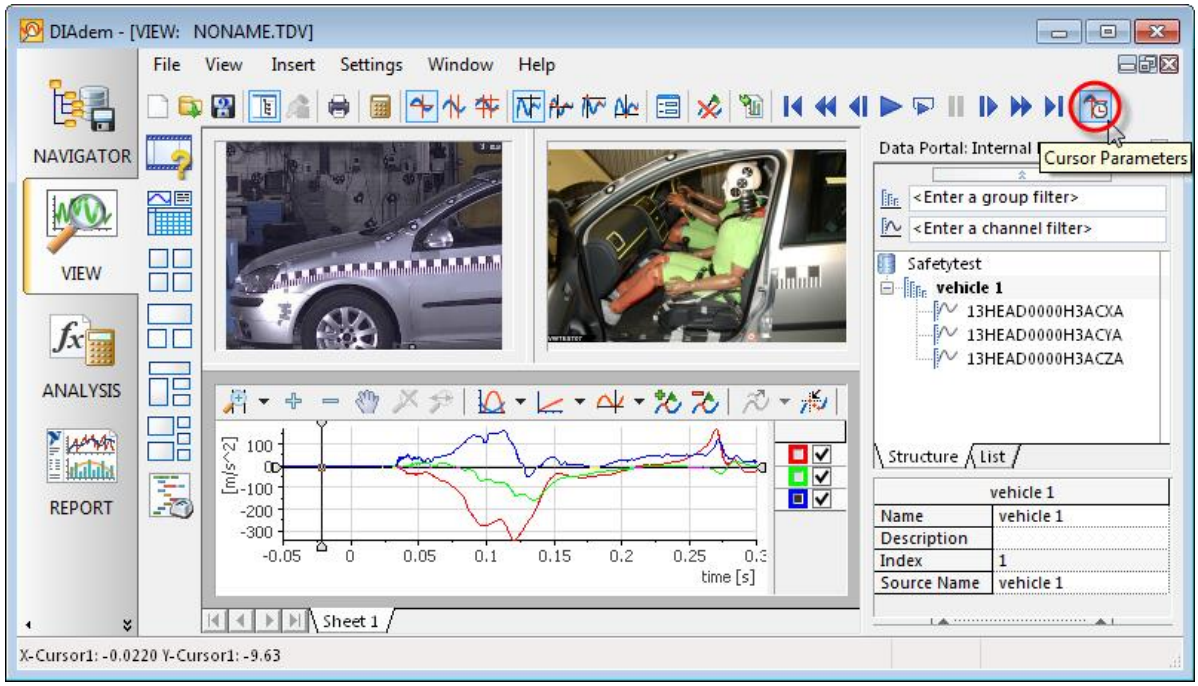
6.17 **Click** on the **"OK"** button to assign this picture file to the VIEW area



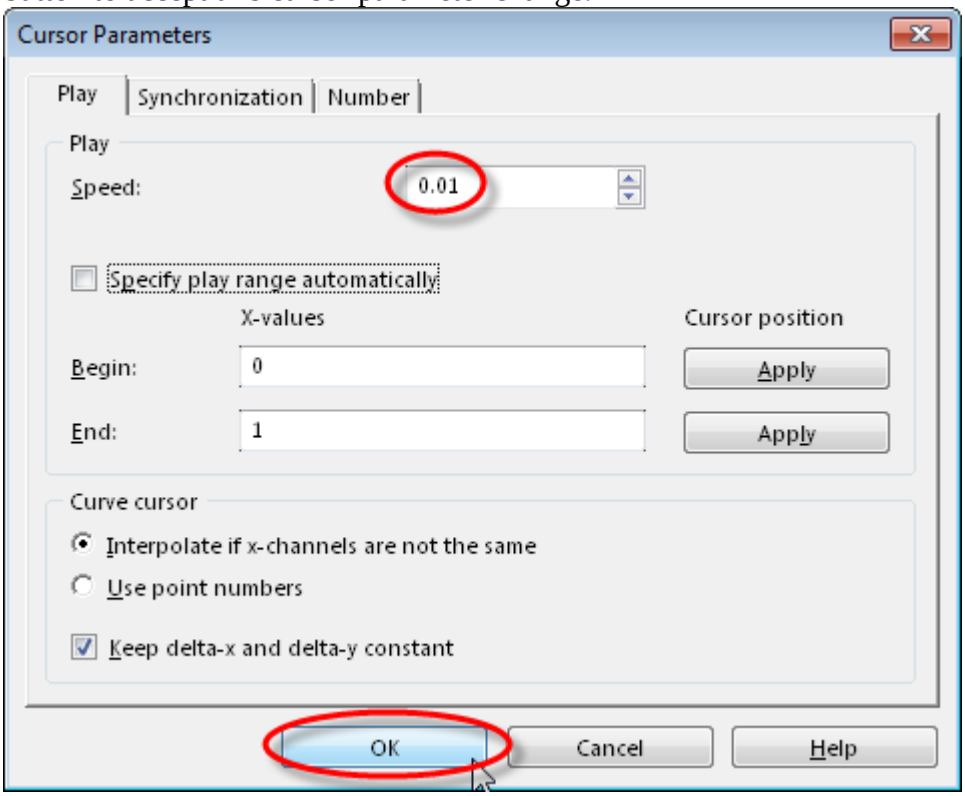
6.18 You now have all of the elements of your VIEW layout assembled. **Left-click** on the bottom **graph** area so that the playback tool bar at the top right of the screen becomes active. Then **click** on the **"Play"** button in the playback tool bar to play once through the video and the data synchronized. You can see the current time value by watching the vertical cursor on the graph move from left to right.



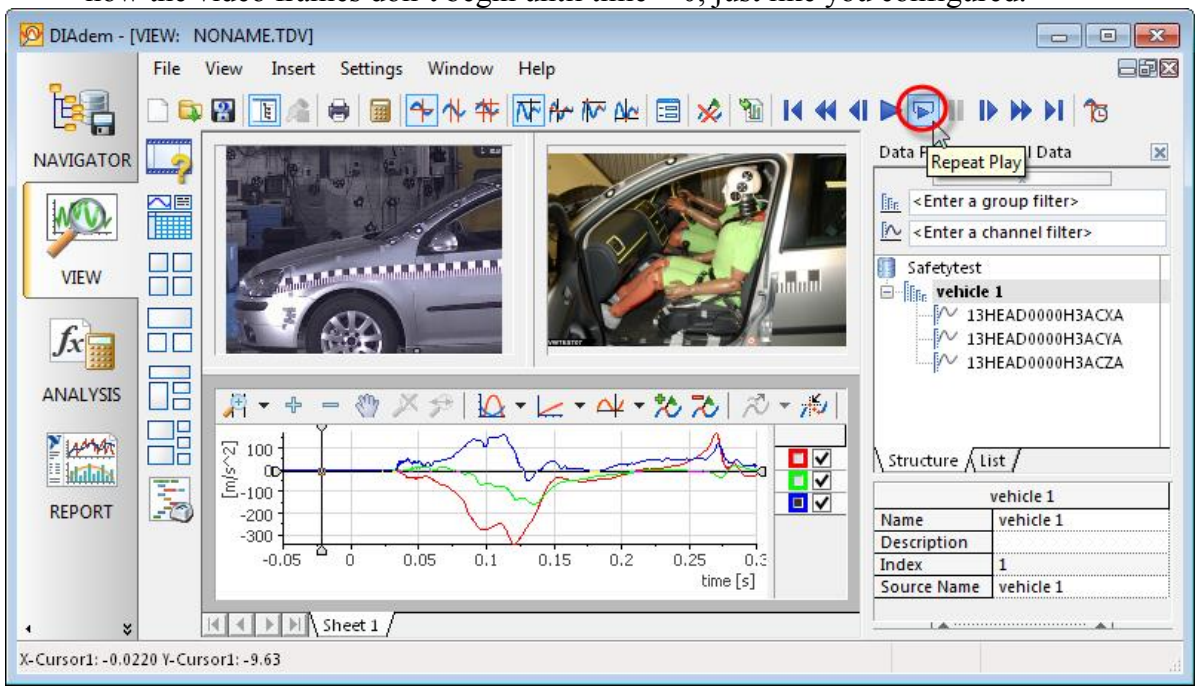
6.19 The crash data spans 0.3 seconds, and the playback is in real time by default, which is way too fast for human eyes. **Click** on the **"Cursor Parameters"** icon at the far right of the screen to slow down the replay so you can watch the crash develop in slow motion.



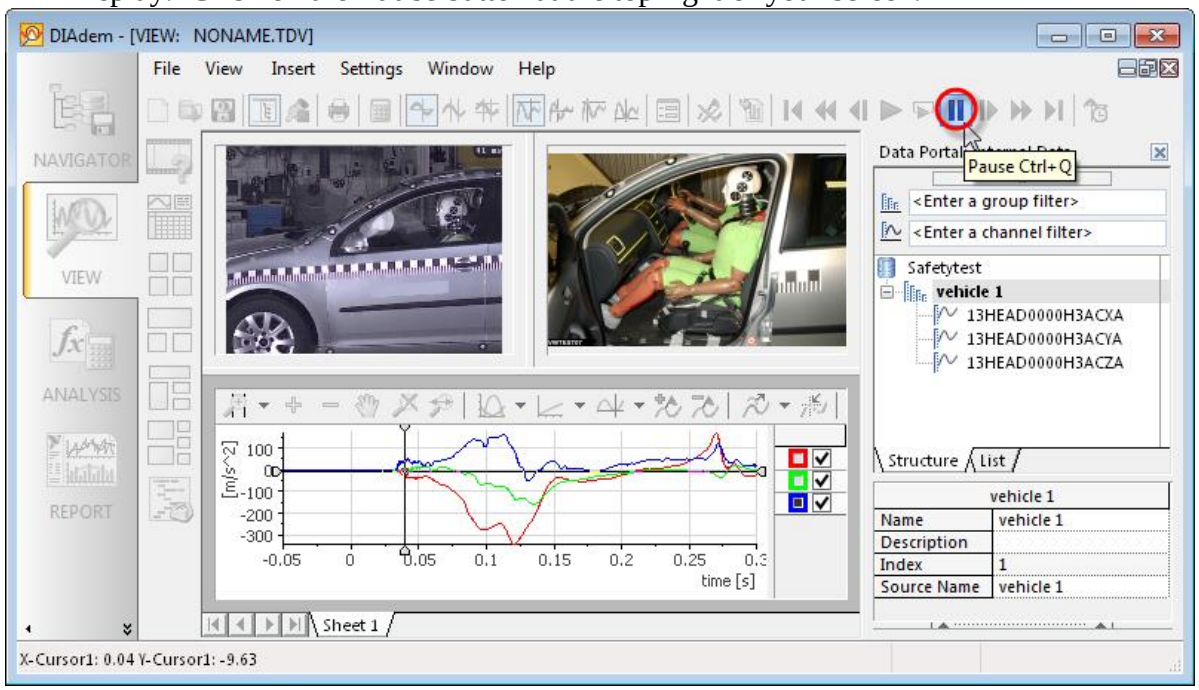
6.20 **Change** the replay **"Speed"** parameter to **0.01** from its original 1.0 value. This will play the video back at a hundredth of the actual recorded speed. **Click** the **"OK"** button to accept this cursor parameter change.



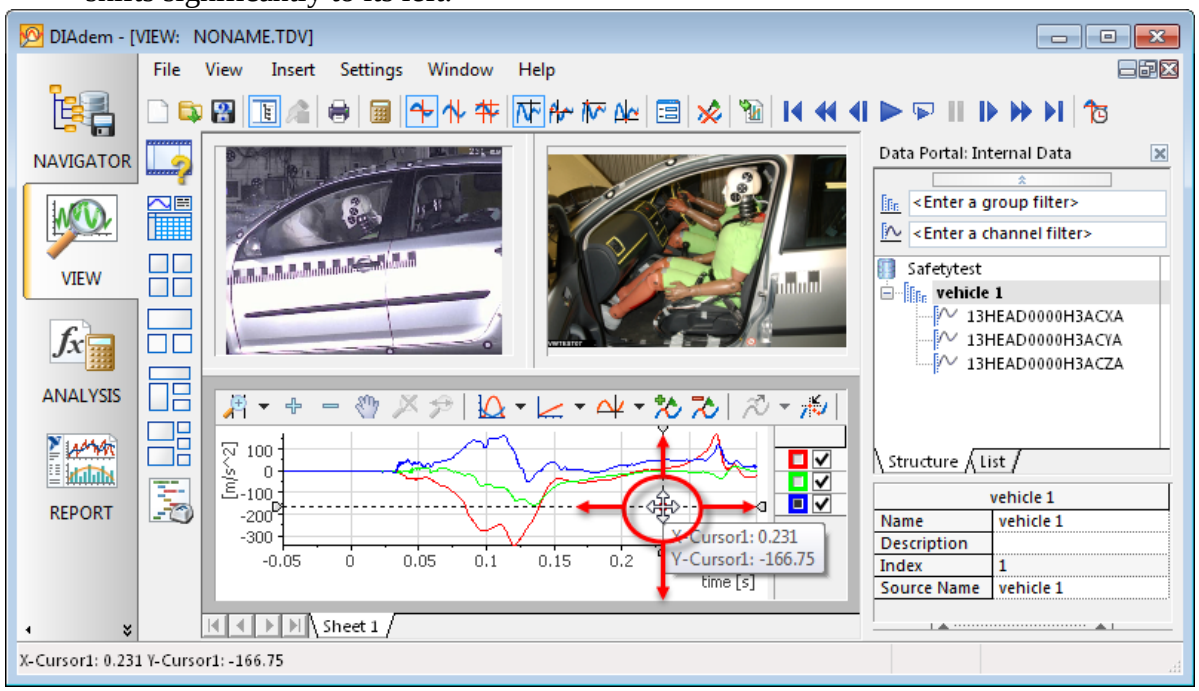
6.21 Now play the video and data synchronized in slow motion. Click on the **"Repeat Play"** button at the top right of your screen to replay the crash continuously. Notice how the video frames don't begin until time = 0, just like you configured.



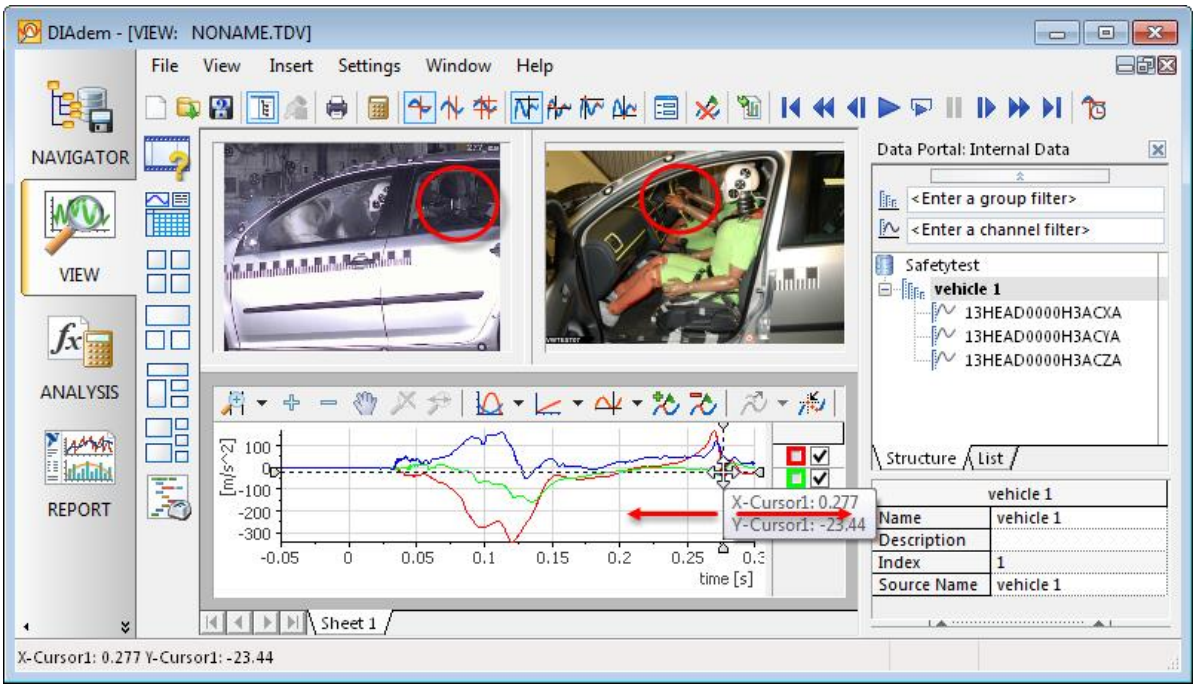
6.22 After watching the crash loop a time or two, you now want to be able to zero in on a particular time of interest— the headrest impact. First you must stop the continuous replay. **Click** on the **Pause** button at the top right of your screen.



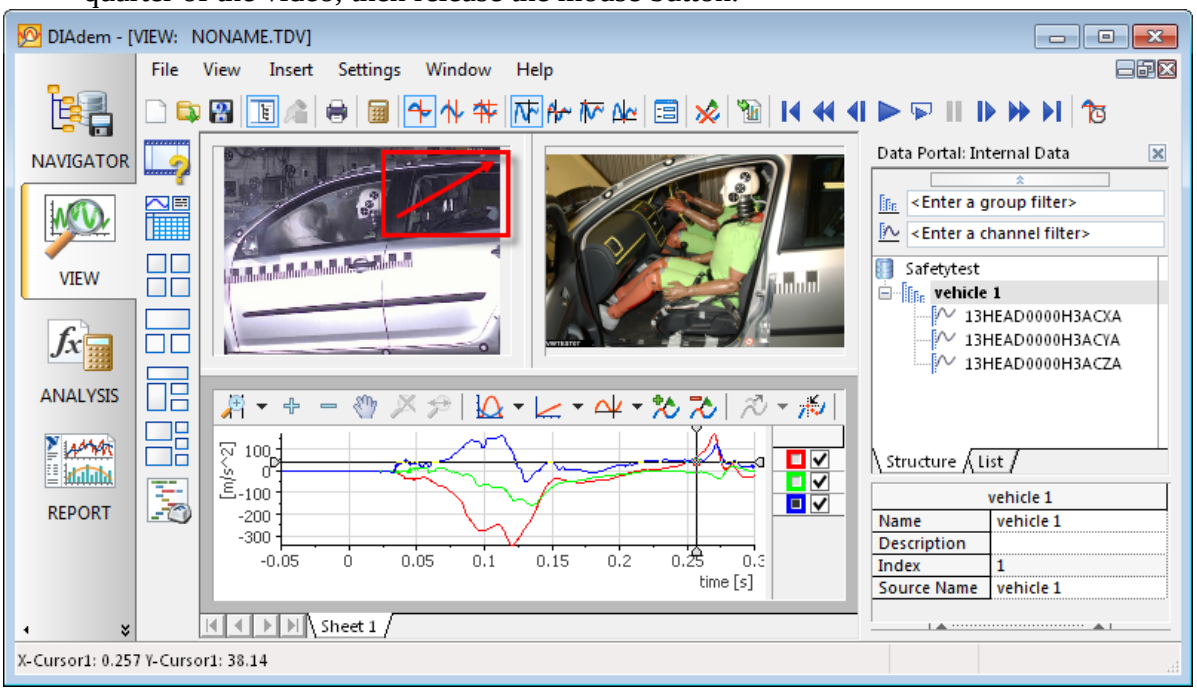
6.23 **Click** and **drag** your mouse **cursor on** the bottom **graph** area **left and right**, which will move the graph cursor backwards and forwards in time, dragging the synchronized video frames with it. Notice that after the impact the rear of the car shifts significantly to its left.



6.24 Now move your cursor slightly left and right near the 0.25 second mark. It looks like the dummy further away from you hits his head on the headrest when the acceleration channels peak again. Also notice in the static image of the test setup that this is a car for right-hand drivers (UK, India, etc.), so that would be the driver dummy who hit his head.

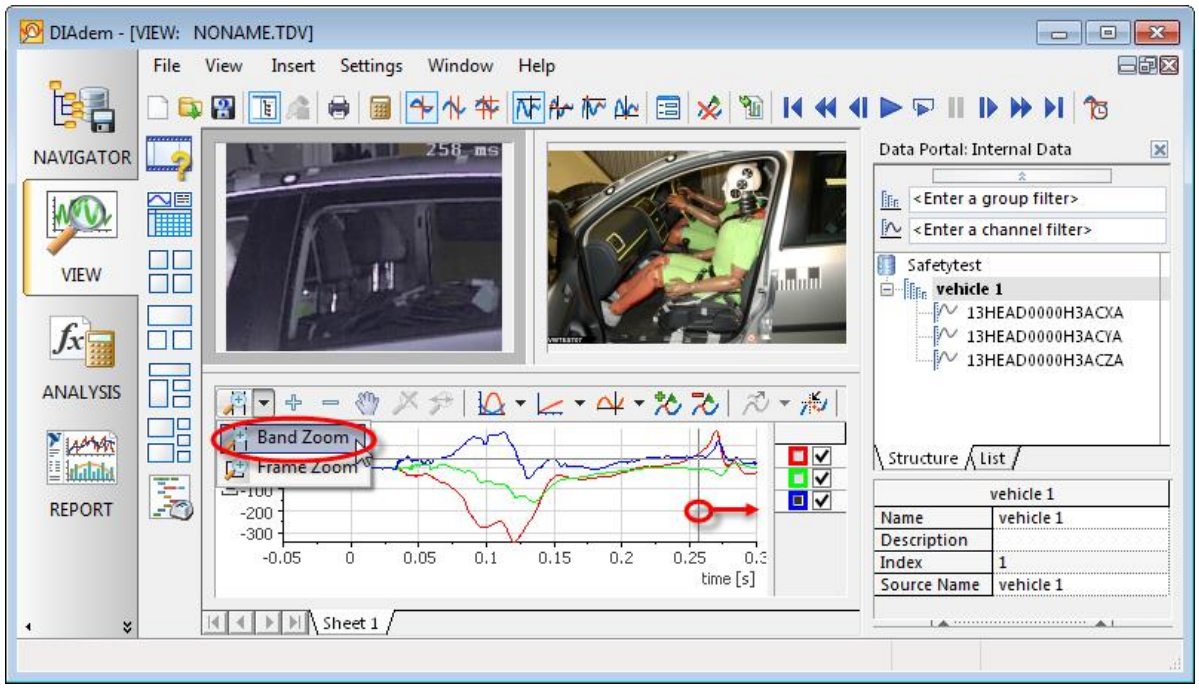


6.25 You want to zoom into the top right region of the video to take a closer look at the headrest impact. **Position** your **mouse** at the **center** of the **video** area, then **right-click**, **hold** and **drag** your mouse **to** the **upper right** corner to highlight the top right quarter of the video, then release the mouse button.

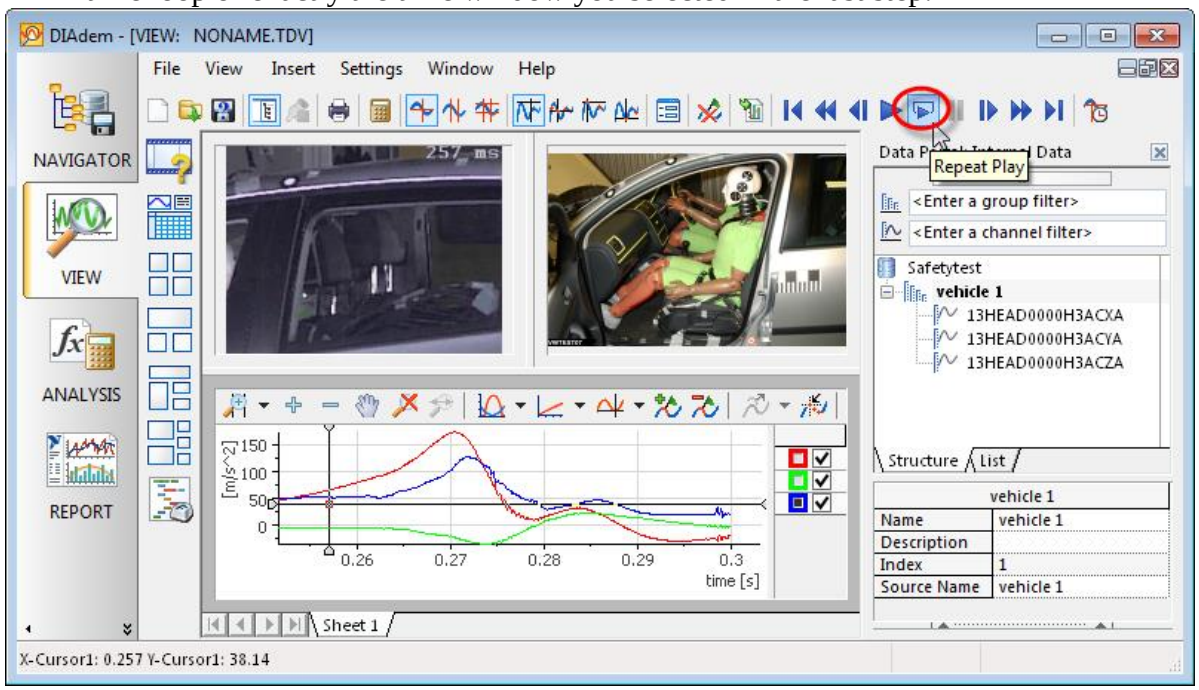


Note: If you want to unzoom the video, just right-click on the video area and select the context menu "Zoom>>Zoom Off".

6.26 You can also zoom into just the time window that contains the headrest impact. **Click** on the **"Band Zoom"** icon at the top left of the acceleration graph, the click, hold and drag the mouse from about 0.25s to the end of the graph (0.3s), finally release the mouse to select this time window for the zoom.

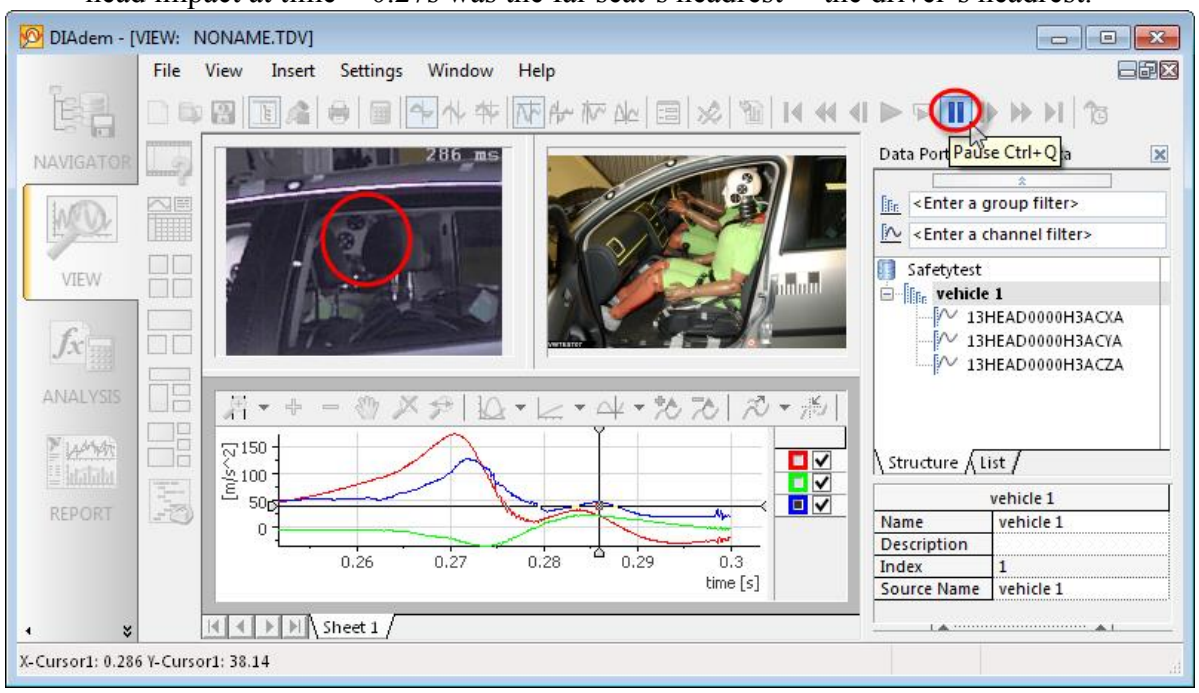


6.27 **Click** on the **"Repeat Play"** icon and observe that now the video replay is in a tight time loop of exactly the time window you selected in the last step.

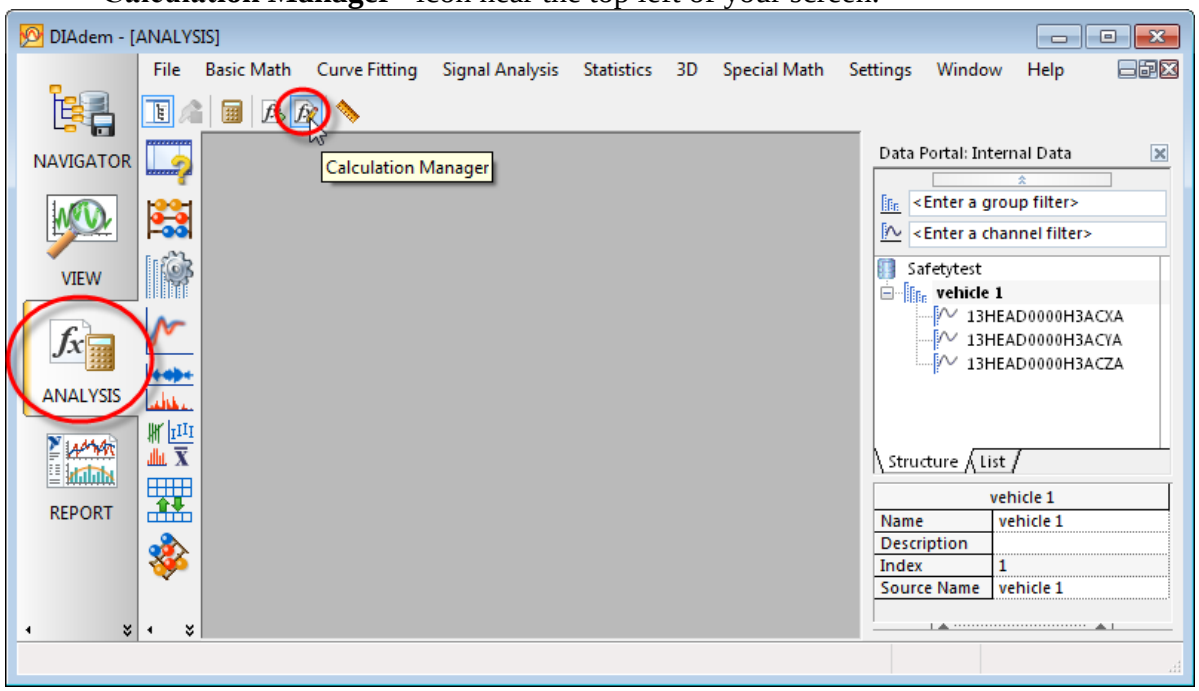


Note: If you had selected the video area prior to clicking on the "Repeat Play" icon, the entire video would have replayed. The "Play" and "Repeat Play" icons infer the time window to use from the currently selected VIEW area.

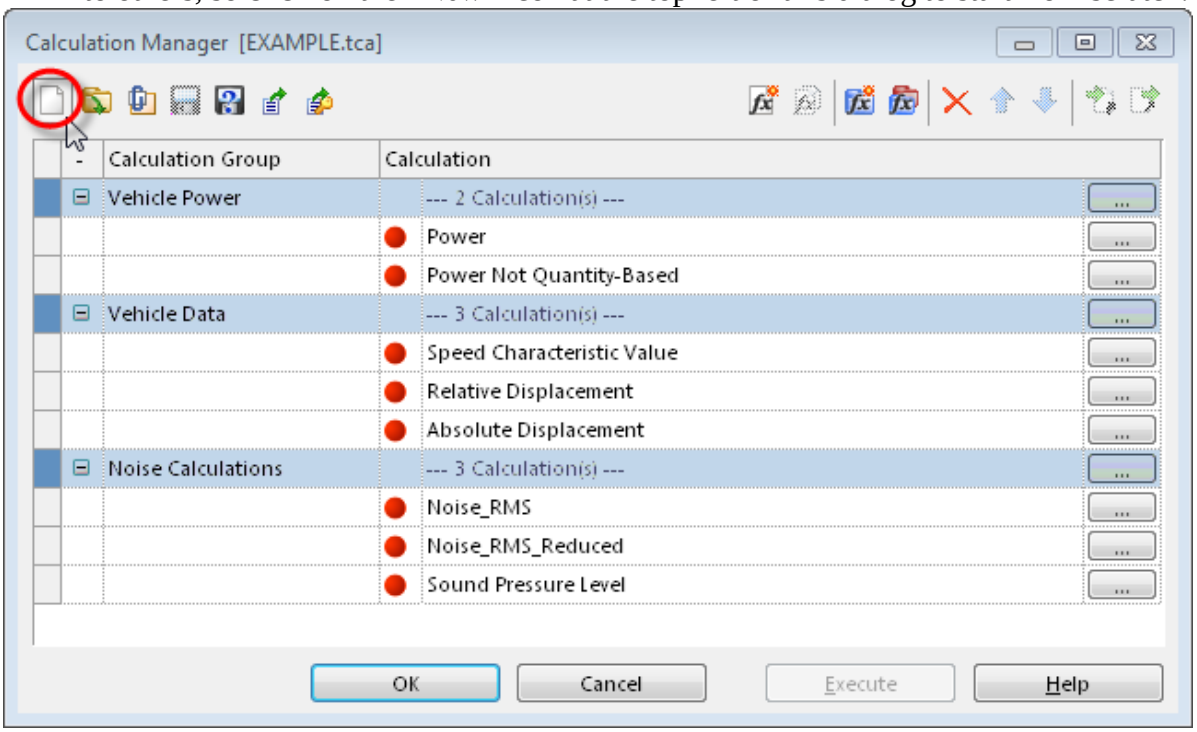
6.28 **Click** on the **"Pause"** icon to stop the video replay. Now you're convinced that the head impact at time = 0.27s was the far seat's headrest— the driver's headrest.



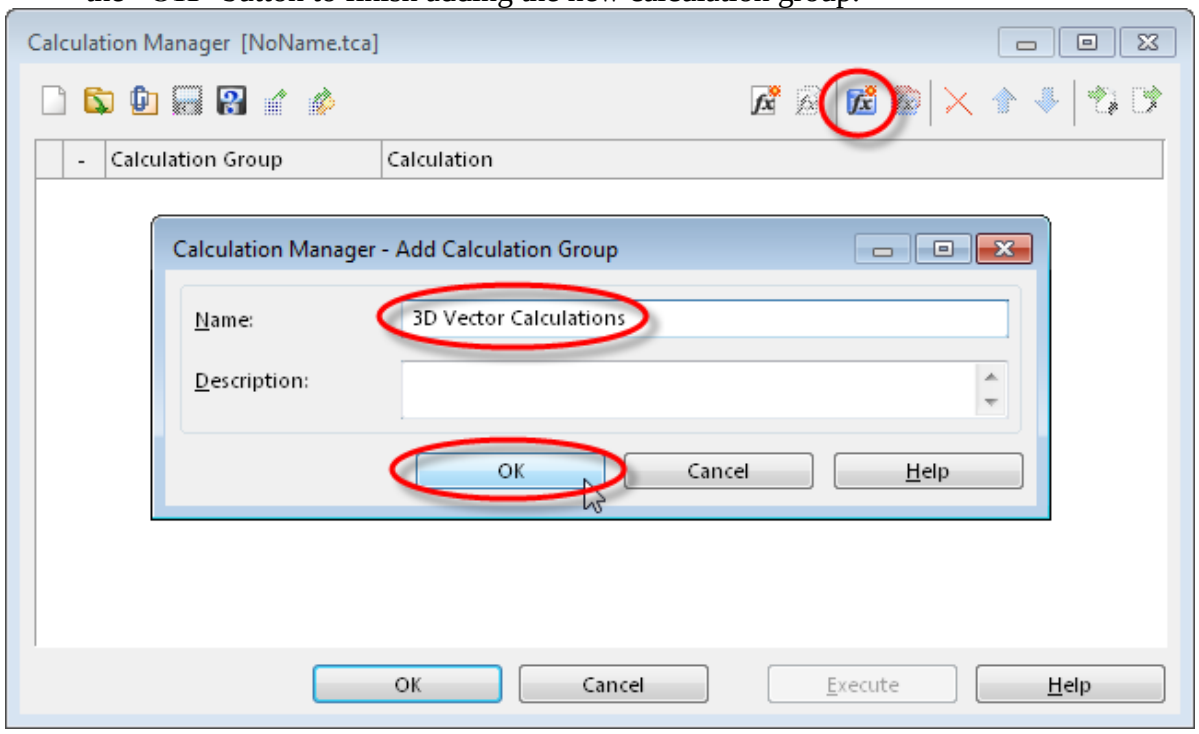
6.29 Now it's time to calculate the resultant acceleration. You know the DIAdem Crash Analysis Toolkit has a built-in function for this and many other standard crash algorithms, but you don't have that installed yet. You figure you ought to be able to do this with a general-purpose channel calculation. **Click** on the **ANALYSIS** tab at the left of your screen to switch to the ANALYSIS panel, then **click** on the **"Calculation Manager"** icon near the top left of your screen.



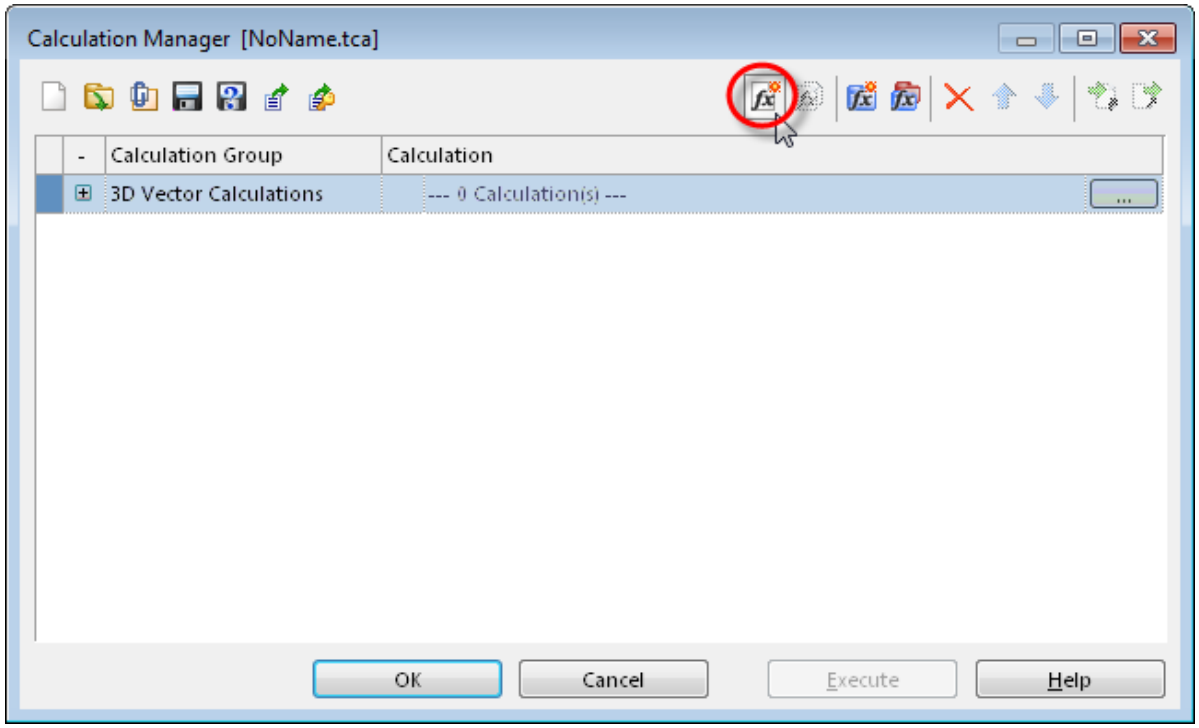
6.30 This is the "Calculation Manager" in DIAdem, in which you can configure, save, load, and execute channel calculations. These calculations are usually a single, free-form equation taking one or more channels as inputs and always resulting in one channel of calculated values. Sometimes a series of calculations need to be performed, with the output of the first calculation used as an input in the second calculation, etc. Other times the calculation is more complicated than a single equation. In all cases the Calculation Manager keeps track of the logic of each calculation and the sequence and interconnectedness of multiple calculations. The default calculation groups you see below ("Vehicle power", "Vehicle data", "Noise calculations") are installed by DIAdem as the default example calculation set. You want to create a brand new calculation set from scratch that you can re-use and send to others, so **click** on the **"New"** icon at the top left of this dialog to start from scratch.



6.31 Your new calculation set will have only one formula in it (to calculate the 3D resultant value), but you still need to create and name a calculation group, so **click** on the **"Add Calculation Group"** icon at the top of this dialog. **Name** the new calculation group **"3D Vector Calculations"** in the dialog that pops up, then **click** on the **"OK"** button to finish adding the new calculation group.

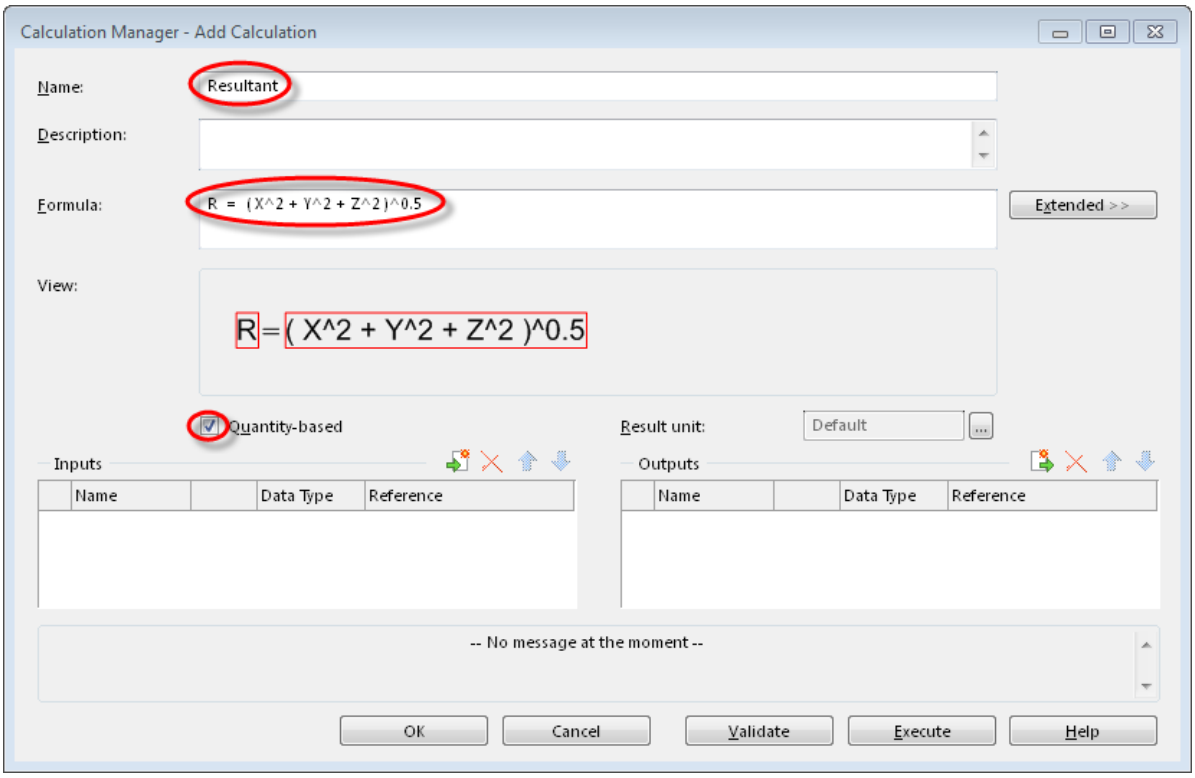


6.32 **Click** on the **"Add Calculation"** icon at the top of your dialog to add a channel calculation to your new calculation group "3D Vector Calculations" that will determine the 3D vector resultant channel from the respective X, Y, and Z component channels.



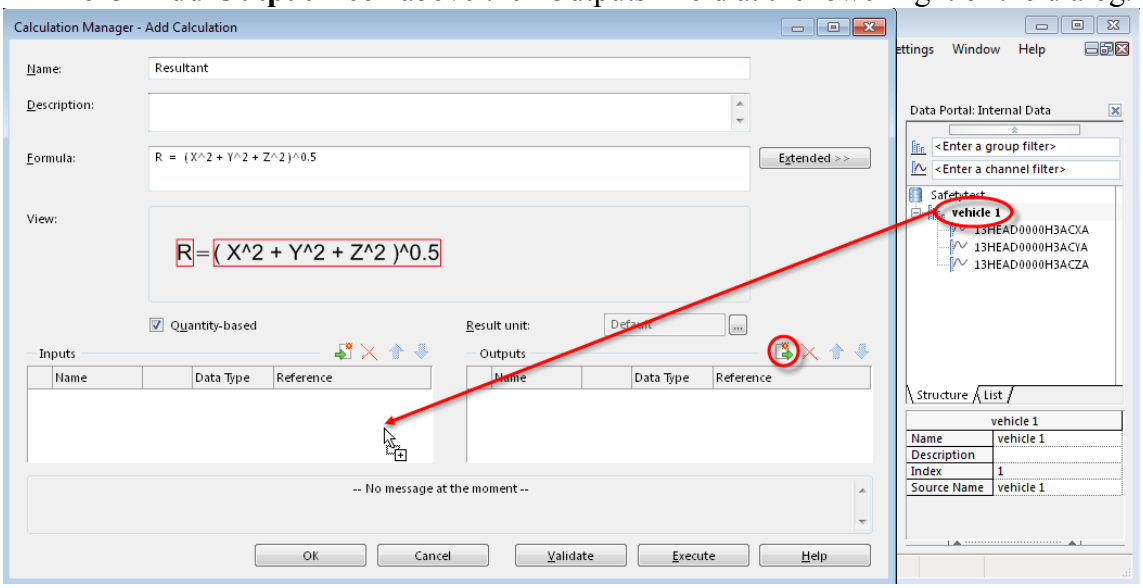
6.33 First **name** the new channel calculation **"Resultant"** in the "Name:" field at the top left of the dialog. Next **check** the **"Quantity-based"** checkbox at the left middle of the dialog to enable automatic unit conversions. Finally **type** into the "Formula:" field the **following equation** to calculate the 3D vector resultant channel from the respective X, Y, and Z component channels:

R = (X^2 + Y^2 + Z^2)^0.5

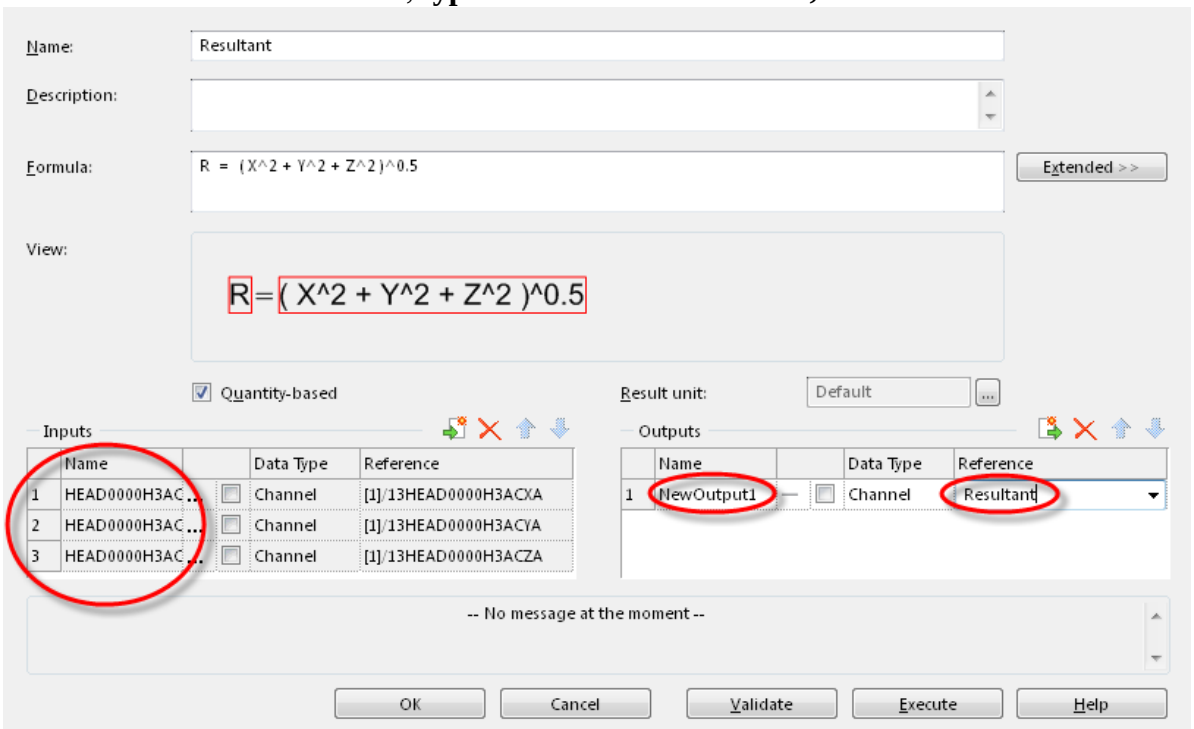


The upper half of the Calculation Manager dialog specifies the name, description and formula of the calculation. The lower half of the Calculation Manager dialog links each variable (R, X, Y, Z) in the calculation's formula with a data source or data target. All array variables are mapped one-to-one to a channel in the Data Portal. Scalar variables, on the other hand, can be mapped to a constant value, a DIAdem expression, or a property value from the Data Portal. Additionally, input variables in this calculation can be mapped from the outputs of previous calculations, and the output variable in this calculation can be mapped to an input of a subsequent calculation.

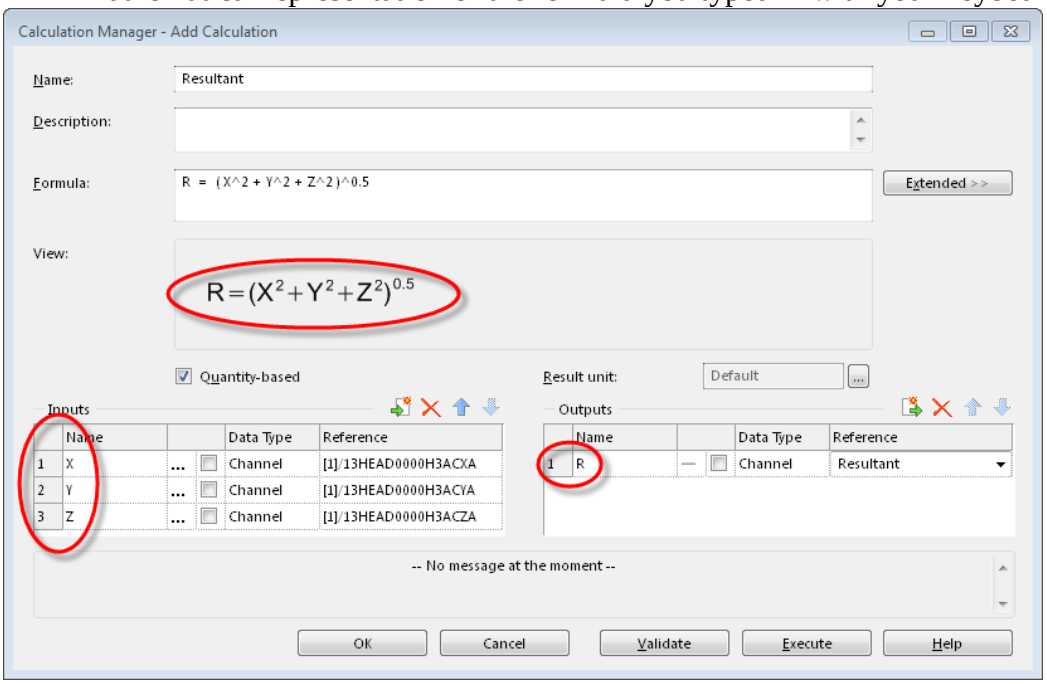
6.34 You need to add 3 input definitions (X, Y, Z) and one output definition (R) to the bottom half of this dialog. **Drag** the **"vehicle 1"** group from the Data Portal at the right of DIAdem into the "Inputs" field in the lower left of the dialog, then **click** on the **"Add Output"** icon above the "Outputs" field at the lower right of the dialog.



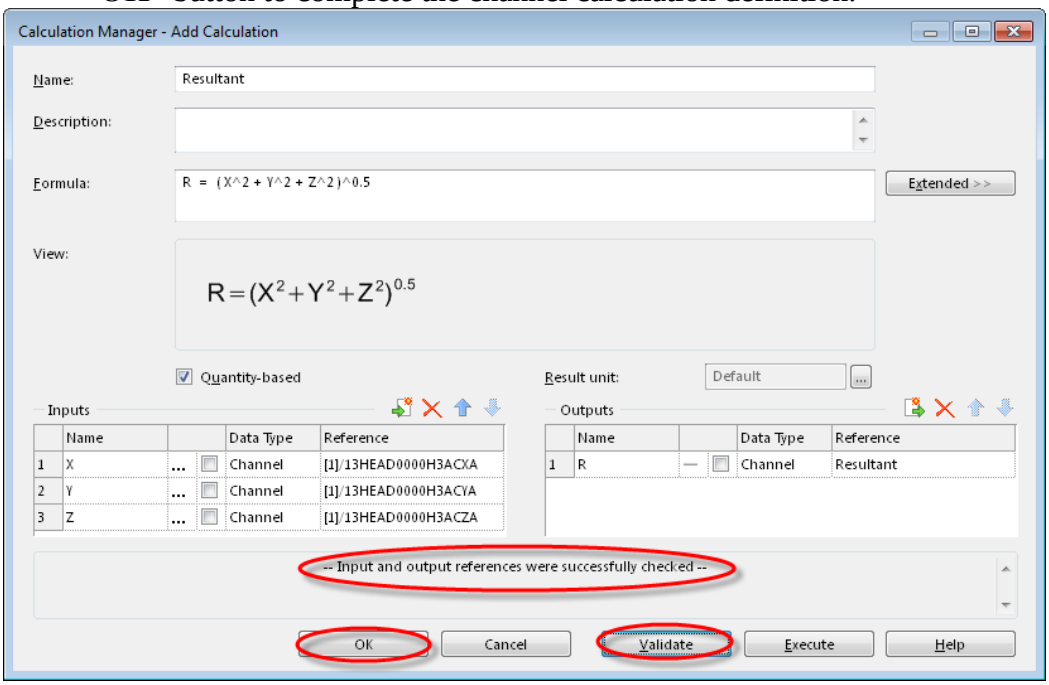
6.35 Now you have 3 channel inputs that will supply the values to the X, Y, Z variables in your equation, plus 1 channel output that will receive the R variable values from your equation. Since you want these R variable values to be sent to a new channel, you need to type in the name of the new channel in the "Reference" field. **Double-click** on the **"Reference"** field, **type** in the name **"Resultant",** and hit <Enter>.



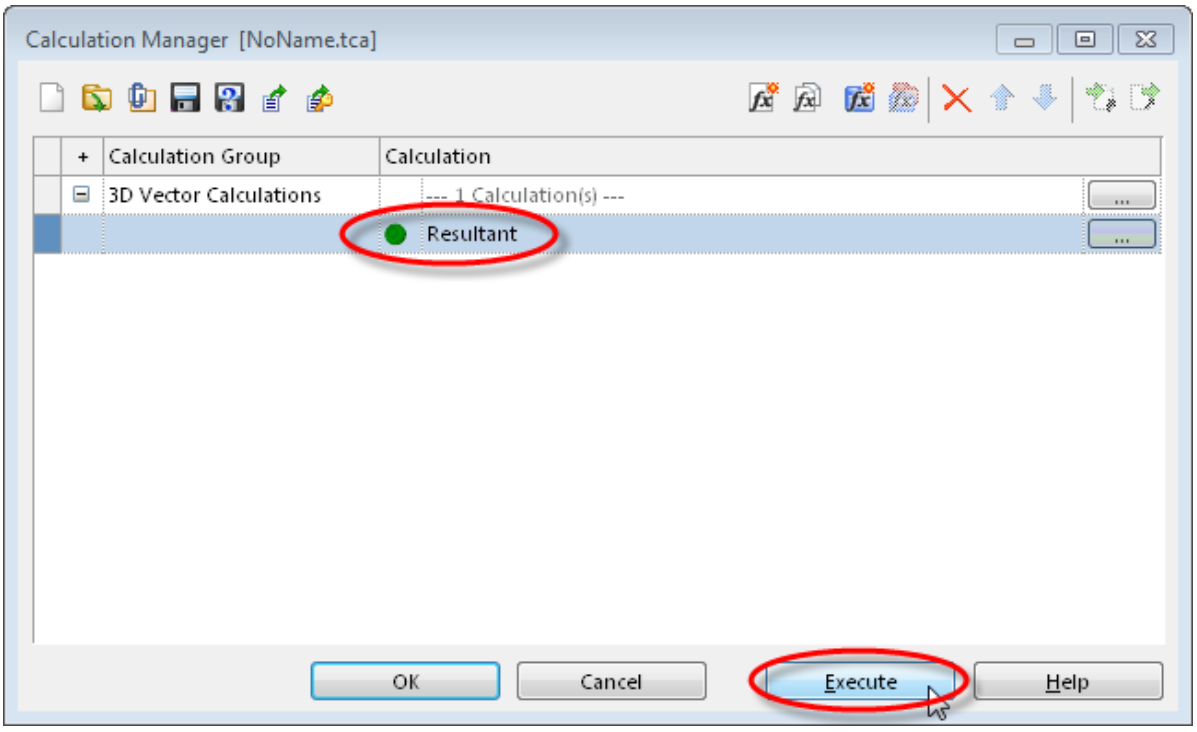
6.36 You still need to supply the matching variable names to each input and output. **Rename** the 3 inputs to **"X", "Y, "Z"**, and rename "NewOutput1" to **"R"**. When the last variable is entered correctly, you will see the "View:" display switch to a mathematical representation of the formula you typed in with your keyboard.



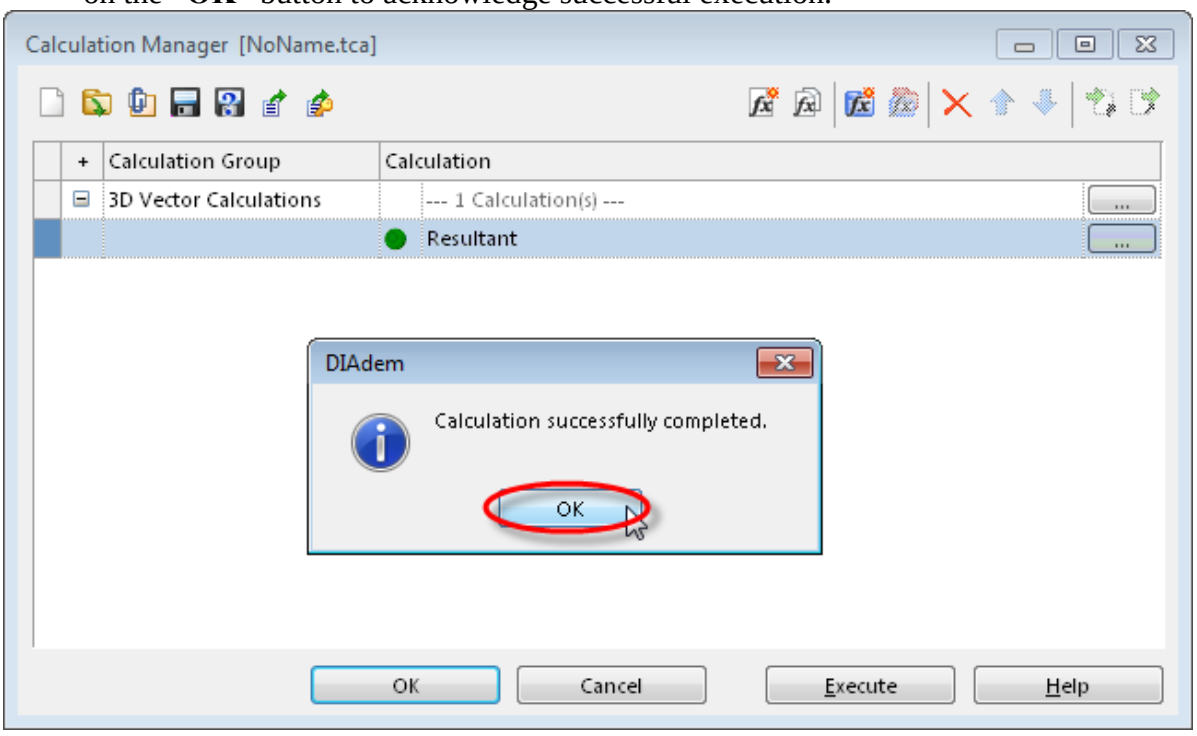
6.37 Finally, **click** on the **"Validate"** button at the bottom of the dialog to check if the channel calculation is error-free and ready to execute. If you don't get the "…successfully checked" message shown below, carefully review the contents of this channel calculation dialog and fix any discrepancies before proceeding. **Click** the **"OK"** button to complete the channel calculation definition.



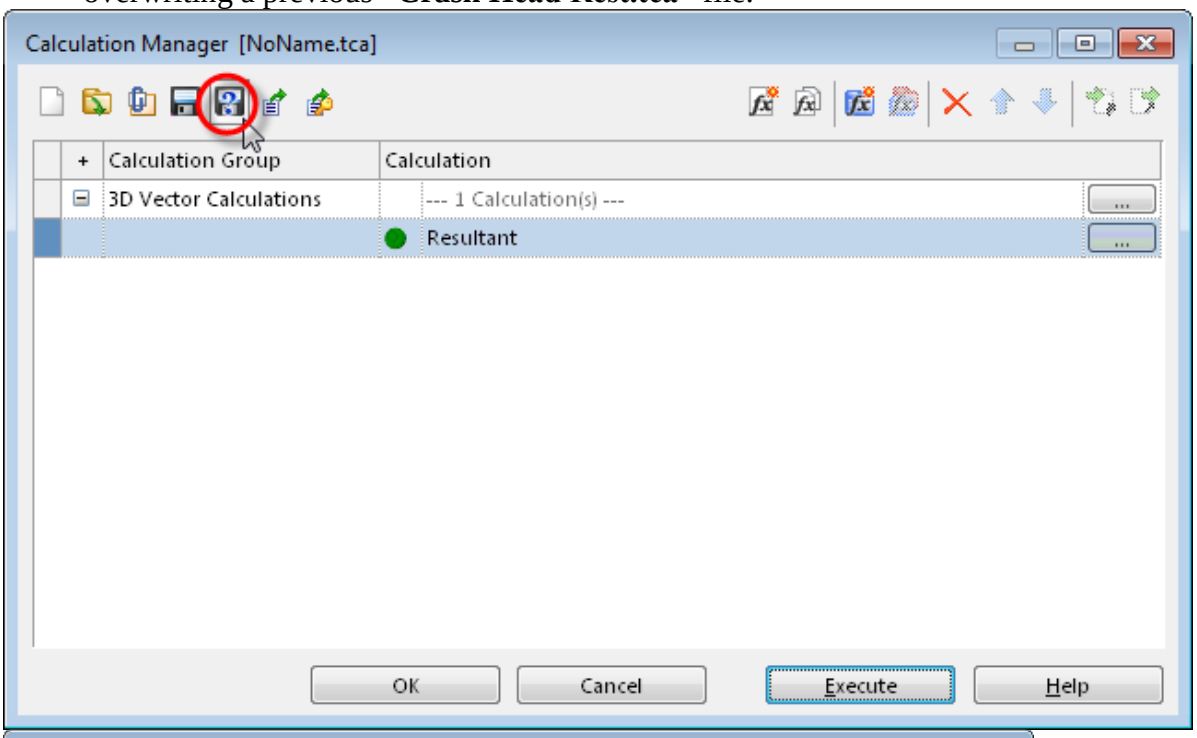
6.38 Now you see the new "Resultant" channel calculation in your "3D Vector Calculations" Group. The green LED next to it indicates that the channel calculation is verified and ready to run. **Click** on the **"Execute"** button to finally calculate the 3D vector resultant acceleration channel.

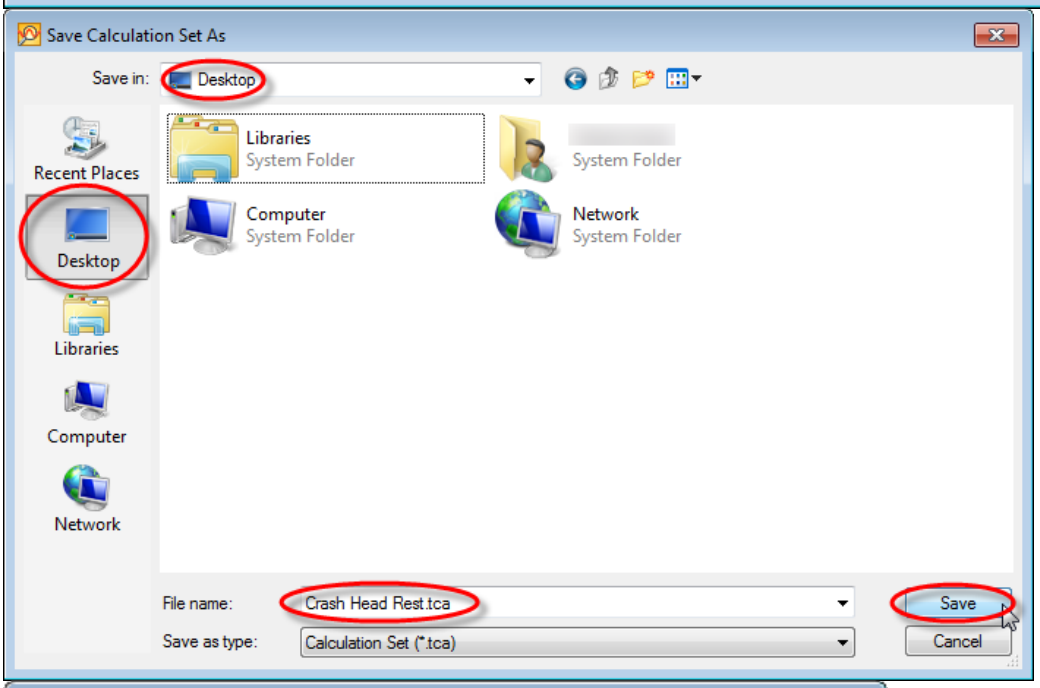


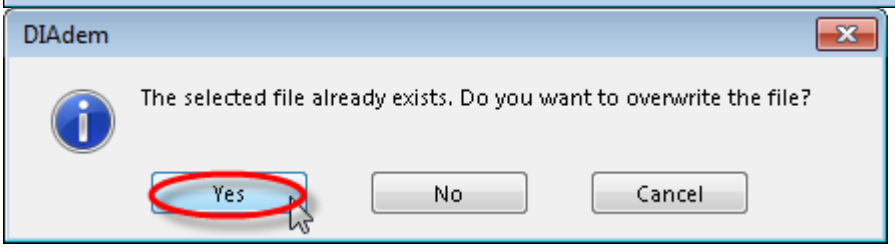
6.39 The channel calculation adds the new "Resultant" channel to the Data Portal—**click** on the **"OK"** button to acknowledge successful execution.



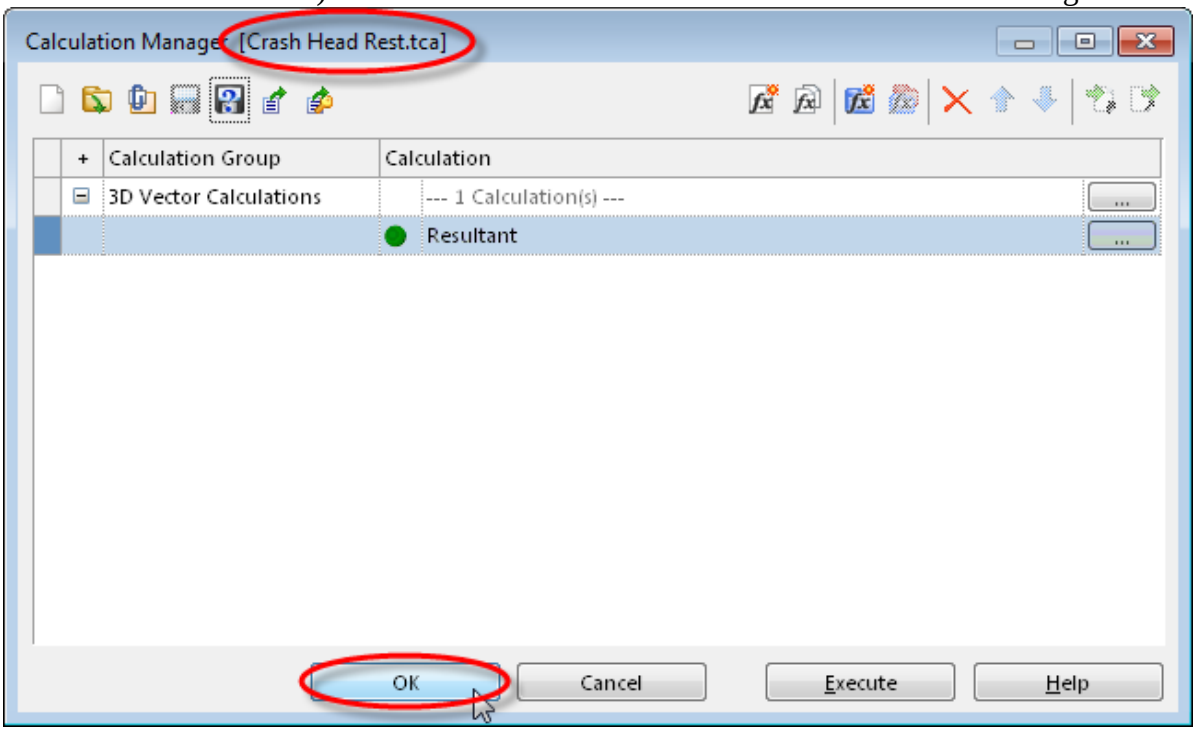
6.40 You need to send all your results to your mentor, so **click** on the **"Save As"** icon at the top left of this dialog to export your new 3D vector resultant channel calculation to a file your mentor can load on his computer. **Click "Yes"** if you are asked to confirm overwriting a previous **"Crash Head Rest.tca"** file.



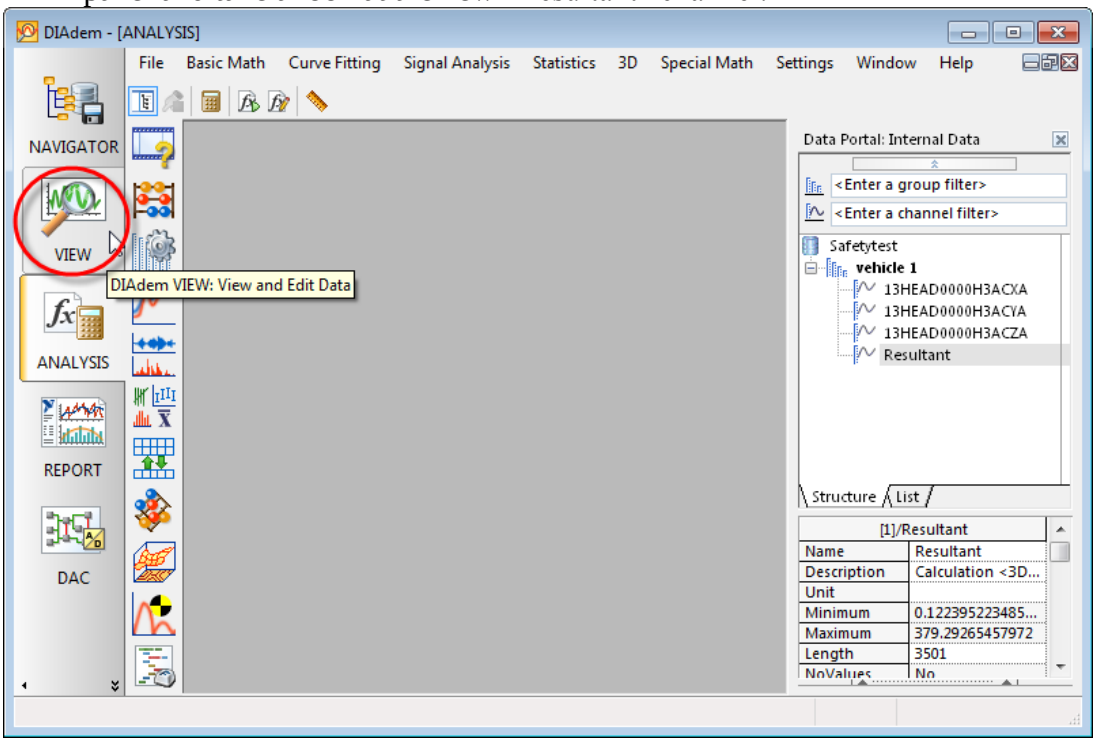




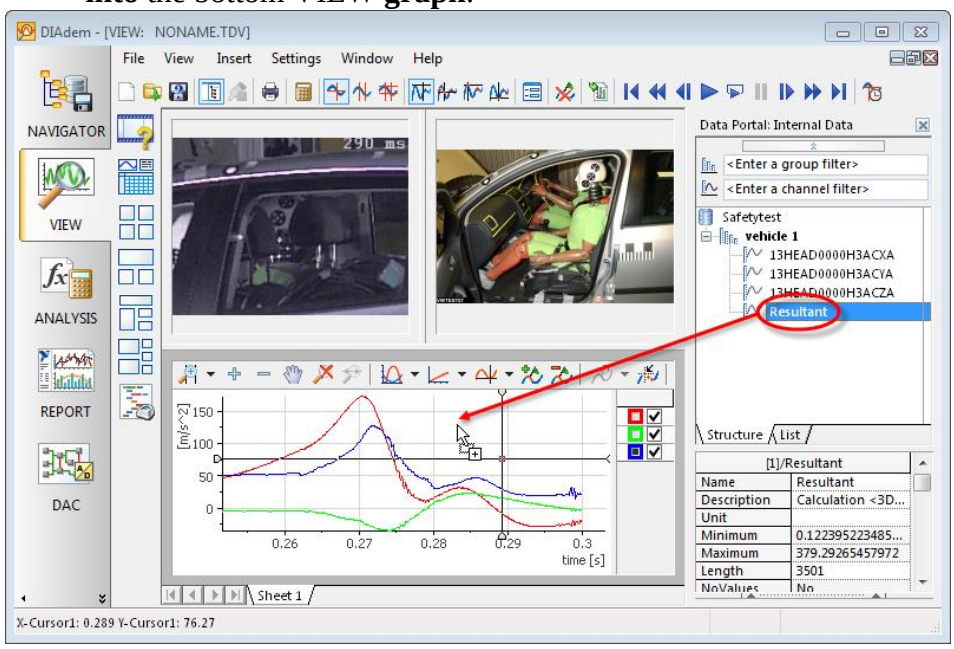
6.41 You are now done with the 3D resultant calculation (maybe you SHOULD activate that Crash Toolkit). **Click** on the **"OK"** button to exit the Calculation Manager.



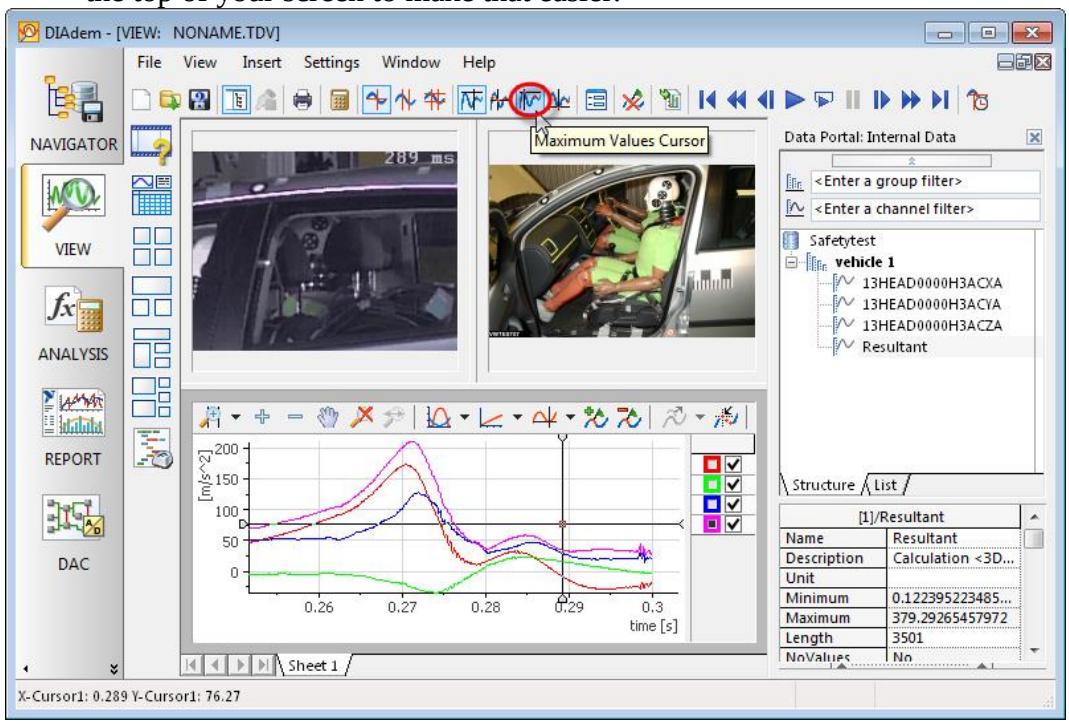
6.42 **Click** on the large **"VIEW"** icon at the left of your screen to switch back to the VIEW panel and take a look at the new "Resultant" channel.



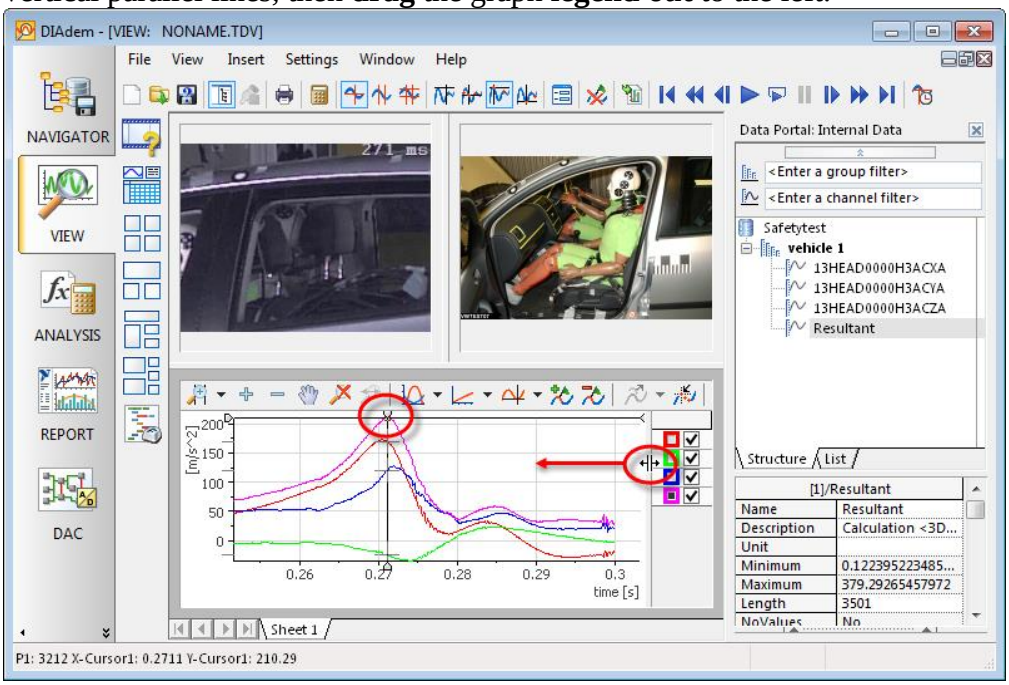
6.43 **Drag** the new **"Resultant" channel** from the Data Portal on the right of your screen **into** the bottom VIEW **graph**.



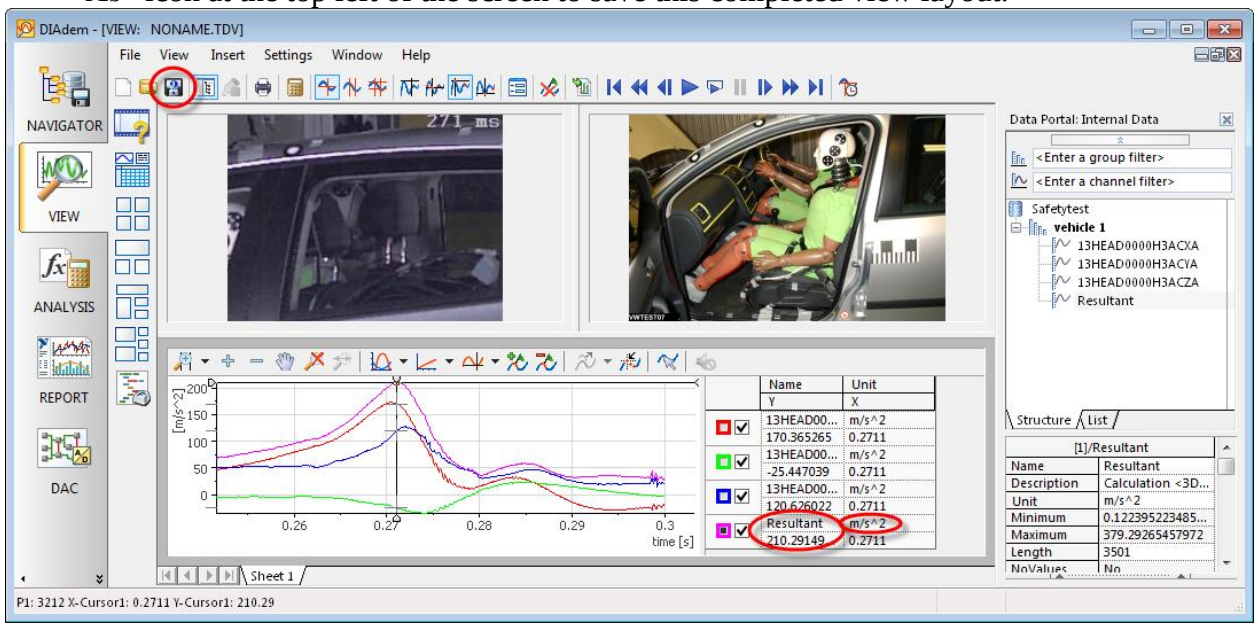
6.44 Now you see the resultant acceleration for each time during the crash. Your mentor had specifically asked you to check the peak resultant acceleration when the head slammed back into the headrest. **Click** on the **"Maximum Values Cursor"** icon at the top of your screen to make that easier.



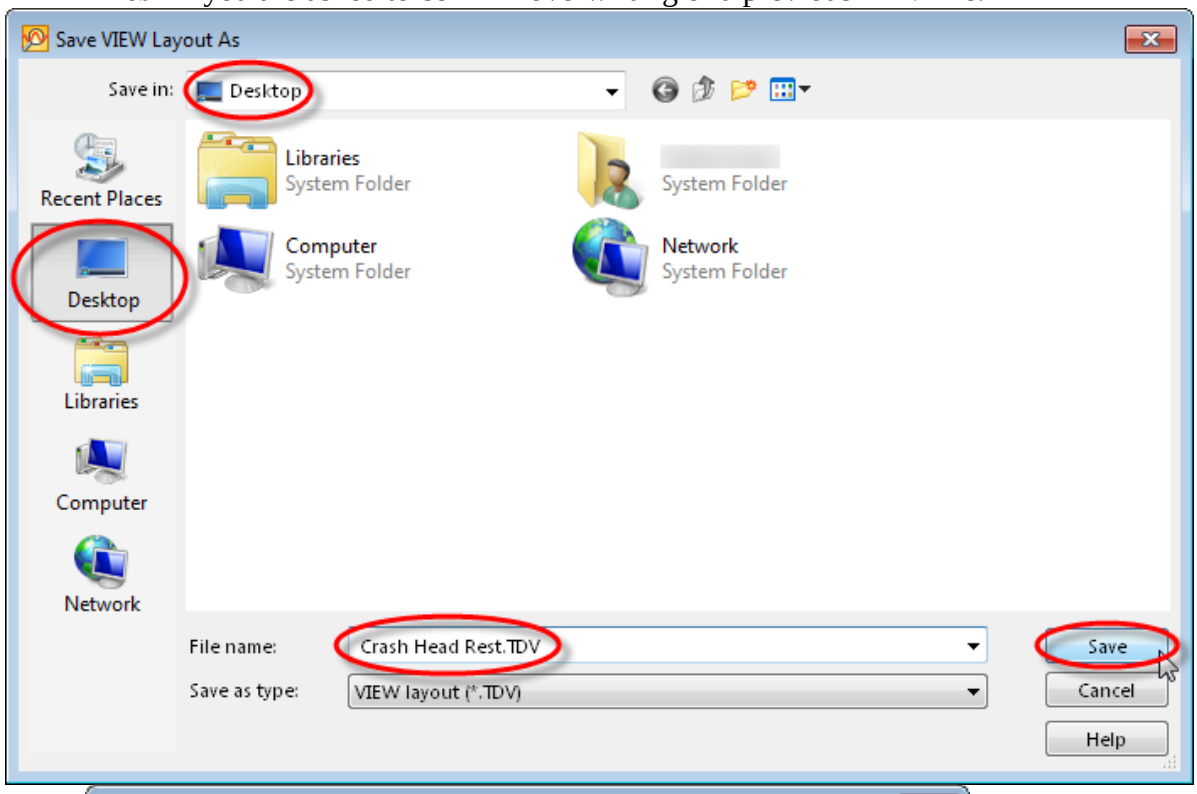
6.45 This "Maximum Values Cursor" jumps between local maxima of the active curve (currently the pink "Resultant" curve). **Click** on your **left** and **right arrow keys** a few times until the **cursor** lands exactly **on** the **headrest peak**, as shown below. Now **hover** your **mouse** over the right **edge** of the graph until the cursor changes to 2 vertical parallel lines, then **drag** the graph **legend out** to the left.

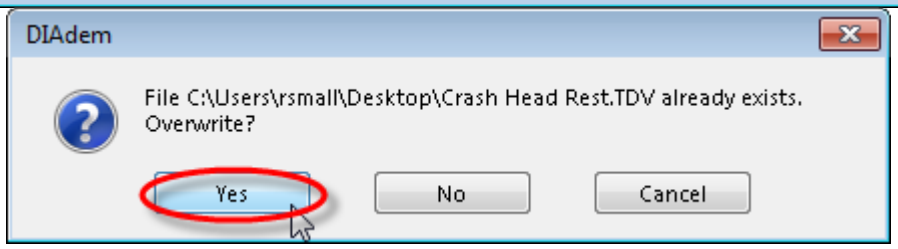


6.46 Now you can see in the Legend that the "Resultant" peak value at headrest impact is over 210 m/s^2-- you must tell your mentor that the 205 m/s^2 limit was exceeded. Note that the "m/s^2" unit in the Resultant channel was automatically inherited from the X, Y, and Z component channels in the channel calculation. **Click** on the **"Save Layout As"** icon at the top left of the screen to save this completed view layout.

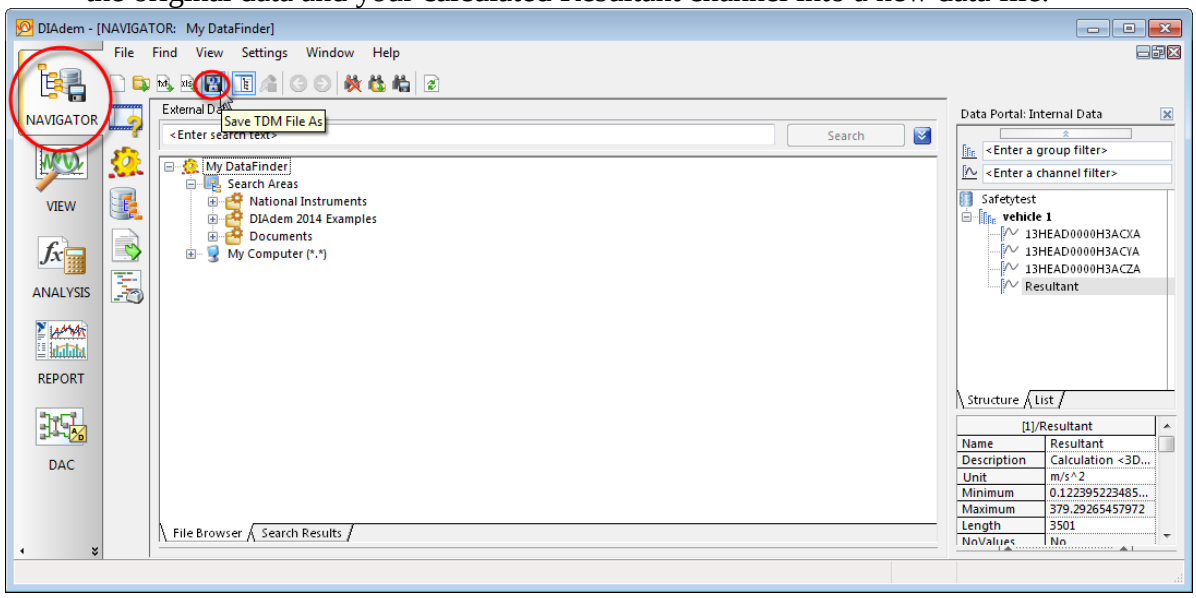


6.47 **Navigate** to the **Desktop** and **name** the VIEW layout file **"Crash Head Rest.TDV"**, then **click** on the **"Save"** button to export your VIEW layout. Your mentor will be able to load this TDV file and see the crash synchronization you see now. **Click "Yes"** if you are asked to confirm overwriting of a previous TDV file.

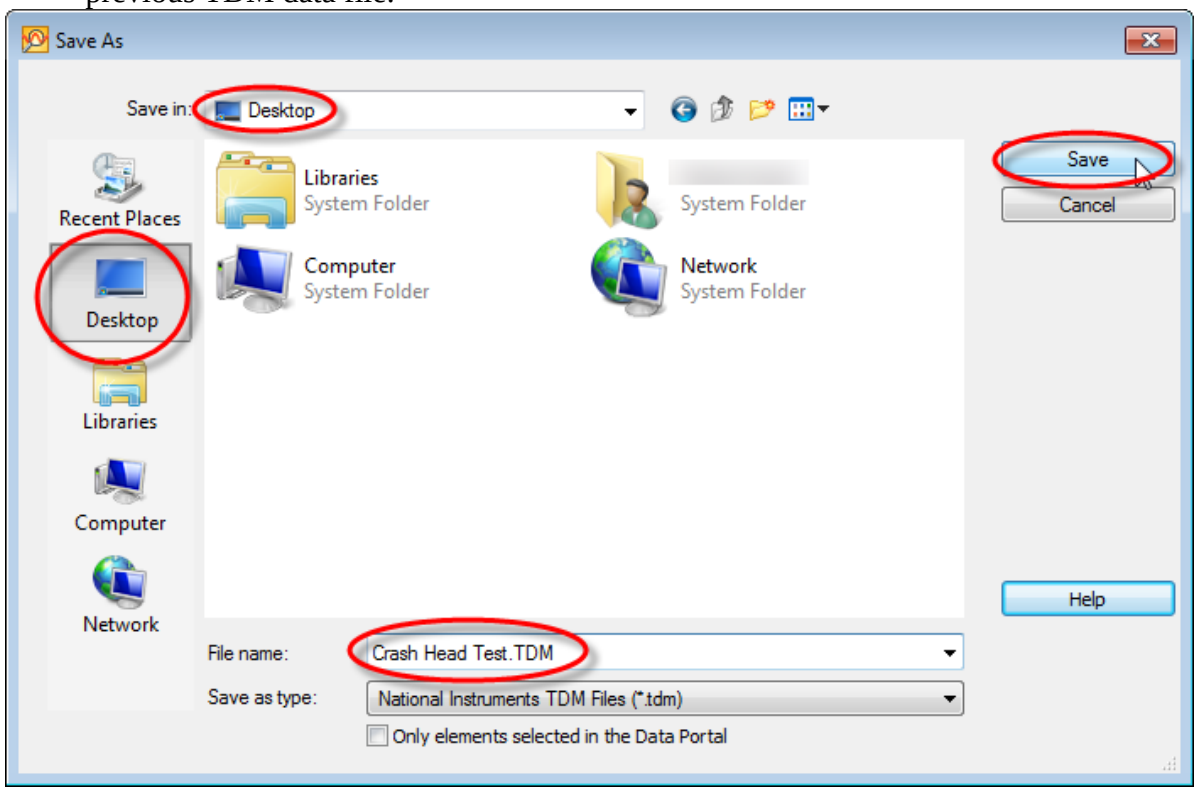


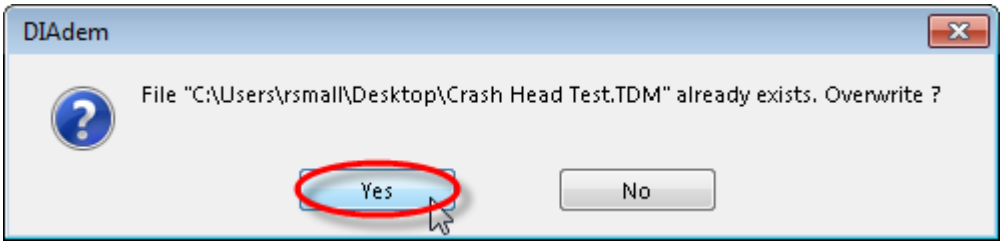


6.48 **Click** on the **NAVIGATOR** tab, then **click** on the **"Save TDM File As"** icon to save the original data and your calculated Resultant channel into a new data file.

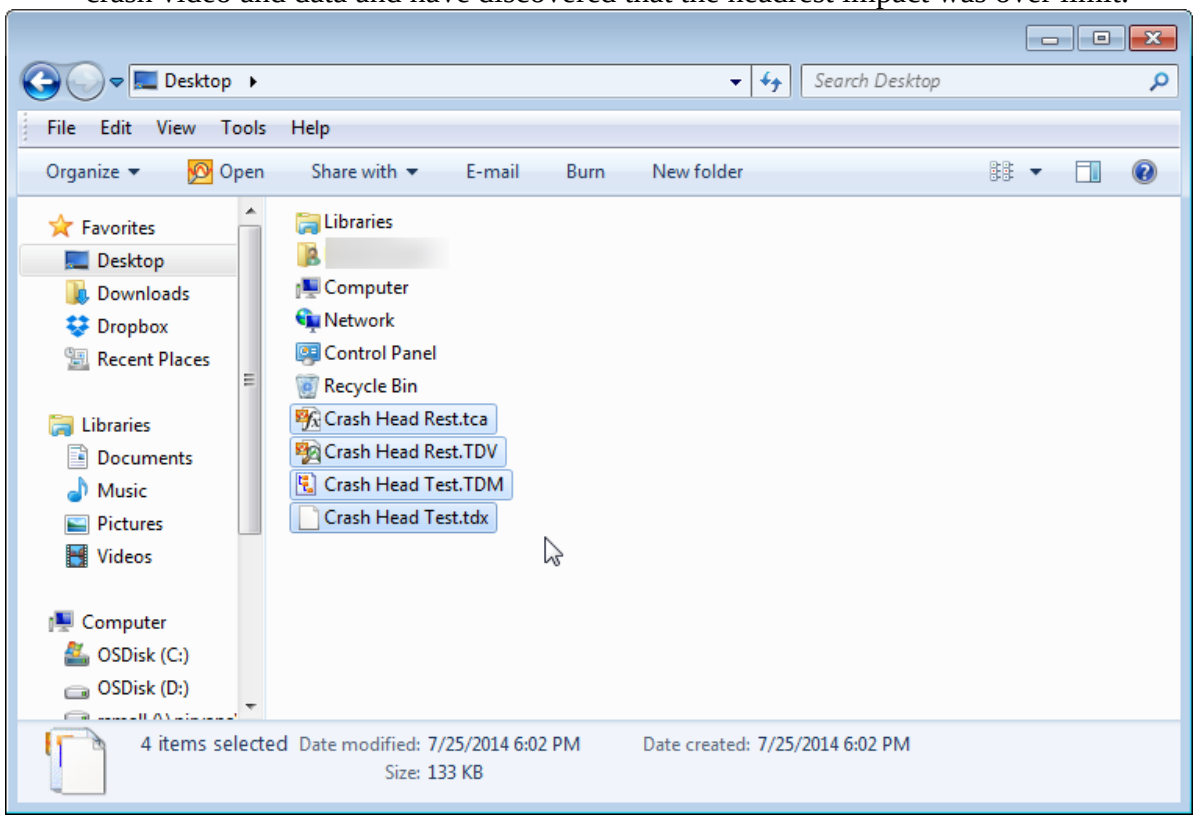


6.49 **Navigate** to the **Desktop** and **name** the data file **"Crash Head Rest.TDM"**, then **click** on the **"Save"** button to export all 4 of your Data Portal channels to a new TDM data file. It is important for you to send your mentor both the TDV VIEW layout file as well as the TDM (and TDX) data file(s), because the VIEW layout references the "Resultant" channel which you have calculated and which your mentor does not have unless you give it to him. **Click "Yes"** if you are asked to confirm overwriting of a previous TDM data file.





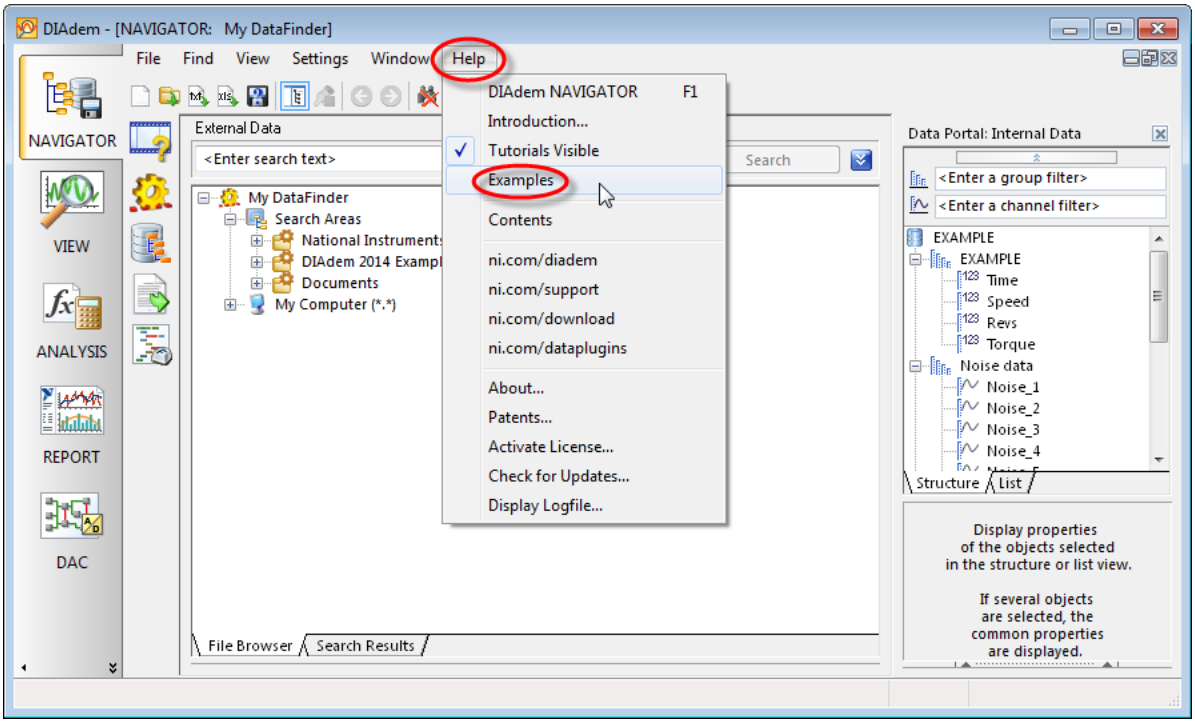
6.50 **Open** up Windows **Explorer** and **navigate** to the **Desktop**. Here you see the 4 files you need to send your mentor: the *.tca file with your resultant channel calculation, the *.tdv file with the VIEW layout, plus the 2 data files that contain the raw data and the calculated resultant channel. There are two data files because the TDM data file has a TDX data file which stores the actual channel values—you must send both TDM and TDX for the data channels to load in your mentor's DIAdem. When he gets back from his vacation, he will see that you have synchronized the display of the crash video and data and have discovered that the headrest impact was over limit.



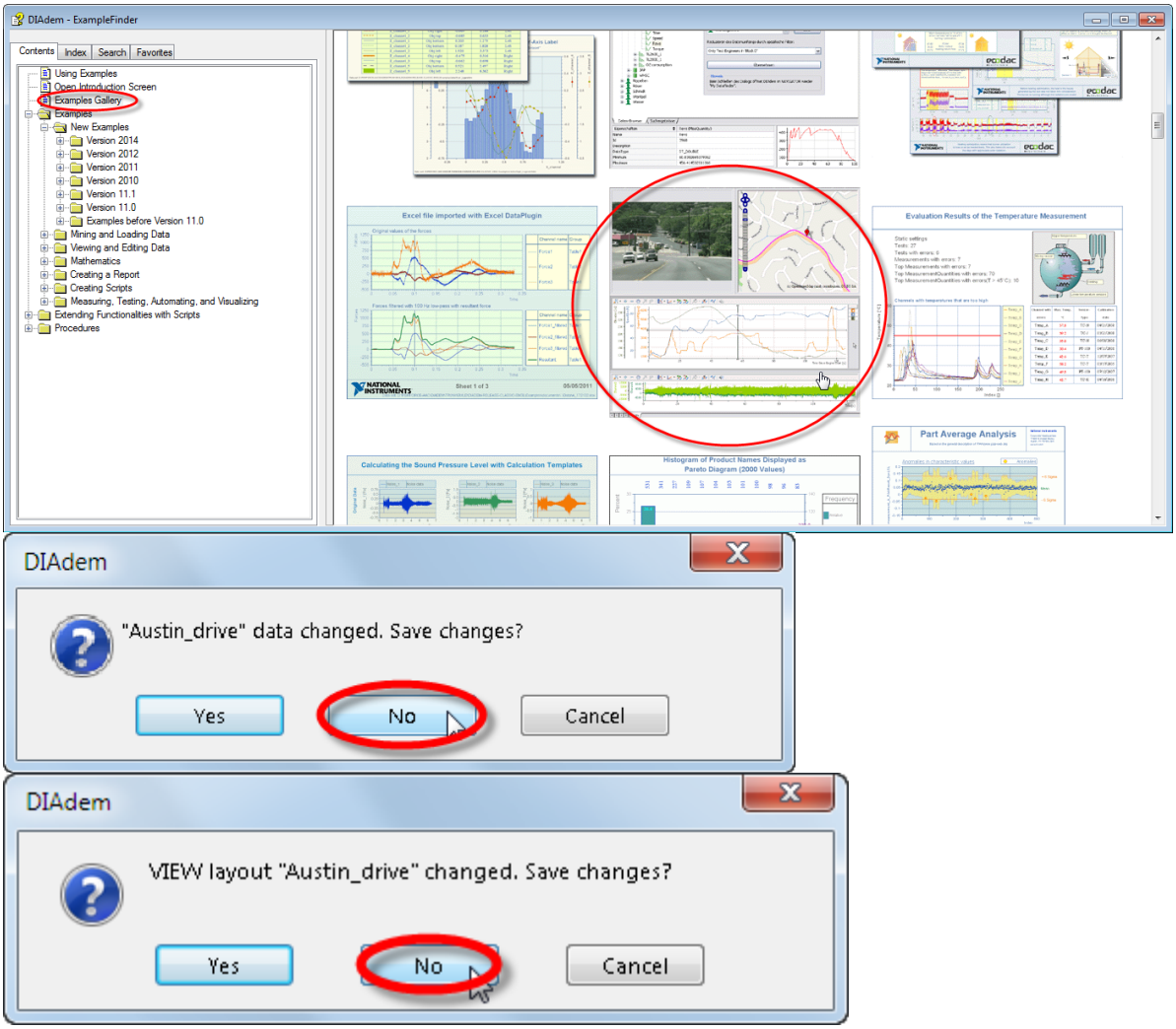
Exercise #7 Run Selected Shipping Examples

Scenario: You have a particular application or series of evaluation steps that were (sadly) not covered in the first 6 exercises of the DIAdem Hands-On. You are hoping that at least DIAdem installs a similar example which you can use to get started. In this exercise you will learn how to find examples visually with the Example Gallery as well as by running a search on a desired technology term using the ExampleFinder dialog.

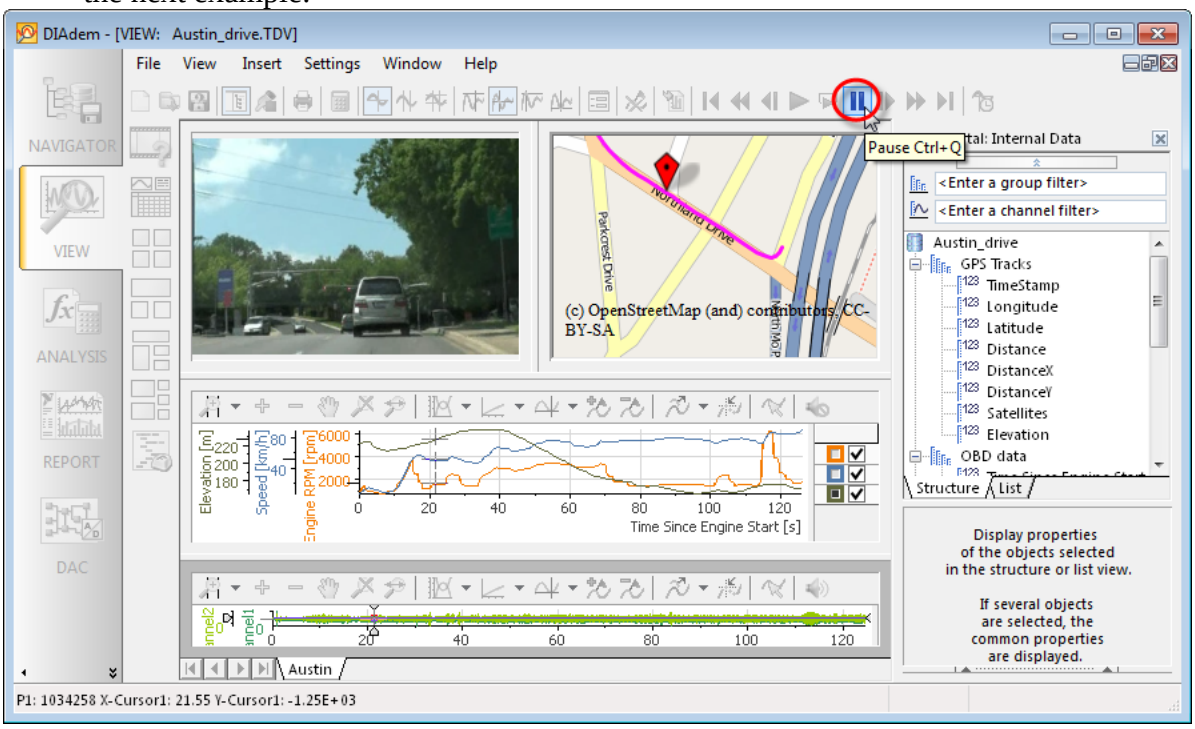
7.1 You need to start by launching the "ExampleFinder" dialog, with which you will find all the examples in this exercise and from which you will launch each of the examples to view them in DIAdem. **Click** on the **"Help" menu** at the top of your screen and **choose** the **"Examples"** menu.



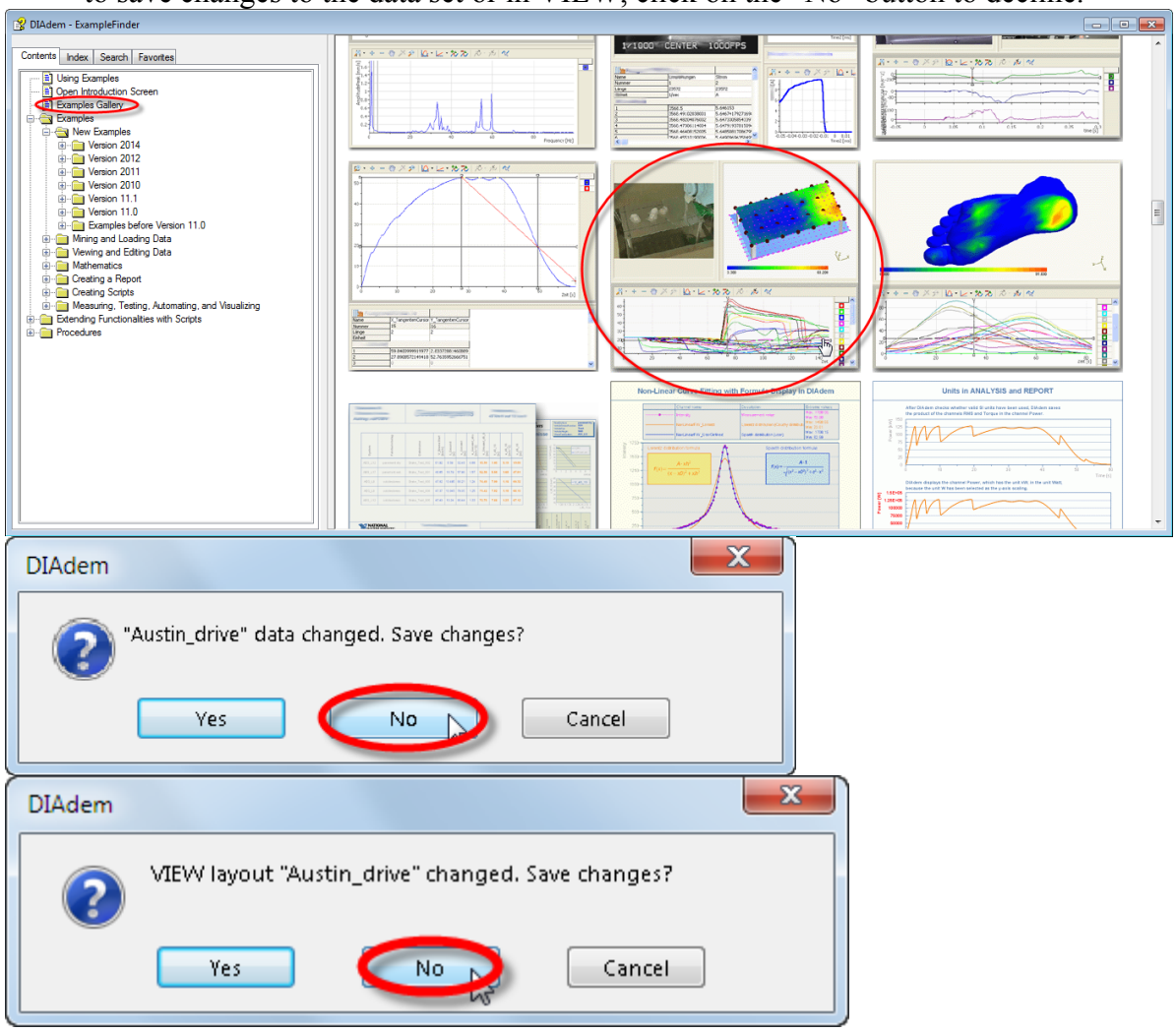
7.2 Navigate in the tree view at the top left of the ExampleFinder dialog to **"Examples Gallery"**. You will need to resize the ExampleFinder to show 3 example previews per "row" in the Examples Gallery, as shown below. This is the absolute easiest way to find an example— just browse through the preview icons in the Examples Gallery and click on any that look promising. Start by selecting the first icon you see that has a video of a road with cars on it— **click** on the example **icon** in the Examples Gallery to launch it. If asked to save changes to the current data set or the current layout in VIEW, click on the "No" button to decline.



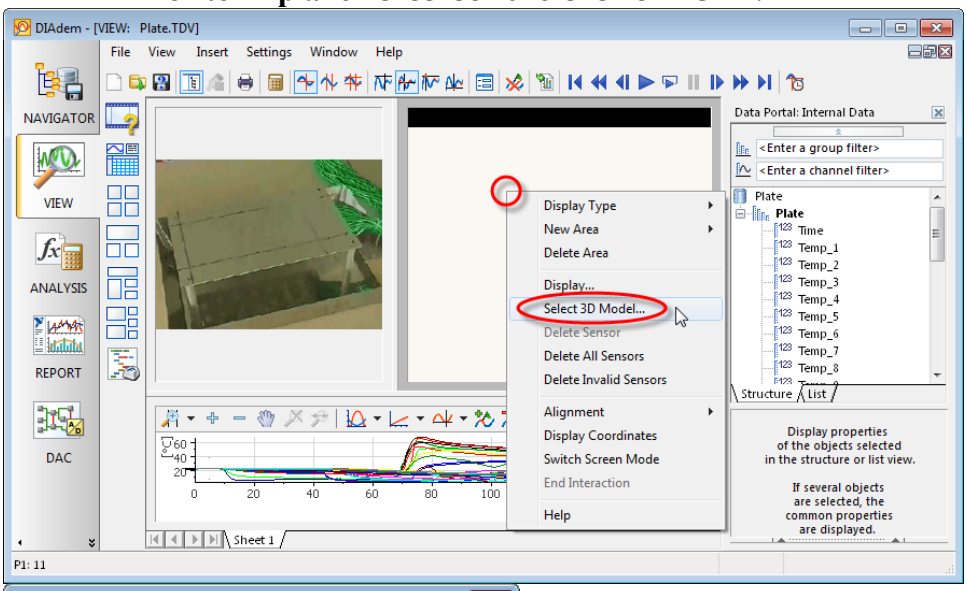
7.3 The example automatically starts and activates the DIAdem VIEW panel to show you the synchronization of data, video, sound and a native GPS map display. In this case a GPS tracker was on board the test car, and the car's CAN bus was polled and stored to disk. DIAdem installs with DataPlugins to read most audio and GPS data files as well as with a Bus Log converter to turn CAN data logs into TDM files. You're looking at graphs of the GPS data (Elevation), CAN data (Engine Speed, Engine RPMs), as well as the left and right audio data from a stereo microphone also on board. DIAdem deftly synchronizes all this information from these 4 very different sources in one unified and highly informative user interface. **Click** the **"Pause" icon** at the top of your screen to stop the synchronized playback so you can proceed on to the next example.

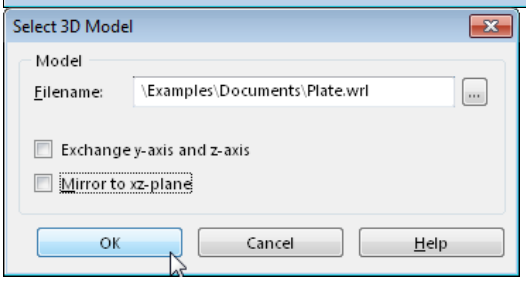


7.4 **Switch** back **to** the **ExampleFinder** window, which should still be open, then scroll down several "rows" until you see the colorful temperature plate example, shown below. This example synchronizes data and video with the projection of the data onto a 3D CAD model defined outside DIAdem, based on the location of the sensors on that model, defined inside DIAdem. **Click** on the example **icon** to launch it. If asked to save changes to the data set or in VIEW, click on the "No" button to decline.

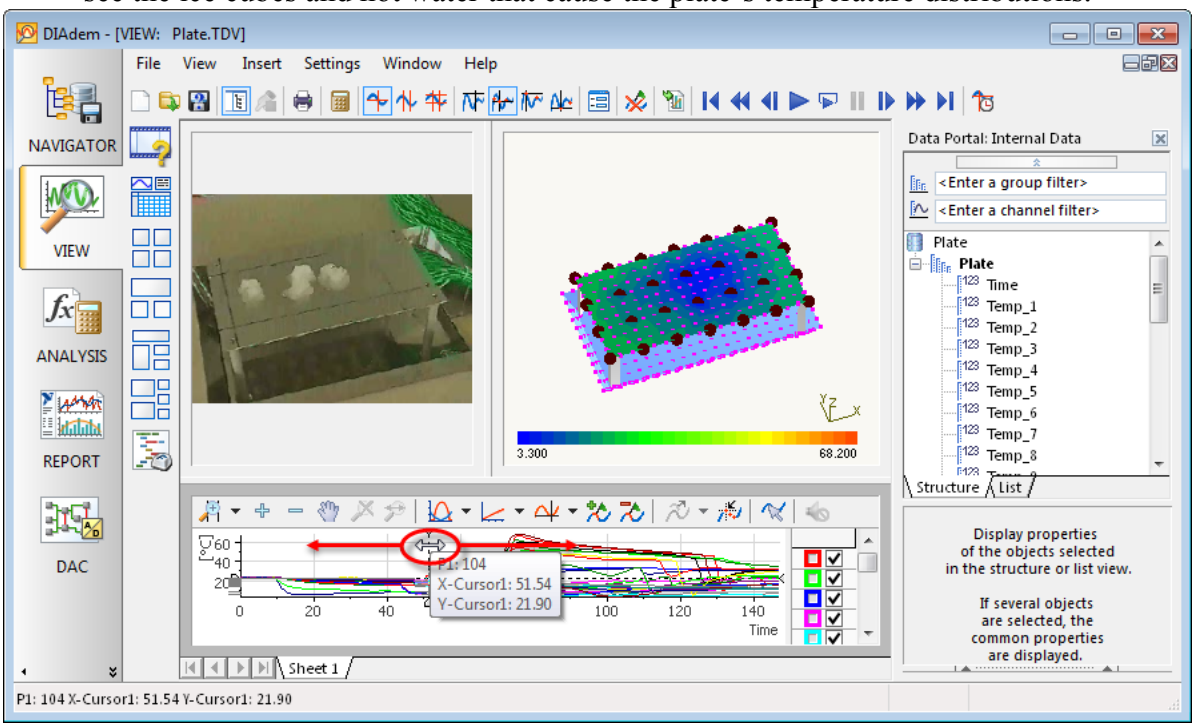


7.5 With some operating systems and video cards, you must invert the 3D CAD model about the XZ plane. If your top right area is mostly black or oddly flickering, **right-click** on it and **choose** the **"Select 3D model…"** context **menu**, then **uncheck** the **"Mirror to xz plane"** checkbox and **click** on **"OK"**.

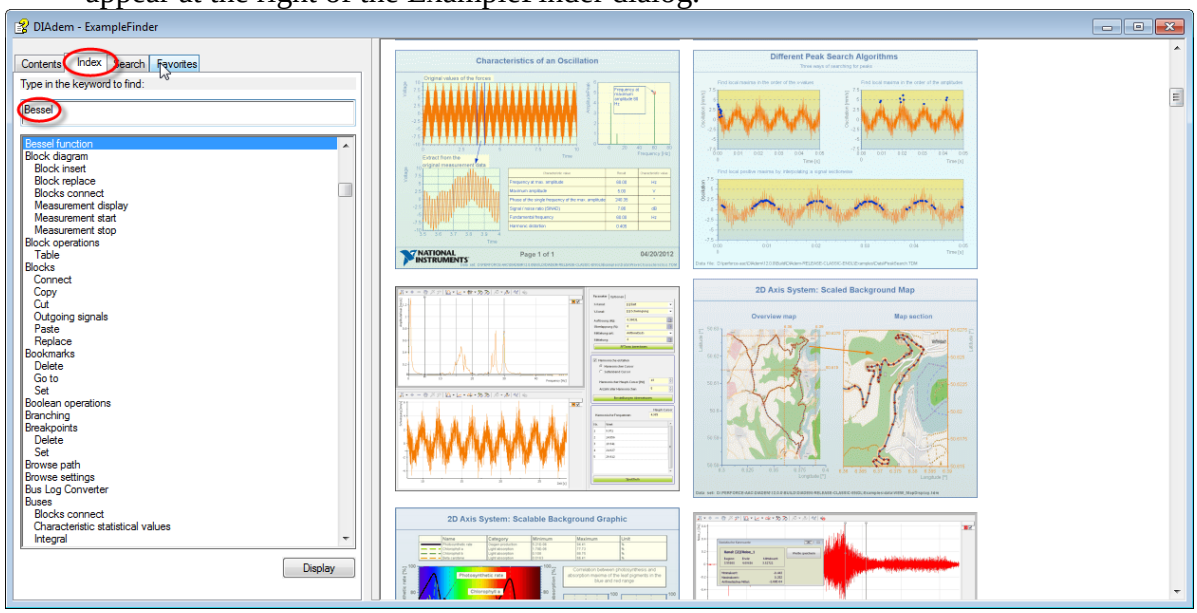




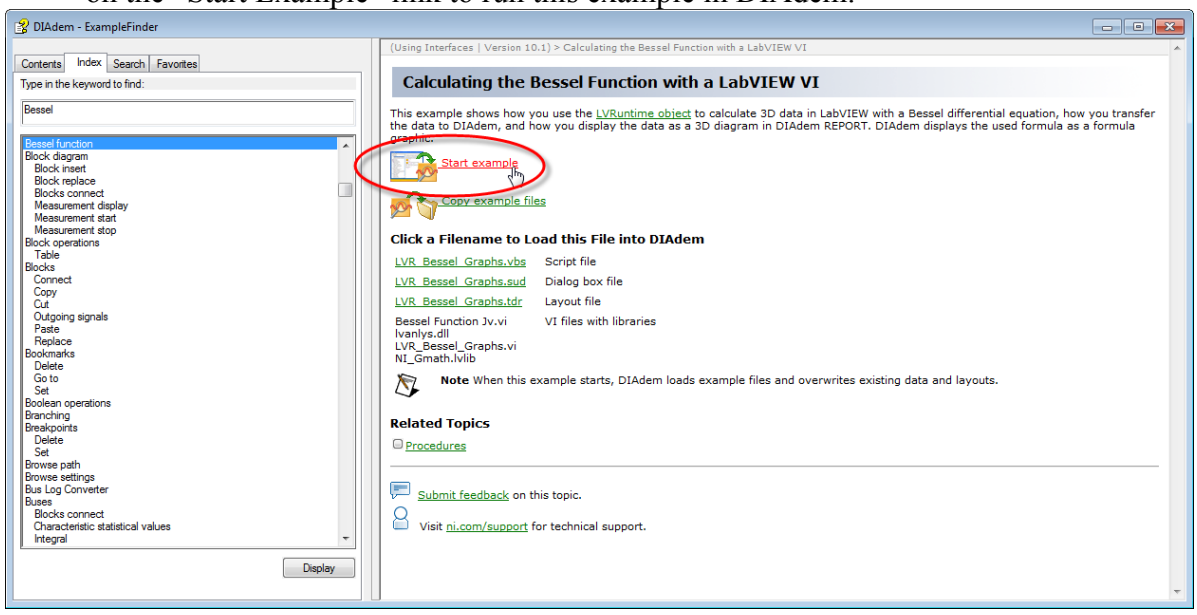
7.6 Now move the cursor from the bottom graph back and forth manually— you will be see the ice cubes and hot water that cause the plate's temperature distributions.



7.7 **Switch** back **to** the **ExampleFinder** window, which should still be open, then **click on** the **"Index" tab** at the top left of the dialog and **type** in **"Bessel" in** the keyword **search field** and **hit <Enter>** on your keyboard. This returns a list of all the examples that contain the word "Bessel", as well as a number of close misses. **Click** on the **first item** returned, named **"Bessel function"** to have its example description appear at the right of the ExampleFinder dialog.



7.8 Now you see a description of this example, plus a list of all its component files. **Click** on the "Start Example" link to run this example in DIAdem.



7.9 This example calls the LabVIEW Runtime Engine to open a particular VI that DIAdem ships, sets the input parameters of the VI, runs it, then reads off the output parameters of the VI and loads the resulting calculation files it creates as well as a REPORT template to visualize the Bessel calculation. **Click** the **"Calculate"** button to run the calculation with these parameters. You can repeat the calculation with different Bessel parameters to see this "Mexican Hat" morph shapes. This is an example of DIAdem calling out to LabVIEW to run an analysis routine not present natively in DIAdem. It is also an example of a DIAdem custom dialog to input the Bessel parameters. **Click** the **"Cancel"** button when finished.