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Thank you for purchasing the DIAdem Basics course kit. This course manual and the accompanying software are used in the three-day, hands-on DIAdem Basics course.

You can apply the full purchase of this course kit toward the corresponding course registration fee if you register within 90 days of purchasing the kit. Visit ni.com/training to register for a course and to access course schedules, syllabi, and training center location information.
A. About This Manual

This course manual teaches you how to use DIAdem to load and manage data, to run mathematical and visual analyses, to generate reports, and to automate work sequences. This course manual assumes that you are familiar with Microsoft Windows.

The course manual is divided into lessons, each covering a topic or a set of topics. Each lesson consists of the following:

- An introduction that describes the purpose of the lesson and what you will learn
- A description of the topics in the lesson
- A set of exercises to reinforce those topics
  Some lessons include optional exercise sections or a set of additional exercises to complete if time permits.
- A summary that outlines important concepts and skills taught in the lesson
B. What You Need to Get Started

Before you use this course manual, make sure you have the following items:

- Windows XP Pro Service Pack 1 or later, Windows 2000 Service Pack 3 or later, or Windows NT 4 Service Pack 6 or later

⚠️ **Caution!** DIAdem does not run with these Windows systems if they do not have the Service Packs. DIAdem does not run with Windows 95/98/Me

- Internet Explorer, Version 5 or later

- DIAdem Professional Edition 9.1 including the Crash Analysis Toolset

- Microsoft Windows Script Debugger which you can download from [Microsoft Windows Script Downloads](#)

- **DIAdem Basics** CD, which contains the following files:

<table>
<thead>
<tr>
<th>Filename</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bin</td>
<td>Folder with the files for the CD user interface</td>
</tr>
<tr>
<td>Exercises</td>
<td>Folder with the files for all the exercises</td>
</tr>
<tr>
<td>Solutions</td>
<td>Folder containing the solutions to all the course exercises</td>
</tr>
</tbody>
</table>
C. Installing the Course Software

Complete the following steps to install the course software.

1. Insert the DIAdem Basics CD.

2. Copy the contents of the Exercises folder to the top level of the C:\ folder.

3. Copy the contents of the Solutions folder to the top level of the C:\ folder.
D. Course Goals

This course presents the following topics:

- Importing and managing data
- Inspecting data, including graphically-interactive analysis
- Mathematical data analysis
- Creating presentation graphics and reports
- Automating work sequences with Visual Basic Script

This course does not describe any of the following:

- Programming with Visual Basic Script
- Creating DIAdem applications

These topics are covered by the DIAdem Advanced course. Refer to ni.com for information on DIAdem Advanced course.
E. Course Conventions

The following conventions are used in this course manual:

<> Angle brackets indicate a key you press to perform a function, for example, <Ctrl> for the control key.

» The » symbol leads you through nested menu items and dialog box options to a final action. The sequence File » Page Setup » Options directs you to pull down the File menu, select the Page Setup item, and select Options from the last dialog box.

💡 This icon denotes a tip, which alerts you to advisory information.

📝 This icon denotes a note, which alerts you to important information.

⚠️ This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

**bold** Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes menu names, functions, or buttons.

*italic* Italic text denotes emphasis, new terms, a cross reference, or an introduction to a key concept.

```monospace``` Text in this font denotes text or characters that you enter from the keyboard, sections of code, programming examples, and syntax examples. This font also is used for the proper names of disk drives, paths, folders, programs, subprograms, subroutines, functions, operations, commands, variables, controls, events, methods, filenames, and filename extensions.
Lesson 1
Introduction to DIAdem

Introduction

This lesson introduces the basics of DIAdem.

Use the Getting Started with DIAdem manual to get started with DIAdem quickly. Use this manual to familiarize yourself with how DIAdem works and with the various functions and features in DIAdem. For more information about the DIAdem concepts, refer to the manual DIAdem: Data Analysis and Report Generation.

To view a PDF (Portable Document Format) version of the DIAdem manuals in the DIAdem Help, select Contents»DIAdem»Additional Information Sources, or refer to the DIAdem CD.

You Will Learn About:

A. The Modular DIAdem Concept
B. The Structure of DIAdem Panels
C. The DIAdem Help
D. Configuring DIAdem
A. The Modular DIAdem Concept

DIAdem is designed to help you manage, inspect, and analyze data and generate reports so you can transform test data to the results you need. DIAdem includes a separate panel for each function - managing data, viewing data, analyzing data, creating reports, and automating your analysis and reports.

DIAdem includes the following panels:

- **Use DIAdem NAVIGATOR** to navigate in various data types and data storages. You drag and drop your data into DIAdem.

- **Use DIAdem VIEW** to view your data as curves or to edit single values in tables.

- **Use DIAdem ANALYSIS** to mathematically evaluate your data using standard functions from the extensive mathematics libraries or using your own formulas.

- **Use DIAdem REPORT** to generate reports of your test data and analysis results.

- **Use DIAdem SCRIPT** to automate recurring tasks, from loading data, to analysis, to report generation, using scripts.
B. The Structure of DIAdem Panels

When you select a DIAdem panel, the group bars, function bars, and menus appear for quick access to the functions you want. Each DIAdem panel has its own group bar to the right of the panel bar. Click a function bar button in the group bar and select the function you want when the function bar opens. The workspace also changes with the DIAdem panel and displays a folder hierarchy or a worksheet. Each panel has its own toolbar and shortcut menus, which contain frequently used functions.

Figure 1-1 shows DIAdem VIEW as an example of the structure of a DIAdem panel.

Figure 1-1. DIAdem VIEW as an Example of the DIAdem Window Structure

1. Panel bar
2. Group bar
3. Function bar with tables and axis systems
4. ToolTip for the selected function
5. DIAdem VIEW toolbar
6. Data Portal
7. DIAdem VIEW workspace
8. Status bar
The DIAdem Panels

The DIAdem panels constitute the main level, where functions are grouped into related areas. The panels are arranged on the left side of the screen and are always visible, enabling you to switch from one panel to another. All the DIAdem modules read data into and out of the Data Portal.

The Functions

When you click a panel, the respective group bar appears next to the panel bar. This second level contains groups of related functions. Click an item in the group bar to open the associated function bar, and select the function you want. For example, you can select axis systems and tables in DIAdem REPORT or select mathematical functions in DIAdem ANALYSIS. DIAdem carries out actions in the panel workspace.

Note: You can purchase the DIAdem Base, Advanced, and Professional editions. If you install the Base edition, the function bar buttons and group bar buttons for the functions not included in the Base edition are dimmed.

You can modify all default settings at any time. Right-click the function bar button of the function you want to modify. Select Default setting in the shortcut menu. The dialog box for the function appears. Click Change to save the new settings.

The Workspace

Each DIAdem panel has a different workspace for displaying and editing functions. DIAdem VIEW has a predefined workspace, where you enable axis systems and tables for an overview of your data. The DIAdem REPORT workspace is an empty page where you can position and resize axis systems, tables, text, comments, and pictures.

You always edit objects in the workspace in the same way: click an object once to enable it. Double-click an object to set the object parameters in a dialog box. Right-click to open the shortcut menu.

The toolbar is above the workspace. The toolbar contains the functions that you require to work in the panel.

The status bar is below the workspace. The status bar displays messages, ToolTips, and notes about the functions of the selected objects and actions.

Shortcut menus are of key importance in DIAdem. The shortcut menu contains the functions you require to work with the object you click. Some functions are only located in shortcut menus, such as the browser settings in DIAdem NAVIGATOR and generating data in DIAdem VIEW channel tables.
**The Dialog Boxes**

DIAdem often needs additional information to execute a command or an action. Enter this additional information, called settings, into a feature-specific dialog box.

Double-click a 2D axis system in the workspace in DIAdem REPORT. Figure 1-2 shows the dialog box for curve and axis definition.

![Dialog Box for 2D Curve and Axis Definition in DIAdem REPORT](image)

**Figure 1-2.** Dialog Box for 2D Curve and Axis Definition in DIAdem REPORT

The curve and axis definition demonstrates the hierarchy of the DIAdem dialog boxes. Basic settings such as channel pairs, which you often change, are in the main dialog box. Other settings, such as the axis scaling, are in subdialog boxes that you click a button to open.
C. The DIAdem Help

DIAdem has four kinds of help: ToolTips for the user interface, the dialog box help for all the settings, and the help contents, with descriptions and examples.

ToolTips describe the button functions. When you idle the mouse over a button, a yellow field with the button name appears.

Click the Help button in a dialog box to access the description of the dialog box. The dialog box help describes the single settings in the open dialog box and refers you to other explanations. You also can press <F1> to access the help for the dialog box or panel.

Select Help » Examples to display demos. The user templates provide solutions for simple tasks, whereas the application examples demonstrate the range of DIAdem applications.

You can start examples directly in the DIAdem help. Click Start example to display the example in DIAdem. Press <Esc> to abort the example. Click Copy example files to copy example files to your folder.
D. Configuring DIAdem

You can configure various program settings in DIAdem. The program settings can be general program behavior settings or specific panel settings. You can set memory management parameters in the data area, and configure the folder structure. Use the Settings menu to adapt the program settings to your requirements.

To save your settings in a configuration file, first select Window»Close all. Then click Save desktop. Click Load desktop to load a project-related configuration. Refer to the DIAdem Help for more information about configuration.

Note Each lesson that describes a new panel includes a description of the panel settings at the end.

The Folder Structure

DIAdem installs folders on three levels, as shown in Figure 1-3:

1. The program level contains program files (.exe,.dll), control files, and the ReadMe file.
2. The *structure level* divides the files:

<table>
<thead>
<tr>
<th>ADDINFO</th>
<th>System files</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMO</td>
<td>Exercises from the manual</td>
</tr>
<tr>
<td>LIBR</td>
<td>Examples, demos, and templates</td>
</tr>
<tr>
<td>SYMBOLS</td>
<td>System files</td>
</tr>
<tr>
<td>USER</td>
<td>User files</td>
</tr>
</tbody>
</table>

3. The *file level* contains files from all DIAdem panels in different folders:

<table>
<thead>
<tr>
<th>AUT</th>
<th>Scripts (.vbs, .aut)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAT</td>
<td>Compiled scripts (.vbc, .suc, .auc)</td>
</tr>
<tr>
<td>DAT</td>
<td>List files (.lst)</td>
</tr>
<tr>
<td>DAT</td>
<td>Variable definitions (.vas)</td>
</tr>
<tr>
<td>DAT</td>
<td>User dialog boxes (.sud)</td>
</tr>
<tr>
<td>DAT</td>
<td>Header files (.tdm, .dat)</td>
</tr>
<tr>
<td>DAT</td>
<td>Data files (.tdx, .r64, .i16 and others)</td>
</tr>
<tr>
<td>GRA</td>
<td>REPORT layouts (.tdr, .lpd)</td>
</tr>
<tr>
<td>GRA</td>
<td>Metafiles (.wmf, .bmp, .tif, .jpg and others)</td>
</tr>
<tr>
<td>GRA</td>
<td>VIEW layouts (.tdv)</td>
</tr>
</tbody>
</table>
Exercise 1-1

Objective: Configuring the File Paths

In the following exercise you select the solutions folder path as the library path, and the exercise folder path as the user path, and DIAdem then displays all the course files in the file selection dialog boxes.

1. Select Window»Close all.
2. Select Settings»General.

3. Click Path selection.
4. Click the Setting line next to the NAVIGATOR library path.

5. Click Path selection and navigate to the C:\Solutions\DIAdem Basics\ folder.
   Click OK.

6. Click the Setting line next to the NAVIGATOR user path.

7. Click Path selection and open the C:\Exercises\DIAdem Basics\ folder.
   Click OK.

8. Repeat steps 4 and 5 for all other library paths.

9. Repeat steps 6 and 7 for all other user paths.
The path selection dialog box looks like this:

![Path selection dialog box](image)

10. Click **OK** to close all the dialog boxes.

11. Click **Save desktop** in the toolbar.

   Navigate to the **C:\Programme\National Instruments\DIAadem 9.1** folder and overwrite the desktop file **Desktop.ddd**.

**End of Exercise 1-1**
Summary, Tips, and Tricks

- DIAdem is modular. Each DIAdem panel is designed for specific tasks and therefore contains specific functions. Switch between the DIAdem panels in the panel bar.
- Use DIAdem NAVIGATOR to navigate in various data types and data storages.
- Use DIAdem VIEW to view your data as curves or to edit single values in tables.
- Use DIAdem ANALYSIS to mathematically evaluate your data using standard functions from the extensive mathematics libraries or using your own formulas.
- Use DIAdem REPORT to generate reports of your test data and analysis results.
- Use DIAdem SCRIPT to automate recurring tasks, from loading data, to analysis, to report generation, using scripts.
- DIAdem has four kinds of help: ToolTips for the user interface, the dialog box help for all the parameters, and the help contents, with descriptions and examples. Press <F1> to open the help in each panel. Click the Help button in the respective dialog box for help with the individual functions.
- You can configure various program settings in DIAdem. To save your settings in a configuration file, first select Window»Close all. Then click Save desktop.
Lesson 2
Generating Your First Report

Introduction

This lesson describes the Report Wizard, which you use to create a report in three easy steps.

You Will Learn About:

A. Working with the Report Wizard
A. Working with the Report Wizard

Use the DIAdem Report Wizard to generate a report. You can generate a report in three easy steps:

1. Select the data,
2. Specify the curves, and
3. Specify the layout for the axis system.

DIAdem uses your settings to generate the report, which you can add comments to and illustrate with graphics in DIAdem REPORT. If you select a VIEW layout in the last step of the Report Wizard, DIAdem creates a layout in DIAdem VIEW, where you can view your data as a curve.

By default, the Report Wizard opens when you launch DIAdem. To modify the default setting, select **Settings**»**Desktop parameters**»**General**. You can click the Report Wizard button in the toolbars of the DIAdem REPORT and DIAdem VIEW panels, or press <Ctrl-W> in all other panels to open the **Report Wizard**.
Exercise 2-1

Objective: Creating Your First Report with the Report Wizard

In the following exercise, you create a report with the Report Wizard, simply by selecting the data and the layout.

1. If the Report Wizard does not open when you launch DIAdem, press <Ctrl-W>.
   If Report Wizard Step 1 of 3 does not appear, click Next or Back to open this page.

2. Select FILES: My DIAdem 9.1 as the data source.

3. Open the folder C:\Exercises\DIAdem Basics.

4. Select the file D3Display_1.tdm.

The simplest type of data storage is a folder with data files. My Computer provides all the drives on your computer. Other available data storages include Citadel, SQL, and AOP databases, VI Logger files, and ATF files.

5. Click Next to open the Report Wizard - step 2 of 3 dialog box.

   In the second step, the Report Wizard analyzes the loaded data channels. The Report Wizard interprets time and frequency channels as x-channels, and interprets the other channels as y-channels. The Report Wizard assigns an x-channel to each y-channel.
To change the x/y-channel pairs that DIAdem displays, click in the table and select another x-channel at the bottom of the wizard page. Set Use as No for channels you do not want to display.

6. Click **Next** to open the Report Wizard - step 3 of 3 dialog box.

7. Click **Y-axes** to display all curves on one x-axis, in one axis system, with several y-scales.

8. Click the **Finish** button.
DIAdem displays the report.

Note You can switch back and forth among the three steps to change your settings. In each step you can click Finish to bypass the remaining steps and create the report. DIAdem uses standard settings for steps you leave out.

9. Click Save layout as.

Navigate to the C:\Exercises\DIAdem Basics\ folder and save the report file as MyFirstReport.tdr.

End of Exercise 2-1
Summary, Tips, and Tricks

- The DIAdem Report Wizard opens when you press <Ctrl-W>. You can use the Wizard to create your first report.
- Use the Report Wizard to generate a report in three steps:
  - First select the data you want to display.
  - Specify the x and y-channels for the curves.
  - Select the curve display mode.
- The Wizard either creates a view in a new DIAdem VIEW worksheet, or DIAdem creates a report in the current DIAdem REPORT worksheet, according to your specifications.
Notes
Lesson 3
Managing Data

Introduction
In this lesson you will learn how to load data and manage data in DIAdem.

You Will Learn About:

A. Loading, Managing, and Saving Data
B. Navigating External Data with DIAdem NAVIGATOR
C. Managing Data in the Data Portal
D. Working with the Data Properties
E. Working with DAT Files
F. Configuring DIAdem NAVIGATOR
A. Loading, Managing, and Saving Data

You load, manage, and save your data in the DIAdem NAVIGATOR panel.

In DIAdem NAVIGATOR, you navigate data files, file folders, and databases to find your external data. The properties window displays the properties of a selected data set. You load the data set into the Data Portal, which manages all internal data and makes the data accessible for all DIAdem panels.

The data in the Data Portal is organized in channels, and each channel is a separate series of data. You can group several channels into channel groups to sort and prepare your data for evaluations and presentations.

Figure 3-1 shows the DIAdem NAVIGATOR interface, with the properties window and the Data Portal.
Use the function bars **File-based data storage** and **Server-based data storage** to reduce the external data storage display in DIAdem NAVIGATOR to the files and servers needed.

The toolbar has functions for loading external data into the Data Portal and for saving and deleting the internal data storage in the Data Portal. You also can register and filter the data storage.

Shortcut menus are important for data management. Right-click in the DIAdem NAVIGATOR to open the browser settings. If you right-click a data set in DIAdem NAVIGATOR, DIAdem registers large data sets without loading the data. Right-click the Data Portal to create new channels and channel groups.
B. Navigating External Data with DIAdem NAVIGATOR

The DIAdem NAVIGATOR displays your external data as a tree view, which is a hierarchical view. You can navigate data on your computer, on other network drives, and on all registered databases.

Use the function bar to select the type of data storage you navigate in. You can display file-based or server-based data storages. If you select file-based data storage, DIAdem displays the data files that are on your computer drives or on the network. If you select server-based data storage, DIAdem displays the data that are in the registered databases.

You can use the associated properties to configure the view of the data you want displayed in a way that enables you to find the data quickly, even in extensive data storages.

Use filter settings to limit the number of files listed in DIAdem NAVIGATOR. Select View»Filter settings to open the dialog box for filter settings. For example, to view all Test files from a certain date, enter the name Test.* and the storage date.

Select Settings»Desktop parameters»Panel specific in DIAdem NAVIGATOR to specify which data storage DIAdem automatically loads when it launches.

The properties window in DIAdem NAVIGATOR shows the properties of selected data storage, such as the name, the size, and the storage date of a file, or folder attributes. If the properties window is not open, click and drag up the bottom edge of the NAVIGATOR window.

Loading Data

To load DIAdem data, click DIAdem 9 files (*.tdm) in the function bar for file-based data storage. All the drives registered on your computer appear in DIAdem NAVIGATOR. Open the folder with the data you want. Drag and drop the data file into the Data Portal. DIAdem creates a new channel group, copies the contents of the file, and lists all the file channels in this group.

DIAdem automatically uses the associated loading procedure for the data type. If DIAdem cannot automatically load a file, you can specify the loading procedure. For example, if you want to load an earlier LabVIEW file in ASCII format, right-click the file and select Open with from the shortcut menu. In the dialog box that appears you specify the ASCII import loading procedure, to import LabVIEW data.

When you browse through a database, you can drag and drop channels and channel groups into the Data Portal. DIAdem displays selected channels,
channel groups or files that you can load into the Data Portal, with a blue background.

For example, select Selective opening in the shortcut menu to load single channels from a TDM file. Click the plus signs to view channels and channel groups in this data file. Select the channels you want and click Load. DIAdem loads the selected channels and adds the channels from the default group in the Data Portal.

You can work with large data sets in the Data Portal without actually loading the data. To do this, you register the data in DIAdem. To register a data file, select Register data in the shortcut menu. Double-click the data file to register individual channels. Select the channels and click Register in the dialog box that appears.

You can display and calculate registered data, but you cannot modify registered data. To edit a registered channel, select Expand channel in the Data Portal shortcut menu. DIAdem then loads the associated data into the Data Portal.

**Registering Data Storage**

The data storage manager displays all the data storages available in DIAdem. You can configure, delete, and select the available data storage and load the data storage into DIAdem NAVIGATOR. You also can register new data storages in the data storage manager.

To register a new data storage, select File»Change data storage. The data storage manager appears with the registered data storage, in a hierarchical structure. For example, select the data storage type SQL for a database. Double-click New data storage to register the new SQL database. Enter a name and the settings.

The data storages available in the function bars have predefined names in the data storage manager, for example, Default SQL for ODBC/SQLb data. Do not delete the predefined data storage. You can modify the configuration of the predefined data storage for quick access to frequently-used data. For example, if you want to change the registered SQL database for the ODBC/SQL data, right-click Default SQL in the data storage manager. Select Properties and switch databases.
Supported Data Storage

DIAdem uses many file formats and databases. The data storage manager and the dialog box for loading procedures contain information about which data the current installation of DIAdem can load.

**DIAdem Data**

DIAdem uses the TDM format to save the properties and the numeric data in different files that have the same filenames. DIAdem saves the data properties in a text file with the filename extension `.tdm`, and the numeric data in a binary file with the filename extension `.tdx`.

Use the **DIAdem 9 files (*.tdm)** button in the **File-based data storage** function bar to load DIAdem data. DIAdem NAVIGATOR displays only data files with the filename extension `.tdm`. DIAdem reads the properties from the TDM file and loads the associated data from the TDX data file with the same name.

**DAT Data**

Click the **DIAdem 8 files (*.dat)** button in the **File-based data storage** function bar to load data from earlier DIAdem versions.

Before Version 8.1, the DAT format was the standard DIAdem format. In the DAT format, DIAdem saves the data properties as text in a header file with the extension `.dat`. DIAdem saves the numeric data in the binary format that uses the least amount of space for that data. One data set can include several binary files, for example, files with the file name extension `.w16` or `.r48`.

Refer to the section on **Working with DAT Files** for more information.

**LabVIEW Data**

Use the **LabVIEW files (*.lvm)** button in the **File-based data storage** function bar to load LabVIEW data. DIAdem NAVIGATOR displays only data files with the filename extension `.lvm`. DIAdem reads the LVM file header and loads the data accordingly. LabVIEW saves descriptive information such as the delimiter used, the start value and the step width of the x-channel, and the actual values in a file.

Earlier VIEW data files have the filename extensions `.lvd` or `.txt`. These ASCII files only contain the actual values. Select **Open with›ASCII Import** in the DIAdem NAVIGATOR shortcut menu to load the files.

Use the LabVIEW DIAdem Connectivity VIs in LabVIEW to exchange data directly with DIAdem. These VIs can start DIAdem directly, to write acquired data straight into the Data Portal. The LabVIEW DIAdem
Connectivity VIs are on the DIAdem CD, and you can download them from the NI Web site.

Use the LabVIEW DSC module data button in the Server-based data storage function bar to open a database that the LabVIEW Datalogging and Supervisory Control (DSC) Module has generated. In addition to the measurement data, the LabVIEW DSC panel saves recorded data about the monitoring run, alarms that occur, and control tasks executed.

**VI Logger Data**

Use the VI Logger data button in the Server-based data storage function bar to load data from a VI Logger database. VI Logger saves measured data, including the record data, in the database.

**Lookout Data**

Use the Lookout data button in the Server-based data storage function bar to load data from a Lookout database. Lookout saves data from various sources and saves recorded data with the measured data. You can accelerate access to a large database by specifying a time interval for which you load data into the Data Portal.

**ASCII Data**

Use the ASCII files (*.asc, *.txt, *.csv) button in the File-based data storage function bar to import ASCII data. A wizard helps you to analyze the data you want to import. For example, you specify whether a file contains text, or empty lines, and whether the values are in blocks or channels.

In the wizard preview, you check the settings, which you then save in a configuration file with the extension .stp. To import another ASCII file with the same structure, specify this configuration file in the wizard.

**Excel Data**

Use the Excel files (*.xls) button in the File-based data storage function bar to load Excel data from Excel 97 and later. As with ASCII files, a wizard helps you to analyze the data to be imported. You specify whether the file contains several table sheets and where text is located. In the wizard preview, you specify text as a channel name, comment, or unit.

You check the settings, which you can save in a configuration file with the extension .stp. To import another Excel file with the same structure, specify that configuration file in the wizard.
ASAM Data

Use the ASAM-AOP data button in the Server-based data storage function bar to load data from ASAM-compliant databases using the ASAM-ODS Protocol (AOP). The Association for Standardization of Automation and Measurement Systems (ASAM) data model saves values and descriptive metadata in a hierarchical structure.

ODBC/SQL Data

Use the ODBC/SQL data button in the Server-based data storage function bar to load data from Access, Oracle, or ADO databases. Use SQL (Structured Query Language) commands to access an ODBC (Open Database Connectivity) database. DIAdem also can access data with OLE (Object Linking and Embedding) and with ADO (ActiveX Data Objects) in client-server architecture, and in Web-based applications.

Binary Data

Select File»DAT files»Import via header to import binary data. To import the data, you create a header file containing information about the data set and the data channels. Click Execute in the dialog box to load the channels into the default group in the Data Portal according to the header information. When you create a header, you can use an existing header file and adjust it to the binary data to be loaded.

Refer to the section on Working with DAT Files for more information.

Crash Test Data

DIAdem can load crash test data from the vehicle safety area in the EGV file format based on ISO DTR-13499, and in the MME format according to ISO-MME (TS 13499). To load EGV or MME data, select Settings»Desktop parameters»GPI-DLL registration and register the appropriate GPI file filter. Load the function library egvload.dll for the EGV format and gfsmme.dll for the MME format, from the folder ..\diadem\addinfo.
Exercise 3-1

Objective: Expanding Data Storage

In the following exercise you add the folder with the exercises for this training course to the data source MyDIAdem 9.1.

1. Select DIAdem NAVIGATOR.

2. Open the DIAdem NAVIGATOR shortcut menu.

3. Select Properties in the shortcut menu. The following dialog box appears.

4. Open the folder C:\Exercises\DIAdem Basics.

5. Click Add elements. The DIAdem Basics folder appears in the top window.

6. Double-click the icon of the new folder in the top window.

   An entry field for the Alias name appears.
Lesson 3  Managing Data

7. Enter MyTraining.

8. Click OK.
   The MyTraining folder appears in DIAdem NAVIGATOR.

9. Open the folder MyTraining.

End of Exercise 3-1
DIAdem automatically saves the new folder in the MyDIAdem 9.1 data storage. The next time DIAdem launches, the MyTraining folder appears.
Exercise 3-2

Objective: Filtering Data Files

In the following exercise you display only the data from MyDIAdem 9.1 that was saved after September 4, 2004.

1. Select DIAdem NAVIGATOR.
2. Click Filter settings in the toolbar.
3. Click Extend list in the middle of the dialog.
4. Set the filter criteria as shown in the following figure:

Click OK.

5. DIAdem NAVIGATOR now lists only the files saved after September 4, 2004.
Lesson 3  Managing Data

6. Click **Filter On/Off** in the toolbar to display all the data files in the C:\Exercises\DIAdem Basics folder.

End of Exercise 3-2
C. Managing Data in the Data Portal

When DIAdem NAVIGATOR opens, the Data Portal appears to the right of the workspace. Click the Data Portal button in the toolbar to display and hide the Data Portal. Select Window»Data Portal floating to position the Data Portal anywhere in the window.

The Data Portal in Figure 3-2 displays an overview of channels currently in the data area. The Data Portal makes the internal data accessible in all DIAdem panels. The Data Portal contains data channels, time channels, and text channels. The Data Portal organizes channels in groups and displays their properties. DIAdem only loads internal data from the Data Portal temporarily in the workspace. The changes you make to the internal data are not stored until you save the data in a file or a database. Registered data do not occupy memory space. DIAdem only creates a reference to the numeric data.

Figure 3-2. The Structure View of the Data Portal with Channel Groups, Channels, and Properties
Working with Channels and Channel Groups

If you load a data set from the DIAdem NAVIGATOR to the Data Portal, DIAdem automatically generates a new channel group. This channel group contains all the channels of the data set, such as data channels with measured values from sensors, and a time channel with the associated time values. All DIAdem panels work with channels. In DIAdem ANALYSIS you can select two channels in the Data Portal for an FFT calculation, and in DIAdem REPORT you can select two channels for displaying a curve.

DIAdem identifies the last data set that you load in the Data Portal as the default group. If you load a selection of data set channels to the Data Portal, DIAdem stores these channels in the default group. You can move each channel in the Data Portal to another channel group.

Click a channel to select a single channel. To select a block of channels, click the first channel, and <Shift>-click the last channel you want. To select several non-consecutive channels, <Ctrl>-click the channels. Selected channels have a dark background.

Tip You also can select or delete several channels by clicking the symbol to the left of the channel names, as shown in Figure 3-3. If you use these symbols, you do not need to press <Shift> or <Ctrl>.

Data, Time, and Text Channels

DIAdem works with three different channel types: data channels, time channels, and text channels.

A data channel contains acquired values such as the measurement values from a sensor, calculation results, input values, or values loaded from files. DIAdem can use any data channel for calculations and displays.

DIAdem generates a time channel from numerical date and time specifications. In the time format, DIAdem saves the seconds from the year...
zero up to now. A time channel, for example, contains the time values that DIAdem acquires during a measurement. A time channel is often the x-channel for calculations and displays of the respective measurement values in the y-channels.

A text channel contains text in the unicode format. Unicode characters include Chinese, Japanese, and Arabic characters. You can display text channels in tables in the DIAdem panels VIEW and REPORT. Use text channels to record observations during a measurement.

Generating New Channels
You can use the Data Portal shortcut menu to generate new channels and channel groups. Select New»Channel in the shortcut menu. In the dialog box that appears you specify whether the channel is a numeric channel, a time channel, or a text channel. You also specify the maximum length and the name.

After the channel is generated, you can either enter the channel values manually, or generate the values, in DIAdem VIEW. Open the Predefined screen partitioning function bar in DIAdem VIEW and select One channel table. Enter the data in the channel table or select Generate in the shortcut menu.

The List View in the Data Portal
Click the List tab to switch from the structure view to channel-oriented display. The list view lists all channels on one level, according to the property you select. The channel number is an important property in the list view. DIAdem uses the group index and the channel index to reference channels, and several Calculator functions still use the channel number.

Note You can sort the channels in the list in any way. The channel order in the List tab does not affect the channel order in the Structure tab.

The Data Area
DIAdem adjusts the data area to the current data storage. A data set can have several channels with different lengths. Each data channel is an independent series of numbers. The channel length and the number of channels are practically unlimited, because DIAdem can manage up to 2 billion values.

If you use more channels than the program configuration specifies, DIAdem enlarges the data area accordingly. DIAdem also extends the channel length dynamically to the actual number of values. First select Windows»Close all and then select Settings»Memory organization»Data area to change the length and the number of channels DIAdem starts with. This involves a total
memory reorganization and the changes do not come into effect until you save these settings and DIAdem automatically restarts.

**Saving and Exporting Internal Data**

The data in the Data Portal only exists while the program is running. DIAdem only registers changes temporarily. You must save data to make it accessible later.

You can save the entire data of the Data Portal in DIAdem format. Drag and drop your internal data to a folder in DIAdem NAVIGATOR, where DIAdem saves the data as a TDM file. When you drop data to a data file, DIAdem adopts the filename and overwrites the data file with the new data. To save all the data from the Data Portal, click **Save TDM file as** in the toolbar. DIAdem saves the data in the file in the same structure as in the Data Portal.

You also can save individual channels and channel groups in DIAdem format. Drag and drop the selected channels or channel groups to a DIAdem NAVIGATOR folder for storage. Enter a new filename in the **Save as** dialog box.

To save data in the DAT format, select the DAT format in the **Save as** dialog box. When you save data in DAT format, you provide your data to applications such as DIAdem CLIP, which only can read DAT files.

To save data in the ASCII format, select **File»DAT files»Storage parameters** and change the DAT data type to ASCII. If you save files in the DAT format, DIAdem generates an ASCII file.

To save data in the Excel format, select the XLS format in the **Save as** dialog box. The Excel Export Wizard saves the data in the Data Portal as an Excel file.

If you want to save data in the ASAM data format, select **File»ASAM Data service** or use the script commands in DIAdem SCRIPT. You can use SQL commands in DIAdem SCRIPT to write data into SQL databases.
Exercise 3-3

Objective: Loading a Data File to the Data Portal

In the following exercise you load the data set FrontCrash_1.tdm to the DIAdem Data Portal. The data are from a crash test and will be analyzed in the following exercises.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate in the MyTraining folder to the FrontCrash_1.tdm data file and click the file.

4. Drag and drop the FrontCrash_1.tdm data file into the Data Portal.
The Data Portal looks like this:

End of Exercise 3-3
You use these data in the subsequent exercises.
D. Working with the Data Properties

DIAadem displays the properties of the internal data in the bottom section of the Data Portal. If the properties do not appear in the Data Portal, click the bottom edge of the Data Portal and drag open the properties window. Click the name of a channel group in the structure view to view the properties of the loaded data set. Click a channel to view the properties and characteristic values of the channel.

Properties you can edit appear in white fields. These properties include channel name, comment, physical unit, channel length, display format, and additional information. Click a property field to delete or to overwrite the contents. Double-click a properties field to edit the property. Channel properties that you cannot edit such as maximum length, NoValue occurrence, monotony behavior, minimum values, and maximum values appear in dark gray display fields.
You also can specify properties such as name, description, and author for the root element, which is above the channel groups. To enter the data set comments in the properties window, click the root name in the structure view.

In the Data Portal structure view, DIAdem can display properties of the channels, the channel groups, or the root element. Select Select properties in the shortcut menu to select properties.

The following tables 3-1 to 3-3 list the properties of the root element, the channel groups, and the channels.

**Table 3-1. Properties of the Root Element**

<table>
<thead>
<tr>
<th>Property</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Data set name</td>
</tr>
<tr>
<td>Description</td>
<td>Data set description</td>
</tr>
<tr>
<td>Title</td>
<td>Title</td>
</tr>
<tr>
<td>Author</td>
<td>Author</td>
</tr>
<tr>
<td>RegisterTxt1</td>
<td>Additional descriptive information</td>
</tr>
<tr>
<td>RegisterTxt2</td>
<td></td>
</tr>
<tr>
<td>RegisterTxt3</td>
<td></td>
</tr>
<tr>
<td>DateString</td>
<td>Date</td>
</tr>
<tr>
<td>TimeString</td>
<td>Time</td>
</tr>
</tbody>
</table>

**Table 3-2. Channel Group Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Channel group name</td>
</tr>
<tr>
<td>Description</td>
<td>Channel group description</td>
</tr>
<tr>
<td>Index</td>
<td>Channel group index</td>
</tr>
</tbody>
</table>
You can specify custom properties for each structure element in the Data Portal, in addition to the standard properties and the predefined custom properties. To create a custom property for a channel group, open the shortcut menu for the channel group and select **New»Custom property.** You specify the data type and the property name in the dialog box that appears. You also can select several elements in the Data Portal and create a custom property for all the selected elements.

### Table 3-3. Channel Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Channel name</td>
</tr>
<tr>
<td>Description</td>
<td>Channel description</td>
</tr>
<tr>
<td>Unit_String</td>
<td>Channel unit</td>
</tr>
<tr>
<td>Length</td>
<td>Channel length</td>
</tr>
<tr>
<td>Minimum</td>
<td>Minimum value in the channel</td>
</tr>
<tr>
<td>Maximum</td>
<td>Maximum value in the channel</td>
</tr>
<tr>
<td>Monotony</td>
<td>Channel monotony</td>
</tr>
<tr>
<td>NoValueKey</td>
<td>Occurrence of NoValues in the channel</td>
</tr>
<tr>
<td>Status</td>
<td>Channel status</td>
</tr>
<tr>
<td>LengthMax</td>
<td>Maximum channel length</td>
</tr>
<tr>
<td>GroupIndex</td>
<td>Channel group index</td>
</tr>
<tr>
<td>Number</td>
<td>Channel number</td>
</tr>
<tr>
<td>DisplayType</td>
<td>Channel display format</td>
</tr>
<tr>
<td>ValueType</td>
<td>Channel data type</td>
</tr>
<tr>
<td>RegisterInt1...</td>
<td>Descriptive integer channel information</td>
</tr>
<tr>
<td>RegisterInt5</td>
<td>Descriptive integer channel information</td>
</tr>
<tr>
<td>RegisterVal1...</td>
<td>Descriptive non-integer channel information</td>
</tr>
<tr>
<td>RegisterVal6</td>
<td>Descriptive non-integer channel information</td>
</tr>
<tr>
<td>RegisterTxt1...</td>
<td>Descriptive channel information</td>
</tr>
<tr>
<td>RegisterTxt2</td>
<td>Descriptive channel information</td>
</tr>
</tbody>
</table>
DIAdem saves your custom properties with the data set. If you export the data to the DAT format, you lose the custom properties and the channel group information. When DIAdem loads external data, DIAdem automatically converts non-TDM properties into custom properties.

**Functions and Variables for Accessing Properties**

You can use the following variables and commands in scripts and formulas to access root element properties, channel group properties, or channel properties.

Select *Functions, Commands and Variables* in the DIAdem help contents for more information about functions and variables that you can use to read and set data properties.

**Root Element Properties**

**RootPropCount**

Specifies the number of properties in a data set.

**RootPropCreate (PropName, DataType)**

Creates the PropName data set property, which is DataType.

**RootPropDel (PropName)**

Deletes the PropName data set property.

**RootPropGet (PropName)**

Determines the value of the PropName data set property.

**RootPropInfoGet (PropName)**

Determines information about the PropName data set property. DIAdem saves the results in the variables DataType, PropIsFixed, and PropIsReadOnly.

**RootPropName (Index)**

Specifies the name of the property of a data set specified by the Index.

**RootPropNameChk (PropName)**

Checks the name of a new data set property. If the name conventions are not met, DIAdem corrects the name and saves the name in the PropName variable.

**RootPropSet (PropName, PropValue)**

Sets the PropName data set property as PropValue.
Channel Group Properties

**GroupChnCount (Index)**

Specifies the number of channels in the Index channel group.

**GroupCount**

Specifies the number of channel groups in the Data Portal.

**GroupCreate(GroupCreateName [, TargetGroupIndex])**

Creates a channel group called GroupCreateName at the position TargetGroupIndex in the Data Portal.

**GroupDefaultGet**

Specifies the index of the default group.

**GroupDefaultSet (TargetGroupIndex)**

Specifies the index channel group as the default group.

**GroupDel (TargetGroupIndex)**

Deletes the index channel group.

**GroupIndexGet (GroupName)**

Determines the position of the GroupName channel group in the Data Portal.

**GroupName (Index)**

Specifies the name of the property of the Index channel group.

**GroupPropCount (Index)**

Specifies the number of properties in the Index channel group.

**GroupPropCreate (TargetGroupIndex, PropName, DataType)**

Creates the Propname property, which has the DataType data type, for the channel group specified by the index.

**GroupPropDel (TargetGroupIndex, PropName)**

Deletes the PropName property from the channel group specified in the index.

**GroupPropGet (SourceGroupIndex, PropName)**

Determines the value of the PropName property from the channel group specified by the SourceGroupIndex.
GroupPropInfoGet(TargetGroupIndex, PropName)
Determines information about the PropName property in the channel
group specified by the index. DIAdem saves the results in the variables
DataType, PropIsFixed, and PropIsReadOnly.

GroupPropNameGet(SourceGroupIndex, GroupPropIndex)
Determines the name of a group property specified by the index.

GroupPropSet(TargetGroupIndex, PropName, PropValue)
Sets the PropName property in the channel group specified by the index
to PropValue.

Channel Properties

ChnPropCount(Index)
Specifies the number of properties of the specified channel.

ChnPropCreate(TargetGroupIndex, PropName, DataType)
Creates the PropName property of the data type DataType, for the
specified channel.

ChnPropDel(TargetChn, PropName)
Deletes the PropName property of the specified channel.

ChnPropGet(ChannelNumber, PropName)
Determines the value of the PropName property of the channel specified
by the channel number.

ChnPropInfoGet(TargetChn, PropName)
Determines the PropName property of the specified channel. DIAdem
saves the results in the variables DataType, PropIsFixed, and
PropIsReadOnly.

ChnPropNameGet(ChannelNumber, ChnPropIndex)
Determines the name of the channel property specified by the index, for
the channel specified by the channel number.

ChnPropSet(TargetChn, PropName, PropValue)
Sets the PropName property as PropValue.
**Exercise 3-4**

**Objective:** Editing the Data Set Properties and Saving the Data

In this exercise you give the data set comments that contain information about the measurement. You then save the data.

1. Select **DIAdem NAVIGATOR**.

2. In the Data Portal, open the shortcut menu for **FrontCrash_1** and select **Data set comments**.

3. Enter the following information in the data set comments dialog box to describe the data set:

4. Select **FrontCrash_1** in the Data Portal and drag and drop the selected data set to the tree for the **MyTraining** data storage. Enter the filename **Training3.tdm** and click **Save**.

**End of Exercise 3-4**

The **FrontCrash_2.tdm** data set, which contains the solution for this exercise, is in the **C:\Solutions\DIAdem Basics\** folder.
Exercise 3-5

Objective: Creating a Custom Property for a Channel

In the following exercise you create a custom property and integrate the property into a report.

1. Select DIAdem NAVIGATOR.

2. In the Data Portal, open the shortcut menu for the p_Airbag channel, and select New»Custom property.

3. Enter Test setting as the Name and select String as the Type.

4. Double-click the Test setting field in the properties window and enter the following text:

   Trigger after 10 ms

5. Select DIAdem REPORT.

6. Delete the current layout without saving the layout.

7. Drag and drop the Test setting custom property from the properties window in the Data Portal to the current worksheet.
End of Exercise 3-5
E. Working with DAT Files

Before Version 8.1, the DAT format was the standard DIAdem format. In DAT format, DIAdem stores the data itself in one file and the organizational information for data management in another file.

You can drag and drop DAT files from DIAdem NAVIGATOR to the Data Portal, and you can select File»DAT files to load and save DAT data selectively, to load binary data, and to export DAT data.

Selective Loading

Select File»DAT files»Paste from file to load sections from single channels of a DAT file to the Data Portal. Open the DAT file and select the channels you want to load. Then you can reduce the values to be loaded and edit the data set properties. DIAdem loads the selected channel values into the default group in the Data Portal.

Loading Binary Files

When you load a DAT format file, the header file controls access to the actual data. Before you actually load binary data, you must generate the data set properties from which DIAdem obtains the administrative data for accessing external files. The user must be familiar with the data organization. When the file with data set properties is generated, DIAdem can load the external file like a DAT file.

Select File»DAT files»Import via header to load, generate, save, edit, and delete the channel properties for importing binary data.

Load external data as follows:

1. **Load** an existing header file that describes a data structure similar to the data to be loaded. If necessary, **delete** the channel properties.
2. Open the **Properties** subdialog box to edit the properties of the data storage to be loaded.
3. **Generate** the channel properties associated with each channel of the external data that is to be read. Then **edit** the generated channel properties.
4. **Save** the created data set and channel properties.
5. **Click Execute** to load the external data into the default group in the Data Portal.

When the properties are saved, DIAdem can read the data with the normal loading function.
Specifying Storage Parameters

When you save data in DAT format, you provide your data to applications that only can read DAT files. For example, to analyze data and videos in DIAdem CLIP, the data must be in DAT format.

Select **File»DAT files»Storage parameters** to specify the storage format for DAT files. You can set the following parameters for the DAT format:

- **Storage mode**: Specifies the storage format for the data files. DIAdem saves data in columns or tables.
- **Type of data**: Specifies the data type. DIAdem uses various binary formats and the ASCII format.
- **Real format**: Specifies the format of the real numbers for ASCII block storage. The letter $d$ stands for numbers, and the letter $e$ stands for the exponent. Use points or commas as decimal characters.
- **Integer length**: Specifies the minimum length of the ordinal numbers for ASCII block storage.
- **Separator**: Specifies the separator for ASCII block storage.
- **Check implicit data**: Checks implicit channels. DIAdem saves the generating instructions (start value, step width, number of values) for implicit channels, for example, time channels with equidistant partitioning. Therefore these channels must not be changed in the DIAdem VIEW channel table.

Selective Storage

Select **File»DAT files»Selective storage** to save channels selected in the Data Portal as a DAT file, or to add these channels to an existing DAT file. When you enter the filename in the dialog box, you specify how DIAdem saves the data. If you enter a filename that does not exist in the selected folder, DIAdem saves the selected channels under the new filename. If you enter a filename that does exist in the selected folder, you can add the selected channels to the channels in the file, or overwrite the file.

**Note** When DIAdem saves data in DAT format, it ignores custom properties and group information.

Refer to Lesson 8, *The DIAdem Calculator* and to the section on *Loading External Data* in Lesson 10, *Loading External Data*, for more DAT file information and examples.
F. Configuring DIAdem NAVIGATOR

You can make settings for the specific panels and configure the DIAdem data area.

Making Panel-Specific Settings

In DIAdem NAVIGATOR, select Settings»Desktop parameters»Panel specific. The configuration dialog box has the following settings:

- **Library path**: Displays the current library folder with data files.
- **User path**: Displays the current user folder with data sets.
- **Data storage**: Specifies the data storage that DIAdem loads when the NAVIGATOR panel opens.
- **Default file**: Specifies the data file that DIAdem loads when the Data Portal opens.

Configuring the Data Area

You do not have to have a default configuration for the data area. The data area adapts automatically to the loaded data, and only uses as much memory space as absolutely necessary.

If you do have to configure the data area, select Window»Close all to close all panels. Then select Settings»Memory management»Data area.

If you modify the data area, DIAdem saves the current settings in a desktop file with the filename extension *.ddd. DIAdem automatically restarts with this desktop file and the new settings are effective.
Summary, Tips, and Tricks

- In DIAdem NAVIGATOR, you navigate data files, file folders, and databases to find your external data. You can display file-based or server-based data storages.
- You load the data set into the Data Portal, which manages all internal data and makes the data accessible for all DIAdem panels.
- The Data Portal contains data channels, time channels, and text channels. The Data Portal organizes channels in groups and displays their properties.
- You also can load several data files into the Data Portal at the same time. DIAdem generates a separate channel group for each loaded data file.
- You can display and calculate registered data, but you cannot modify registered data. Registered data do not occupy memory space. DIAdem only creates a reference to the numeric data.
- DIAdem identifies the last data set that you load in the Data Portal as the default group. If you load a selection of data set channels to the Data Portal, DIAdem stores these channels in the default group.
- Use the shortcut menu in the Data Portal to modify the default group.
- The data in the Data Portal only exists while the program is running. DIAdem only registers changes temporarily. You must save data to make it accessible later.
- Select Settings»Desktop parameters»Panel specific to specify a Default file, that is, you specify the data set that is loaded into the data area when the program starts.
Notes
Lesson 4
Viewing Data

Introduction
In this lesson you will learn how to view and edit your data, and use graphics to interactively analyze your data.

You Will Learn About:

A. Viewing, Measuring, and Editing Data
B. Creating a Layout
C. Viewing Data as Curves
D. Describing an Evaluation in Textboxes
E. Editing Data in Channel Tables
F. Configuring DIAdem VIEW
A. Viewing, Measuring, and Editing Data

You can use DIAdem VIEW to view, measure, and edit the data in the Data Portal.

You create curves in 2D axis systems to get an overall impression of your data. You examine the curves with a graphic cursor, zoom curve sections, and delete or replace incorrect curve points. You list data channels and text channels in channel tables to view and edit data and text in detail. If you modify curves or edit channels, the changes affect the channels in the Data Portal. You describe the evaluation in textboxes.

Figure 4-1 shows a worksheet with two axis systems, the coordinate window, a channel table, and a textbox.

Select screen partitioning in the group bar to align the axis systems, channel tables, and textboxes in the worksheet. The function bars provide various partitioning combinations.

A VIEW layout may contain several worksheets with different views of your data. Select Insert>Worksheet to create new worksheets.
The toolbar contains various *graphics cursors* and *cursor types* for inspecting curves and accessing characteristic curve points. The toolbar also contains the buttons for enabling and disabling the *coordinate window*, for defining the curve display, and for loading and saving your own layouts. You can print a view or transfer the view to a report.

The toolbar has a button that opens the Calculator. You can use the Calculator to create and calculate channels.

Each axis system also has its own *toolbar*. Use this toolbar to specify the scaling mode for the y-axis, to resize a selected section of the curve, and to set flags.
B. Creating a Layout

You can include axis systems, channel tables, and textboxes in one worksheet, to see the data on the curve and the associated numeric values simultaneously, and to record your evaluation in a textbox. The screen partitioning function bars have templates for splitting the worksheet into varying numbers of sections that are in different positions.

For example, if you want to display your data as a curve in an axis system and list the numeric values in a channel table, divide the worksheet into two areas. Open the Predefined screen partitioning function bar and select Axis system/channel table horizontal. DIAdem generates an axis system in the top part of the worksheet and a channel table in the bottom part.

To generate a curve, select two data channels in the Data Portal. Click the channel you want to use as the x-channel. <Ctrl>-click the y-channel you want to use. Drag and drop this channel pair into the axis system. Then select the channels and drag and drop the channels into the channel table.

The worksheet partitions in the top four function bars are not predefined. To define one area of the split window, right-click the area and select Display type from the shortcut menu. You can select 2D axis system, Channel table, Textbox or Empty as the display type.

The partitions in the fifth function bar includes various combinations of axis systems, channel tables, and textboxes. If you select one of these preassigned partitions, DIAdem creates the view in a new worksheet. The channel table defined on the first button automatically displays all the Data Portal channels.

Move the frame to resize separate areas. You cannot move areas. To generate new areas, you can either use the shortcut menu to split an existing area, or you can load more areas in a partition you specify yourself. If you select non-preassigned worksheet partitioning with fewer areas than the current view, the definitions for the surplus areas are lost.

No matter how many areas you have, and what types they are, you only work in the area that DIAdem highlights with a dark frame.

Loading and Saving a Layout

You can save the layout of your current view in a file with the filename extension .tdv. In this layout file, DIAdem stores for each worksheet the description of all axis systems and channel tables, with the names of the channels to be displayed, and all textboxes, including the text. You can use the layout again later for other evaluations.
You can load a prepared layout as a template for a view, and adapt the settings to your evaluation.

**Using the Report Wizard**

Press <Ctrl-W> to open the Report Wizard and generate a view.

Use the Report Wizard to generate a view with axis systems, in three steps:
1. First select the data you want to display.
2. Specify the x and y-channels for the curves.
3. Select the VIEW display style.

DIAdem creates a view in a new worksheet according to the parameters you set in the Report Wizard. You can use the display as a template and edit it.

**Creating a Report**

To document the current view of your data in a report, you can transfer the worksheet to DIAdem REPORT. Click Transfer to REPORT in the DIAdem VIEW toolbar. DIAdem REPORT generates a new worksheet with the axis systems, tables, and comments, in the same layout as in the DIAdem VIEW worksheet.
C. Viewing Data as Curves

Use 2D axis systems for an overall view of your data. In 2D axis systems, DIAdem generates a curve from two data channels by creating data pairs for each curve point from the the x-channel and the y-channel values. If the two data channels are not the same length, the curve is as long as the shortest data channel.

To define another curve, select two data channels in the Data Portal and drag and drop the channel pair to the axis system. To display several curves, you also can select several channels and drag and drop them into an axis system. DIAdem uses the first channel you select, as the x-channel.

Double-click the axis system to open the Display dialog box, where you add, modify, or delete curves. Figure 4-2 shows the dialog box for curve definition.

![Figure 4-2. Dialog Box for Curve Definition](image)

The list at the top of the dialog box contains the defined curves. Click the list entry to select a curve definition, and you can then change the settings in the bottom part of the dialog box, for example, you can assign another color.

Click **New Entry** to open the subdialog where you can select an x-channel and one or more y-channels. Click **Curve markers** to open the subdialog box where you specify the line that joins the curve points. You also can specify the curve markers.

DIAdem then displays the curve in the axis system. A *curve symbol* appears next to the axis system, as a checkbox the same color as the curve.
The axis system has a graphic cursor for measuring and editing the curve. Use the mouse to move the cursor along the curve, and the coordinates appear in the coordinate window.

**Axis Scaling**

If you want to compare curves that have different value ranges in one axis system, you can use the axis system toolbar to select another scaling mode that improves the display.

You can choose from the following scaling types:

- **1 system [phys.]**
  
  Use **1 system [phys.]** to display several curves with one scale, in one system. The y-axis displays physical values. The value range is the common value range for all curves. The cursor position is in relation to all the curves.

- **1 system [%]**

  Use **1 system [%]** to display all curves in one axis system. The y-axis display ranges from 0–100%. The y-cursor position is in relation to the main curve. DIAdem indicates the y-positions on the other curves with dashes.

- **n systems [phys.]**

  Use **n systems [phys.]** to display each curve with a subaxis. The y-scaling is physical. The range of values for each axis corresponds to the range of values of the curve. DIAdem displays a separate graphic cursor in each axis system. You only can move the cursor in the main axis system.

To scale the y-axis, DIAdem uses the lowest and the highest y-value of the displayed curves. If you set **1 system [phys.]** scaling or **n systems [phys.]** scaling, you can scale the y-axis manually to inspect a specific curve section. You do this in the dialog box for curve definition, which is shown in Figure 4-2.

**The Graphics Cursors**

You use the various graphics cursors to move and measure one or more curves. You can choose a **Crosshair cursor**, a **Band cursor**, or a **Frame cursor**. You can click from one cursor type to another in the toolbar.

You can use the mouse or the cursor keys to move the graphic cursor in the enabled axis system. The graphics cursor runs parallel in the other axis systems if the range of values is the same.
You can observe the coordinates of the graphics cursors in the coordinate display and in the legend.

A crosshair cursor consists of a vertical line and a horizontal line, each of which you can move separately. The x and y-cursor coordinates that DIAdem displays as \( x_1 \) and \( y_1 \) specify the point where the lines intersect.

If you idle the mouse on one of the cursor lines, the graphic cursor changes to a horizontal or to a vertical arrow. Click and drag to move the cursor line vertically or horizontally. DIAdem refreshes the coordinates in the coordinate window.

The band cursor consists of two parallel, vertical lines that define a curve section with a delta-x bandwidth. DIAdem uses the x-position of the line with a little square for the \( x_1 \) coordinate, and the x-position of the other line for the \( x_2 \) coordinate.

If you move the mouse cursor along one of the two lines, the cursor changes to a double arrow, indicating the extended mode. To change the bandwidth delta-x of the graphics cursor, click and drag to the right or left.

When the cursor is inside the band cursor, it appears as two crossed arrows. You can click and drag the entire band along the curve.

The frame cursor is a rectangular area framed by two horizontal and two vertical lines. A small square indicates the point of intersection, which is at the cursor coordinates \( x_1 \) and \( y_1 \). The diagonally opposite point of intersection is at the coordinate points \( x_2 \) and \( y_2 \). Delta-x and delta-y are the distances between the horizontal and the vertical lines, which means the frame height and the frame width.

The frame cursor works the same way as the band cursor. You also can move the frame cursor up and down.

The Global Coordinate Display

You can display the current graphic cursor coordinates in a separate window. Click the Coordinates button in the toolbar to open and close the coordinates window. You can move the coordinates window around.

The small rectangle on the cursor indicates the data point for which DIAdem displays the coordinates in the coordinate window.

You also can use the coordinate window to position your cursor in the axis system. For the enabled graphics cursor, enter the point numbers, the x and y-values, or the distance between the cursor lines \( dx \) and \( dy \), and press <Enter>. DIAdem changes or moves the cursor accordingly.
The Cursor Position

Each axis system has a graphic cursor, which you drag along a curve. The default cursor is the **free cursor**, which you can move freely in the enabled axis system.

Use the **curve cursor** to move along the single curve points. You can display the coordinates of each point on the curve.

Use the **maximum values cursor** or the **minimum values cursor** to move the graphics cursor along the extreme values on the curve.

Defining Leading Curve

If an axis system contains several curves, you must specify which curve the graphics cursor relates to.

To specify the *leading curve*, click the associated curve symbol in the legend area.

If you have several axis systems in your worksheet, the graphic cursors move along the same value ranges in the other axis systems.

Curve Legend

If you move the cursor to the right edge of an axis system, a window divider appears. Click and move the edge of the resizable window to open the axis system legend.

The legend contains the y-channel name for each curve, and a checkbox that is the same color as the curve. You can add channel properties such as unit, extreme values, or cursor coordinates, and any text. Double-click the legend area to open the configuration for the legend in Figure 4-3.

![Figure 4-3. Dialog Box for Legend Configuration](image-url)
The properties that DIAdem can display in the legend are on the left of the dialog box. The overview on the right is a list of the properties that DIAdem currently displays in the legend.

To display another legend property, select the property in the list on the left of the dialog box and click > to add the property to the **Properties to be displayed**. The **Format/expression** specifies the display format for the numeric values, which are the x and y-numeric values or the time values.

Select the `<freetext>` property for display, specify in **Format/expression** the general text or the calculator expression that you want DIAdem to display in the legend window. You also can enter the heading for the display field in the **Title** column.

**Note**  
DIAdem only displays the properties **CursorX** and **CursorY**, which are the x and y-coordinates of the cursor, if one of the graphics cursors such as the curve, maximum value, or minimum value cursor, is enabled.

### Zooming and Scrolling

Use the zoom function to enlarge and to inspect separate sections of the curve. You only can use the zoom function with a band cursor or a frame cursor.

Move the band cursor or the frame cursor to a position where the curve section you want is inside the cursor lines. To move the cursor, click between the cursor lines and drag the mouse to the right or left. You define the width of the cursor by positioning the cursor lines.

Click **Zoom, static** in the axis system toolbar. The curve section that the cursor specifies covers the entire axis system. The narrower the cursor, the greater the enlargement.

You can repeatedly select and zoom, to examine smaller and smaller curve sections.

When you click **Zoom off**, DIAdem displays the original curve, regardless of how many times you zoomed the curve.

Whereas you use **Zoom, static** to zoom separate curve sections, you can use **Zoom, dynamic** to move the zoom along the entire curve. To move along the curve, click and drag the cursor horizontally.
Editing Curves

You can view and resize curves in axis systems, and you also can use flag functions to edit the curves.

Use the graphic cursor to specify single points or curve sections. Then click **Set flags** in the axis system toolbar to select all the curve points in the section. If the axis system contains more than one curve, DIAdem selects only the leading curve. To select the specific area in all the curves, <Shift>-click the **Set flags** function.

You also can select several separate areas. You move the graphics cursor and click **Set flags** in the axis toolbar.

Then specify the flag function you want to use to edit the selected values. You can choose from:

- **Flags: Delete data points**
  Deletes the curve sections specified by flags.
  Select **Settings»Flag parameters** to specify whether DIAdem deletes curve points from the data channel or replaces them with NoValues.

- **Flags: Copy data points**
  Copies the curve sections specified by flags into new data channels.

- **Flags: Interpolate points**
  Interpolates the curve sections specified by flags.
  Select **Settings»Flag parameters** to specify whether DIAdem interpolates the data points as a line or as a spline.

- **Set data point and flag**
  Marks single points with the crosshair cursor.

If a section of the curve is incorrect, you can replace the data points. Set the edges of the band cursor to the right and left of the erroneous section. Click **Set flags** to mark all the curve points in the section, and then click **Flags: Interpolate points**. This section of the curve is now linear. DIAdem stores the calculated values in the y-data channel of the active curve.

You also can delete the flags without the flag functions. You can use the axis system toolbar to delete specific flags. You move the graphics cursor to the selected area and click **Reset flags** in the axis toolbar. If the axis system contains more than one curve, DIAdem only deletes the flags on the leading curve. To delete the flags from all the curves in the selected area, <Shift>-click the **Reset flags** function.

You can use the DIAdem VIEW toolbar buttons to delete all the flags in all curves or all the flags from the data in the Data Portal. Click **Global flag reset**.
Exercise 4-1

Objective: Viewing the Loaded Data

In the following exercise, you view the loaded data as curves in an axis system and define a legend. This gives you an overview of the channels in the Data Portal.

1. Select DIAdem VIEW.

2. Open the Predefined screen partitioning function bar and select One channel table with all channels.

   The channel table contains the contents of all channels in the Data Portal. You can scroll the displayed extract.

3. Select Insert»Worksheet.

4. Select the channels shown in the following figure in the Data Portal:

5. Drag and drop the selected channels into the second worksheet.

6. Select the 2D axis system display type to display the selected channels as curves.

7. Click Coordinates in the toolbar to open the coordinate window.

   DIAdem displays three curves in the axis system. You can position the graphic cursor anywhere in the axis system. DIAdem displays the exact cursor position in the coordinate window.

8. Click the edge of the resizable window at the right of the axis system and drag open the legend.

9. Double-click the legend area to open the dialog box where you set the legend parameters.
10. Enter \( \text{d, dd} \) under **Format/expression** for the properties **CursorX** and **CursorY**.

![Select properties: (Legend)](image)

Click **OK**.

11. Click **Curve cursor** in the toolbar.

The graphic cursor attaches to a curve point. You can now only move the cursor along the curve point by point.

In this mode, the legend displays the coordinates of the current curve point. In the coordinate window, DIAdem displays the coordinates and the current point number.

12. Click a curve symbol in the legend area to specify a different leading curve. The graphic cursor attaches to the new curve.

13. Click **Minimum values cursor** and then **Maximum values cursor** in the toolbar. You move the graphics cursor from one local minimum value to the next, or from one local maximum value to the next.

14. Now click **Curve cursor** in the toolbar.

15. Click **1 system [%]** in the axis toolbar.

DIAdem displays all the curves in one axis system with one common y-scale that displays the value range 0–100%.
16. Click **n systems [phys.]** in the axis toolbar.

DIAdem displays each curve in a separate axis system.

Use the **1 system [%]** scaling and the **n systems [phys.]** scaling to compare curves with different value ranges.

Use **1 system [phys.]** scaling to display several curves with one absolute y-scale, in one axis system.

If you hide the Data Portal, the display with **1 system [phys.]** scaling looks like this:

---

**End of Exercise 4-1**

The **FrontCrash_1.tdv** layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 4-2

Objective: Zooming a Curve Section

In the following exercise you use the zoom and scroll functions in DIAdem VIEW to inspect and measure curves. Select screen partitioning with three areas. Display the original data in the top axis system and use the frame cursor to specify a curve section. Zoom this curve section in the middle axis system and scroll the curve in the bottom axis system.

1. Select DIAdem VIEW.

2. Click New layout in the toolbar without saving the current view.

3. Open the Regular screen partitioning function bar and select Three areas.

4. Select the Time1 and a_Head_hor channels in the Data Portal and drag and drop the selected channels into each of the three areas.
   Select the 2D axis system display type.

5. Click Band cursor in the toolbar.
   In all three axis systems, the band cursor consists of two parallel, vertical lines that define a curve section with a $dx$ bandwidth.

6. Click the top axis system and move the sides of the band cursor to specify a curve section.
   If you idle the cursor over one of the lines, the cursor changes into a double arrow. Click and drag the mouse to the right or left to change the bandwidth of the graphics cursor.
   When the cursor is inside the band cursor, it turns into two crossed arrows. Click and drag to move the entire band along the curve.

7. If you have closed the coordinates window, click Coordinates in the toolbar.
   The $x_1$-coordinate specifies the x-position of the band cursor line that is marked with a small square. The $x_2$-coordinate specifies the x-position of the second line.

8. Click Zoom, static in the toolbar of the middle axis system.
   DIAdem displays the range inside the band cursor in the middle axis system.
   The smaller the band cursor section the more you zoom into that section. You can enlarge the zoom by specifying a new section in the zoomed display area.

9. Click Zoom, dynamic in the toolbar of the bottom axis system.
The static zoom in the middle axis system enlarges the curve section, and you scroll the curve through the enlarged dynamic zoom view in the bottom axis system. To move the displayed area, click and drag the area to the right or left.

If you hide the Data Portal, the view looks like this:

End of Exercise 4-2
The FrontCrash_2.tdv layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 4-3

Objective: Editing Curves

In the following exercise you use the flag functions to edit curves.

1. Select DIAdem VIEW.

2. Click Coordinates in the toolbar to close the coordinate window.

3. Open the Regular screen partitioning function bar and select One area.

DIAdem uses the curve from the top axis system.

4. Click Free cursor in the toolbar to move the cursor anywhere along the curve.

5. Click Band cursor in the toolbar and position the band cursor on any curve section.

6. Click Set flags in the axis toolbar to select the curve section.

7. Click Flags: Delete data points in the axis toolbar to delete the curve section.

   This makes a gap in the curve, because DIAdem replaces the y-values of the selected curve points with NoValues. DIAdem does not change the x-values of the curve points and the length of the two channels when it deletes the points.

Note In DIAdem you can define a numeric value as invalid. These numeric values are called NoValues. DIAdem does not include NoValues in DIAdem VIEW and REPORT displays, or in mathematical analysis.

8. Click Crosshair cursor in the toolbar.

9. Move the crosshair cursor to any position in the area you deleted. Click Set flags in the axis toolbar to include the current point in the curve.

10. Repeat step 9 twice to specify a total of three new curve points.

11. Click Band cursor in the toolbar.

12. Move and enlarge the band so it covers the gap in the curve.

13. Click Set flags in the axis toolbar to select the curve section.
14. Select **Settings > Flag parameters** and set **Spline interpolation** for **Interpolation** as shown in the following figure:

Click OK.

15. Click **Flags: Interpolate points** in the axis toolbar to reconstruct the deleted section of the curve.

DIAdem uses the boundary points and the specified curve points to recalculate the section with a spline function.

16. Click **Reset flags** in the axis toolbar to undo the curve section selection.

The view could look like this:

End of Exercise 4-3

The **FrontCrash_3.tdv** layout, which contains the solution for this exercise, is in the **C:\Solutions\DIAdem Basics\** folder.
D. Describing an Evaluation in Textboxes

Use the textboxes to comment your evaluation and to display variable contents, as shown in Figure 4-4.

If you want to define an area as a textbox, select **Display type=Textbox** in the shortcut menu. Double-click a textbox to edit texts or to insert new text.

![Figure 4-4. View with Textbox](image)

To display channel properties, select the properties in the Data Portal and drag and drop the properties into the textbox. DIAdem automatically sets two @ in before and after the expression.

Your text may include formula expressions, which return a single value. The formula expression must be set in @. You can use the Calculator operands and operations in formula calculations. DIAdem evaluates this expression and displays the result in the textbox.

Select **Refresh** in the shortcut menu to refresh variable contents and to calculate formulas. The shortcut menu also includes the **Textbox settings** for font, font size, font color, and line alignment.
Exercise 4-4

Objective: Commenting an Evaluation

In the following exercise you create a textbox and comment the evaluation.

1. Select DIAdem VIEW.

2. Open the Regular screen partitioning function bar and select Two areas.
   DIAdem displays the axis system in the top area.

3. Right-click the bottom area and select Display type »Textbox in the shortcut menu.

4. Reduce the size of the textbox.

5. Double-click the textbox and enter the following text:
   Crash data evaluation:

6. Press <Enter>.

7. Select the a_Head_hor data channel in the Data Portal.

8. Select Name in the left column of the channel properties and drag and drop the property into the textbox.

9. Select Maximum in the left column of the channel properties and drag and drop this property into the textbox too.

10. Right-click the textbox and select Textbox settings in the shortcut menu.

11. Set the font size to 14 and set the font color to Blue as shown in the following figure:

   ![Textbox settings dialog box]

   Click OK.
The view looks like this:

End of Exercise 4-4
The FrontCrash_4.tdv layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Additional Exercise

If you have time, complete the following exercise.

1. Use the **Transfer to REPORT** function to transfer the current worksheet to DIAdem REPORT.
2. In DIAdem REPORT, add a frame and grid lines.
3. Set manual scaling for the x-axis and limit the value range from 10 to 80 ms.
4. Save the report.

The report could look like this:
E. Editing Data in Channel Tables

Use channel tables to view and edit the contents of data channels, time channels, and text channels.

To list channels in a channel table, select the channels in the Data Portal and drag and drop the channels into the channel table. DIAdem displays channels columnwise in the channel table, with headings that are channel properties such as, name, number, and channel length.

To edit the y-values of the curves specified in an axis system, select Displaytype » Channel table in the shortcut menu.

Double-click the left edge of the channel table to open the Display dialog box shown in Figure 4-5. In this dialog box you can specify new columns, or move, modify, and delete existing columns. For each column, you can select another channel in the bottom part of the dialog box and enter a display format.

![Dialog Box for Defining Channel Tables](image)

**Figure 4-5.** Dialog Box for Defining Channel Tables

Click the column header in the channel table to select the column. You can move selected columns and press <Del> to delete selected columns from the channel table. To change the width of a column, move the right or left edge of the column header. The width of the other columns does not change.

Click Table settings in the shortcut menu to specify the display for the table contents, such as the font size.
The Channel Contents: Editing Single Values

Depending on the window size and the length of the channels, DIAdem only displays an extract of the data in the channel table. You can scroll the extract horizontally or vertically.

You can edit one or more channels, data from one or more channels (data blocks), or one single datum. To delete or overwrite a datum, click the data field. To edit a datum, double-click the data field.

To select a data block, click the first data field and drag to the last data field. Figure 4-6 shows a selected data block. If the block you want to select is larger than the extract displayed, drag the cursor over the edge in the direction you want.

![Figure 4-6. Selected Data Block in a Channel Table](image)

Click the column heading to select a channel. Then right-click to open the shortcut menu, which contains the editing functions. The shortcut menu also includes functions such as **Delete** and **Generate**.

**Delete** deletes selected channel values. Use the **Generate** function to insert equidistant values into a channel.

**Note** When you edit the data in channel tables you change the internal data. You cannot undo data changes you make. To restore the data, you must reload the original data set.
You can use the Calculator to edit and calculate your data in DIAdem VIEW. You can use the Calculator to create and calculate channels. You also can use the Calculator to calculate and display single values and to assign variables.

Refer to Lesson 8, *The DIAdem Calculator* for more information about the Calculator, which you also can use in the DIAdem panels ANALYSIS and SCRIPT.

**Channel Properties: Viewing and Editing Characteristic Values**

To display other properties than the name, numbers, and length of the channels, select the properties in the Data Portal and drag and drop the properties into the channel table.

To delete properties from the table header or to change the display format, select **Select properties** in the shortcut menu. The dialog box shown in Figure 4-7 appears. The properties and characteristic channel values that DIAdem can display in channel tables are displayed on the left. The properties include comments, physical unit, channel type, the display format for the channel contents, and additional information. The overview on the right is a list of the properties that DIAdem currently displays in the channel table.

![Figure 4-7. Dialog Box for Selecting the Channel Properties in Channel Tables](image)

To display another property in the channel table heading, select the property from the list on the left of the dialog box, and click > to include the property in the **Properties to be displayed**. The **Format** specifies the display format for the numeric properties and characteristic values.

In the table heading, DIAdem dims channel properties that you cannot edit, such as maximum length, NoValues, monotony behavior, and minimum and maximum value. Property fields that you can edit have a white background.
in the channel table. Click a property field to delete or to overwrite the contents. Double-click a property field to edit the contents.

Note  You specify the channel properties in the Data Portal. In the custom properties, you can include special information for each channel, such as test conditions or characteristic statistical values.
Exercise 4-5

Objective: Generating a Data Channel

In the following exercise you load the data of a measurement that took approximately 250 ms. When you view the data, you see that the channels have different lengths of 324 and 1944 values, which means that the data were acquired at different sampling rates in this time interval. Therefore, you cannot assign all channels to the existing time channel.

In the following exercise you generate a new time channel for the data measured at a lower sampling rate and enter associated channel properties.

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal without saving the data.
3. Navigate to the FrontCrash_2.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. In the Data Portal, open the shortcut menu for the channel group Car_1, and select New » Channel.
5. Enter Time2 as the name and click OK.
6. Move the Time2 channel to the fifth position in the Data Portal. The time basis is now at the top of each Data Portal group, followed by the data channels that relate to that time basis.

This means that the channels a_Head_hor, a_Head_ver, and a_Head_lat are related to the time base Time1; and Speed and p_Airbag are related to the time base Time2.

7. Select DIAdem VIEW.
8. Open the Predefined screen partitioning function bar and select One channel table with all channels.

The channel table displays the contents of all the channels in the Data Portal.
9. Select the first channel value of the empty channel Time2.

10. Select **Generate** in the shortcut menu.
11. Set the dialog box parameters as shown in the following figure:

If you enter $CMax(1)/323$, DIAdem reads the maximum value of the first channel, which is the exact time the measurement takes, and divides this value by the number of intervals. The number of intervals is lower than the number of values.

You can enter variables and mathematical expressions in dialog box entry fields. The Calculator calculates your entries. This allows you to also calculate and display single values in entry fields.

**Note** Refer to Lesson 8, *The DIAdem Calculator* for more information about the Calculator.

Click **OK**. DIAdem creates the channel values according to the generation rule.

12. Set the following channel properties for the $Time2$ channel in the appropriate property fields of the channel table:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ms</td>
<td>Time for slower channels</td>
</tr>
</tbody>
</table>
The view looks like this:

![DIAdem interface showing channel properties and contents](image)

**Note** This function generates numeric values in equidistant steps in a channel. The **Basic mathematics** in DIAdem ANALYSIS includes more functions for generating channel data. Select the **Generate time channels** function to create channels with equidistant time values. Select **Generate data** to break down existing channels, and to generate new channels with equidistant or geometric step widths.

**End of Exercise 4-5**

The FrontCrash_3.tdm data set, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
Exercise 4-6

Objective: Calculating Channels

In the following exercise you use the Calculator to determine the resultant of the three head accelerations.

1. Select DIAdem VIEW.

2. Click the Calculator in the toolbar.

3. Use the following formula to calculate the resultant $R$ from the head accelerations:

$$R = \sqrt{x^2 + y^2 + z^2}$$

Use the $\text{sqrt}$ function to calculate the square root. Use the $\text{sqr}$ function to calculate the square. If you replace the variables $x$, $y$, and $z$ with the appropriate data channels, the following formula results:

$$\text{Ch('Resultant')} := \sqrt{\text{sqr('a_Head_hor')} + \text{sqr('a_Head_ver')} + \text{sqr('a_Head_lat')}}$$

Enter the formula in the Edit field.

Click Calculate.

In the Data Portal, DIAdem generates the new Resultant channel with the formula result.

4. Close the Calculator.

5. Enter the $g$ as the unit property for the Resultant channel in the Data Portal.
6. Position the Resultant channel above the Time2 channel in the Data Portal:

![Diagram showing channel positioning]

**End of Exercise 4-6**

The FrontCrash_4.tdm data set, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
F. Configuring DIAdem VIEW

The Desktop parameters are the program settings you can specify in DIAdem.

Making Panel-Specific Settings

In DIAdem VIEW, select Settings » Desktop parameters » Panel specific. The configuration dialog box has the following settings:

- **Library path**: Displays the current library folder with VIEW layouts.
- **User path**: Displays the current user folder with VIEW layouts.
- **Default file**: Specifies the VIEW layout that DIAdem displays when the VIEW panel opens.

You load and save VIEW layouts in the REPORT folders. Therefore, you cannot modify the library and user path in the panel-specific DIAdem VIEW settings: you also can modify them in the DIAdem REPORT settings or by selecting Settings » Desktop parameters » General » Path selection.

You can save all the program settings in a desktop file. The desktop file has the filename extension .ddd. To save your settings in a desktop file, first select Window » Close all. Then click Save desktop.

Specifying Layout Parameters

Select Settings » Layout parameters to specify how DIAdem accesses channels. You can use the channel name or the channel number to assign channels. By default, DIAdem works with the channel names and the group index.

DIAdem saves the layout parameters with the layouts.

**Note**  The channel assignments in channel tables and 2D axis systems stay the same, regardless of which mode is set, even if you assign new channel numbers. If you save a layout in a name-oriented mode and then reload it, DIAdem uses the first channel with the specified name when the channels have the same name but different channel numbers. The channel assignments in channel tables and 2D axis systems remain unchanged even if you delete channels in the Data Portal, or if you load a layout with channels assigned that DIAdem cannot find in the Data Portal.
Configuring Flag Parameters

Select Settings » Flag parameters to specify how the flag functions in DIAdem VIEW work.

- Use the Delete parameter to specify whether DIAdem VIEW deletes the selected data or sets NoValues when you click Flags: Delete data points.
- Use Interpolate to specify how DIAdem VIEW approximates the areas marked by the flags when you click Flags: Interpolate points.
Summary, Tips, and Tricks

- You can include axis systems, channel tables, and textboxes in one worksheet, to see the data on the curve and the associated numeric values simultaneously, and to record your evaluation in a textbox.

- The screen partitioning function bars have templates for splitting the worksheet into varying numbers of sections that are in different positions. Previous graph entries are included in new screen partitioning as far as possible.

- To generate a curve, select two data channels in the Data Portal. Click the channel you want to use as the x-channel. <Ctrl>-click the y-channel you want to use. Drag and drop this channel pair into the axis system. You list data in channel tables in the same way.

- To specify the leading curve, click the associated curve symbol in the legend area.

- Use the zoom function in the axis toolbar to enlarge and to inspect separate sections of the curve. You only can use the zoom function with a band cursor or a frame cursor. The zoom function always affects all the curves in an axis system.

- When you edit the data in channel tables you change the internal data. You cannot undo data changes you make. To restore the data, you must reload the original data set.

- You can use the Calculator to create and calculate channels. You also can use the Calculator to calculate and display single values and to assign variables. You also can use the Calculator functions in the dialog box textboxes.
Lesson 5
Creating Reports

Introduction
In this lesson you will learn how to document and present data in DIAdem.

You Will Learn About:

A. Documenting Data
B. Creating a Report
C. Printing a Report
D. Saving the Layout
E. Format and Display Modes
F. Configuring DIAdem REPORT
A. Documenting Data

You use DIAdem REPORT to generate reports that document your data. You can access all the data in the Data Portal and present it in a variety of ways. Figure 5-1 shows the DIAdem REPORT interface.

The various graphical display objects are grouped into function bars: 2D and 3D axis systems, 2D and 3D tables, polar axis systems, graphics, and decorations. The related function bars have different types of these objects.

A report may consist of several worksheets with different views of your data. When you lay out your worksheets, you can combine all the graphic objects, and position and scale them freely. Double-click an object to assign data to it and to set the object parameters.

You save the report worksheets and the links to the displayed data, in a file with the filename extension *.tdr*. You can reuse layouts as templates for similar reports.

The toolbar contains functions for loading and saving layouts and for printing the report. The toolbar also has functions for aligning selected objects, and for refreshing the report.
Lesson 5  Creating Reports

B. Creating a Report

You can use any combination of axis systems, tables, text, and graphics in a report. DIAdem displays the data in curves or bar diagrams in axis systems, and lists numeric data in tables. You can label your report with text and comments and illustrate your report with graphics and lines.

In DIAdem REPORT you do almost everything with the mouse. You use the mouse to position the various objects in the worksheet and you drag and drop the data channels to be displayed, from the Data Portal to the axis system or table.

You can include existing layout files or blank worksheets in your report. To add a blank worksheet, click New in the tab bar shortcut menu. To add several blank worksheets, select Manage in the shortcut menu. In the dialog box that appears you can add, delete, and change the order of the worksheets. Select File»Append layout to add completed worksheets.

Using the Report Wizard

Press <Ctrl-W> to open the Report Wizard, which you use to generate a report.

Use the Report Wizard to generate a report in three steps:

1. First select the data you want to display.
2. Specify the x and y-channels for the curves.
3. Select the curve display mode.

DIAdem creates a report in the current DIAdem REPORT worksheet according to the parameters you set in the Report Wizard. You can use the report as a template and edit it.

Template: Predefined Layout

You save and load layouts separately from the data. This allows you to reuse the layout for any data set.

You can load a report as a template for a prepared layout, and then adapt the layout to data you want to evaluate, or to the project, or to specific company standards.

When you open DIAdem REPORT, the worksheet contains the layout that you designate as the Default file in the dialog box that opens when you select Settings»Desktop parameters»Panel specific. If you want to always access a specific layout when you click New, specify this layout as the Template in this dialog box. You can insert objects that every report should have, such as the company logo.
Lesson 5  Creating Reports

Figure 5-2 shows the standard DIAdem default layout. The layout has a frame. You can only move, scale, or rotate graphic objects inside this frame. Select Settings»Layout parameters to specify the frame.

Figure 5-2. Default Layout that DIAdem Loads when It Launches

When you load a layout, DIAdem displays the report with the data channels specified in the layout. If no data appears in the axis systems or tables although the appropriate data is in the Data Portal, you saved the layout last time without assigning data. Drag and drop the data channels you want to display from the Data Portal to the axis system or the table.

Page Format

To protect the object alignment, specify the page format before you create the report. You can specify a relative or a scaled page format. DIAdem saves the page format with the layout.

A relative page format specifies the paper format and page orientation. In the print dialog box you enter the width of the printout, corresponding to the selected paper format. If you change the paper format later, DIAdem can adapt the report to the new format because it specifies the distance from each object to the edge of the page as a percentage of the page width and the page height.

For scaled page format, select Settings»Layout parameters and enter a fixed height and a fixed width for your worksheets. DIAdem always prints your report in the specified size, regardless of the selected paper format. If
you select scaled page layout, you can scale your axis system manually to ensure that DIAdem always prints the same number of units per centimeter, for example, 10°C/cm.

**Editing Objects**

You can combine axis systems, tables, text, graphics, and decorations in a report, position them where you want, and resize them.

**Selecting Objects**

You use either the mouse or the <Tab> key to select objects. The latter is useful if the objects are underneath each other.

You can select several objects at once by drawing a selection box. To do this, click anywhere in the worksheet and drag to enclose the objects you want to select. Alternatively, click the first object, press <Ctrl>, and click additional objects.

You also can click *subobjects* to enable them. The subobjects of an axis system include the axes, the axes labels, the axis scale, and the curves. The subobjects of a table include the table header and the single columns. You can select, move, and configure each subobject separately.

Go through the subobjects of a selected object with <Shift-Tab>. <Shift>-click overlapping objects. The enabled object has a thick blue frame. When you release the <Shift> key, the object is selected and you can edit and configure the object.

Selected objects are framed with scaling marks on the corners and on the middle of the sides.

To undo a selection, click anywhere in the worksheet, or press <Esc>.

**Manipulating Objects**

You can move or resize selected objects.

When you idle the cursor over the scaling marks, the shape of the cursor changes. To resize the object, click and drag a scaling mark.

Click and drag the corner marks to resize the object maintaining the height to width ratio. If you use the marks at the sides, you can move the sides separately.

To disable proportional scaling, click the corner marks and press <Shift> at the same time. You only can do this with graphic objects that may distort. Text only can be scaled proportionally.
The corner and side markers opposite the side you move, do not change position when you scale an object. However, if you press <Ctrl> at the same time, only the center of the object remains the same. This applies for all graphic DIAdem objects.

If you position the cursor on the enabled object, the moving cursor becomes visible. Press the left mouse button and move the object.

You can rotate one-line text freely. Click one of the corner markers again to enable the rotation mode.

**Aligning Objects**

The toolbar has several functions for aligning and scaling several objects.

You can align objects on one of the four edges, and DIAdem uses the object that protrudes the furthest as the reference point. You also can align objects horizontally, adjust the distance between objects to be equal, or make all selected objects the same size.

You can edit groups of selected objects in the same way as individual objects. This means you can move, resize, and configure the objects, but only if the edits apply for all the objects in the group. For example, if you cannot enlarge one of the objects, this applies to the entire group.

To enter common parameters like color, line width, line style, font, and font size for a group of selected objects, open the shortcut menu for the group and select **Properties**. In this dialog box, the settings that do not have the same default for all the selected objects are empty.

**Undoing Object Edits**

You can undo your edits in DIAdem REPORT. To undo actions such as positioning, rotating, and scaling, starting from the last action, select **Edit»Undo**.

**Note** DIAdem cannot undo object definitions you set in dialog boxes.

**Axis Systems: Displaying Data as Curves**

Axis systems display data channels in relation to each other. For example, you use a 2D axis system to display velocity over time, or 3D axis systems to display air pressure and a related temperature over time as isolines. You can display the sensitivity of a microphone in a polar axis system.
2D Axis Systems

Use 2D axis systems to display data channels as curves or as bar diagrams.

The 2D axis system function bar contains templates for 2D axis systems, for example, with and without grid lines, with linear or logarithmic partitioning, and with one or more y-axes. Select Simple 2D axis system to insert an axis system into the worksheet.

Click and drag open the 2D axis system anywhere in the worksheet. DIAdem inserts the axis system and displays it with a selection frame. Now you can move and scale the axis system.

To generate a curve, select two data channels in the Data Portal. Click the channel you want to use as the x-channel. <Ctrl>-click the y-channel you want to use. Drag and drop this channel pair into the axis system.

Double-click the axis system to open the dialog box where you specify the layout for the axis system and for the curve. Figure 5-3 shows the dialog box for curve and axis definition.

![Figure 5-3. Dialog Box for 2D Curves and Axis Definition](image)

Use the Axis definition subdialog box to set the global display parameters, which specify the appearance of the axis, of the frame, and of the grid lines.

Use the Curve param subdialog box to specify other curve parameters that apply for the selected display mode. For example, in the Line display mode,
you can specify that markers appear at every twentieth displayed data point, as shown in Figure 5-4.

![Figure 5-4. Curve with Markers](image)

You can enter more than one curve in an axis system. If the y-channel value ranges differ very greatly, specify several y-axes.

The **2D axis system** function bar has prepared axis systems that have several y-axes. You also can add **subaxes** to an existing 2D axis system. To modify existing subaxes and to specify additional y-axes, select the **Subaxes** subdialog in the dialog box for curve and axis definition.

In the main dialog box for the curve and axis definition, you specify several y-axes and you must assign a subaxis system to each channel pair as shown in Figure 5-5. First enable the channel pair in the overview and then enable the subaxis system in the selection list.
Figure 5-5. Each Curve Can Have a Separate Subaxis System

After you display the axis system, you can move the subaxes and reduce them, as in the top axis system in Figure 5-6. When you reduce the subaxes, the curves and the reference axis change.

Figure 5-6. The Top Axis System Has Two Different Y-Axes
When you display multiple curves in one axis system, as shown in Figure 5-7, use a Legend to assign the curves to the data. Enable the legend display in the dialog box for curve and axis definitions. Set parameters for legend labels, headings, position, and size in the Legend subdialog. Double-click a legend to open the dialog box where you can modify the parameters.

Figure 5-7. Each Axis System Can Display a Legend

3D Axis Systems

Use 3D axis systems for surface, waterfall, isoline, 2D matrix, and 3D curve display. For example, you can display the results of a rainflow matrix in a 2D matrix where the size of the square reflects the frequency counted.

The 3D axis system function bar has various templates for 3D axis systems, for example, with and without grid lines. Select Simple 3D axis system to insert an axis system into the worksheet.

Click and drag open the 3D axis system anywhere in the worksheet. DIAdem inserts the axis system and displays it with a selection frame. Now you can move and scale the axis system.

To generate a curve, select three data channels in the Data Portal. Click the channel you want to use as the x-channel. <Ctrl>-click the y-channel and the z-channel you want to use. Drag and drop this channel triple into the axis system.
Which display features you can use in the axis system depends on how your 3D data is organized. Depending on the type of display, data must be stored as xyz-value triples or as an xyz-matrix. DIAdem requires matrix data for surface, waterfall, bar, 2D matrix, and 3D curve display, but DIAdem also can use value triples for spike and symbol display. Refer to Lesson 11, *Organizing 3D Data* for more information.

Double-click the axis system to open the dialog box where you specify the layout for the axis system and for the curve. To change the view of a 3D axis system, rotate the axis system by resetting the *Axis definition* dialog box. You can scale and label each display level separately, and add grid lines.

You also can position a display layer vertical to the two other display layers in the worksheet. To move a plane outwards, click the edge of the plane. The cursor changes to a triangle and you can click and drag the plane outwards.

**Polar Axis Systems**

Use polar axis systems to project the values of a channel onto a circle.

The *Polar axis system* function bar has various polar axis system definitions, including 360°, 180°, and 90° aperture angles. Click *Polar axis system with 360-degree aperture angle* to insert a polar axis system into the worksheet.

Click and drag open the polar axis system anywhere in the worksheet. DIAdem inserts the polar axis system and displays it with a selection frame. Now you can move and scale the polar axis system.

To generate a curve, select two data channels in the Data Portal. Click the channel you want to use as the x-channel with the angle values. <Ctrl>-click the y-channel with the length values you want to use. Drag and drop this channel pair into the polar axis system.

Double-click the axis system to open the dialog box where you specify the layout for the polar axis system and for the curve. Use the subdialogs *Scaling*, *Numbers*, *Labeling* and *Display* to set the parameters for your polar axis system.

**Using Tables: Displaying Data Numerically**

Tables list channels numerically. 2D tables also can display text channels, formula expressions, and variable contents. You can display tables horizontally or vertically.

**2D Tables**

Use 2D tables if you want to list data channels, time channels, and text channels in columns.
The 2D table function bar has various templates, for example, for 2D tables with and without separators. To insert a simple table in the worksheet, select **2D table with horizontal and vertical separators**.

Click and drag open the 2D table anywhere in the worksheet. DIAdem inserts the table and displays it with a selection frame. Now you can move and scale the table.

Select channels in the Data Portal and drag and drop the channels into the table. DIAdem transfers the channels in the order you select them in. You can resize the column width and the row height by shifting the corresponding separating lines.

Double-click the table to open the dialog box where you specify the display for the table and for the data. Figure 5-8 shows the dialog box for 2D table definition. The dialog box for the table definition gives you an overview of the channels to be displayed. You can modify the table display in the subdialog boxes **Headers, Columns** and **Display**.

![Figure 5-8. Dialog Box for 2D Table Definition](image)

Tables can display not only the contents of a channel, but also variables or results of an expression, which means a combination of text and variables.

For the **Variable** data type, you enter only the variable name in the dialog box, without a dimension or format instruction. If the variable is a scalar variable, the table only displays the variable content once. The table displays the contents of vector variables according to the variable type and the table length.
With the Expression data type, you can format a variable and add any new text. If you use a variable in an expression, you must enclose the variable in @ characters. Vector variables also require a reference to the dimension.

Note To access table columns use the variable D2TabCol in an expression, and to access table rows use the variable D2TabRow in an expression.

Example  

[@CD(D2TabRow)@]

This expression enters the channel unit in the table in brackets. If you use the variable D2TabRow, the unit of the first channel appears in the first table row, the unit of the second channel appears in the second row, and so on.

The table in Figure 5-9 displays all the values and text from the selected channels. Display very long channels in sections so the numbers and text are more legible. If you want to display the trends in the single channels, only display every twentieth value, for example.

Select Automatic expand as the Table length in the Table definition dialog box for complete documentation of long channels. This defines a table that lists the channel contents on several pages. Use the functions Previous table contents and Next table contents in the DIAdem REPORT toolbar to scroll in the table. DIAdem automatically prints reports with multipage tables on several pages.

Figure 5-9. Report with Two Axis Systems and a Table
3D Tables

Use 3D tables if you want to numerically list data channels as a matrix.

The 3D table function bar has two templates for 3D tables, with and without labels. Select 3D table without labels to insert a basic table into the worksheet.

Click and drag open the 3D table anywhere in the worksheet. DIAdem inserts the table and displays it with a selection frame. Now you can move and scale the table.

To display an xyz-matrix, select three data channels in the Data Portal. Click the channel you want to use as the x-channel. <Ctrl>-click the y-channel you want to use and the first z-channel. Drag and drop this channel triple into the axis system. 3D tables assign each xy-value pair the associated z-value.

Double-click the table to open the dialog box where you specify the display for the table and for the data. The 3D table can display the entire data matrix or a section. The 3D table can also skip values in long channels, and only display every twentieth value, for example. You enter display parameters like font and display mode separately for the x, y, and z-values, not columnwise.

Note To display data channels as triples, list the three data channels in a 2D table. Each row in the table then contains a value triple. Refer to Lesson 11, Organizing 3D Data for more information about 3D data.

Texts: Labels, Descriptions, Comments

Reports often include explanatory text. You can insert text anywhere in the worksheet.

You can integrate two kinds of text: free text and text objects. Use free text for short text like headings and expressions, and the text object for long texts with several lines that can contain more than one text format, such as a text field.

Free Text

Use free text to include short texts in your report or if you want to align and rotate text in relation to objects.

The Decorations function bar has free text, a text object, comments, rectangles, circles, lines, and arrows. Click Texts to enter text.

The cursor changes and appears as a vertical line with Abc attached. Use the text cursor to click the position where you want to insert the text in the worksheet. A blinking entry marker appears.
Click anywhere in the worksheet, a flashing text cursor appears, and you enter your text. Press <Return> to separate lines: DIAdem generates a free text for each line. Click another position in the worksheet to finish the text entry.

Now you can move and resize the text. If you use the selection frame to zoom text in the worksheet, you enlarge the font size.

Double-click the text to open the dialog box where you expand the text or modify the font attributes. You also can include formulas and variables in text. DIAdem only recognizes formulas and variables set in @ characters.

You can rotate free text. Click one of the squares at the corners of the selected text shown in Figure 5-10, and rotate the text to the right or to the left with the curved arrow.

**Figure 5-10.** Rotating Free Text

Select **Default setting** in the shortcut menu for the button to change the font attributes for the free text. Any text you write after changing the attributes appears with the new attributes.
Text Objects with Different Formats
Use text objects to generate several lines of block text with different formats.

The **Decorations** function bar has free text, a text object, comments, rectangles, circles, lines, and arrows. Select **Text object** to insert a text object into the worksheet.

DIAdem inserts the text object into the worksheet as a white rectangle. Double-click the white field to open the text editor, which you use to enter text, to import existing files in ASCII, RTF, or HTML format, and to integrate DIAdem variables. Figure 5-11 shows the text editor, where you can set the following formats for single words, formulas, and sections:

- The following standard functions are available for character formatting: font, font size, font color, font type, subscript and superscript.
- For paragraph formatting the following options are available: alignment, bullets, numbering, and left and right tabs.
- Use the menu bar options to format the background and insert DIAdem expressions, tables, and graphics.

![Text Object Editor](image)

**Figure 5-11.** All Kinds of Formats are Available for Text Objects

When you close the editor, you can move and resize text objects. If you resize the text object, you only change the line feed for multiline text, not the size of the actual letters. You cannot rotate text objects.
Figure 5-12 displays the text object at the bottom right in the report:

![Image of a report with text object](image)

**Figure 5-12. Report with Text Object**

**Note** Text object font size definitions are different from single-line text and axis label definitions. You specify the font size for the text object in points, not in relation to the page width.

**Graphics, Rectangles, and Lines**

Use graphics to include a diagram of a test stand, or to insert a company logo into your graphic, for example.

You can use the **Graphics file** function bar to load graphics in various formats, such as `wmf`, `bmp`, `jpg`, `tif`, and `gif`. The first four buttons in the function bar have predefined graphics. Select the fifth button, **Load graphics**, to load a graphic from the folder.

When you select a graphic in the preview, DIAdem inserts the graphic in the top left of the worksheet. Now you can move and resize the graphic. Figure 5-13 displays a graphic at the bottom right in the report.

When you integrate graphics in your report, DIAdem only generates a link to the graphics file. DIAdem saves the link with the path in the layout. If you load a layout and DIAdem displays a gray frame instead of a graphic, DIAdem was not able to find the graphics file in the specified folder. Double-click the graphic and correct the path definition.
Click **Default setting** in the shortcut menu to assign frequently used graphics to the four buttons in the **Graphics** function bar. You then click the appropriate button to integrate the logo into your report.

![Image](image_url)

**Figure 5-13.** Report with Graphic

Use rectangles to frame text fields or headings in reports.

The **Decorations** function bar has rectangles, circles, lines, and arrows. Select **Rectangles** to insert a rectangle into the worksheet.

Click and drag open the rectangle anywhere in the worksheet. DIAdem inserts the rectangle and displays it with a selection frame. Now you can move and scale the rectangle. Double-click the rectangle to open the dialog box where you specify the frame and the background color.

The **Decorations** function bar also includes comments. Use comments to link objects in a report to a comment text. Use circles and ellipses to highlight an area of your report. Use lines and arrows to display report objects or curve points.
Displaying the Report

You can superimpose axis systems, tables, text, and graphics in a worksheet. The superimposed objects are visible because the backgrounds are transparent. To highlight a text in an axis system, select White for the text background.

DIAdem displays objects in the same order you insert them. The new objects are in the foreground. You can change the order of the objects. For example, to position a graphic behind an axis system, select the graphic and click Move to background in the shortcut menu.

You can refresh the report display, which means that DIAdem then redraws the report, updates the variable contents, and displays the objects in the actual order.

To display reports with large graphics and extensive data channels faster, you can temporarily block the display of graphics and curves. Deselect View>Graphic layer to display a gray wildcard with the filename instead of the graphic. Deselect View>Data layer to delete all curves and table entries. Select Graphic layer to redisplay the graphics and select Data layer to redisplay the curves and table entries.
Exercise 5-1

Objective: Creating a Report with Three Axis Systems

In the following three exercises you create a report for a crash test. In the first exercise you display the head acceleration, the resultant, the velocity, and the airbag pressure over time, in three axis systems.

1. Select DIAdem REPORT.
2. Click Load layout.
   Navigate to the FrontCrash_1.tdr layout in the C:\Exercises\DIAdem Basics\ folder and open the layout.
3. Open the 2D axis system function bar and select a Simple 2D axis system.
4. Click and drag open the 2D axis system where you want to have it in the worksheet.
5. Click the Time1 channel in the Data Portal and select the channels shown in the following figure.

6. Drag and drop these channels into the axis system.
7. Double-click the y-axis labeling to open the dialog box for y-axis labeling, and change the text as shown in the following figure:

Click OK.

8. Repeat steps 3 - 6 to specify two more 2D axis systems, as described in the following steps:
   - Display the Time1, Resultant curve in the middle axis system
   - Display the curves Time2, Speed and Time2, p_Airbag in the bottom axis system

9. Position the three axis systems underneath each other and adjust the size.
The report looks like this:

**Crash Test**

<table>
<thead>
<tr>
<th>Date:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle:</td>
<td></td>
</tr>
<tr>
<td>Dummy:</td>
<td>Larry Leadfoot</td>
</tr>
<tr>
<td>Tester:</td>
<td>Kr</td>
</tr>
</tbody>
</table>

**End of Exercise 5-1**

The `FrontCrash_2.tdr` layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 5-2

Objective:  Multiple Y-Axis Scaling

In the following exercise you create a second y-axis in the bottom axis system to scale the airbag pressure separately, because the velocity and the airbag pressure have different units and value ranges.

1. Select DIAdem REPORT.

2. Double-click the bottom axis system to open the dialog box where you set the parameters.

3. Click Subaxes to define another axis:

4. Click New axis to generate another axis:

Specify the Offset as %, which is the distance between the new axis and the first y-axis, as a percentage.

A negative entry moves the axis to the left in relation to the defined reference point (axis origin), and a positive entry moves it to the right.

Click OK.
5. Click the curve pair $\text{Time2,p\_Airbag}$ in the list of curves and select the subaxis system $\text{2 X-1/Y-2 (0.0,-8.0)}$ in the dialog box. Click **OK**.

6. Move the left edge of the bottom axis system to the right until both y-axes appear.
The report looks like this:

End of Exercise 5-2

The `FrontCrash_3.tdr` layout, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
C. Printing a Report

You can print the report on any printer that is installed in the system. Click the **Print** button in the toolbar.

If you select **Settings»Layout parameters** and set relative page format, you can specify the size of the printout in the print dialog box.

Click **Save graphic as** in the toolbar to export your report as a graphic. DIAdem supports various graphics formats.

Click **Copy graphic to Clipboard** in the toolbar to copy the report to the Windows clipboard and from there into an open text document. The status bar shows you when the report is copied. In text processing you use the **Paste** function to copy your report from the clipboard as a Windows metafile.
D. Saving the Layout

You can save a completed report as a template and load the template at any time to display other data. The layout contains specifications for aligning the graphic objects and the channel names that DIAdem displays in the respective objects. You save the data set separately in DIAdem NAVIGATOR.

Before you save the layout, select **Settings » Layout-Info** to assign the name of the author, the project name, and brief comments on the layout.

You can use your report layout as a template for an analysis in DIAdem VIEW. To transfer the layout of the visible worksheet to DIAdem VIEW, click **Transfer to VIEW** in the toolbar. In DIAdem VIEW, 2D axis systems do not change, 2D tables become channel tables, and 3D axis systems, 3D tables, and polar axis systems generate empty spaces. Text disappears.
Exercise 5-3

Objective: Integrating Graphics and Text

In the following exercise you integrate a picture of the measurement object and a test description in the report.

1. Select DIAdem REPORT.

2. Open the Graphics file function bar and select Load graphics.
   Navigate to the FrontCrash.wmf graphic in the C:\Exercises\DIAdem Basics\ folder and load the graphic.

3. Position the graphic in the top right of the worksheet and adjust the size.

4. Open the Decorations function bar and select Texts to enter a free text.

5. Click the text cursor in the worksheet where you want to insert the text. Enter the DIAdem variable @CurrDate@ to display the current date.

6. Press <Enter> twice to insert a blank line between the two lines of text. Enter a text in the bottom line, for example, the vehicle type Amalfi. Click another position in the worksheet to finish the text entry.

7. Double-click the text to open the dialog box with the text parameters. Set the Arial font, the font size 4, and blue as the font color.

   ![Text dialog box](image)

   Click OK.

8. Position the text in the text field on the right of the report, as shown in the following figure.
9. Click **Save layout as**.

Open the C:\Exercises\DIAdem Basics\ folder and save the report file as **FrontCrash_2.tdr**.

The report looks like this:

![Graphical representation of the report](image)

**Note**  Update the report to display the final result after editing and before printing. This is especially important when you integrate graphics or modify the data in the Data Portal.

**End of Exercise 5-3**

The **FrontCrash_4.tdr** layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Additional Exercise

If you have time, complete the following exercise.

1. Use the **Copy graphic to clipboard** function to copy the created report to the Windows clipboard.
   Paste the report into a word processor such as MS Word or WordPad to check the graphic export.

2. Use the **Save graphic as** function to export the report as a JPG file.
   Open the JPG file in the Explorer to check the export.

3. Select **Insert » Graphics** to paste the JPG file created in step 2 into the current worksheet in DIAdem REPORT.
E. Format and Display Modes

DIAdem offers various formats for displaying numbers, time data, and text. This section also includes information about several display modes.

Format Options

You can specify a format wherever numeric data or time data are displayed. This includes labeling axis systems, displaying data as a table, and displaying numerical variables formatted in labels.

Formatting Numeric Data

Format specifications for numerical display are useful in the following cases:

- Only a particular number of places after the decimal point are relevant for the data.
- The report to be generated does not have enough space to display all the numbers.
- The range of measured values is so large or small that the E format is more informative than floating point display.

Format specifications for numeric labels may include the following characters:

- **d** Identifier for decimal format (floating comma display)
  - `dd.dde` displays numbers with two places before and three places after the decimal point, for example, `12.345`. If numbers with more than two places before the decimal point occur, DIAdem automatically expands the display.

- **e** Identifier for numbers in E format
  - `d.dde` displays exponentials, for example, `1.23E+01`.

- **h** Identifier for powers of ten
  - `d.ddh` displays numbers as exponentials with a superscripted power of ten, for example, `1.23*10²`.

- **. or ,** Decimal character
  - A point or a comma separates the digits before and after the decimal separator.

- **b** Identifier for binary format
  - DIAdem displays numbers as single bits.
  - `bbbb bbbb` means eight bits and the value range 0...255. The number 43 then appears as `0010 1011`. All bits are displayed.
Time Data Format

DIAdem writes time data numerically. The time is a code calculated as the number of seconds from the year 0 up to now.

Note Time specifications are only useful in the internal DIAdem time code.

For DIAdem to recognize a format as a time format, you must enter a leading # character. A format specification can consist of any combination of the default time format:

- $mm/dd/yyyy$ or $hh:nn:ss.ffff$
  - Month/Day/Year Hour:Minute:Second.Fraction of a second

Format specifications for time data may include the following characters:

- m or M: Wildcard for month
- d or D: Wildcard for day
- y or Y: Wildcard for year
- k or K: Wildcard for calendar week
- h or H: Wildcard for hour
- n or N: Wildcard for minute
- s or S: Wildcard for second
- f: Wildcard for fraction of a second

If you use uppercase letters instead of lowercase letters in the format specification, DIAdem replaces leading zeros with blanks.

Examples

- hh:nn:ss => 01:01:00
- HH:NN:SS => 1: 1: 0
- HH:nn:ss => 1:01:00

Identifiers

- $\$$ Identifier for hexadecimal format
  - $$\$$ represents the value range 0...65,535. For example, the number 43 appears as $2B$. The $\$ character appears before the numbers to indicate a hexadecimal number. DIAdem suppresses leading zeros.

- ! No text display for NoValues
  - DIAdem suppresses the text NoValue for NoValues.

- abs Identifier for the absolute value
  - You can combine this identifier with the characters listed above, for example, abs d.dd.
The following codes are reserved for the display of months and week days as texts. The codes either provide the complete term or are limited to a particular number of letters:

- \( t, tt \)   Months (1, 2, ... characters)
- \( T \)   Written months
- \( w, ww \)   Weekdays (1, 2, ... characters)
- \( W \)   Written weekdays

**Example**

```
```

If the time format goes over two lines, use a / slash to separate the top line from the bottom line. DIAdem repeats the top labels for each tick and displays the bottom labels centered in relation to the time unit.

For example, the format \( #ttt/yy \) displays the first three characters of the respective month at each tick. The last two numbers of the year are specified in a second line in the middle of the year specification.

**Formatting Text**

Any text that appears in the report can also contain variables with format instructions and special codes, in addition to normal characters and special characters.

You can use the DIAdem Calculator features to display text. Refer to Lesson 8, *The DIAdem Calculator* for more information about the Calculator.

**Superscripting and Subscripting Free Text**

You can subscript or superscript separate characters or character groups within text. Enter one of the following control characters in front of the text:

- ^\( t \)   Subscripts the following text by one layer
- ^\( h \)   Superscripts the following text by one layer
- ^\( n \)   Resets the subscript or superscript by one layer

You also can nest the above forms inside each other. You can use up to ten levels. DIAdem reduces the subscripted or superscripted text by a factor that relates to the index level:

**Example**

```
X^{t(abs)^n} = 100 \text{ mm}^{h^2^n} => X_{(abs)} = 100 \text{ mm}^2
```
Integrating Variable Contents

To integrate the contents of a variable in a report, enclose the variable name in @ characters. For example, if you use @CurrDate@ in any text for display, the current date appears at the respective position in the report:

Example

Date: @CurrDate@  =>  Date: 12.10.2004

The Calculator evaluates the expression between the @ characters before display. This means that you can use the Calculator operands and operations, and that all the expressions interpreted as single expressions are valid entries.

DIAdem offers several special variables you can use with the Calculator or for report labeling. These variables contain information on channel properties or data set properties or show the current date or time. Table 5-1 displays an overview of these variables:

Table 5-1. Special Variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch(No)</td>
<td>Channel data with the channel number No</td>
</tr>
<tr>
<td>ChD(Line, No)</td>
<td>Value of the channel with the channel number No in the line Line</td>
</tr>
<tr>
<td>ChT(Line, No)</td>
<td>Value of the text channel with the channel number No in the line Line</td>
</tr>
<tr>
<td>CN(No)</td>
<td>Name of the channel with the channel number No</td>
</tr>
<tr>
<td>CC(No)</td>
<td>Comments on the channel with the channel number No</td>
</tr>
<tr>
<td>CD(No)</td>
<td>Unit of the channel number No</td>
</tr>
<tr>
<td>CL(No)</td>
<td>Length of the channel with the channel number No</td>
</tr>
<tr>
<td>CMax(No)</td>
<td>Maximum value of the channel with the channel number No</td>
</tr>
<tr>
<td>CMin(No)</td>
<td>Minimum value of the channel with the channel number No</td>
</tr>
<tr>
<td>CurrDate</td>
<td>Current date</td>
</tr>
<tr>
<td>CurrTime</td>
<td>Current time</td>
</tr>
<tr>
<td>CurrDateTime</td>
<td>Current date/time</td>
</tr>
<tr>
<td>CurrDateTimeReal</td>
<td>Current date/time in seconds</td>
</tr>
<tr>
<td>DataSetName</td>
<td>Data set name</td>
</tr>
</tbody>
</table>
You can replace the parameter No used in the first list with Name. In this case, the variables refer to the channel called Name, not to the channel with the number No. Use Group name/Channel name to access a channel of a certain channel group.

For flexible object labeling, use CCN as the variable index. If you replace the No parameter with CCN, the respective variable always accesses the channel specified in the first line of the object dialog box instead of accessing a specific channel.

### Formatting Variable Contents

You also can export variable contents with a specific format instruction. You use the `str` function, with the variable and the format definition as parameters. The expression must be enclosed between @ separators:

```plaintext
@str(variable name,'Format template')@
```

#### Examples

**Minimum value:** `@str(CMin(1),'dddd.dd')@ [mm]`

The expression outputs the following text for a minimum value of 156.344 in channel 1:

```
Minimum value: 156.34 [mm]
```

**Display time:** `@str(CurrTime,'RRRRR')@ Time`

This expression outputs the following text for the computer time 16:37:

```
Time: 16:37
```

The format 'RRRRR' specifies that five characters are displayed flush right. Alternatively, you can enter 'R:5'. The format 'R:8' displays seconds as well. Without a format instruction, DIAdem automatically uses the following variable format.

**Examples**

**Date:** `@str(TTR(CurrDateTime),'#mm-dd-yyyy')@`

This expression outputs the following text for the date 06/12/2004:

```
Date: 06-12-2004
```
Formatting with User Commands

Use user commands as format instructions if you want to display data in a format that DIAdem does not recognize. You define user commands in DIAdem SCRIPT. Refer to DIAdem help for more information about user commands.

Notes on the Display Modes

In axis systems, you can select various curve display modes. The following sections are about the display modes Differential, Constant and Line and symbol.

Differential

Use differential display to display the distance between two curves. Both curves use the same x-channel. This display mode displays a bar or a line between the curve points x/y and x/y1.

Constant

Use the constant display mode to display lines in a 2D axis system. DIAdem uses the function x=constant or y=constant to display a line in the selected axis system or subaxis system.

To define a constant, select the constant display mode in the dialog box for curve and axis definitions. You then enter the values of the x and/or y-constant to be displayed. Specify the line parameters in the Curve parameters subdialog box.

Line and Symbol

Use the Line and symbol display mode to display a curve that has symbols at certain points. You can use all the fonts in DIAdem as symbol characters or symbol strings. You also can use text control characters and special characters in the symbol character string. To integrate variable contents in the symbol character string, enclose the variable name and any format instructions in @ characters.

The codes listed below can be combined with free text and with each other:

n

Repeating symbols
The n character followed by a number means that DIAdem only displays the symbol at every nth curve point.

x(), y(), p()

Coordinates
DIAdem displays the x or y-value, or the number of the data point, at the curve point.
%([XPos]/YPos))  

**Shift**

DIAdem can position labels in relation to the x or y-axis of the coordinate system, regardless of the curve coordinates. You also can use the /X and /Y parameters. The parameter /y with a numerical position entry, specifies the percentage of the height of the axis system, by which DIAdem shifts the label vertically in the y-direction, in relation to the x-axis. Positive settings position the label above the x-axis, negative settings position the label below the x-axis.

W([B]/E)[Long])  

**Repetition**

Specifies the number of labels on a curve and displays the labels at equal intervals. You can display the symbol at the first (Begin) and/or at the last (End) point on the curve. You also can specify the number of labels in relation to the curve length, which you enter as a percentage of the diagram diagonals.

T([/Dfile][/Iindex channel])  

**Text file access**

DIAdem uses the text labels from an ASCII file called file (with extension). The /I parameter with indexchannel specifies access to the text lines in the file. DIAdem reads the text lines either according to the running index of the curve display (index channel=0), or according to the contents of the index channel.

K([/Kchannel number][/Iindex channel])  

**Access to channel contents**

DIAdem uses the numeric values of the channel number channel for labeling. If you do not specify an index channel, DIAdem accesses the channel number channel with the running index in the curve display. If you do specify the index channel, DIAdem uses the index channel contents to access the channel indirectly.
Name-Oriented Mode

By default, DIAdem uses the channel name and the group index to assign the data channels in the report. This works well if the channels in the data files to be evaluated always have the same channel name and are always in the same channel group. However, if the channels in the data files to be evaluated have different channel names, but are always at the same position in the data set, you can use number-oriented channel reference in DIAdem REPORT. If you set number-oriented channel reference, DIAdem displays the channel number in front of the channel name in the definitions of the axis systems and tables. The channel number appears in the list view of the Data Portal.

Select Settings»Layout parameters to enable the name-oriented mode or the number-oriented mode. If you specify the channels to be displayed in the name-oriented mode, and enable the Expansion mode, DIAdem displays all curves with the same channel name when you enter the curve definition, not only the first channel pair with the name. Select Settings»Layout parameters»Curve expansion to assign each curve its own set of display attributes. To enable DIAdem to find the channel names independently of the channel groups, select Settings»Desktop parameters»General and select Only channel name for the syntax.

After you define the channel assignment for an axis system or a table, DIAdem displays the assignment as follows:

1. DIAdem searches for a channel with the specified channel name. The search starts at the first channel.
2. If DIAdem finds an x-channel, the search for a related y-channel and, if required, y1-channel begins.
3. In expanded mode, DIAdem continues with point 1. DIAdem keeps searching for other pairs until it reaches the end of the data.

Example

The following channels are in the Data Portal:

1. Time
2. Speed
3. Distance
4. Torque
5. Time
6. Speed
7. Time
8. Speed
The 2D axis definition contains the following entries:

<table>
<thead>
<tr>
<th>Row</th>
<th>X-channel</th>
<th>Y-channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>Speed</td>
</tr>
<tr>
<td>2</td>
<td>Distance</td>
<td>Torque</td>
</tr>
</tbody>
</table>

The non-expanding mode displays the following channel pairs:

- X-channel: Time
- Y-channel: Speed

- X-channel: Distance
- Y-channel: Torque

The expanding mode displays the following channel pairs:

- X-channel: Time
- Y-channel: Speed
- X-channel: Time
- Y-channel: Speed
- X-channel: Time
- Y-channel: Speed
- X-channel: Distance
- Y-channel: Torque
Exercise 5-4

Objective: Displaying Time Data Graphically

For a representative display of data measured over a period of weeks, the measured values must be assigned to a time reference in the report.

In the following exercise you load the House_1.tdm data file and layout. You use the time format for the numeric display of the x-axis.

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal without saving the data.
3. Navigate to the House_1.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. Select DIAdem REPORT.
5. Click Load layout.
   Navigate to the prepared House_1.tdr layout in the C:\Exercises\DIAdem Basics\ folder and open the layout.
6. Select the channels Date, Electricity, Water, and Gas in the Data Portal and drag and drop the channels into the top axis system.
7. Double-click the top axis system to open the dialog box for the curve definition.
8. Assign the curves to the **subaxis system** as shown in the following figure:

![Curve and axis definition dialog box](image)

Click **OK**.

9. Double-click the numbers of the x-axis to open the dialog box for numeric display.

10. Check the time format for the x-axis:

![Numeric display dialog box](image)

Click **OK**.
The report looks like this:

![Graph Image]

**End of Exercise 5-4**

The *House_2.tdr* layout, which contains the solution for this exercise, is in the `C:\Solutions\DIADEM Basics\` folder.
Lesson 5  Creating Reports

Exercise 5-5

Objective:  Data Overview in Tables

In the following exercise you insert a table in another worksheet in the report from the last exercise, to display selected data as numbers.

1. Select DIAdem REPORT.
2. Open the shortcut menu for the Sheet 1 tab and select Manage.
3. Click Rename and enter Graphic for the first worksheet.
4. Click New entry and enter Table for the second worksheet.

Click OK. DIAdem opens the second worksheet.

5. Open the 2D table function bar and select 2D-table with horizontal and vertical separators.
6. Drag open the table in the top left of the worksheet.
7. Select the channels Date, Electricity, and Water, in the Data Portal and drag and drop the channels into the table.
8. Double-click the table to open table definition. Select **Automatic minimum** as the **Table length**.

9. Click **Headers** to specify the table labels:
   - The first line of the heading is \(\text{@CN (CCN) @}\) for the channel name.
   - Enter \(\text{@CD (CCN) @}\) for the physical unit in the second line.

Click **OK**.

10. Click **Columns** to set the following format for the columns with the time entries:
11. Click OK in all the dialog boxes.

12. Drag the separator underneath the heading downwards to enlarge the table heading.

13. Click Save layout as.

Navigate to the report file in the C:\Exercises\DIAdem Basics\ folder and save the report file as House_New.tdr.

The report looks like this:

<table>
<thead>
<tr>
<th>Date</th>
<th>Electricity kWh</th>
<th>Water m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/28/2002</td>
<td>586.32</td>
<td>2.57</td>
</tr>
<tr>
<td>03/08/2002</td>
<td>678.24</td>
<td>4.81</td>
</tr>
<tr>
<td>03/26/2002</td>
<td>895.21</td>
<td>8.50</td>
</tr>
<tr>
<td>04/14/2002</td>
<td>1035.73</td>
<td>12.40</td>
</tr>
<tr>
<td>04/17/2002</td>
<td>1066.54</td>
<td>13.40</td>
</tr>
<tr>
<td>05/07/2002</td>
<td>1275.41</td>
<td>15.85</td>
</tr>
<tr>
<td>06/10/2002</td>
<td>1627.48</td>
<td>22.25</td>
</tr>
<tr>
<td>07/02/2003</td>
<td>1685.64</td>
<td>29.69</td>
</tr>
<tr>
<td>07/10/2002</td>
<td>1704.25</td>
<td>24.51</td>
</tr>
<tr>
<td>07/23/2002</td>
<td>1896.20</td>
<td>27.98</td>
</tr>
<tr>
<td>08/06/2003</td>
<td>2020.55</td>
<td>30.73</td>
</tr>
<tr>
<td>08/23/2003</td>
<td>2159.22</td>
<td>33.84</td>
</tr>
<tr>
<td>09/10/2002</td>
<td>2335.73</td>
<td>37.17</td>
</tr>
<tr>
<td>10/06/2002</td>
<td>2003.70</td>
<td>44.16</td>
</tr>
<tr>
<td>11/06/2002</td>
<td>2991.03</td>
<td>46.82</td>
</tr>
<tr>
<td>11/26/2002</td>
<td>3717.48</td>
<td>51.53</td>
</tr>
<tr>
<td>12/11/2002</td>
<td>3433.83</td>
<td>55.94</td>
</tr>
<tr>
<td>01/10/2003</td>
<td>3708.75</td>
<td>50.23</td>
</tr>
<tr>
<td>01/16/2003</td>
<td>3929.60</td>
<td>62.92</td>
</tr>
</tbody>
</table>

End of Exercise 5-5

The House_3.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 5-6

Objective: Using the Expansion Mode

In the following exercise you create a new report and use the expansion mode.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate to the Expand.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select Settings»Desktop parameters»General and set Only channel name as the Syntax. Click OK.

5. Select DIAdem REPORT.

6. Delete the current layout without saving the layout.

7. Select Settings»Layout parameters and click Curve expansion.

8. Select Expand curves and Use attribute list.

Click OK to close all the dialog boxes.

9. Open the 2D axis system function bar and select a Simple 2D axis system.

10. Drag open the axis system in the top left of the worksheet.
11. Select the result channels \textit{TimeCopy} and \textit{VibrationCopy} in the first channel group and drag and drop the selected data channels into the axis system.

DIAdem now displays all curve pairs called \textit{TimeCopy}, \textit{VibrationCopy}.

The report looks like this:
End of Exercise 5-6
The Expand.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Select Settings\Desktop parameters\General and reset the default syntax [Group index]/Channel name.
F. Configuring DIAdem REPORT

The Desktop parameters are the program settings you can specify in DIAdem.

Setting Panel-Specific Parameters

In DIAdem REPORT, select Settings»Desktop parameters»Panel specific to access the panel-specific settings. The configuration dialog box has the following settings:

- Library path: Displays the current library folder with report layouts.
- User path: Displays the current user folder with report layouts.
- Default file: Specifies the report layout that DIAdem displays when the REPORT panel opens.
- Template: Specifies the report layout that DIAdem REPORT loads when you select File»New.
- Hardware text positioning: Specifies whether DIAdem or the printer routine calculates the text position for printing.

You can save all the program settings in a desktop file. The desktop file has the filename extension .ddd. To save your settings in a desktop file, first select Window»Close all. Then click Save desktop.

Setting Layout Parameters

To specify the global appearance of the report, select Settings»Layout parameters. In the dialog box, you specify the page format, the frame, autoscaling, the name-oriented mode, and the commands to be performed.

You can specify the page format in relation to the paper format, or scaled. Relative page format adjusts to the selected paper format and the orientation. You specify the size of the report in relation to the selected paper format, later in the printer dialog box. You can print your report to take up whole pages, or less, regardless of the paper format.

Scaled display contains fixed dimensions for the height and width of your report. Specify the margins and distances for your objects in centimeters or in inches. DIAdem prints your report in the specified size, regardless of which paper format you select in the print dialog box.
If you want a frame around your report, specify the color and line width.

Axis autoscaling can use the standard progression 1, 2, 5, 10, 20 and so on, or the sequence 2, 2.5, 5, 10 and so on. When DIAdem scales the axes according to standard progression, the range from 0 to 100 is scaled as 20, 40, 60, 80 and 100, otherwise DIAdem scales the axis at 25, 50, 75 and 100.

If you use number-oriented channel reference, you use the channel number to assign channels in graphic objects, not the channel names.

Under Commands to be performed you enter the names of the VBS user commands that you have registered by selecting Settings»Desktop parameters»User commands, and that DIAdem performs when the report refreshes.

DIAdem saves the layout parameters with the layouts.

**Color Palettes**

Select Settings»Color palettes to specify the color palette properties, the number of colors and how the colors are assigned to the data value range. You also can modify the global line attributes of the display.

**Layout Information**

Select Settings»Layout-Info to include a comment in your report. DIAdem saves the layout information with the layout.
Summary, Tips, and Tricks

- You can use any combination of axis systems, tables, text, and graphics in a report. DIAdem displays the data in curves or bar diagrams in axis systems, and lists numeric data in tables. You can label your report with text and comments and illustrate your report with graphics and lines.

- You save and load layouts separately from the data. This allows you to reuse the layout for any data set. The layout contains all the data for arranging the graphics objects and the data channel assignments. Save the data set separately in DIAdem NAVIGATOR.

- When you open DIAdem REPORT, the worksheet contains the layout that you designate as the Default file in the dialog box that opens when you select Settings»Desktop parameters»Panel specific. If you want to always access a specific layout when you click New, specify this layout as the Template in this dialog box.

- Assign a button to graphics objects you use frequently in the respective function bar. Select Default setting in the shortcut menu.

- You also can include formulas and variables in text. DIAdem only recognizes formulas and variables set in @ characters.

- You can use the Graphics file function bar to load various formats, such as wmf, bmp, jpg, tif, and gif.

- You can export reports in all kinds of formats and use them in other applications.
Lesson 6
Analyzing Data with Mathematics Functions

Introduction

In this lesson you will learn how to use mathematical functions to evaluate the data in the Data Portal.

With the standard mathematical functions you perform calculations without having to enter a formula. You select the input data and make the settings you want.

Use the Calculator to define and calculate your own formulas.

You Will Learn About:

A. Analyzing and Evaluating Data
B. Running Calculations
C. Calculating with Invalid Values
Lesson 6  Analyzing Data with Mathematics Functions

A. Analyzing and Evaluating Data

With DIAdem ANALYSIS you analyze the data of the Data Portal mathematically to reveal correlations and to derive further information from the data. Figure 6-1 shows the DIAdem ANALYSIS interface.

DIAdem ANALYSIS contains extensive libraries of mathematical standard functions that are located in various function bars. The functions include basic mathematics such as differentiation, signal analysis such as FFT, and 3D analysis such as isoline calculations.

Note Which functions you can use depends on which options you have in your DIAdem license. The buttons for the functions that are not included in your license are dimmed in the function bar and the group bar.

To use a standard function, click the function button in the group bar and select the feature you want in the function bar that opens. A dialog box appears where you set the parameters for your calculation.

The DIAdem ANALYSIS workspace shows you which calculations you have run with which data channels.
DIAdem stores the calculation results in new data channels in the default group or overwrites the input channels with the result data. You specify the default group in the shortcut menu of the Data Portal structure view.

The toolbar has a button that opens the Calculator. You can use the Calculator to create and calculate channels. You also can use the Calculator to calculate and display single values and to assign variables.
Lesson 6 Analyzing Data with Mathematics Functions

B. Running Calculations

DIAdem ANALYSIS has a wide range of mathematical functions. They include the standard functions that you call, parameterize, and execute, as well as the Calculator, which you use to link channels or single values with various functions.

DIAdem uses the data in the Data Portal for analyses, and returns the results to the Data Portal.

Example: Differentiation

To execute a standard function DIAdem needs additional information: the channels that DIAdem uses for the mathematical operations. Differentiation is one of the standard functions.

Differentiate speed over time to determine the acceleration.

Click Basic mathematics functions in the group bar.

The respective function bar has basic functions such as averaging, integration, differentiation, and peak search.

Click the Differentiation button in the function bar. Figure 6-2 shows the dialog box for differentiation, where you specify the channels you want to differentiate.

![Figure 6-2. Dialog Box for the Standard Function Differentiation](image)

Select the channels **Time** and **Speed** and click **Execute** to calculate the differentiation.

The workspace in DIAdem ANALYSIS contains information about the completed calculations. It shows you whether the calculation was completed successfully, which input channels were used, and which channels contain the results.

DIAdem saves the calculation result in the default group of the Data Portal. In the default group DIAdem creates two result channels for the differentiation. The x-values of the differentiated curve, which is the time axis, are in the first channel. These values result from the mean value of two
neighboring x-values from the input time channel. The second result channel contains the associated y-values, which are the calculated difference quotients. The values in this channel represent the physical acceleration.

Some mathematical calculations save their results in channels in the Data Portal and also assign the results to appropriate DIAdem variables. These functions include the calculation of the statistical characteristic values, approximation, and regression. In the dialog boxes for these three functions, you can specify that DIAdem also copies the result values to the Windows clipboard. You can then include the results in your report as text.

**Example: Smoothing Curves**

In the differentiation example above, the only parameters required were the input channels to be analyzed. Other functions require additional input parameters. One example is graph smoothing by calculating a floating mean value.

The following example shows the smoothing of the calculated channel \( Y_{\text{Diff}} \). Smoothing can be useful to emphasize significant structures in a graph or to suppress distortion.

Click the **Curve fitting functions** button in the group bar.

The function bar has various curve fitting functions: splines, approximation, smoothing, and others.

Click the **Smoothing** button in the function bar. Figure 6-3 shows the smoothing dialog box where you specify the previously calculated acceleration \( Y_{\text{Diff}} \) as the channel to be smoothed.

You must specify the channel to be calculated and the smoothing width. The smoothing width specifies the number of neighboring data points to the left and to the right of the curve point currently to be calculated. DIAdem uses the data points to calculate the mean values.

![Figure 6-3. Dialog Box for the Standard Function Smoothing](image)
To specify the smoothing width enter the number in the field or use the increment arrows to count up or down stepwise. Click **Execute** to start the calculation.

Enter all the necessary information for a standard mathematical function in the dialog box. As in the other panels, less important settings that you do not have to reset very often are included in subdialog boxes. Click the respective buttons in the main dialog box to access the subdialog boxes. If you do not open a subdialog box or do not make changes, the standard function uses the default parameters.

Mathematical functions work with one or more channels. If a function, for example averaging, works with several channels, there are three points next to the channel selection field. Select all the channels you want in the Data Portal and drag and drop the channels into the channel selection field.

Figure 6-4 shows the workspace with the record of the calculations that have been run.

![Figure 6-4. Workspace with the Calculation Protocol](image)

**Using Free Formulas**

The dialog boxes for the standard mathematical functions guide you through the calculations so you do not have to enter a formula. Enter and calculate your own formulas in the DIAdem Calculator. In such formulas you can combine and calculate channels and generate new channels. You can calculate single values, save values in variables, and request variable contents.
The following example uses the Calculator to convert the velocity from m/s to km/h.

Click the Calculator in the toolbar.

Use the keyboard or the Calculator keys to enter your formula in the input box. DIAdem displays the status or the calculated result in the result bar.

A formula consists of the assignment target, the assignment operator, and the calculation instruction:

Assignment target := Calculation instruction

Enter the following line to convert the velocity from m/s to km/s:

Ch('KmSpeed') := 'Speed'/1000

Note When you define a formula, use a point as the decimal character and set character strings in quotation marks.

Click Calculate to evaluate the formula.

Note If the result of a calculation is non-defined, such as division by zero, DIAdem assigns NoValue as the result.

Enter the following line to convert the velocity from km/s to km/h:

Ch('KmSpeed') := 'KmSpeed'*3600

Assign the respective unit to the calculated channel KmSpeed. To change the variable contents with the Calculator, enter:

CD('KmSpeed') := 'km/h'

Using formulas is an easy way to generate any type of value.

Refer to Lesson 8, The DIAdem Calculator for more information about the Calculator, which you also can use in the DIAdem ANALYSIS and DIAdem SCRIPT panels.
Exercise 6-1

Objective: Using Basic Mathematics Functions

In the following exercise you differentiate the House_1.tdm data file, which contains consumption values for a household, acquired over a long period of time. You display the differentiation results in the bottom axis system of the House_1.tdr report, which you started in the last lesson.

1. Select DIAdem NAVIGATOR.
2. **Delete** the data in the Data Portal without saving the data.
3. Navigate to the House_1.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. Select DIAdem ANALYSIS.
5. Open the **Basic mathematics functions** function bar and select **Differentiation**.
6. Select **Date** as the x-channel and **Gas** as the y-channel.

Click **Execute**.

7. Click the first result channel **X_Diff** in the Data Portal. Enter **Time_Diff** as the name in the properties and select **Time** as the display format.
8. Click the second result channel Y.Diff in the Data Portal. Enter Gas_Consumption as the name.

9. Click the Calculator in the toolbar.

10. Enter the following formula in the entry field:

Ch('Gas_Consumption') := Ch('Gas_Consumption') * 60 * 60 * 24

The result of the differentiation is in the unit seconds. The specified formula calculates the values in days (60 sec. * 60 min. * 24 h.).

Calculate the daily gas consumption.

Close the Calculator.

11. Select DIAdem REPORT.
12. Click **Load layout**.
   Open the C:\Exercises\DIAdem Basics\ folder and load the prepared layout `House_3.tdr`.

13. Open the Graphic worksheet.

14. Select the result channels `Time_Diff` and `Gas_Consumption` in the Data Portal and drag and drop the data channels into the bottom axis system.

15. Double-click the x-axis numbers to open the dialog box for numeric display and check the format as shown in the following figure:

   ![Numeric display dialog box](image)

   Click **OK**.
The report looks like this:

End of Exercise 6-1

The House_4.tdr layout and the House_2.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 6-2

Objective: Using Complex Mathematical Functions

In the following exercise you use the Peak search function to determine the maximum gas consumption, and highlight the maximum values as labeled asterisks in the bottom axis system of the report.

1. Select DIAdem ANALYSIS.
2. Open the Basic mathematic functions function bar and select Peak search.
3. Set the dialog box parameters as shown in the following figure:

   ![Peak search dialog box](image)

   Click **Execute**.
4. Select DIAdem REPORT.
5. Select the result channels X_Peak and Y_Peak in the Data Portal and drag and drop the data channels into the bottom axis system.
6. Double-click the bottom axis system to open the dialog box for curve and axis definition.
7. Select the Line and symbol display mode for the X_Peak/Y_Peak curve.
8. Open the Curve param subdialog box. Select **blank** as the line style and ***** as the symbol style.
9. Click **OK** to return to the curve and axis definition dialog box.
10. Click **Copy** to define a second entry with the result channels X_Peak and Y_Peak:
11. Click Curve param.
   Delete the asterisk and select numeric labeling for the y-value.

12. Click Symbol and specify the relative position as top and the format as d.dd.
   Click OK to close all the dialog boxes.

13. Double-click the y-axis to open the axis scaling, and specify manual scaling as shown in the following figure:

   ![Axis Scaling Dialog Box]

   Click OK.
14. Click **Save layout as**.
   Navigate to the report file in the C:\Exercises\DIAdem Basics\ folder and save the report file as House_New.tdr.

15. Select **DIAdem NAVIGATOR**.

16. Select the **House_1** channel group in the Data Portal and drag and drop the selected channel group to the tree view of the MyTraining data storage. Enter the filename **House_New.tdm** and click **Save**.

The report looks like this:

End of Exercise 6-2
The **House_5.tdr** layout and the **House_3.tdm** data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 6-3

Objective:  Mathematical Analysis - Statistical Characteristic Values

Cooling aggregates were tested in a large-scale experiment. The results are evaluated with the functions for classification and for statistics calculation, to draw conclusions on the durability of the devices.

In the next exercise you load the Cold.tdm data set. Carry out a durability Classification and calculate the minimum value, the maximum value, the average durability, and the 0.75 quantile (upper quartile). Display the results in the Cold.tdr layout.

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal.
3. Navigate to the Cold.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. Select DIAdem REPORT.
5. Click Load layout.
   Navigate to the Cold.tdr layout in the C:\Exercises\DIAdem Basics\ folder and open the prepared layout.
6. Select the data channels LifeSpan and CoolingAggregate in the Data Portal and drag and drop the channels into the axis system.
7. Double-click the axis system to open the dialog box for the axis definition and select the Horizontal bars display mode.
Click **OK**.

8. Select **DIAdem ANALYSIS**.

9. Open the **Statistics functions** function bar and select **Single classification**.

   Set the dialog box parameters as shown in the following figure:

   ![Single classification dialog box]

   Click **Classes** to set the parameters for class determination:
10. Click **Execute** to start the calculation.

11. Select **DIAdem REPORT**.

12. Open the **2D axis system** function bar and select a **Simple 2D axis system** to display the classification results in another axis system.

13. Drag open the 2D axis system starting from the top left corner of the workspace.

14. Select the data channel **Class mean** and then the data channel **Sample count** in the Data Portal and drag and drop the channels into the axis system on the right.

15. Double-click the axis system on the right to open the dialog box for the axis definition and select the **Bars display mode**.

16. Select **DIAdem ANALYSIS**.

17. Open the **Statistics functions** function bar and select **Statistical characteristic values**.

18. Select the **LifeSpan** channel for evaluation.

19. Click **All off** to reset the dialog box parameters.

20. Select the checkboxes for the **Minimum**, the **Maximum**, the **Arithmetic mean** and the **0.75 quantile**:
21. Click **Results** and specify the mode for transferring the results into the clipboard as shown in the following figure:

![Result storage dialog box](image)

Click **OK**.

22. Click **Execute**.

23. Select **DIAdem REPORT**.

24. Press `<Ctrl-V>` to insert the statistical results from the clipboard into the report.

The statistics results appear as text in the top left of the graphics area.

25. Position the selected texts in front of the axis system on the left.

26. Open the **Decorations** function bar and select **Rectangles**.

Draw a frame around the texts that contain the statistical characteristic values.
27. Double-click the frame to open the dialog box for rectangles. Select white as the **Background color**: 

![Rectangle dialog box](image)

Click **OK**.

28. Select **One layer down** four times in the shortcut menu of the selected rectangle, so the rectangle is behind the four texts but in front of the axis system.

The report looks like this:

![Report image](image)

**End of Exercise 6-3**

The `Cold_1.tdr` layout and the `Cold_1.tdm` data file, which contain the solution for this exercise, are in the `C:\Solutions\DIAdem Basics\` folder.
Exercise 6-4

**Objective:** Mathematical and Graphical Interactive Analysis

Only use parts of the existing data for mathematical calculations.

In the following exercise you view the View.tdm data set in DIAdem VIEW, select a particular value range, and use the **Smoothing** function to mathematically evaluate this range. You display the result in DIAdem VIEW.

1. Select **DIAdem NAVIGATOR**.

2. **Delete** the data in the Data Portal without saving the data.

3. Navigate to the View.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select **DIAdem VIEW**.

5. **Delete** the current view without saving the layout.

6. Open the **Screen partitioning in three areas** function bar and select the first **Three areas** button.

7. Select the channels *Time* and *Vertical_Ampl* in the Data Portal and drag and drop the channels into the top area.

   Select the **2D axis system** display type.

8. Repeat step 7 for the bottom left area.

9. Enable the **Band cursor**.

10. Change the width (dx) of the band cursor in the top axis system.

11. Click **Zoom, static** in the axis system toolbar of the bottom left axis system.

   DIAdem zooms the range inside the band cursor.

12. Click **Set flags** in the axis toolbar to mark all the values in the selected range.

13. Click **Flags: Copy data points** in the axis toolbar to copy the data of the selected curve range into separate data channels.

14. Click **Global flag reset** in the toolbar.
15. Select **DIAdem ANALYSIS**.

16. Open the **Curve fitting functions** function bar and select **Smoothing**.

17. Set the dialog box parameters as shown in the following figure:

![Smoothing.png]

Click **Execute**.

18. Select **DIAdem VIEW**.

19. Select the channels **XCopy_Time** and **Y_smooth** in the Data Portal and drag and drop the channels into the bottom right area.

Select the **2D axis system** display type.

20. Open the legend in the bottom right axis system. Idle the cursor over the window divider on the right of the axis system. The cursor changes. Click and drag the edge of the window to the left to enlarge the legend and to display the additional information. You minimize the area in the same way.

21. Double-click the legend to open the properties selection.

22. Change the settings as shown in the following figure:

- Select all the lines of the **Properties to be displayed** except <name> and click < to delete the lines.
- Select <freetext> in the **Properties not for display** and click >. Then enter **Y_Max** under **Title** and @str(CMax(Y_smooth), 'd.dd')@ under **Format/expression**.
- Select <freetext> again in the **Properties not for display** and click >. Then enter **Time** under **Title** and @str(ChD(PNo(Y_smooth, CMax(Y_smooth)), XCopy_Time), 'd.dd')@ under **Format/expression**.
Click **OK**.

23. Adjust the size of the legend.

   The workspace looks like this:

   ![Workspace Image]

**End of Exercise 6-4**

The `View.tdv` layout and the `View_1.tdm` data file, which contain the solution for this exercise, are in the `C:\Solutions\DIAdem Basics\` folder.
Additional Exercise

If you have time, complete the following exercise.

1. Smooth the Vertical_Ampl signal in DIAdem ANALYSIS.
2. Display the result Y_smooth over Time in the top axis system of the current view in DIAdem VIEW.
3. Smooth the signal again with different smoothing widths.
4. Compare all the results with the original signal in DIAdem VIEW.
Exercise 6-5

Objective: Mathematical Analysis - Splines

You can use splines to approximate measurement data.

In the following exercise you load the SplineA.tdm data file, select a suitable spline procedure to approximate the data, and display the results with the SplineA.tdr layout.

1. Select DIAdem NAVIGATOR.
2. **Delete** the data in the Data Portal without saving the data.
3. Navigate to the SplineA.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. Select DIAdem ANALYSIS.
5. Open the Curve fitting functions function bar and select **Non-parametrical splines**.
6. Set the dialog box parameters as shown in the following figure:

   ![Non-parametric splines dialog box]

   Click **Execute**.
7. Open the Curve fitting functions function bar and select **Parametrical splines**.
8. Set the parameters in the dialog box for calculating parametrical, periodic splines as shown in the following figure:

![Parametric splines dialog box](image)

Click **Execute**.

9. Open the **Curve fitting functions** function bar and select **Parametrical splines**.

10. Set the parameters in the dialog box for calculating parametrical, approximating splines as shown in the following figure:

![Parametric splines dialog box](image)

Click **Execute**.

11. Open the **Curve fitting functions** function bar and select **Akima subsplines**.
12. Set the parameters in the dialog box for calculating the Akima subsplines as shown in the following figure:

![Akima subsplines dialog box](image)

Click **Execute**.

13. Select **DIAdem REPORT**.

14. Click **Load layout** without saving the layout.

Navigate to the `SplineA.tdr` layout in the `C:\Exercises\DIAdem Basics\` folder and open the layout to display the original data.

15. Display the calculation results as curves in the prepared axis systems.

- **Top left**: `Param_Spline_Y1 over Param_Spline_X1`
- **Top right**: `Param_Spline_Y over Param_Spline_X`
- **Bottom left**: `Akima_Y over Akima_X`
- **Bottom right**: `Spline_Y over Spline_X`
The report looks like this:

![Graphs showing spline calculation with DIAdem](image)

**End of Exercise 6-5**

The SplineB.tdr layout and the SplineB.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 6-6

Objective: Mathematical Analysis - Fast Fourier Transformation (FFT)

Use Fast Fourier Transformation to determine the frequency characteristics and their amplitudes, the phase position, and the frequency response locus for measured data.

In the following exercise you run a FFT calculation on the FFTA.tdm data set and display the results in the FFTA.tdr REPORT layout.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate to the FFTA.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select DIAdem ANALYSIS.

5. Open the Signal analysis functions function bar and select FFT (one time signal).

6. Set the channels to be evaluated as shown in the following figure:

7. Click FFT functions to check the functions to be calculated, as shown in the following figure:

Click OK.
8. Click **Time intervals** to check the time intervals as shown in the following figure:

![Time intervals window](image)

Click **OK**.

9. Click **Window function** to check the window function as shown in the following figure:

![Window function window](image)

Click **OK**.

10. Click **Execute** to calculate the FFT.

11. Select **DIAdem REPORT**.

12. Click **Load layout** without saving the current layout.

   Navigate to the prepared layout FFTA.tdr in the
   C:\Exercises\DIAdem Basics\ folder and open the layout.

13. Display the original **Noise over Time** data in the top axis system.

14. Display the results **Ampl_Peak over Frequency** in the bottom axis system.
The report looks like this:

![Fast Fourier Transformation](image)

End of Exercise 6-6

The FFTB.tdr layout and the FFTB.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 6-7

Objective: Mathematical Analysis - Digital Filters

You can use digital filters to eliminate disturbing frequency characteristics. In this example the disturbance is at 500 Hz.

In the following exercise you filter a noise signal with the IIR method, filter type Butterworth, 5th order, and a lowpass of 500 Hz. You calculate a FFT for the filtered signal and add the results to the report from the previous exercise.

1. Select DIAdem ANALYSIS.

2. Open the Signal analysis functions function bar and select Digital filters.

3. Set the dialog box parameters as shown in the following figure:

4. Click IIR param to select the filtering method as shown in the following figure:

   ![Digital Filters dialog box](image)

   ![IIR parameters dialog box](image)

   Click OK.
5. Click **Execute** to calculate the digital filter.

6. Open the **Signal analysis functions** function bar and select **FFT (one time signal)**.

7. Set the channels to be evaluated as shown in the following figure:

![FFT with one time signal](image)

8. Click **FFT functions** to check the functions to be calculated as shown in the following figure:

![FFT functions for one time signal](image)

   Click **OK**.

9. Click **Time intervals** to check the time intervals as shown in the following figure:

![Determination of Time Intervals](image)

   Click **OK**.
10. Click **Window function** to check the window function as shown in the following figure:

![Window function dialog box](image)

Click **OK**.

11. Click **Execute** to calculate the FFT.

12. Select **DIAdem REPORT**.

13. Select the result channels **Ampl_Peak1** over **Frequency1** in the Data Portal and drag and drop the channels into the bottom axis system.

14. Double-click the x-axis in the bottom axis system to open the dialog box for 2D scaling.

15. Set **Manual** as the **Scaling mode** for the x-axis. Enter **2000** as the **End** and **500** as the **Tick distance** as shown in the following figure:

![2D scaling dialog box](image)

Click **OK**.
The report looks like this:

![Graph showing Fast Fourier Transformation](image)

**End of Exercise 6-7**

The DigFilter.tdr layout and the DigFilter.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAadem Basics\ folder.
Additional Exercise

If you have time, complete the following exercise.

1. Use different filter settings on the same data channels.
2. View the individual results in DIAdem VIEW.

The following graphic shows the original signal and the results of a selection of applied digital filters. Note the differences in amplitude and phase between the filtering methods.
Exercise 6-8

Objective: Mathematical Analysis - Linear Mapping

Linear mapping allows you to map data that is recorded with varying sampling rates in a common x-value range.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate to the 10HertzData.tdm and 25HertzData.tdm data files in the C:\Exercises\DIAdem Basics\ folder and drag and drop the files into the Data Portal.

4. Select DIAdem ANALYSIS.

5. Open the Curve fitting functions function bar and select Linear mapping.

6. Check the dialog box parameters as shown in the following figure:

![Linear mapping dialog box]

Click Execute.

7. Select DIAdem VIEW.

8. Click New layout in the toolbar without saving the current view.

9. Open the Regular screen partitioning function bar and select One area.

10. In the Data Portal, select the data channels Time, Temp and Lin_image in the 25HertzData01 channel group and the Temp channel in the 10HertzData01 channel group.

11. Drag and drop the selected channels into the area. Select the 2D axis system display type.
The view looks like this:

End of Exercise 6-8
The LinMapping.tdv layout and the LinMapping.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAadem Basics\ folder.
C. Calculating with Invalid Values

In DIAdem, *NoValue* identifies an invalid value. NoValue is the greatest number that can be processed in DIAdem. You can select **Settings»Desktop parameters»General** to change the NoValue in the general DIAdem configuration.

DIAdem does not display NoValues in reports or include NoValues in function calculations. This means that if you replace values with NoValue, you can omit single data or data ranges from calculations and in the graphic display, as shown in Figure 6-5. For example, if you want to carry out a statistical analysis for a channel without invalid values distorting the result, replace the values with **NoValue** in the DIAdem VIEW channel table before the analysis.

![Figure 6-5](image.png)

**Figure 6-5.** On the Left, Signal with Disturbance Adjusted with NoValues and on the Right, Classification Results.

**NoValue Handling**

You can use the mathematical functions for handling NoValues to delete NoValues from single channels or from associated channel groups, or you can replace the NoValues by linear interpolation of the neighboring values.
Rules for Calculating with NoValues

If one of the terms in the calculation formula is a NoValue, the result of a calculation is NoValue. The result is NoValue if there are no channel values or if the specified value range is exceeded.

The above does not apply for multiplication or division by NoValue. The following rules apply:

- The result is NoValue if the other operand is not equal to zero.
  
  \[
  10 \times \text{NoValue} = \text{NoValue} \\
  10 / \text{NoValue} = \text{NoValue}
  \]

- The result is zero if the other operand is equal to zero:
  
  \[
  0 \times \text{NoValue} = 0 \\
  0 / \text{NoValue} = 0
  \]

For example, to eliminate values greater than 10 in the Example data channel, enter the following formula in the Calculator input field:

\[
\text{Ch('Example') := 'Example' + ('Example' > 10) * NoValue}
\]

The Boolean request ('Example' > 10) returns 0 or 1. Multiplication by NoValues produces either 0 or NoValues. The result of addition with a data channel is either the original channel value or NoValue. This formula has replaced all values greater than 10 with NoValues.
Summary, Tips, and Tricks

- DIAdem ANALYSIS contains extensive libraries of standard mathematical functions that are located in various function bars. To use a standard function, click the function button in the group bar and select the feature you want in the function bar that opens. A dialog box appears where you set the parameters for your calculation.

- DIAdem stores the calculation results in new data channels in the default group or overwrites the input channels with the result data. You specify the default group in the shortcut menu of the Data Portal structure view.

- You can predefine the parameters of the functions that are on the function bar - except for the channel data. Select Default setting in the shortcut menu and change the settings. DIAdem saves the new default settings and these settings are available for reuse in DIAdem.

- NoValues
  - are values that are defined invalid.
  - are represented by the highest value that can be displayed.
  - can be defined as any value.
  - are not displayed in the report or included in the calculation.

- If one of the terms in the calculation formula is a NoValue, the result of a calculation is NoValue.
  The exceptions are:
  - $0 \times \text{NoValue} = 0$
  - $0 / \text{NoValue} = 0$
Lesson 7
Automating Tasks

Introduction
In this lesson you will learn how to automate recurring sequences and standard evaluations as scripts.

You create scripts by running them once, and then edit the scripts in the DIAdem SCRIPT editor.

You Will Learn About:

A. Automating Processes
B. DIAdem SCRIPT Toolbar
C. Script Structure and Syntax
D. Creating a Script
E. Tools that Help You to Create Scripts
F. Editing Scripts
G. Configuring DIAdem SCRIPT
A. Automating Processes

You use scripts to automate recurring operations and standard evaluations in DIAdem. Each action and function in DIAdem has a command. A script consists of a series of commands that DIAdem executes consecutively.

To create a script, you record the actions you perform in the recording mode. The recording mode records the commands associated to the actions, in the script editor. If you disable the recording mode, you can edit, expand, save, and test the commands.

You can use scripts to perform complex tasks from data loading, to evaluation and display, at the press of a button. You can customize DIAdem to fit user requirements.

The DIAdem SCRIPT workspace is divided into the file overview, the editor, and the information area for the debug mode.

Figure 7-1. A Script in DIAdem SCRIPT

Initially, only the script editor and information area are visible. The file overview appears after you resize the editor window. Idle the cursor over the left edge of the window and click and drag the edge to resize the window. Use the bottom edge of the script editor to resize the information area.
The File Overview

The file overview is the organizational part of the DIAdem SCRIPT workspace. The tree structure provides an overview of the files you are working on. Here you define and delete folders, specify the folder properties, and load, open, and save files.

If you click a file in the file overview, DIAdem SCRIPT moves this file to the foreground of the script editor.

To save the current file overview settings in a file with the filename extension .wsp (workspace), select Save workspace in the shortcut menu. To load a file overview you saved previously, select Open workspace in the shortcut menu.

Script Editor

You can view and alter scripts in the script editor. You can edit scripts to include control structures that change the linear sequence of commands, for example. You also can integrate request dialog boxes, or enable the user to interact with the script while the script is running.

Select the script in the file overview. Syntax coloring helps you to distinguish between comments, commands, and variables. You can set the syntax coloring in the shortcut menu of the file overview. The editor provides features like syntax line numbering, bookmarks, and find and replace. The status bar of the script editor displays the current cursor position, the insert or overwrite mode, changes to the script, and any read/write protection.

ToolTips show the correct syntax and the context help provides explanations on each command.

The Debugger and the Information Area

You can use the debugger integrated in the editor to check scripts for errors. The information area contains a corresponding error report in the log file. You also can display the current contents of specific variables and acquire intermediate results at any time.

Note  The debugger is not installed with DIAdem so initially the debugger symbols are dimmed in the toolbar. Refer to the Student Guide, B. What You Need to Get Started for instructions on installing the Script Debugger from the Microsoft homepage.
B. DIAdem SCRIPT Toolbar

The toolbar in DIAdem SCRIPT has functions for loading, saving and printing scripts, and the following functions:

- **New file**
  Use this function to create a new script (*.vbs, *.aut), a file to define user variables (*.vas), or an empty file. The new file appears automatically for editing in the script editor.

- **End interaction**
  Use the InteractionOn function to pause a script at any point and switch to a mode that enables you to operate DIAdem, without ending the script. End interaction continues the script.

- **Run script**
  Use this function to start script files (.vbs, .aut, .auc). DIAdem executes VBS scripts directly.

- **Enable recording mode**
  Use this function to enable the recording mode in which DIAdem automatically records all the relevant commands. DIAdem automatically gives this script file a comment header.

- **Disable recording mode**
  Use this function to end the recording mode. The recorded script then appears in the script editor.

- **Create user dialog box**
  Use this function to open the dialog editor where you can create your own dialog boxes. You use a dialog box to assign entries to specific variables while the script is running.

- **Activate user variables file**
  This function loads variable definition files (*.vas) to enable the defined variables, which are then available to DIAdem. When you enable variables, DIAdem adds these variables to the existing collection of variables, which means DIAdem reserves the required amount of memory and initializes the variables.

**Note** Variable definition is exclusive. If you load a second variable definition file, DIAdem deletes the user variables defined previously.
C. Script Structure and Syntax

A script consists of comments, commands, variable assignments, formula calculations, control structures, procedures, and blank lines.

Comments
You can include comments anywhere in scripts. Indicate comments either with `rem`, or with single quotation marks `. Comments do not slow down scripts.

Commands
Commands carry out internal functions. Most of these functions require settings, which are transferred to a parameter list. You call commands with

```
Call Command(parameterlist)
```

You can transfer channel and variable parameters in the parameter list.

The command name indicates the object the command relates to, and the action the command executes. For example, `ChnSmooth` smooths a channel: `Chn` stands for the channel, and `Smooth` for the smoothing function. `DataLoad` is the command for loading data.

Variable Assignments
Variable assignments assign a numeric value or a string to a program variable or to a user variable. The assignments are made with equal signs:

```
Variable = Formula expression
```

This formula expression links operands by operations.

Declare all of the variables used in the script early in the script, and assign default values to the variables, to define the status of the variables. This prevents unexpected script behavior.

Formula Calculations
Use the `FormulaCalc` command to call the DIAdem Calculator and run formula calculations, which calculate entire data channels in scripts, not just single values. Formula expressions must be in quotation marks.

```
Call FormulaCalc("Formula expression")
```
Control Structures
Control structures such as loops and branches involve conditions and change the linear progress of the script. Use loops to repeat instructions until a specific condition is true. Use branches for the script to perform different instructions in response to a condition.

Procedures
You can include repeated instructions, or a group of related instructions, in separate procedures. Procedures start and end with the keywords Sub and End Sub. To run a procedure, Call the procedure name.

Blank Lines
DIAdem ignores blank lines in scripts. Blank lines make scripts easier to read.
D. Creating a Script

The easiest way to create a script is to enable the recording mode. You also can create scripts manually. This requires considerable knowledge of DIAdem commands and variables. You can edit or start scripts at any time.

Recording a Script

To create a script in the recording mode, complete the following four steps:

1. Enable the recording mode.
   In the dialog box that appears, select your recording settings and enter comments for the script.

2. Carry out the functions and operations you want to automate in the script.
   DIAdem registers the relevant actions and stores the associated commands in the script.
   The status bar shows that DIAdem is recording.

3. Disable the recording mode.

4. Save the script.
   The specified command sequence is only temporary in the editor. You must save the created script to be able to reuse the script later.

Channel References in Scripts

Enable the recording mode in DIAdem SCRIPT to define how scripts record channel references. You can use channel names or channel numbers to access channels.

If you use channel names, DIAdem records the channel names when it records the script, otherwise DIAdem records the channel numbers.

Call ChnSmooth("[1]/Speed","/Y_smooth",17,"maxNumber")

or

Call ChnSmooth(2,5,17,"maxNumber")

File References in Scripts

Enable the recording mode in DIAdem SCRIPT to specify how DIAdem records file references in scripts. If you select the Record absolute path checkbox, DIAdem stores a complete path for each filename you use. This ensures that the script always works with the files you want, irrespective of which current folders are set as user paths.
Starting a Script

Start a script in one of the following ways:

- Click **Execute script file** in the toolbar to start a script without loading the script in the script editor. The dialog box that appears displays the scripts available in the current script path. You can modify the user path here.

- Click **Run script** in the toolbar to start a script that is displayed in the script editor.

Once you start the script, the script runs automatically.

You can assign a frequently-used script to a button in the DIAdem SCRIPT function bar. The bottom function bar is available in all the DIAdem panels, so you can use the scripts you assign here in all panels.
E. Tools that Help You to Create Scripts

You can use the recording mode, the keys <Ctrl-A>, and the DIAdem help to create scripts.

The Recording Mode

In the recording mode, DIAdem records all commands and some variables. This mode facilitates creating scripts. The initial script is the basis for your script.

The recording mode records the following functions in the separate panels:

- **DIAdem NAVIGATOR**
  - Loading, saving, and importing data
  - Operations in the Data Portal

- **DIAdem VIEW**
  - Block operations such as deleting or inserting, in the channel contents
  - Setting and deleting flags

- **DIAdem ANALYSIS**
  - All calculations
    In rare cases, the recording mode also records variable assignments.

- **DIAdem REPORT**
  - Functions such as opening, saving, displaying, and printing layouts.
    The recording mode does not register interactive actions like inserting, moving, or configuring graph objects.

The Key Combination <Ctrl-A>

When you generate a script in the recording mode, DIAdem does not generally record variable assignments. If you change axis, curve, or text parameters in the recording mode, you see the changes in the window, but the related variable assignments are not stored in the script.

To record dialog box parameters and variables in the recording mode, press <Ctrl-A> in the open dialog box.

If the recording mode is not enabled, press <Ctrl-A> in an open dialog box and DIAdem copies the variables and their contents to the clipboard. You can insert these variable assignments in the script editor.
The DIAdem Help

The DIAdem help shows you where to find variable names and command names.

- In the script editor
  - If you select a DIAdem term in the script editor, press <F1> to access the help page for this variable or command.
  - When the cursor idles on a selected command or variable in the script editor, the ToolTip appears with information on the command parameters or on the type and value range of the variable.

- In dialog boxes
  - Every DIAdem dialog box has a help button that opens the DIAdem help page with the commands and variables for the dialog box. You can click terms underscored in green to access the variable for a dialog box parameter, or the syntax for including the variable in the script.

- Command and variable overview in the DIAdem help
  - In the help tree, the Functions, Commands, and Variables folder has various lists of DIAdem commands and variables.

- DIAdem SCRIPT help
  - In the help tree, select Getting Started»DIAdem SCRIPT for a general description of DIAdem SCRIPT, and select Procedures»Working with DIAdem SCRIPT for a step-by-step description of how to create and to edit scripts.
Exercise 7-1

Objective: Creating a Script

You must repeat specific sequences several times a day, but you do not want to repeat each step each time. A series of commands could be loading a data set, running a mathematical function with this data, and then creating a report.

In the following exercise you create a script that loads the Vibration.tdm data file, calculates the envelope curve, and displays the result in the Envelopes.tdr layout.

1. Select DIAdem SCRIPT.
2. Click Enable recording mode in the toolbar.
3. Comment the script as shown in the following figure:

If you select Number as Channel reference, the recording mode records the channel numbers and not the channel names when it accesses channels.

Click OK.

The temporary file TeachIn(1).vbs appears in the editor. DIAdem displays the script recording in the status bar.

4. Select DIAdem NAVIGATOR.
5. Delete the data in the Data Portal without saving the data.
6. Navigate to the Vibration.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
7. Select **DIAdem REPORT**.

8. Click **Load layout** without saving the current layout.

   Navigate to the prepared layout *Envelopes.tdr* in the
   C:\Exercises\DIAdem Basics\ folder and load the layout.

9. Select **DIAdem ANALYSIS**.

10. Open the **Curve fitting functions** function bar and select **Envelope curves**.

11. Set the parameters as shown in the following figure:

   ![Envelope curves dialog box](image)

   Click **Execute**.

12. Select **DIAdem REPORT**.

13. Click **Redraw** in the toolbar to refresh the report.

14. Select **DIAdem SCRIPT**.

   The actions carried out reflect the work sequence.

15. Click **Disable recording mode** in the toolbar.

   In the script editor you see the commands recorded in the recording mode.

16. Click **Save file as** to save the script you recorded in the recording mode.

   Open the C:\Exercises\DIAdem Basics\ folder and save the script as *Training.vbs*.

17. Click **Run script** to test the *Training.vbs* script in the editor.
When the script finishes, the following report appears:

![Graph showing Envelopes Curve Calculation: 50 per cent]

The Training.vbs script contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad("Vibration.tdm","",""

Call PicLoad("Envelopes")
Call PicUpdate()

Call ChnEnvelopes(1,2,3,4,5,6,50)
Call PicUpdate()
```

To ensure clarity, the results are displayed but not the comments.

**End of Exercise 7-1**

The Basic_07_01.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 7-2

Objective:  Including Scripts in the DIAdem User Interface

Use scripts to automate repetitive processes and to carry out these processes at the push of a button. Assign scripts to buttons to make it easier to start frequently-used scripts.

In the following exercise you assign the created script Training.vbs to the third button of the third function bar.

1. Select DIAdem SCRIPT.

2. Open the DIAdem scripts function bar and select Default setting in the shortcut menu of the third button.

3. Navigate to the Training.vbs script in the C:\Exercises\DIAdem Basics\ folder and select the script.

4. Click Open to assign the script to the third button.

5. Open the last function bar again and idle the cursor on the third button.

   The name of the assigned script appears in the ToolTip.

6. Open the DIAdem scripts function bar and select VBS Script: Training to start the Training.vbs script.

   To start scripts, click the function bar button or use keys. Press <Shift-F3> to start the script assigned to the third button.

End of Exercise 7-2
Exercise 7-3

Objective: Extending a Script

In the following exercise you include the command for saving the calculation results in the script.

1. Select DIAdem SCRIPT.
2. Click Enable recording mode in the toolbar to record a command.
3. Click OK in the Configure recording mode dialog box.
4. Select DIAdem NAVIGATOR.
5. Click Save TDM file as.
   - Open the C:\Exercises\DIAdem Basics\ folder and save the current Data Portal data as Envelopes.tdm. If the filename already exists, overwrite the file with this name.
6. Select DIAdem SCRIPT.
7. Click Disable recording mode in the toolbar.
   - The TeachIn(2).vbs script appears in the script editor.
8. Click the line number of the recorded command.
9. Click Copy in the toolbar.
10. Click the tabs at the bottom of the script editor to switch to the Training.vbs script.
11. Paste the copied command to the end of the script.
12. Click Save file as.
   - Open the C:\Exercises\DIAdem Basics\ folder and save the modified script as Training.vbs. You also can press <Ctrl-S> to save the script.
13. Click Run script in the toolbar to test the Training.vbs script.
   - TeachIn(2).vbs is a temporary script, so you do not have to save the contents of this file.
The `Training.vbs` script contains the following instructions:

```vbnet
Call DataDelAll(1)
Call DataFileLoad("Vibration.tdm","","")

Call PicLoad("Envelopes")
Call PicUpdate()

Call ChnEnvelopes(1,2,3,4,5,6,50)
Call PicUpdate()

Call DataFileSave("Envelopes.tdm","TDM")
```

**End of Exercise 7-3**

The `Basic_07_02.vbs` script, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
F. Editing Scripts

A script consists of a series of commands that DIAdem executes consecutively. The script files are ASCII files that you view and modify or extend with any ASCII editor.

You can edit scripts to include loops and branches, which control the sequence of commands. You also can edit scripts to enable the user to interact with the script while the script is running.

Script Commands and Variables

Tables 7-1 and 7-2 contain a selection of frequently-used script commands and variables. Refer to the ToolTips and the context help for more information on the commands.

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoQuit</td>
<td>Stops a script</td>
</tr>
<tr>
<td>ChnAlloc</td>
<td>Allocates and names channels</td>
</tr>
<tr>
<td>DirLstWrite</td>
<td>Creates a list file</td>
</tr>
<tr>
<td>ExtProgram</td>
<td>Calls an external program</td>
</tr>
<tr>
<td>FileX</td>
<td>Checks whether an ASCII file exists</td>
</tr>
<tr>
<td>FileNameGet</td>
<td>Standard dialog box for entering filenames</td>
</tr>
<tr>
<td>FormulaCalc</td>
<td>Calculates any user-defined function</td>
</tr>
<tr>
<td>InteractionOn</td>
<td>Interrupts a script</td>
</tr>
<tr>
<td>KeyWait</td>
<td>Script waits for next keystroke</td>
</tr>
<tr>
<td>MsgBoxDisp</td>
<td>Displays a user message in a message box</td>
</tr>
<tr>
<td>MsgLineDisp</td>
<td>Displays a user message in the status bar</td>
</tr>
<tr>
<td>PathNameGet</td>
<td>Opens the standard dialog box for path selection</td>
</tr>
<tr>
<td>Pause</td>
<td>Stops a script</td>
</tr>
<tr>
<td>ScriptStart</td>
<td>Calls a subscript / routine</td>
</tr>
<tr>
<td>SubSequence</td>
<td>Scripts can only start as Include scripts</td>
</tr>
<tr>
<td>SudDefLoad</td>
<td>Loads a dialog box description file</td>
</tr>
<tr>
<td>SudDlgShow</td>
<td>Displays a user dialog box</td>
</tr>
<tr>
<td>TextFileClose</td>
<td>Closes a text file</td>
</tr>
</tbody>
</table>
Control Structures: Loops and Branching

DIAdem works through scripts consecutively and stops when it reaches the end of the script. DIAdem has control structures that execute commands multiple times until a condition is true.

Use control structures such as condition and loop instructions, to specify how DIAdem executes the script. Use conditions and loops to write code that allows you to make decisions, and that repeats actions.
The following control structures are available:

- **Simple branching**
  
  ```plaintext
  if ... then ...
  if ... then ... end if
  if ... then ... else ... end if  (and alternative)
  ```

- **Multiple branching**
  
  ```plaintext
  select case ... end select
  select case ... else ... end select  (and alternative)
  ```

- **Counter loops**
  
  ```plaintext
  for ... to ... next
  ```

- **Condition-dependent loops**
  
  ```plaintext
  do while ... loop
  do ... loop until
  ```

Use clear, readable syntax in your scripts to minimize the probability of errors. Follow these guidelines for control structure syntax:

- Write only one command in each line.
- Indent commands inside branching and loops.
- Use consistent spelling and capitalization, for example, capitalize the keywords in the control structures.

**Control Commands**

Use control commands to interrupt, to end, or to repeat your script. The `KeyWait` command interrupts the script until the user presses any key. The `Pause` command stops the script for a specific time. The `AutoQuit` command terminates the script. The `AutoRepeat` command repeats all the instructions above the control command.

**Messages and Requests**

The `MsgBoxDisp` command is for displaying tips, warnings, or error messages in a message box. Extend the optional parameter to use this command for standard requests as well.

**Syntax**

```plaintext
MsgBoxDisp(MsgText, [MsgButtonType])
```

- **MsgText**: Specifies any text.
  
  Because the `MsgText` variable is limited to 80 characters, you assign longer message text to a text variable and use the variable in the call.
MsgButtonType  Specifies the type of button in the message box.  Possible settings:

- "MB_OK"  Ok
- "MB_OKCancel"  OK / Cancel
- "MB_RetryCancel"  Retry / Cancel
- "MB_YesNo"  Yes / No
- "MB_YesNoCancel"  Yes / No / Cancel
- "MB_AbortRetryIgnore"  Abort/Retry/Ignore
- "MB_NoButton"  No button

The MsgState variable contains the button that was clicked to close the message: "IDOk", "IDCancel", "IDRetry", "IDYes", "IDNo", "IDAbort" and "IDIgnore".

Note: The @CRLF@ inserts carriage-return and linefeed characters. The syntax @Variable@ inside a message text displays the contents of the DIAdem variable called Variable.

Creating a Serial Evaluation

You create a script for a serial evaluation to analyze and display several data files that have the same structure, in the same way. To enable serial evaluation, select Settings»Desktop parameters»Panel specific in DIAdem SCRIPT. Figure 7-2 shows the selected checkbox Enable serial evaluation during recording mode.

![Figure 7-2. Enabling Serial Evaluation in the DIAdem SCRIPT Configuration](image)

If you close the DIAdem SCRIPT configuration and click Enable recording mode in the toolbar, you can select and load multiple files in the file selection dialog boxes. DIAdem automatically stores the filenames you select in a script list file. When you save the script, you must save the associated script list file with the same name, but with the filename extension .lst.
Note If you select only one file in a file selection dialog box, the recording mode records the command in the script, with this filename as a parameter.

When you start the script for serial evaluation, DIAdem reads out the script list file in sequence when the script loads and saves a file. When you use different load or save commands ensure that the sequence of the filenames in the list file corresponds.

You only have to make minor modifications to change existing scripts into serial scripts. Replace the loading and saving parameters in your script with the identifier UseFileList. Create a script list file with the same name. The script list file contains the filenames to be used in the serial evaluation.
Exercise 7-4

Objective: Using Loop Instructions

Repeat the envelope curve calculation. Vary the interval width, which specifies the extent to which the envelope curve adheres to the original curve.

In the following exercise you create a loop that repeats the envelope curve calculation.

1. Select DIAdem SCRIPT.
2. Select the Training.vbs tab to view the script with the same name in the script editor.
3. Insert a do...loop until loop for repeating instructions:

   ```
   Do
   Call ChnEnvelopes(1,2,3,4,5,6,50)
   Call PicUpdate()
   Loop Until (DxPeak<1)
   Call DataFileSave("Envelopes.tdm","TDM")
   ```

4. Vary the interval width by adding the following instructions:

   ```
   DxPeak = 50
   Do
   Call ChnEnvelopes(1,2,3,4,5,6,DxPeak)
   Call PicUpdate()
   DxPeak = DxPeak/2
   Loop Until (DxPeak<1)
   Call DataFileSave("Envelopes.tdm","TDM")
   ```

5. Use the Pause command to stop the script after the report displays:

   ```
   Call PicUpdate()
   Call Pause(5)
   DxPeak = DxPeak/2
   ```

6. Click Save file as.

   Open the C:\Exercises\DIAdem Basics\ folder and save the extended script as Training.vbs.

7. Click Run script in the toolbar to test the Training.vbs script.
When the Training.vbs script finishes, the following report appears:

![Graph showing vibration over time]

The Training.vbs script contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad("Vibration.tdm","","")

Call PicLoad("Envelopes")
Call PicUpdate()

DxPeak = 50
Do
  Call ChnEnvelopes(1,2,3,4,5,6,DxPeak)
  Call PicUpdate()
  Call Pause(5)

  DxPeak=DxPeak/2
Loop until (DxPeak<1)

Call DataFileSave("Envelopes.tdm","TDM")
```

**End of Exercise 7-4**

The Basic_07_03.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 7-5

Objective: Using Standard Requests

The envelope calculation does not have to be repeated in all cases. Therefore, you integrate a request to ask the user whether he wants DIAdem to run the rest of the calculation or not.

In the following exercise you define a standard dialog box for this request.

1. Select DIAdem SCRIPT.
2. Select the Training.vbs tab to view the script with the same name in the script editor.
3. Use the following instructions to display a message:

   ```vbs
   DxPeak=DxPeak/2
   Call MsgBoxDisp("Execute another calculation?",_ 
                   "MB_YesNo")
   Loop Until (DxPeak<1)
   Call DataFileSave("Envelopes.tdm","TDM")
   ``

4. Ask if the user wants to end the loop:

   ```vbs
   Call MsgBoxDisp("Execute another calculation?",_ 
                   "MB_YesNo")
   Loop Until (DxPeak<1) or (MsgState="IDNo")
   Call DataFileSave("Envelopes.tdm","TDM")
   ``

5. Click Save file as.
   Open the C:\Exercises\DIAdem Basics\ folder and save the extended script as Training.vbs.

6. Click Run script in the toolbar to test the Training.vbs script.
When each report displays, the following message appears:

![Image showing a graph](image)

**Envelopes Curve Calculation: 50 per cent**

The Training.vbs script contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad("Vibration.tdm", "", "")
Call PicLoad("Envelopes")
Call PicUpdate()

DxPeak = 50
Do
    Call ChnEnvelopes(1, 2, 3, 4, 5, 6, DxPeak)
    Call PicUpdate()
    Call Pause(5)
    DxPeak = DxPeak / 2
    Call MsgBoxDisp("Execute another calculation?", _
                   "MB_YesNo")
    Loop Until (DxPeak < 1) or (MsgState = "IDNo")
Call DataFileSave("Envelopes.tdm", "TDM")
End
```

**End of Exercise 7-5**

The Basic_07_04.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 7-6

Objective: Creating a Serial Evaluation in the Recording Mode

In the following exercise you create a script for serial evaluation. The script loads several data files, integrates the second channel, and displays the results in the Integration.tdr layout.

1. Select DIAdem SCRIPT.

2. Select Settings»Desktop parameters»Panel specific and select Enable serial evaluation during recording mode.

Click OK.

3. Click Enable recording mode in the toolbar.

Comment the script. Ensure that the Channel reference is set as Name.

Click OK.

4. Select DIAdem NAVIGATOR.

5. Delete the data in the Data Portal without saving the data.

6. Click Load data file.

Navigate to the C:\Exercises\DIAdem Basics\ folder and select all the data files that start with Meas_05. Click Load.

7. Select DIAdem ANALYSIS.

8. Open the Basic mathematics functions function bar and select Integration.
9. Check the channels to be integrated as shown in the following figure:

Click **Execute**.

10. Select **DIAdem REPORT**.

11. Click **Load layout** without saving the current layout.

   Open the C:\Exercises\DIAdem Basics\ folder and load the layout Integration.tdr.

   In addition to the original data, the report also displays the integrated signal.

12. Select **DIAdem SCRIPT**.

13. Click **Disable recording mode** in the toolbar.

14. Click **Save file as**.

   Open the C:\Exercises\DIAdem Basics\ folder and save the TeachIn(3).vbs script as Integration.vbs.

15. Click the tab at the bottom of the script editor and switch to the TeachIn(3).lst list file.

16. Click **Save file as**.

   Open the C:\Exercises\DIAdem Basics\ folder and save the TeachIn(3).lst list file as Integration.lst.

   Ensure that the only difference between the script name and the list file name is the filename extension, vbs or lst.

17. Click the tab at the bottom of the script editor to switch to the Integration.vbs script.

18. Click **Run script** in the toolbar to test the Integration.vbs script.

   **Tip** If the last instruction is the command for waiting for any key stroke, Call KeyWait(), you can check the results at your own pace.
When the script runs through the first time, the report looks like this:

![Graph](image)

When you finish this exercise, the Integration.lst list file contains the following entries:

- C:\Exercises\DIAdem Basics\Meas_0519_01.tdm
- C:\Exercises\DIAdem Basics\Meas_0520_01.tdm
- C:\Exercises\DIAdem Basics\Meas_0520_02.tdm
- C:\Exercises\DIAdem Basics\Meas_0521_01.tdm
- C:\Exercises\DIAdem Basics\Meas_0521_02.tdm
- C:\Exercises\DIAdem Basics\Meas_0522_01.tdm

The Integration.vbs script contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad(UseFileList,"TDM","Load")
Call ChnIntegrate("
    
    "[1]/Date\Time","[1]/Output","/Y_Integral")
Call PicLoad("Integration")
Call PicUpdate()
Call KeyWait()
```

**End of Exercise 7-6**

The Basic_07_05.vbs script and the Basic_07_05.lst list file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 7-7

Objective: Creating a Serial Evaluation with a Loop

In the following exercise you add a loop to the serial evaluation script.

1. Select DIAdem SCRIPT.

2. Click the tab at the bottom of the script editor to switch to the Integration.lst list file.

3. Delete the comments from the list file so that only the following characters remain:

4. Click Save file as.

   Open the C:\Exercises\DIAdem Basics\ folder and save the list file as Integration.lst.

5. Click the tab at the bottom of the script editor to switch to the Integration.vbs script.

6. At the beginning of the script, enter the following instructions for opening and positioning the text file:

   Dim FNo, FErr
   FNo  = TextFileOpen(AutoActPath & "Integration.lst",_ 
   tfRead)
   FErr = TextFileSeek(FNo,1)
   ...

7. Replace the command for loading data

   Call DataFileLoad(UseFileList,"TDM","Load")

   with the following instructions:

   DataFileName = trim(TextFileReadLn(FNo))
   Call DataFileLoad(DataFileName)
8. To access the list file and read the filenames, define the following loop around the existing commands:

```
... 
Do While Not TextFileEOF(FNo)
   Call DataDelAll(1)

   DataFileName = trim(TextFileReadLn(FNo))
   Call DataFileLoad(DataFileName)

   Call ChnIntegrate(_
       "[1]/Date\Time","[1]/Output","/Y_Integral")

   Call PicLoad("Integration")
   Call PicUpdate()
   Call KeyWait()
Loop
```

9. At the end of the script, enter the instruction for closing the text file:

```
... 
Loop
FNo = TextFileClose(-1)
```

10. Click **Save file as**.
    Open the C:\Exercises\DIAdem Basics\ folder and save the script as Integration_Loop.vbs.

11. Click **Run script** in the toolbar to test the Integration_Loop.vbs script.

The Integration_Loop.vbs script contains the following instructions:

```
FNo = TextFileOpen(AutoActPath & "Integration.lst",_tfRead)
FErr = TextFileSeek(FNo,1)
Do While Not TextFileEOF(FNo)
   Call DataDelAll(1)
   DataFileName = trim(TextFileReadLn(FNo))
   Call DataFileLoad(DataFileName)
   Call ChnIntegrate(_
       "[1]/Date\Time","[1]/Output","/Y_Integral")
   Call PicLoad("Integration")
   Call PicUpdate()
   Call KeyWait()
Loop
FNo = TextFileClose(-1)
```
Note  The following example also opens a file and reads the contents line by line to the end. If an error occurs, the example displays the error number and error text:

FNo  = TextFileOpen(AutoActPath & "Integration.lst",_tfRead)
If FNo = 0 Then
   Call MsgBoxDisp("Error number: " & TextFileError(FNo)& _
   VbCrLf & _
   "message: " & TextFileErrorTxt(FNo))
Else
   FErr = TextFileSeek(FNo,1)
   Do While Not TextFileEoF(FNo)
      Call DataDelAll(1)
      DataFileName = trim(TextFileReadLn(FNo))
      Call DataFileLoad(DataFileName)

      Call ChnIntegrate(_
         "[1]/Date\Time","[1]/Output","/Y_Integral")

      Call PicLoad("Integration")
      Call PicUpdate()
      Call KeyWait()
   Loop
End If
FNo  = TextFileClose(-1)

End of Exercise 7-7

The Basic_07_06.vbs script and the Basic_07_05.lst list file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
G. Configuring DIAdem SCRIPT

The Desktop parameters are the program settings you can specify in DIAdem.

Setting Panel-Specific Parameters

In DIAdem SCRIPT, select Settings»Desktop parameters»Panel specific. The configuration dialog box has the following settings:

- **Library path**: Displays the current library folder with scripts.
- **User path**: Displays the current user folder with scripts.
- **Activate series evaluation**: Enables the function that you can use to select several filenames in specific file selection dialog boxes. The script to be recorded can then evaluate several files.
- **File coding**: Specifies the code for saving the script.

You can save all the program settings in a desktop file. The desktop file has the filename extension `.ddd`. To save your settings in a desktop file, first select Window»Close all. Then click Save desktop.
Summary, Tips, and Tricks

- To create a script, you record the actions you perform in the *recording mode*. The recording mode records the commands associated to the actions, in the script editor. If you disable the recording mode, you can edit, expand, save, and test the commands.

- The specified command sequence is only temporary in the editor. You must save the created script to be able to reuse the script later.

- You can extend and control scripts using loops, condition-related branching, procedures, and user-defined dialog boxes.

- In the script editor, syntax coloring helps you to distinguish between comments, commands, and variables. You can set the syntax coloring in the shortcut menu of the file overview.

- To record dialog box parameters and variables in the recording mode, press <Ctrl-A> in the open dialog box.

- If you select a DIAdem term in the script editor, press <F1> to access the help page for this variable or command. In the Help tree, the *Functions, Commands, and Variables* folder has an alphabetical list of all the DIAdem commands and variables.
Lesson 8
The DIAdem Calculator

Introduction
In this lesson you will learn how to use the Calculator to analyze data with your own formulas.

In formulas you can specify operations with data channels and generate new data channels. You also can calculate and display single values and assign the values to variables. The Calculator can run numeric, Boolean, and text operations.

You Will Learn About:

A. Using the DIAdem Calculator
B. Working with the Calculator
C. Operands, Operations, and Auxiliary Variables
D. Additional Notes
A. Using the DIAdem Calculator

The DIAdem VIEW, DIAdem ANALYSIS and DIAdem SCRIPT panels have an integrated calculator. Click the Calculator button in the toolbar to open the Calculator. Figure 8-1 shows the Calculator interface.

**Figure 8-1.** Extended Calculator Mode

**Entry Field**

Use the keyboard or the Calculator keys to enter your formula in the entry field. The formula must not exceed a maximum of 1000 characters.

**Result Bar**

DIAdem displays the calculation results and confirmation or error messages in the result bar.

**Buttons**

The buttons **Calculate**, **Command stack**, **Basic**, **Extended**, **Help** and **Close** are to the right of the entry field.

Click **Calculate** to evaluate the formula. When the calculation is complete the entry field background is blue.
Click **Command stack** to open the list of the last calculations performed. The last formula calculated is at the top of the list. Double-click the formula to copy it to the entry field.

Click **Extended** or **Basic** to change the range of Calculator functions. The **Basic** mode provides calculator functions, and the **Extended** mode includes the operations table and the variables table.

**Keys**
The keys below the result bar are for the basic calculator functions. They are grouped in blocks.

**Operations Table**
The operations table is on the bottom left in the Extended view. The operations are listed in alphabetical order. The ToolTip displays the name and the argument of the operation for each table cell. Use the tabs to switch between numeric, Boolean, and text operations.

Double-click the name of an operation to copy it into the entry field.

**Variable Table**
The variables table is on the bottom right in the Extended view. This table contains variables frequently used in formula expressions. The variables include various single and vector variables and an overview of the current channels in the Data Portal.

Double-click a variable name or a channel name to copy it into the entry field.
B. Working with the Calculator

The formulas you enter in the Calculator can perform all types of mathematical tasks. The formulas often have different syntax and return varying results. The formulas can request single values and variables, assign values to variables, and calculate data channels.

Requesting Single Values

Requesting single values means that the result is a single value. You can request the contents of a variable or calculate a formula.

Syntax

Variable name?
Formula expression?

For a variable request, the Calculator displays the contents of the variable in the result bar.

If you enter a formula expression that has a single value result, the Calculator evaluates the formula and displays the result in the result bar. A formula expression runs operations on operands.

Note that the Calculator can call and display only single values directly. You must assign a result channel for a channel operation.

Examples

Pi?
The value of the constant Pi appears in the result line.

sin(0.14598)?
The Calculator calculates the sine of the value 0.14598 and displays the result in the result bar.

Invalid

Ch('Input')+5.345?
The formula expression contains a channel, Ch('Input'). The result of the calculation is not a single value, it is a complete channel that DIAdem cannot display in the result line. This request leads to an error message.

Assigning Values to Variables

Assigning a value to a variable means that a variable receives a single value, or the result value of a formula calculation.

Syntax

Variable := Value
Variable := Formula expression

The variable that you specify on the left-hand side of the assignment must be either a scalar variable or an element of a multi-dimensional variable.

A formula expression runs operations on operands.
Note  In all formula calculations, ensure that the result type is compatible with the variable on the left.

Examples

\[ R_1 := \sin(\pi/2) \]

The real variable \( R_1 \) receives the value of the sine function at \( \pi/2 \).

\[ T_1 := \'Value of \pi: \' + \text{str}(\pi,'d.dd') \]

The \( T_1 \) text variable contains text that consists of a specific text and a formula expression. The formula converts the numeric quantity \( \pi \) into text. The format instruction \( 'd.dd' \) displays numbers with two decimal places.

Invalid

\[ L_1 := 23/5 \]

The result of the formula expression is Real (floating-point number). You cannot assign 23/5 to the \( L_1 \) variable without first converting this value to an integer (without decimal places). This assignment leads to an error message.

\[ R_1 := \text{Ch('Input')}/10 \]

The formula expression contains a reference to the \( Input \) channel. The result of this formula is a channel. You can only assign one value to a variable. This assignment leads to an error message.

Calculating Channels

Calculating channels means that a formula runs an operation on data channels, or data channels and variables, or data channels and constants. The result of this formula is also a channel, which DIAdem stores in the default channel group in the Data Portal.

Syntax

\[ \text{Channel} := \text{Formula expression} \]

A formula expression runs operations on operands.

A channel calculation always applies to the entire channel. Every element of the channel is calculated according to the formula expression. The result channel is the same length as the shortest of the channels involved in the calculation.

If the formula expression does not include a channel, the result of the calculation is a single value. You can only assign one single value to one variable.

Result Channel for Channel Calculations

The result of a channel calculation is a channel, which you enter on the left side of the formula with the expression \( \text{Ch()} \). The expression can specify the result channel, or the Calculator searches for a target channel.
You can specify the result channel in various ways:

- **Ch(‘Channelname’) := Formula expression**
  
  This formula references the result channel by name.

  If a channel with this name already exists in the Data Portal, the Calculator overwrites the previous channel contents with the calculation results.

  If no channel with this name exists in the Data Portal, the Calculator creates a new channel in the default group and fills the channel with the results of the channel calculation.

- **Ch(Channelnumber) := Formula expression**
  
  This formula references the result channel by the channel number.

  If no channel with this channel number exists in the Data Portal, or if the Data Portal contains less channels than the number of the channel, the Calculator creates a new channel in the default group and generates a channel name.

- **Ch(#) := Formula expression**
  
  This formula does not specify a result channel. In this case, the Calculator specifies the result channel. The Calculator generates a result channel in the default group and generates a channel name.

Use channel names instead of channel numbers in formula expressions to increase readability and flexibility. Only use channel numbers if several channels have the same name and you want to access a particular channel and not the first channel. You also can enter Group name/Channel name to refer to a particular channel.

If you use the channel name in the formula expression, we recommend you use quotation marks. This way you avoid misinterpretations which arise if a channel name contains special characters such as + / - *, or if the channel name has the name of an internal function such as sin.

**Examples**

- **Ch(‘Sine’) := Sin(‘Values’)**
  
  This formula expression evaluates the Values channel with the sine function. The Calculator saves the results in the Sine channel. If there is no channel with the name Sine, the Calculator automatically creates a new channel in the default channel group. Otherwise the Calculator overwrites the contents of the existing channel with the new values.

- **Ch(3) := Ch(2)/Ch(1)**
  
  The Calculator divides each value of the second channel by the respective value of the first channel and saves each result in the third channel of the Data Portal.
Ch(#) := 'Distance'/'Time'

The Calculator divides the values of the Distance channel by the values of the Time channel. If # is set, the Calculator automatically specifies the result channel in the default channel group, generates a name for the result channel, and saves the average speed determined.

Invalid

Ch('Result') := Sin(Pi/2)

The result of the calculation is a single value that you only can assign to a variable but not to a channel. If you want to generate a channel with constant values, use the channel generating function. This calculation leads to an error message.

Ch(Sin) := Sin('Values')

This instruction calculates the sine for each value of the Values channel and saves the results in the Sin channel. However this conflicts with the internal sin function that calculates the sine. For the Calculator to accept the channel name Sin you must enclose the name in single quotation marks. This calculation leads to an error message.
C. Operands, Operations, and Auxiliary Variables

A formula expression runs operations on operands and saves the result in auxiliary variables, for example.

Using Operands

Operands can be program variables, auxiliary variables, and user variables, which represent constants, single values, vectors, matrices, or channels.

The operands have different operand forms and operand types.

Operand forms include constants whose contents cannot be changed, scalar variables that accept exactly one value, vector variables and matrix variables that represent one or two dimensional fields, and channels that display numeric vectors with additional information such as the channel name or unit.

Note In the Calculator you only can run operations with single values, with Numeric or Time type channels, and with individual elements of vectors and matrices.

Table 8-1 shows which operands are available for the various operand forms.

<table>
<thead>
<tr>
<th>Operand Type</th>
<th>Operand</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>Program variable</td>
<td>Pi</td>
</tr>
<tr>
<td></td>
<td>User variable</td>
<td>Freely definable</td>
</tr>
<tr>
<td>Scalar variables</td>
<td>Program variable</td>
<td>SmoothWidth</td>
</tr>
<tr>
<td></td>
<td>Auxiliary variable</td>
<td>R1, B1, L18</td>
</tr>
<tr>
<td></td>
<td>User variable</td>
<td>Freely definable</td>
</tr>
<tr>
<td>Vector variable</td>
<td>Program variable</td>
<td>ChnName (2)</td>
</tr>
<tr>
<td></td>
<td>Auxiliary variable</td>
<td>RV1(3), LV3(2), TV(3)</td>
</tr>
<tr>
<td></td>
<td>User variable</td>
<td>Freely definable</td>
</tr>
<tr>
<td>Matrix variable</td>
<td>Program variable</td>
<td>ChD (2, 25)</td>
</tr>
<tr>
<td></td>
<td>User variable</td>
<td>Freely definable</td>
</tr>
<tr>
<td>Channel</td>
<td>Program variable</td>
<td>Ch (3), Ch ('Name')</td>
</tr>
</tbody>
</table>

The constants that are frequently used in calculations, π and e, are predefined in DIAdem and can be used by name.

- Circle constant π 3.1415926536
- Euler number e 2.7182818285
The operand type specifies the type and the range of the values the operand can have:

- **Integer type**: Byte, Integer, Word, LongInteger
- **Real type**: Real
- **Text type**: Free text, Enumeration, Dynamic enumeration list
- **Boolean type**: Boolean

Program variables and user variables can accept any of the types, whereas auxiliary variables only can accept LongInteger, Real, Boolean, Free text, and Dynamic enumeration list types.

In formula calculations the operand type is important both for calculating the formula expression and for the result assignment. The Calculator cannot calculate formula expressions containing operands with incompatible types. The same applies if a formula result is assigned to a variable type that is not compatible with the result type.

The Calculator has the following functions for converting the operands into compatible types:

- **Trunc** converts numeric types into integer types.
- **Str** converts numeric values into text.
- **Val** converts text into a numeric value.

**Using Operations**

The Calculator enables you to connect numeric, Boolean, bit, and text operands. The Tables 8-2 to 8-6 list the available operations.

*Arg* means you can specify a *Numeric* or a *Time* channel and a number. Parameters in brackets [ ] are optional.
### Table 8-2. Numeric Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constants</strong></td>
<td>$$\pi, \ e$$</td>
</tr>
<tr>
<td><strong>Basic calculation types</strong></td>
<td>$$+, -, *, /$$</td>
</tr>
<tr>
<td><strong>Exponentiation</strong></td>
<td>$$^\wedge$$</td>
</tr>
<tr>
<td><strong>Root Square</strong></td>
<td>$$\text{Sqrt}(\text{Arg})$$, $$\text{Sqr}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Trigonometric functions</strong></td>
<td>$$\sin(\text{Arg}), \cos(\text{Arg}), \tan(\text{Arg})$$, $$\text{Arcsin}(\text{Arg}), \text{Arccos}(\text{Arg})$$, $$\text{Arctan}(\text{Arg})$$, $$\text{ATanK}(\text{Opposite leg}, \text{Adjacent leg})$$ or $$\text{Atk}(\text{Arg})$$, $$\sinh(\text{Arg}), \cosh(\text{Arg}), \tanh(\text{Arg})$$, $$\text{Arctanh}(\text{Arg})$$ or $$\text{Atanh}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Random values</strong></td>
<td>$$\text{Rnd}(\text{Arg})$$ [0 &lt;= $$\text{Rnd}(\text{Arg})$$ &lt;= $$\text{Arg}$$]</td>
</tr>
<tr>
<td><strong>Standard normal distribution</strong></td>
<td>$$\text{Snd}(X)$$</td>
</tr>
<tr>
<td><strong>Conversion radian, degrees</strong></td>
<td>$$\text{Rad}(\text{DegArg})$$, $$\text{Deg}(\text{RadArg})$$</td>
</tr>
<tr>
<td><strong>e(^x), natural logarithm</strong></td>
<td>$$\exp(\text{Arg})$$, $$\ln(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Power of ten</strong></td>
<td>$$\text{Eex}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Logarithm</strong></td>
<td>$$\lg(\text{Arg})$$ or $$\log(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Absolute value</strong></td>
<td>$$\text{Abs}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Signum function</strong></td>
<td>$$\text{Sign}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Factorial</strong></td>
<td>$$\text{Fac}(\text{IntegerArg})$$</td>
</tr>
<tr>
<td><strong>Truncating</strong></td>
<td>$$\text{Trunc}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Rounding off</strong></td>
<td>$$\text{Round}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Decimal places</strong></td>
<td>$$\text{Frac}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Remainder (Modulus)</strong></td>
<td>$$\text{Mod}(\text{Arg})$$</td>
</tr>
<tr>
<td><strong>Characteristic values of the channel</strong></td>
<td>$$\text{CCh}(\text{Channel}, \text{Type})$$</td>
</tr>
<tr>
<td><strong>Extreme values</strong></td>
<td>$$\text{MinV}(\text{Value1}, \text{Value2})$$, $$\text{MaxV}(\text{Value1}, \text{Value2})$$</td>
</tr>
</tbody>
</table>
### Table 8-2. Numeric Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text conversion</td>
<td><code>Str(Number [,Format])</code></td>
</tr>
<tr>
<td></td>
<td><code>Char(Number)</code></td>
</tr>
<tr>
<td></td>
<td><code>RTT(Number [,#Format])</code></td>
</tr>
<tr>
<td></td>
<td><code>RTP(RealTime, PartialFormat)</code></td>
</tr>
<tr>
<td>Search function</td>
<td><code>Find(Condition [,StartLine])</code></td>
</tr>
<tr>
<td></td>
<td><code>FindReverse(Condition [, StartLine])</code></td>
</tr>
<tr>
<td></td>
<td><code>PNo(Channel, Value)</code></td>
</tr>
</tbody>
</table>

### Table 8-3. Boolean Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison operations</td>
<td><code>&lt;, &lt;=, =, &gt;=, &gt;</code></td>
</tr>
<tr>
<td>Boolean operations</td>
<td><code>And, Or, Not</code></td>
</tr>
<tr>
<td>Variable file activated?</td>
<td><code>VSA(&quot;FileName&quot;)</code></td>
</tr>
<tr>
<td>User variable activated?</td>
<td><code>VIT(&quot;UserVariable&quot;)</code></td>
</tr>
</tbody>
</table>

### Table 8-4. Bit Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets a bit</td>
<td><code>SetB(Arg, BitNo)</code></td>
</tr>
<tr>
<td>Deletes a bit</td>
<td><code>ClrB(Arg, BitNo)</code></td>
</tr>
<tr>
<td>Reads a bit</td>
<td><code>GetB(Arg, BitNo)</code></td>
</tr>
<tr>
<td>Left shift</td>
<td><code>Shl (Arg, BitNum)</code></td>
</tr>
<tr>
<td>Right shift</td>
<td><code>Shr (Arg, BitNum)</code></td>
</tr>
<tr>
<td>Boolean operations</td>
<td><code>AndB(Arg1, Arg2)</code></td>
</tr>
<tr>
<td></td>
<td><code>OrB(Arg1, Arg2)</code></td>
</tr>
<tr>
<td></td>
<td><code>XorB(Arg1, Arg2)</code></td>
</tr>
<tr>
<td></td>
<td><code>NotB(Arg, ByteNum)</code></td>
</tr>
</tbody>
</table>
## Table 8-5. Text Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text addition</td>
<td>+</td>
</tr>
<tr>
<td>Conversion to numeric type</td>
<td>Val(Text)</td>
</tr>
<tr>
<td></td>
<td>Ord(ASCII characters)</td>
</tr>
<tr>
<td></td>
<td>TTR(Date/time text [,Format])</td>
</tr>
<tr>
<td>Channel search</td>
<td>CNo(ChannelName [, Start])</td>
</tr>
<tr>
<td>Upper case</td>
<td>UpC(Text)</td>
</tr>
<tr>
<td>Lower case</td>
<td>LoC(Text)</td>
</tr>
<tr>
<td>Index to text vector</td>
<td>Idx(Text, &quot;VarName&quot;)</td>
</tr>
<tr>
<td>Determines keyword</td>
<td>Enum(EnumerationlVariable, Index)</td>
</tr>
<tr>
<td></td>
<td>MaxOrd(EnumerationVariable)</td>
</tr>
<tr>
<td>Copy</td>
<td>Cop(Text, Number)</td>
</tr>
<tr>
<td>Delete</td>
<td>Del(Text, Number)</td>
</tr>
<tr>
<td>Character position</td>
<td>Pos (SearchString, Text)</td>
</tr>
<tr>
<td>Text length</td>
<td>Len(Text)</td>
</tr>
<tr>
<td>Formatting</td>
<td>Str(Text, Format)</td>
</tr>
<tr>
<td></td>
<td>PU(TextVariable, Format)</td>
</tr>
<tr>
<td>Deleting blanks</td>
<td>LTrim(Text)</td>
</tr>
<tr>
<td></td>
<td>RTrim(Text)</td>
</tr>
<tr>
<td></td>
<td>Trim(Text)</td>
</tr>
<tr>
<td>Working with channel number</td>
<td>ChnStrAdd(ChannelNoStr, ChannelNo)</td>
</tr>
<tr>
<td>character strings</td>
<td>ChnStrCnt(ChannelNo channelNoStr)</td>
</tr>
<tr>
<td></td>
<td>ChnStrRead(ChannelNoStr, Index)</td>
</tr>
<tr>
<td>Decoding a file name</td>
<td>NameSplit(Text, Type)</td>
</tr>
<tr>
<td>Writing a line to a file</td>
<td>TextFileWriteLn(FileHandle)</td>
</tr>
<tr>
<td>Reading a line from a file</td>
<td>FR(Filename, Linenumber)</td>
</tr>
<tr>
<td></td>
<td>TextFileReadLn(FileHandle)</td>
</tr>
</tbody>
</table>
Using Auxiliary Variables

DIAdem provides auxiliary variables that you can use for intermediate storage of formula results.

Table 8-7 lists names, dimensions, and the type of the auxiliary variables.

<table>
<thead>
<tr>
<th>Type</th>
<th>Variables name</th>
<th>Value range</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Integer</td>
<td>L1, L2,..., L30</td>
<td>Single value</td>
<td>L3 := 12345</td>
</tr>
<tr>
<td></td>
<td>LV1, LV2, LV3</td>
<td>Vector[1...15]</td>
<td>LV2(2) := -235</td>
</tr>
<tr>
<td>Real</td>
<td>R1, R2,..., R30</td>
<td>Single value</td>
<td>R2 := 0.12345</td>
</tr>
<tr>
<td></td>
<td>RV1, RV2, RV3</td>
<td>Vector[1...15]</td>
<td>RV3(1) := 12.35</td>
</tr>
<tr>
<td>Boolean</td>
<td>B1, B2,..., B10</td>
<td>Single value</td>
<td>B5 := Yes</td>
</tr>
</tbody>
</table>

Table 8-6. File and Folder Operations

<table>
<thead>
<tr>
<th>Function</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opens and closes a text file</td>
<td><code>TextFileOpen(Filename,Mode)</code> <code>TextFileClose(FileHandle)</code></td>
</tr>
<tr>
<td>Error when accessing text file</td>
<td><code>TextFileError(FileHandle)</code> <code>TextFileErrorTxt(FileHandle)</code></td>
</tr>
<tr>
<td>Checks end of text file</td>
<td><code>TextFileEOF(FileHandle)</code></td>
</tr>
<tr>
<td>Jumps to row in text file</td>
<td><code>TextFileSeek(FileHandle, LineNumber)</code></td>
</tr>
<tr>
<td>Checks file attribute</td>
<td><code>FileAttrCheck(FileName, Attribute)</code></td>
</tr>
<tr>
<td>Determines file size</td>
<td><code>DataFileSize(FileName)</code> <code>FileSize(FileName)</code></td>
</tr>
<tr>
<td>File exists?</td>
<td><code>FilEx(FileName)</code></td>
</tr>
<tr>
<td>Checks file access</td>
<td><code>FileDateGet(FileName, Time)</code></td>
</tr>
<tr>
<td>Checks folder attribute</td>
<td><code>FolderAttrCheck(Folder, Attribute)</code></td>
</tr>
<tr>
<td>Determines folder size</td>
<td><code>FolderSize(Folder)</code></td>
</tr>
<tr>
<td>Folder exists?</td>
<td><code>FolderExist(Folder)</code></td>
</tr>
<tr>
<td>Checks folder access</td>
<td><code>FolderDateGet(Folder, Time)</code></td>
</tr>
</tbody>
</table>
Note Each (auxiliary) variable has a defined, constant type and therefore only can accept values of this type.

To access single elements of a multi-dimensional variable, specify the indexes. You also can use Integer type variables as indexes.

Select Edit→Auxiliary variables, or open the expanded Calculator panel to view and to modify the auxiliary variables in DIAdem SCRIPT.
D. Additional Notes

The following sections include typical Calculator applications.

Working with Channel Names
You can access channels with channel numbers that have specific channels or with channel names.

Working with Channel Numbers
Example Ch(5) := Ch(1) + Ch(2)
In the above formula all channel positions are specified, which means that DIAdem stores the sum of the first and second channels in the list view of the Data Portal in the fifth channel. The channel names are irrelevant.

If the result channel 5 does not exist when DIAdem evaluates the formula, the Calculator creates the channel and generates a channel name.

Working with Channel Names
Example Ch('Power') := 'Revs' * 'Torque'
In the above formula the channels to be used are specified by name. Therefore, their channel number is irrelevant.

If a channel named Power already exists when the channel is calculated, the Calculator overwrites the channel contents with the calculation results.

If no channel with the specified name exists in the Data Portal, the Calculator automatically generates a channel called Power and fills it with the results of the multiplication of the Revs channel by the Torque channel.

Defining Conditions
You formulate conditions with Boolean operators. Conditions only can have the values true (result: Yes, 1) or false (result: No, 0). You can link conditions with each other and with numeric operations. For example, combining different operations is useful when you analyze channels.
In formula expressions you can use the comparison operators listed in Table 8-8 and the operations listed in Table 8-9.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
</tr>
<tr>
<td>=</td>
<td>Equal to</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Not equal to</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
</tbody>
</table>

Table 8-9. Logical Operators

<table>
<thead>
<tr>
<th>Concatenation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>and</td>
<td>The expression is fulfilled (true) if both operands have the value true</td>
</tr>
<tr>
<td>or</td>
<td>The expression is not fulfilled (false) if both operands have the value false</td>
</tr>
<tr>
<td>not</td>
<td>The value of the operands is inverted</td>
</tr>
</tbody>
</table>

In the following formula the Calculator compares the data in the Angle2 channel with the data in the Sine channel linewise and stores the results in the Result channel. If the current value from Angle2 is greater than the value in the same line of the Sine channel, the value is 1 at the same place in the Result channel, because the condition is true. Otherwise, the result channel has the value 0 at the same place.

Examples  
Ch('Result') := ('Angle2' > 'Sine')
Calculating with Invalid Values

In DIAdem, invalid values are called *NoValues*. DIAdem does not display NoValues in a report and does not use NoValues for calculations.

The following rules apply when NoValues are used in calculations:

- If one of the terms in a calculation is a NoValue the result is also a NoValue:
  
  \[ 10 \times \text{NoValue} = \text{NoValue} \]
  
  \[ 10 + \text{NoValue} = \text{NoValue} \]

- This does not apply for multiplication by and division of 0. If one of the factors is 0 the result is also 0:
  
  \[ 0 \times \text{NoValue} = 0 \]
  
  \[ 0 / \text{NoValue} = 0 \]

The aim of the following calculation is to exclude channel values outside the limit values 5 and -1 from subsequent calculations.

**Example**

\[ \text{Ch(6)} := \text{Ch(5)} + ((\text{Ch(5)}>5 \text{ or Ch(5)}<-1)) \times \text{NoValue} \]

If the value from channel 5 is between -1 and 5, the condition \((\text{Ch(5)}>5 \text{ or Ch(5)}<-1))\) is not true, and the result of the multiplication is 0. The summation result is the value of channel 5 at this position, which means it is identical to the inspected datum.

If the value from channel 5 is outside the limit values, the condition is true and the result of the condition check is 1, the result of the multiplication is \(\text{NoValue}\), and the result of the summation is therefore also \(\text{NoValue}\).

The above formula only transfers the values in channel 5 that are inside the limits, to the result channel 6. The other channel values are \(\text{NoValues}\). DIAdem ignores these NoValues in subsequent calculations and functions with this result channel. DIAdem does not display NoValues in reports either.

Using Variable Indexes

To access single elements of multidimensional variables such as vectors and matrices, or to access channels, you must specify the element with an index. For example, specify \(\text{RV1(3)}\) to access the third element of the real vector variable \(\text{RV1}\).

You do not have to enter specific indexes, you can use variables and functions instead. Indexes must be integer numbers.

In the following example, the \(\text{trunc}\) function converts the contents of the real variable \(\text{R2}\) into an integer value, which you can then use as an index. You cannot use \(\text{R2}\) as an index without converting it.

**Example**

\[ \text{R2} := 3.456 \]

\[ \text{LV1(trunc(R2))} := 7 \]
Notes on Some of the Functions

Several key functions are listed below.

Calculating Characteristic Values

Use the descriptive statistics to determine characteristic statistical values such as sums, extreme values, mean values, quantiles, dispersion, and moments. The `CCH` function determines a specific characteristic value of a channel, such as the mean, the minimum value, the maximum value, the range, or the sum.

Syntax

```
CCH(Channel, Type)
```

Find Function

Use the `find` function to check a data channel for the first occurrence of a condition. The channel condition is a Boolean condition applied to channels. A starting line, where DIAdem starts to check for the condition, is optional. The result of this function is the number of the line in which the condition is true for the first time. If the condition is not true for any of the data channel values, the result is 0.

Syntax

```
find(Condition [,Startrow])
```

PNo Function

The `PNo` function searches for the line in a data channel that has the value that is closest to the value searched for. Unlike the `find` function, this function does not need a tolerance setting.

Syntax

```
PNo(Channel, Value)
```

Time Conversion

The `rtt` (real to time) function converts a numeric value into a time format. The format instruction defines the conversion. The numeric value is the number of seconds that have elapsed since 01/01/0000.

Syntax

```
rtt(Number [,Format])
```

Use the `ttr` function (time to real) to convert a text in time format into a real value. DIAdem uses its internal time format. The result is the number of seconds that elapsed from 01/01/0000 until the specific date.

Syntax

```
ttr(Time text [,Format])
```
Exercise 8-1

Objective: Working with the Calculator

To save memory space when you record measurement values, the measurement acquires the characteristic vehicle data at different sampling rates. To combine and calculate the data, you must convert the data to a common time basis.

In the following three exercises you use the functions for DAT files to load the first three channels of the Car.dat file. You then use the function for reducing loading of DAT files to load the last two channels of the Car.dat file. You then calculate the power in kw and use the find function to determine the time when the speed exceeds the limit value 100. You display the results in the Car.tdr report.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.


   Navigate to the Car.dat data file in the C:\Exercises\DIAdem Basics\ folder and select the file.

   Select the channels Time, Speed, and Revs:

   ![Paste From File Dialog]

   Click Execute.

4. Select File»DAT files»Paste from file again.

   Navigate to the Car.dat data file in the C:\Exercises\DIAdem Basics\ folder and select the file.

   Select the Torque channel and select Reduce lines:
5. Click **Line reduction** and set the dialog parameters:
Reduce the data in such a way that DIAdem only loads 1200 values from the first to the last channel value.
- **First value**: 1
- **Last value**: 6000
- **Number of intervals**: 1200

Select Time2 as the x-channel.

6. Click **Execute** to load the data.

7. In the Data Portal properties, compare whether the channels Time and Time2 have the same minimum and maximum values and are both 1200 values long. If the contents are identical, you can calculate the data channels.

8. Select **DIAdem ANALYSIS**.

9. Click the **Calculator** in the toolbar.

Enter the following formulas into the entry field and click **Calculate** for each one, to determine the power of the channels in kW:

```
Ch('Power') := 'Revs'*2*Pi/60 * 'Torque'/1000
Cd('Power') := 'kW'
```
10. Determine the period for accelerating from 0 to 100 km/h with the formula:
   \[ L1 := \text{find('Speed'>=100)} \]
   The `find` function checks for the first instance of the specified condition in the `Speed` data channel. The result is the number of the line with the first value greater than 100. If none of the values is greater than 100, the condition is not true and the result is `false`.

11. Determine the time with the formula
   \[ R1 := \text{ChD}(L1,'Time') \]
   The matrix variable `ChD` accesses the line `L1` in the `Time` channel.

   **Note** You can combine the two calculations in one formula:
   \[ R1 := \text{ChD(find('Speed'>=100),'}Time') \]

12. **Close** the Calculator.

13. Select **DIAdem REPORT**.

14. Click **Load layout**.
    Navigate to the `Car.tdr` layout in the C:\Exercises\DIAdem Basics\ folder and open the prepared layout.

15. Double-click the top axis system to open the dialog box for the curve definition.
    The `Time, Speed` curve is already defined in the dialog box.
16. Click **New entry** and select the **Constant display mode**.
   Enter the calculated time value $R1$ as the **x-constant** and the speed value 100 as the **y-constant**.

   17. Open the **Decorations** function bar and select **Texts**.

   18. Click the text cursor in the worksheet and enter the text:
      
      From 0 to 100 in $\text{@str(R1, 'd.d')}@$ s

   Click **OK** in both dialog boxes.
The report looks like this:

**End of Exercise 8-1**

The Car_1.tdr layout and the Car_1.dat data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 8-2

Objective: Isolating Events

In the following exercise you use Boolean functions and NoValues in the formula calculation to isolate velocity values that exceed 100 km/h in a test drive measurement.

1. Select DIAdem SCRIPT.

2. Click Execute script file in the toolbar.

   Navigate to the Car_fp.vbs script in the C:\Exercises\DIAdem Basics\ folder and start the prepared script.

3. A report appears.

   Press the space bar to continue the script. The Calculator appears.

4. Enter the following formula to determine where the values of the Speed channel are greater than 100:

   Ch('Result') := 'Speed' >= 100

   Click Calculate. This is a logical operation, so the result channel Result only receives the values 0 (condition not true) and 1 (condition true).

   Close the Calculator.

5. Press the space bar again, click Yes in the dialog box that opens, and enter the following formula:

   Ch('Result') := ('Speed' >= 100) * 'Speed'

   Click Calculate. The formula replaces each 1 in the Result channel with the corresponding value in the original Speed channel.

   Close the Calculator.

6. Press the space bar again, click Yes in the dialog box that opens, and enter the following formula:

   Ch('Result') :=
   ('Speed' >= 100) * 'Speed' + ('Speed' <100) * NV

   Click Calculate. The formula hides all the values of the original Speed channel that are less than 100. You use the characteristics of NoValue calculation.

   If one of the terms in the formula is NoValue, the result of the mathematical operation is automatically NoValue. This does not apply for multiplication by 0.
If the **Speed** channel values are greater than 100, the result channel accepts the values (see Figure 8-2), otherwise the values are **NoValues** (see Figure 8-3).

![Formula Diagram](image)

**Figure 8-2.** Result of the Check for Values Greater than 100

![Formula Diagram](image)

**Figure 8-3.** Result of the Check for Values Less than 100

**Note** You can combine the last two formulas into the following formula:

\[
\text{Ch('Result')} := \text{'Speed'} + (\text{'Speed'} < 100) \times \text{NoValue}
\]

That means you can eliminate data in a channel with the following type of formula:

\[
\text{Channel} := \text{Channel} + \text{Counter condition} \times \text{NoValue}
\]

7. **Close** the Calculator.

8. Press the space bar and click **No** in the dialog box to end the script.
When the script ends, the report looks like this:

![Graphs showing data over time](image)

**End of Exercise 8-2**

The `Car_fp.tdr` layout, which contains the solution for this exercise, is in the `C:\Solutions\DIAadem Basics\` folder.
Summary, Tips, and Tricks

- The Calculator can perform numeric, Boolean and text operations. Use the Calculator to calculate channel formulas. The Calculator can also calculate and display single values and assign single values to variables:
  - Request
    - Variable name? or
    - Formula expression?
  - Variable assignment
    - Variable := Formula expression
    - Variable := Value
  - Channel calculation
    - Channel := Formula expression

- Use the find function to check the data area for a freely definable condition.

- NoValues
  - are values that are defined invalid.
  - are represented by the highest value that can be displayed.
  - can be defined as any value.
  - are not usually displayed in reports or included in calculations.

- The result of a calculation with NoValue is NoValue.
  The exceptions are:
  - 0 * NoValue = 0
  - 0 / NoValue = 0
Lesson 9
Additional Exercises

Introduction

In the following exercises you will reinforce the skills you have learnt.

In the first example you can check what you have learnt. In the second example you use a special function for creating a report and for mathematical analysis.
A. Example I

The first example consists of three exercises. The exercises revise the skills you have learnt for working with DIAdem REPORT.

You will carry out the following actions:

- Load a data set
- Display data in a report
- Integrate a diagram of the measurement object in the report and create a test description
- Analyze the data with an approximation
- Display the mathematical results in the report
Exercise 9-1

Objective: Creating a Report

In the following exercise you load the data file Fridge.tdm and create a report layout with three axis systems with grid lines, to display three measurement signals separately. You create another axis system with a legend, to display all three measurement signals together.

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal without saving the data.
3. Navigate to the Fridge.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
4. Select DIAdem REPORT.
5. Delete the current layout without saving the layout.
6. Open the 2D axis system function bar and select a Simple 2D axis system.
7. Drag open the axis system at the top left of the worksheet.
8. Double-click the axis system to open the dialog box for curve and axis definition.
9. Click Axis definition. Enable Frame and define horizontal and vertical grid lines, as shown in the following figure:
10. Select **Show minitick grid** and click **Miniticks** to set up the minitick grid for the x-axis and the y-axis as shown for the x-axis in the following figure:

![Miniticks dialog box](image)

Click **OK** to close all the dialog boxes.

11. Select **Copy** and then select **Paste** three times in the shortcut menu of the axis system and insert three of the same axis systems in your report.

12. Position three axis systems underneath each other in the worksheet. Use the alignment functions in the toolbar to adjust the size and the intervals.

Position the fourth axis system to the right of the three other axis systems, as shown in the report at the end of this exercise.

![Axis system dialog box](image)

**Note** Select **Edit»Undo** or press <Ctrl-Z> to undo the actions carried out last.

13. Select the data channels **Time** and **Freezer** and drag and drop these data channels into the upper left axis system.
14. Select the data channels Time and Center and drag and drop these data channels into the middle axis system on the left.

15. Select the data channels Time and VegCompartment and drag and drop these data channels into the bottom left axis system.

16. Double-click the top axis system to open the dialog box for the axis definition and click Curve param to set the curve parameters as shown in the following figure:

Click OK to close all the dialog boxes.

17. Repeat the last step for the middle and the bottom axis systems.

18. Select all the data channels in the Data Portal and drag and drop the data channels into the fourth, large axis system.

19. Double-click the fourth axis system to open the dialog box for curve and axis definition.
20. Select the **Legend** checkbox.

21. Click **Legend** and select **white** as the **background color**:

Click **OK** to close all the dialog boxes.

22. Click the legend and position the legend at the bottom of the axis system.
23. Double-click the y-axis text to open the dialog box for axis labeling and change the text as shown in the following figure:

Click OK.

The report looks like this:

End of Exercise 9-1
The Fridge_1.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-2  

Objective: Creating a Text Field

In the following exercise you create a text field where you enter the company logo and text that describes the test.

1. Select DIAdem REPORT.
2. Open the Decorations function bar and select Rectangles.
3. Click the frame cursor in the top right of the report and drag open a rectangle for a text field.
4. Double-click the rectangle to open the rectangle dialog box and check the settings shown in the following figure:

5. Click Position to specify the size and position of the rectangle with the following coordinates:

   ![Rectangle dialog box]

Click OK to close all the dialog boxes.
6. Repeat steps 2 to 5 to break down the text field into smaller partitions.
7. Open the Decorations function bar and select Texts to enter a free text.
8. Click the text cursor in the text field and enter the following text: Press <Enter> after each of the first two lines:

   Evaluation:
   @CurrDate@
   @CurrTime@

   Each of the two variable names for the current date and the current time must have a leading and a trailing @ character.
9. Click the text cursor in the worksheet to end text entry.
10. Open the **Decorations** function bar and select **Texts** to enter another text.

11. Click the text cursor in the text field and enter the following text: Press <Enter> after the first line:

   **Tester:**
   I.Icecube

12. Click the text cursor in the worksheet to end text entry.

13. Select both texts with click-<Ctrl>.

14. Select **Properties** in the shortcut menu of the selected texts.

15. Select **Blue** as the **Font color** and click **OK**.

16. Position the texts one above the other as shown in the report at the end of this exercise.

17. Open the **Graphics file** function bar and select **Load graphics**.

18. Select the National Instruments logo.

19. Position the logo at the top of the text field.

20. Click **Redraw** in the toolbar.

The report looks like this:

---

**End of Exercise 9-2**

The **Fridge_2.tdr** layout, which contains the solution for this exercise, is in the **C:\Solutions\DIAdem Basics\** folder.
Exercise 9-3

Objective: Mathematical Analysis - Approximation

You can use the approximation function to describe the measurement data. Use an approximation model function to present the measurement data as exactly as possible.

In the following exercise you calculate the approximation for the signals from the last exercise and display the results in the report.

1. Select DIAdem ANALYSIS.

2. Open the Curve fitting functions function bar and select Approximation.

Set the dialog box parameters as shown in the following figure:

3. Click Set up to select the terms of the following set up function:

   \[ a_1 + a_2 \times x + a_3 \times x^2 + a_4 \times x^3 \]

Click OK.
4. Click **Execute** to run the approximation.

5. Repeat the approximation for the channels **Center** and **VegCompartment**. **Time** is the x-channel for both of the y-channels.

6. Select **DIAdem REPORT**.

7. Select the respective x and y-result channels in the Data Portal for the three approximations and drag and drop these channel pairs to the associated axis system on the left of the worksheet.

8. Click **Save layout as**.

   Navigate to the C:\Exercises\DIAdem Basics\ folder and save the report file as **MyFridge.tdr**.

   The report looks like this:

![Graphs showing temperature changes over time for different compartments](attachment:image.png)

**End of Exercise 9-3**

The **Fridge_3.tdr** layout and the **Fridge_1.tdm** data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Additional Exercise

If you have time, complete the following exercise.

1. Enter a text that displays the last approximation function and the associated coefficients. The coefficients are in the vector variable `ApprAnsatzCoef`.

2. Use the `str` function to limit the number of places after the decimal point for the approximation coefficients:

   `@str(ApprAnsatzCoef(x),’d.dd’)@`
B. Example II

The second example consists of eight exercises. The exercises demonstrate further display features in DIAdem REPORT and functions for working with NoValues.

You will carry out the following actions:

- Load a data set
- Display data as differential bars
- Replace NoValues with interpolated values
- Calculate a mean value
- Add data to the data in the Data Portal
- Create multi-scaled axis systems
- Label the data with symbols and text
Exercise 9-4

**Objective:** Changing the Curve Display

In a measurement, weather data is recorded and saved in a file. In the following exercise you load the data file `Weather_1.tdm` and display the temperature differences as differential bars in a new layout.

1. Select **DIAdem NAVIGATOR**.

2. **Delete** the data in the Data Portal without saving the data.

3. Navigate to the `Weather_1.tdm` data file in the `C:\Exercises\DIAdem Basics\` folder and drag and drop the file into the Data Portal.

4. Select **DIAdem REPORT**.

5. Delete the current layout without saving the layout.

6. Select **Settings»Layout parameters** and set number-oriented channel reference as shown in the following figure:

![Layout parameters settings](image)

Click **OK**.
7. Open the **2D axis system** function bar and select a **Simple 2D-axis system**.

8. Drag open the axis system to cover the entire worksheet.

9. Select the channels **Date**, **T_Min**, and **T_Max** in the Data Portal and drag and drop the channels into the axis system.

10. Double-click the axis system to open the dialog box for curve and axis definition and delete the last curve definition.

11. Change the **display mode** to **Differential** and select **T_max** as the **y1-channel**.

![Axis definition dialog box]

12. Click **Axis definition** and set the global 2D axis system parameters as shown in the following figure.

    Set a frame and horizontal and vertical grid lines for the axis system.
13. Click **Scaling** and change the **Tick style** as shown in the following figure:

   - **Bottom** for the **x-axis**
   - **Left** for the **y-axis**

14. Click **Numbers** to specify the time format `#DD/ T y y` for the **x-axis**. This time format suppresses leading zeros for the day and displays the month and the year in a second line.
Click OK.

15. Click **Labeling** and delete the x-axis label text.

Click **Y-axis** and change the y-axis labels as shown in the following figure:

Click **OK** to close all the dialog boxes.

16. Click **Save layout as**.

Navigate to the C:\Exercises\DIAdem Basics\ folder and save the layout as MyWeather.tdr.
The report looks like this:

![Graph showing temperature over time.

End of Exercise 9-4
The Weather_1.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-5

Objective: Processing NoValues

The weather data sensor occasionally stopped logging. These lapses were recorded as NoValues. You interpolate between the existing data points to recreate the approximate data points.

In the following exercise you use the standard function NoValues and display the result in the report.

1. Select DIAdem ANALYSIS.

2. Open the Basic mathematics functions function bar and select NoValues.

   Set the dialog box parameters as shown in the following figure:

   ![NoValues dialog box](image)

   Click the three points next to y-channels to select the y-channels as shown in the following figure:

   ![Selection of y-channels](image)

   Click OK.

3. Click Execute to run the interpolation.

4. Change the names of the generated channels in the Data Portal to T_min_lin and T_max_lin.
The Data Portal looks like this:

5. Select DIAdem VIEW.

6. Click New layout in the toolbar without saving the current view.

7. Open the Predefined screen partitioning function bar and select One channel table with all channels.

The channel table lists the data of all the data channels in the Data Portal.

End of Exercise 9-5

The Weather_2.tdm data file, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-6

Objective: Calculating Channels

In the following exercise you use the Calculator to calculate the average temperature and display the result with the minimum and maximum temperatures in the report from the last exercise.

1. Select DIAdem VIEW.

2. Click the Calculator in the toolbar.

3. Enter the following formula:
   \[ Ch('AverageTemp') := ('T_{min\_lin}' + 'T_{max\_lin}')/2 \]

Click Calculate and Close the Calculator.

4. Select DIAdem REPORT.

5. Select the channels Date and AverageTemp in the Data Portal and drag and drop the channels into the axis system.

6. Double-click the axis system to open the dialog box for curve and axis definition and select Blue as the Line color for the second curve.
7. Click **Curve param** and select 0.7 as the **Line width**: 

Click **OK** to close both the dialog boxes.
The report looks like this:

End of Exercise 9-6
The Weather_2.tdr layout and the Weather_3.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-7

Objective: Adding New Data to the Existing Data

You load data from a second weather station and show the data in the same report. In the following exercise you use the Selective loading function to add channels from the Weather_4.tdm data file.

1. Select DIAdem NAVIGATOR.
2. Navigate to the Weather_4.tdm data file in the C:\Exercises\DIAdem Basics\ folder and double-click the file.

   The following dialog box appears:

3. Click the + sign to open the data file, and select the channels Rain, T_6h, and Index.
Click **Load**.

4. Click **Save TDM file as**.

   Open the C:\Exercises\DIAdem Basics\ folder and save the data in the Data Portal as **Weather_all.tdm**.

   The Data Portal looks like this:

   ![Data Portal Image]

**End of Exercise 9-7**

The **Weather_5.tdm** data file, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-8

Objective: Multiple Axis Scaling

To show the correlation between several values with different physical units and value ranges, you can display the values in one axis system with several different y-axes.

In the following exercise you display the average temperature and the precipitation in one axis system with several y-axes.

1. Select DIAdem REPORT.
2. Reduce the existing axis system to make room for another axis system below it.
3. Open the 2D axis system function bar and select a Simple 2D axis system.
4. Drag open the axis system in the lower part of the worksheet.
5. Select the channels Date, AverageTemp, and Rain in the Data Portal and drag and drop the channels into the axis system.
6. Double-click the new axis system to open the dialog box for axis definition and click Subaxes.
7. Click New axis to add another y-axis to the axis system:

   Select Axis end as the y-axis Reference and 0 for the Offset as %.
   Click OK.
8. Assign the subaxis systems to the curves as shown in the following figure and select the display mode Bars for the channel pair Date, Rain.
9. Click **Axis definition** to define a frame and horizontal and vertical grid lines for this axis system as shown in the following figure:
10. Click **Scaling** and change the **Tick style** as shown in the following figure:
   - **Bottom** for the **x-axis**
   - **Left** for the **x1/y1-axis**
   - **Right** for the **x1/y2-axis**

   ![Scaling Dialog Box]

   Click **OK**.

11. Click **Numbers** to specify the time format for the **x-axis**.

   Suppress leading zeros in days and months. Display the month and the year in the second line.

   ![Numbers Dialog Box]

   Click **OK** to close all the dialog boxes.
12. Double-click the left y-axis label to open the dialog box for axis labeling and change the text as shown in the following figure:

13. Select the $X_{-1}/Y_{-2}$ subaxis and alter the Y-axis text and the Distance from y-axis as shown in the following figure:

Click OK.
14. Double-click the numbers on the right y-axis to open the dialog box for numeric display and select **Right** as the **Position** as shown in the following figure:

Click **OK**.

The report looks like this:

---

**End of Exercise 9-8**

The `Weather_3.tdr` layout, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
Exercise 9-9

Objective: Highlighting Values

In the following exercise you label the temperatures measured at 6 o'clock with symbols.

1. Select DIAdem ANALYSIS.

2. Open the Basic mathematic functions function bar and select NoValues.

3. Set the dialog box parameters as shown in the following figure:

![NoValues dialog box]

Click Execute.

4. Select DIAdem REPORT.

5. Select the channels Date1 and T_6h1 in the Data Portal and drag and drop the channels into the top axis system.

6. Double-click the top axis system to open the dialog box for axis definition and select the Line and symbol display mode for the new curve Date1, T_6h1.
7. Click **Curve param** and select the **blank** **Line style**. Enter the following string as the **Symbol Style**:

\[ Y() \ °C \ %/(Y125) \]
DIAadem writes the respective y-value and the text °C at the measurement point. The marker %(Y125) moves the symbol label in the y-direction, which means that the entry appears 125% above the x-axis.

8. Click **Symbol** to enter the parameters as shown in the following figure:

![Parameters for 3D symbols](image)

Click **OK** in both dialog boxes.

9. Select **DIAadem NAVIGATOR**.

10. In the Data Portal, open the shortcut menu for the channel group **Weather_1** and select **New CHANNEL**.

11. Enter **Weather** as the **Name** and select **Text** as the **Display format**. Set the **Maximum channel length** to 14.

![Create new channel in the channel group](image)

Click **OK**.

12. Select **DIAadem VIEW**.

13. Open the **Predefined screen partitioning** function bar and select **One channel table with all channels**.

The channel table lists the data of all the data channels in the Data Portal.
14. Enter the following text lines in the Weather channel:
   dry
   drizzle
   light rain
   rain
   cloudless
   slightly overcast
   lightly overcast
   cloudy
   overcast
   heavy cloud
   very cloudy
   snowfall
   fog
   sunny

15. Select DIAdem REPORT.

16. Double-click the top axis system to open the dialog box for curve and axis definition.

17. Click **Copy** to define a second entry with the channels Date1 and T_6h1:
18. Click **Curve param**.

   Enter the following string as the **Symbol Style**:

   \[ K(/\text{kWeather} /\text{iIndex1}) \%(/Y130) \]

   The \( K \) identifier refers to a text channel that DIAdem reads for curve labels. Enter the name of the text channel after the \( /k \) parameter and enter the name of the index channel after the \( /i \) parameter. The index channel specifies which text line DIAdem writes at which curve point.

   The identifier \( \%(/Y130) \) moves the symbol label in the y-direction, which means that the entry appears 130% above the x-axis.

19. Click **Symbol** to enter the following parameters:

   - **Angle** 90
   - **Position** Right
   - **Font** Arial
   - **Font size** 2.5

   Click **OK** to close all the dialog boxes.
The report looks like this:

End of Exercise 9-9

The Weather_4.tdr layout and the Weather_6.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-10

Objective: Integrating Text

In the following exercise you create a text field and a text object to describe the measurement.

1. Select DIAdem REPORT.

2. Open the Decorations function bar and select Rectangles.

3. Use the frame cursor to click the bottom of the report and drag open a frame for a text field at the bottom edge.

4. Double-click the rectangle to open the rectangle dialog box and check the parameters as shown in the following figure:

5. Click Position to specify the size and position of the rectangle with the following coordinates:

Click OK to close all the dialog boxes.

6. Open the Decorations function bar and select Text object.

7. Position the text object to the left in the text field and double-click the white rectangle to open the text object.
8. Enter the text as shown in the following figure:

![Text Object Editor]

9. Select **Background»Frame**.
   
   Click **OK** to close the text object.

10. Open the **Decorations** function bar again and select **Text object**.

11. Position the text object on the right in the text field and double-click the white rectangle to open the second text object.

12. Select **Tables»Insert new table** and set the dialog box parameters as shown in the following figure:

   ![Insert New Table]

   Click **OK**.

13. Mark all six table cells and select **Tables»Configure cells**.

14. Click the **Frame** field to enable internal lines, as shown in the following figure:

   ![Table Properties]

   Click **OK**.

15. Click the table cells to enter the text as shown in the following figure:
Select DIAdem expression » New to enter the DataSetName variable for the filename and the CurrDate variable for the current date. If you click Display DIAdem expression, you see that DIAdem automatically encloses the variables in @ characters.

Click OK to close the text object.

16. Place the second text object on the right of the text field.

The report looks like this:

---

End of Exercise 9-10

The Weather_5.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 9-11

Objective: Integrating Graphics

In the following exercise you integrate a picture that illustrates the measurement results.

1. Select DIAdem REPORT.

2. Open the Graphics file function bar and select Load graphics.
   Navigate to the Weather.wmf background graphic in the C:\Exercises\DIAdem Basics\ folder and load the graphic.

3. Position the graphic in the worksheet and adjust the size.

4. Double-click the graphic to open the dialog box for the graphics file and change the parameters as shown in the following figure:

   ![Graphics File Dialog Box]

   Click OK.

5. Click Redraw in the toolbar.

6. Click Save layout as.
   Navigate to the C:\Exercises\DIAdem Basics\ folder and save the report file as MyWeather.tdr.
The report looks like this:

End of Exercise 9-11

The Weather_6.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
C. Example III

The third example consists of two exercises. Both exercises demonstrate the advantages of storing data separately from layouts.

You will carry out the following actions:

- Analyzing a data set with several layouts
- Display several data sets with the same layout
Exercise 9-12

Objective: Using Several Layouts to Analyze a Data Set

In the following exercise you display measurements in different layouts. The first layout shows all the measurement data and the second layout displays an extract of the measured data.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate to the MixAndMatch1.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select DIAdem REPORT.

5. Click Load layout.

Navigate to the prepared layout MixAndMatch1.tdr in the C:\Exercises\DIAdem Basics\ folder and load the layout.

The report displays all the recorded data channels as shown in the following figure:
6. Click **Load layout**.

Navigate to the prepared layout `MixAndMatch2.tdr` in the `C:\Exercises\DIAdem Basics\` folder and load the layout.

The report displays the four measured pressure values in two separate axis systems. The selected x-extracts display the details more clearly.

7. Click **Load layout**.

Navigate to the prepared layout `MixAndMatch3.tdr` in the `C:\Exercises\DIAdem Basics\` folder and load the layout.
This report also displays the four strain gauge values in two separate axis systems. The selected x-extracts display the details more clearly.

End of Exercise 9-12
Exercise 9-13

Objective: Comparing Several Data Sets in One Layout

In the following exercise you compare the results of a series of measurements in one layout. This produces uniform reports that you can compare.

1. Take a look at the results of the strain gauge measurement from the last exercise. The characteristics in the bottom axis system change for each data set.

2. Select DIAdem NAVIGATOR.

3. Delete the data in the Data Portal without saving the data.

4. Navigate to the MixAndMatch2.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

5. Select DIAdem REPORT.

6. Click Redraw in the toolbar to load the data in the report.

The report looks like this:

![Report Example](image-url)
7. Select DIAdem NAVIGATOR.

8. Delete the data in the Data Portal without saving the data.

9. Navigate to the MixAndMatch3.tdm data file in the
   C:\Exercises\DIAdem Basics\ folder and drag and drop the file
   into the Data Portal.

10. Select DIAdem REPORT.

11. Click Redraw in the toolbar to load the data in the report.

   The report looks like this:

   ![Report Screenshot]

   In the previous layouts, the data channels in the Data Portal have a
   channel number reference. This setting was appropriate because the data
   channels were always at the same position in the Data Portal. If you do
   not know what structure your data set has, but you know that your
   channels always have the same channel names, use the channel name to
   reference the data channels. That is the default setting in DIAdem
   REPORT.
12. Select DIAdem NAVIGATOR.

13. **Delete** the data in the Data Portal without saving the data.

14. Navigate to the `MixAndMatch4.tdm` data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

15. Select DIAdem REPORT.

16. Click **Redraw** in the toolbar to load the data in the report.

   The report looks like this:

   ![Report Image]

   This report is different to the previous reports. The channels in the data set are in a different order. In the Data Portal, the first strain gauge channel, **StrainGauge1**, is now at position 7 instead of position 6.
To display the correct data in your report, you can either change the channel numbers in each axis system, or use the channel name to reference the data channels in the layout.

17. Select **Settings»Layout parameters** and select **Name-oriented Channel reference**.
18. Double-click the top axis system to open the dialog box for curve and axis definition.

Select **Strain Gauge 2** as the new y-channel for the **Time, Event Count A** curve.
Click **OK**.

19. Double-click the bottom axis system to open the dialog box for curve and axis definition.

   Select **Strain Gauge 3** as the new y-channel for the curve **Time, Strain Gauge 2**.

   Select **Strain Gauge 4** as the new y-channel for the **Time, Event CountB** curve.
Lesson 9  Additional Exercises

Click OK.

20. Click **Save layout as**.

Open the C:\Exercises\DIAdem Basics\ folder and save the layout as MixAndMatch.tdr.

21. Now test the layout with the data sets MixAndMatch1.tdm, MixAndMatch2.tdm, and MixAndMatch3.tdm. Click **Redraw** in the DIAdem REPORT toolbar to display the loaded data.

**End of Exercise 9-13**

The MixAndMatch4.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Lesson 10
Loading External Data

Introduction

In this lesson you will learn how to load external data formats in DIAdem.

You Will Learn About:

A. DIAdem Data Organization
B. Loading External Data
A. DIAdem Data Organization

TDM is the standard DIAdem 9 data format for reading external data and for saving data. The TDM data format structures the external data as a root, channel groups, and channels, and organizes the data accordingly in the Data Portal.

Figure 10-1 shows the structure of the TDM data format:

```
Root
    Channelgroup_1
        Channel_1
        ....
        Channel_N
    Channelgroup_1
        ..../Channel_1
        ....
        ..../Channel_N
        ....
    Channelgroup_N
        Channel_1
        ....
```

Figure 10-1. TDM Data Format Structure

The root describes the data set.

The channel groups organize the channels and describe the group properties. You can assign any number of channels to a channel group. The number of channel groups you use is limited only by the amount of memory on your computer.

The channels contain the actual data and describe the channel data. The channel properties include the channel name, channel unit, channel length, and channel origin, and certain characteristic values such as the minimum value and monotony.

You can add any number of custom properties to the root, the channel group, and the channel. DIAdem saves the custom properties with the data set.

In the TDM format, DIAdem 9 saves the descriptions and the numeric data in different files that have the same filenames. DIAdem saves the description in a text file with the filename extension .tdm, and the numeric data in a binary file with the filename extension .tdx.
B. Loading External Data

DIAdem supports many file formats. You select the file type in the file selection dialog box shown in Figure 10-2. DIAdem uses the loading method that corresponds to the file type. According to the file type, a wizard appears where you set the format parameters that enable DIAdem to load the data in TDM format into the Data Portal.

![Figure 10-2. List of Formats in Dialog Box for Data Loading](image)

DIAdem 9 supports the data formats mentioned in the section on Supported Data Storage in Lesson 3, Managing Data and the following formats:

- dBase
- DIF (Data Interchange Format)
- Wave
- ERG (data acquisition from BMW)
- HIS (data logger PR3000 from Philips)
- LAX (data acquisition devices from Medas)
- TEAC

To add file types to the list, you can create a DataPlugin or a GPI file filter for your special data format. A DataPlugin is based on a VBScript that reads data from files and loads the data into the Data Portal. At the DIAdem DataPlugin Web site you can download many prepared DataPlugins or
provide your DataPlugin for other users. To register your data format in DIAdem, select New DataPlugin in the shortcut menu of the data storage manager.

You also can register the GPI file filters from previous DIAdem versions to use the file filters. Refer to the ..\DIAdem\AddInfo folder and the National Instruments Web site for GPI file filters. To register GPI file filters you select Settings»Desktop parameters»GPI-DLL registration.

Loading Data with the ASCII and Excel Wizards

When you load ASCII data and Excel data, the wizards analyze the data you want to import. Enter the import parameters in the wizard dialog boxes. The file data can be structured in any way.

The wizards have a preview so you can see how your settings will affect the import. You can undo the settings.

Both the ASCII Wizard and the Excel Wizard can read text and numeric data. DIAdem can store the text in a dynamic GPI variable or save the text to a file and create an associated index channel. You assign descriptive text such as channel names and units to the data set properties or channel properties.

You can save your settings in a configuration file (*.stp). To import another ASCII file with the same structure, specify this configuration file in the wizard.

Note You only can load an Excel file that is not already open in Excel. The Excel Wizard can read data from Excel 97 or later versions.

Importing Binary Data

You use the DAT data format described in Lesson 3, Working with DAT Files to load binary data. To convert the data into the DAT format, you must create a header file that controls access to the external file. The user must be familiar with the DAT data organization. As soon as the header file exists, DIAdem can load the external file like a DAT file.

Select File»DAT files»Import via header to open the dialog box shown in Figure 10-3, and load, generate, save, edit, and delete the channel properties for importing binary data.
Load external data as follows:

1. **Load** an existing header file that describes a data structure similar to the data to be loaded. If necessary, you can **delete** single channel properties.

2. Open the **Properties** subdialog box to edit the properties of the data storage to be loaded.

3. **Generate** the channel properties associated with each channel of the external data that is to be read. Then **Edit** the generated channel properties.

4. **Save** the created data set and channel properties.

5. Click **Execute** to load the external data into the default group in the Data Portal.

   When the properties are saved, DIAdem can read the data with the normal loading function.

**Importing Data with the Report Wizard**

You also can use the Report Wizard as another way to import data from all kinds of data sources.

As described in Lesson 2, *Working with the Report Wizard*, the Report Wizard page shown in Figure 10-4 opens by default when you launch DIAdem. While you are working in DIAdem, you can press <Ctrl-W> to open the Report Wizard.
In the first Report Wizard step you select your data. Open the data source in the top left of the dialog box and select one or more data sets in the file overview on the right. Click Finish to load the data into the Data Portal.

Define frequently-used data storages in the data storage manager of DIAdem NAVIGATOR to simplify access to these data. You can register the following data storages: Files, VI Logger, Citadel, SQL and AOP databases, and ATF and XML files.

Note When you load ASCII or Excel files, the Import Wizard appears. When you load data from SQL databases, you can load database tables into the Data Portal as channel groups.
Lesson 10  Loading External Data

Exercise 10-1

Objective:  Loading ASCII Block Data

In the following exercise you use the ASCII Import Wizard to create a data set description and load weather data saved in an ASCII file, and display the data in the REPORT layout from the last lesson.

The weather data is in blocks in an ASCII file:

```
ASCII File
Weather data from Aachen
Date;T_min;T_max;T_min_lin;T_max_lin;AverageTemp;Rain;T_6h;Index
-;°C;°C;°C;°C;°C;mm;°C;- 
{February}
01.02.2003 -3 0 -5 1 -1.5 0.1 -3 0
02.02.2003 -4 -1 -6 0 -2.5 0 -4 0
03.02.2003 -2 6 -4 7 2 0.3 4 0
04.02.2003 1 6 -1 7 3.5 12 3 0
05.02.2003 1 7 -1 8 4 5 5 0
06.02.2003 5 8 3 9 6.5 0 6 0
07.02.2003 6 9 4 10 7.5 0 6 0
08.02.2003 1 13 1 14 7 0 2 0
09.02.2003 3 11 1 12 7 3 5 0
10.02.2003 4 7 2 8 5.5 2 4 0
11.02.2003 5 8 3 9 6.5 6 7 \{Rain\} 0
... 
31.03.2003 6 13 3 14 9 0 6 0
```

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal without saving the data.
3. Navigate to the Weather_7.asc data file in the
   C:\Exercises\DIAdem Basics\ folder and drag and drop the file
   into the Data Portal.
4. DIAdem opens the ASCII Import Wizard where you make the settings
   shown in the following figure:
5. Click **Next** and set the parameters for the next step, as shown in the following figure:

6. Click **Next** to specify the destinations and the data set properties. Click the individual entries in the **Channel type** column consecutively and specify the destination in the top section of the dialog box.
   - Select **Header comment 1** for the first row.
   - Select **Header comment 2** for the second row.
   - Select **Name** for the third row.
   - Select **Unit** for the fourth row.
7. Select the column that contains the time format. Select **date/time** and enter the format `dd.mm.yyyy`.

8. Select **DIAdem REPORT**.

9. Click **Redraw** in the toolbar to display the loaded weather data in the current report.

If you have not loaded the report layout from the last exercise, navigate to the `Weather_6.tdr` layout in the `C:\Solutions\DIAdem Basics` folder and load the layout.
The report looks like this:

End of Exercise 10-1

The Weather_7.tdm data file, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 10-2

Objective: Loading ASCII Channel Data

In the following exercise you use the **Import via header** function to create a data set description, load an ASCII file with four data channels, and display the file in a report.

The ASCII data are saved in columns. In the following figure, the first value of each channel is in bold:

```
Sample data set for channel storage
1
2
3
4
5
6
45.48
51.9
53.4
44.8
51.7
48.02
470
1063
1600
2057
47.15
53.73
56.92
45.92
54.58
52.17
```

1. Select **DIAdem NAVIGATOR**.
2. **Delete** the data in the Data Portal without saving the data.
3. Select **File»DAT files»Import via header**.
4. Click **Generate** to create the channel properties as shown in the following figure:

![Generation of channel properties](image1)

5. Click **Continue** and set the parameters as shown in the following figure:

![Explicit data channels](image2)

Click **OK** to create the four channel headers that DIAdem displays in the overview of the main dialog box.

6. Click **Edit** to change the channel properties of the third and fourth channels:
   - Select the third channel and enter 4 as the **No. of values**.
   - Select the fourth channel and enter 20 as the **Position of this channel's first data point**.
7. Click **Properties** to enter the data set properties.
   
   Enter Gasoline as the **Name** in the first comment row, and enter ASCII Import as the **Comment**.

   Click **OK**.

8. Click **Save As**.

   Navigate to the C:\Exercises\DIAdem Basics\ folder and save the header file as Gasoline.dat.

9. Click **Execute** to load the data from the Gasoline.asc ASCII file into the Data Portal according to the created header file.

10. Name the loaded channels in the Data Portal as shown in the following figure:

11. Assign the following units to the channels in the properties window:
   
   - Amount: 1
   - Kilometers: km
   - Price: Euro
12. Select **DIAdem REPORT**.

13. **Delete** the current layout without saving the layout.

14. Open the **2D table** function bar and select **2D table with horizontal and vertical separators**.

15. Drag open the axis system in the middle of the worksheet.

16. Select the channels **Kilometers**, **Amount**, and **Price** in the Data Portal and drag and drop the data channels into the table.

17. Double-click the table to open the table definition dialog box.

18. Click **New entry**. Select **Expression** as the **Data type** and enter the following expression:

   \[@ \text{str}\left(\text{ChD}\left(D2\text{TabRow, Price}\right) / \text{ChD}\left(\text{D2TabRow, Amount}\right), "d.dd"\right)@\]

   Click **OK**.

19. Click **Down** to move the expression to the last row and select **Automatic maximum** as the **Table length**.

20. Click **Headers**.
21. Select **Use individual table heading** for the fourth column and enter the expressions as shown in the following figure:

![Use individual table heading](image1.png)

22. Select the first column.

Clear the **Use individual table heading** checkbox and enter the expressions as shown in the following figure:

![Use individual table heading](image2.png)

Click **OK** to close all the dialog boxes.

23. Drag the separator underneath the heading downwards to enlarge the table heading.
The report looks like this:

<table>
<thead>
<tr>
<th>Kilometers [km]</th>
<th>Price [€]</th>
<th>Amount [l]</th>
<th>[€/l]</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>47.15</td>
<td>45.48</td>
<td>1.04</td>
</tr>
<tr>
<td>1063</td>
<td>53.73</td>
<td>51.9</td>
<td>1.04</td>
</tr>
<tr>
<td>1600</td>
<td>56.92</td>
<td>53.4</td>
<td>1.07</td>
</tr>
<tr>
<td>2057</td>
<td>45.92</td>
<td>44.8</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>54.58</td>
<td>51.7</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>52.17</td>
<td>48.02</td>
<td>1.09</td>
</tr>
</tbody>
</table>

End of Exercise 10-2

The Gasoline.tdr layout and the Gasoline.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 10-3

Objective: Using the Report Wizard to Load Data

In the following exercise you define the SQL database SQL_Example.mdb as the new data source in the data storage manager. You then use the Report Wizard to load data from this SQL database and display the data in a report.

1. Select DIAdem NAVIGATOR.

2. **Delete** the data in the Data Portal without saving the data.

3. Click **Change data storage** in the toolbar.

4. Double-click **New data storage** under SQL. Enter **Training** as the new data storage name.

Press <Return>.
5. Load the data storage in the properties dialog box.

Open the C:\Exercises\DIAdem Basics\ folder and load the SQL_Example.mdb file.

Select **Save password** to open the data storage next time without entering the password.

Click **OK**.

DIAdem opens the new data storage in the NAVIGATOR panel.

Click + to display the data.


7. Select the **SQL: Training** data source and select the Tab_Weather_Info table in the tree.
8. Click **Next** and specify the data you want to display as shown in the following figure:

![Report Wizard - step 1 of 3](image)

9. Click **Next** and select **Y-axes** to specify the layout:
Click **Finish** to display the data in DIAdem REPORT.

The report looks like this:

---

**End of Exercise 10-3**
Exercise 10-4

Objective: Loading Excel Data

In the following exercise you use the Excel Import Wizard to analyze an Excel file and load the data into the Data Portal.

1. Select DIAdem NAVIGATOR.
2. Delete the data in the Data Portal without saving the data.
3. Click Change data storage in the toolbar.
5. Navigate to the Excel_Example.xls data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.
6. DIAdem opens the Excel Import Wizard where you make the settings shown in the following figure:

![Excel Import Wizard](image)

7. Click Next to specify the destination and the data format.
   Click the individual entries in the Channel type column consecutively and specify the destination in the top section of the dialog box.
   - Select Name for the first row.
   - Select Ignore for the second row.
8. Select the last column that contains the time format. Select **Date/Time**.

Mark the two empty columns to the left of the time data and select **Ignore**.

Click **Finish**.

9. Navigate to the **Excel_Example.xls** data file in the **C:\Exercises\DIAdem Basics\** folder and drag and drop the file into the Data Portal again.

10. DIAdem opens the Excel Import Wizard where you select **Transpose** in the first dialog box.
Click **Next**.

11. Click **Reset** and then click **OK** to delete all the previous dialog box settings.

Mark all the columns and select the data format **Ignore**.

Mark the second column and select the data format **Numeric**.

Mark the last three rows of the second column and select **Ignore** as the destination.
Click Finish. DIAdem creates a second channel group for the new channel.

12. Select both channel groups in the Data Portal and drag and drop the selected channel groups to the tree view of the MyTraining data storage. Enter the filename `My3D_data.tdm` and click Save.

13. Select DIAdem REPORT.

14. Delete the current layout without saving the layout.

15. Open the 3D axis system function bar and select a Simple 3D axis system.

16. Drag open the 3D axis system in the middle of the worksheet.

17. Double-click the 3D axis system to open the dialog box for curve and axis definition.

18. Click New entry and specify waterfall display for the channels:
   - Select [1]/TimeStamp as the x-channel.
   - Select [2]/Channel 2 as the y-channel.
   - Select [1]/Band 1 to [1]/Band 20 as the z-matrix.
   - Select Waterfall as the type of curve.
   - Select Glob. palette 1 as the Color.

Click OK.
19. Click **Axis definition**. Enter 210 as the **Rotation around z-axis**. Click **OK** to close all the dialog boxes.

The report looks like this:

![Graphical representation of the data](image)

**End of Exercise 10-4**
**Exercise 10-5**

**Objective:** Loading the Data from a VI Logger Database

In a musical experiment, three frequencies are selected to reproduce a chord. The NI VI Logger software automatically saves the data in a Citadel database.

In the following exercise you register this database in DIAdem as a new data storage and load the data in the Data Portal. In DIAdem VIEW you specify the transition ranges for the three notes to delete the notes. You save the remaining signal ranges in separate channels and calculate the main frequencies.

1. Select **DIAdem NAVIGATOR**.
2. **Delete** the data in the Data Portal without saving the data.
3. Click **Change data storage** in the toolbar.
4. Double-click **VI Logger»New data storage** and enter Demo Box Sweep.
5. Press <Return>. Specify the properties of the new data storage as follows:

Select **Folder** and open the \C:\Exercises\DIAdem Basics\Vi Logger Demo Box Sweep\ folder.

![](image)

Click **OK**.

6. DIAdem opens the new data storage in the NAVIGATOR panel.
7. Click + consecutively until DIAdem displays the channels.

8. Select the bottom test and drag and drop the test to the Data Portal.

9. Select DIAdem VIEW.

10. Delete the current view without saving the layout.

11. Open the Regular screen partitioning function bar and select Three areas.

12. Select four channels in the Data Portal and drag and drop the channels into the top area.
Select the **2D axis system** display type.

13. Select the channels **Time**, **Square Wave** and **Sine Wave** in the Data Portal and drag and drop the three channels to the middle area.

Select the **2D axis system** display type.

![Image](image.png)

The oscillation periods of the signals are short, so DIAdem displays a continuous colored surface. In this view, you cannot see that the oscillation time varies during the measurement, because the oscillations are all 5 seconds shorter.

14. Click **Band cursor** in the toolbar.

15. Click **Zoom, dynamic** in the middle axis system to enable scrolling.

The middle axis system is to function as the zoom window for the top axis system. Set the band cursor in the top axis system so narrow that you can recognize the oscillations in the middle axis system.

16. Click the top axis system and use the band cursor to search for a range between 5 and 6 where the oscillation periods change for the first time.
17. Press <Shift> and click **Set flags** in the toolbar for the middle axis system. DIAdem selects all curves in the selected axis system area.

18. Click **Flags: Delete data points** in the toolbar of the middle axis system to delete the selected curve section.

   The display in the top axis system now has a gap.

19. Move the right edge of the band cursor in the top axis system to the axis origin.

20. Click **Global flag reset** in the toolbar.

21. Press <Shift> and click **Set flags** in the toolbar for the middle axis system to select the first signal section.
22. Click **Flags: Copy data points** in the toolbar of the middle axis system to copy the selected curve section.

You see four new channels in the Data Portal:

23. Select **DIAdem ANALYSIS**.

24. Open the **Signal analysis functions** function bar and select **FFT (one time signal)**.

   Select **XCopy_time** as the **time channel**.
25. Click the three points to the right of **Signal channels** and select the two signal channels **YCopy_SquareWave** and **YCopy_SineWave**.

26. Click **Execute** to calculate the FFT. The FFT creates three result channels in the Data Portal.

27. Select **DIAdem VIEW**.

28. Select the three result channels of the FFT calculation in the Data Portal and drag and drop the selected channels to the bottom area.

Select the **2D axis system** display type.
29. Click **Global flag reset** in the toolbar.

30. Repeat steps 16 to 29 to describe the next transition range for the oscillation periods between 11 and 13.

The view looks like this:

---

End of Exercise 10-5
Summary, Tips, and Tricks

- TDM is the standard DIAdem 9 data format for reading external data and for saving data. The TDM data format structures the external data as a root, channel groups, and channels, and organizes the data accordingly in the Data Portal.

- DIAdem supports many external formats. According to the file type, a wizard appears where you set the external format parameters that enable DIAdem to load the data in TDM format into the Data Portal.

- You use the DAT data format to load binary data. To convert the data into the DAT format, you must create a header file that controls access to the external file.

- You also can use the Report Wizard as another way to import data from all kinds of data sources.
Lesson 11
3D Data Display

Introduction

In this lesson you will learn how DIAdem organizes and displays 3D data.

You Will Learn About:

A. Organizing 3D Data
B. Displaying 3D Data
### A. Organizing 3D Data

DIAdem works with single channels. For 3D display, DIAdem reads the data as a matrix or as a triple. Figure 11-1 shows how DIAdem organizes data in triples and in matrices.

#### Figure 11-1. DIAdem Reads 3D Data in Triples or Matrices

<table>
<thead>
<tr>
<th>Triple Structure</th>
<th>Matrix Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Triple Structure" /></td>
<td><img src="image" alt="Matrix Structure" /></td>
</tr>
</tbody>
</table>

A **value triple** consists of three data channels: one data channel each for the x, y, and z-values. All data channels should be the same length, otherwise the 3D display is limited to the length of the shortest data channel.

A **matrix** consists of an x-channel, a y-channel, and several z-channels. There must be as many z-channels as there are values in the y-channel. The z-channels must be the same length as the x-channel. The z-channels must be in consecutive order in the Data Portal. If the z-channels are not the same length as the x-channel, DIAdem uses a matrix that is shortened accordingly for 3D display.

You can use the basic 3D functions in DIAdem ANALYSIS to convert data channels into a matrix or a value triple.
DIAdem combines the data channels of the matrix in Table 11-1 into the three data channels of the triple in Table 11-2:

**Table 11-1. Matrix Structure**

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z1</th>
<th>Z2</th>
<th>Z3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>9</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>10</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>11</td>
<td>15</td>
<td>19</td>
</tr>
</tbody>
</table>

**Table 11-2. Triple Structure**

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>19</td>
</tr>
</tbody>
</table>
DIAdem expands the data channels of the triple in Table 11-3 into the data channels of the matrix in Table 11-4:

Table 11-3. Triple Structure

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 11-4. Matrix Structure

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z1</th>
<th>Z2</th>
<th>Z3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>8</td>
<td>NoValue</td>
<td>NoValue</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>NoValue</td>
<td>9</td>
<td>NoValue</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>NoValue</td>
<td>10</td>
<td>NoValue</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>NoValue</td>
<td>NoValue</td>
<td>11</td>
</tr>
</tbody>
</table>
B. Displaying 3D Data

You display 3D data graphically in 3D axis systems and numerically in 3D tables.

The **3D axis system** function bar has various definitions for 3D axis systems, for example, with and without grid lines. Click the template you want to display in the worksheet. You can position the 3D axis system anywhere and adjust the size. Double-click the axis system to modify the display and the data assignment.

**Note** The display modes in the 3D axis system depend on the data structure. DIAdem requires the data as a matrix for the display modes Surface, Waterfall, Bars, and 2D matrix. For the display modes Spikes and Symbol, DIAdem can use the data as matrices and as triples.

The **3D table** function bar has various definitions for 3D tables. Use 3D tables for numeric display of the matrix structure of 3D data. To display 3D data as triples, list the three data channels in a 2D table. Each line has a triple.
Exercise 11-1

Objective: Displaying Data as Triples

In the following exercise you use a script to create data triples that you display in various modes in a 3D axis system. You display triple data in the modes 3D curve, Spikes and Symbol.

1. Select DIAdem SCRIPT.

2. Click Open file.

Navigate to the Helix.vbs script in the C:\Exercises\DIAdem Basics\ folder and load the script:

```
Option Explicit
Const MaxPoints = 1000
Const Maxloops = 2

Call GenerateAll(1)
Call GeneratePhi(0, 2*Pi*Maxloops, MaxPoints)
Call FormulaCalc("Ch|X1|", 2*Cos(CH|Phi|) )
Call FormulaCalc("Ch|Y1|", Sin(CH|Phi|) )
Call FormulaCalc("Ch|X2|", Cos(CH|Phi|+Pi*2) )
Call FormulaCalc("Ch|Y2|", Sin(CH|Phi|+Pi*2) )
```

This script generates data triples for helixes. Helixes are spiral-shaped curves. First the script creates the Phi channel with the angle values and calculates from these values the x-values and the y-values of the two helixes, and then calculates the associated z-values.

The data of the first helix are in the data channels X1, Y1, and Z, and the data of the second helix are in the data channels X2, Y2, and Z. The second helix is phase-shifted 180 degrees from the first helix.

3. Click Run script in the toolbar.

4. Select DIAdem REPORT.

5. Delete the current layout without saving the layout.

6. Open the 3D axis system function bar and select a Simple 3D axis system.

7. Drag open the axis system to cover the entire worksheet.

8. Double-click the 3D axis system to open the dialog box for curve and axis definition.
9. Click **New entry** and make the following settings for the first helix:
   - **Channels:** x1, y1, z
   - **Display mode:** 3D curve
   Click **OK**.

10. Click **New entry** and make the following settings for the second helix:
    - **Channels:** x2, y2, z
    - **Display mode:** 3D curve
    Click **OK**.

Click **OK**.
The report looks like this:

11. Select DIAdem SCRIPT.

12. To regenerate the data for the helixes, change the value of the NumLoops constant in the Helix.vbs script as shown in the following figure:

   NumLoops = 0.5
   ....

13. At the end of the script, enter the instruction for refreshing the report:

   ... 
   Call PicUpdate() 

14. Click Run script in the toolbar.
When the script runs through the first time, the report looks like this:

15. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** for both helixes from 3D curve to Spikes.

**Note** Make sure that the **Structure** is always set as **Triple**.

Click **OK**.
The report looks like this:

![3D Data Display](image)

16. Select **DIAdem SCRIPT**.

17. To regenerate the data for the helixes, change the value of the `NumPoints` constant in the `Helix.vbs` script as shown in the following figure:

   ```vbs
   NumPoints = 30
   ...
   ```

18. Click **Run script** in the toolbar.

   DIAdem creates new channel data and then displays the data in the report.

19. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** for the first helix from `Spikes` to `Symbol`.

   **Note** Make sure that the **Structure** is always set as `Triple`.
20. Click **Curve param** and enter the symbol as shown in the following figure:

![Symbol Display](image1.png)

21. Click **Symbol** and enter \d.dd as the **format**:

![Parameters of the 3D symbols](image2.png)

Click **OK** in both dialog boxes.
22. Repeat steps 19 to 21 for the second helix.

The report looks like this:

End of Exercise 11-1
Exercise 11-2

Objective: Displaying Data as a Matrix

In the following exercise you import an Excel file with the measured power and voltage curves of a semiconductor at six different temperatures. You display the temperature-related power and voltage curves in a 3D axis system. You use Surface, Waterfall, Bars, 2D matrix, Spikes and Symbol as the display modes for matrices.

1. Select DIAdem NAVIGATOR.

2. **Delete** the data in the Data Portal without saving the data.

3. Click **Change data storage** in the toolbar.

4. Navigate to **Files»My DIAdem 9.1** and double-click.

5. Navigate to the **Semiconductor.xls** data file in the 
   C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

   DIAdem opens the Excel Import Wizard.

6. Check the default settings in the Excel Wizard dialog box as shown in the following figure:

   ![Excel Import Wizard](image)

7. Click **Next** to specify the destination and the data format.
8. First click **Reset** and then click **OK** to delete all settings.

9. Click the individual entries in the **Channel type** column consecutively and specify the destination in the top section of the dialog box.
   - Select **Name** for the first row.
   - Select **Comment** for the second row.
   - Select **Unit** for the third row.

   ![Excel Import Wizard](image)

   Click **Finish**.

10. In the Data Portal, open the shortcut menu for the channel group **Semiconductor**, and select **New»Channel**.

11. Enter **Temperature** as the **Name**.

   ![Create new channel](image)

   Click **OK**.

12. Move the **Temperature** channel to the second position in the Data Portal.
13. Select DIAdem VIEW.

14. Open the **Predefined screen partitioning** function bar and select **One channel table with all channels**.

15. Enter °C as the unit for the `Temperature` channel in the channel table and enter the channel values -50, -25, 0, 25, 50, and 75.

16. Select DIAdem REPORT.

17. Delete the current layout without saving the layout.

18. Open the **3D axis system** function bar and select a **Simple 3D axis system**.

19. Drag open the axis system to cover the entire worksheet.

20. Double-click the 3D axis system to open the dialog box for curve and axis definition.

21. Click **New entry** and make the following settings for surface display:
   - **Channels**: `Vcc, Temperature, Current -50°C`
   - **Display mode**: `Surface`

   Click **OK**.
Click **OK**.

The report looks like this:

![3D Data Display Diagram](image)

22. Double-click the 3D axis system to open the dialog box for curve and axis definition.
23. Click **Axis definition** and modify the projection angles as shown in the following figure:

![Axis definition dialog box](image)

Click **OK** to close all the dialog boxes.

The report looks like this:

![3D axis system](image)

24. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** from **Surface** to **Waterfall**.

Click **OK**.
25. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the display mode from Waterfall to Bars.

Click OK.

The report looks like this:
26. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** from **Bars** to **2D matrix**.

Click **OK**.

The report looks like this:

![Diagram](image)

In this display mode the width of the bar is proportional to its height.

27. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** from **2D matrix** to **Spikes**.

**Note**  Make sure that the **Structure** is set as **Matrix**.

Click **OK**.
The report looks like this:

28. Double-click the 3D axis system to open the dialog box for curve and axis definition and change the **display mode** from *Spikes* to *Symbol*.

⚠️ **Note**  Make sure that the **Structure** is set as *Matrix*.

29. Click **Curve param** and select the symbol type as shown in the following figure:

Click **OK** to close all the dialog boxes.
The report looks like this:

![3D Data Display Diagram](image1)

In this display mode, DIAdem displays the z-value at each curve point.

30. Click **Save layout as**.

   Open the C:\Exercises\DIAdem Basics\ folder and save the layout as MyTripleChart.tdr.

31. Select **DIAdem NAVIGATOR**.

32. Select the Semiconductor channel group in the Data Portal and drag and drop the selected channel group to the MyTraining data storage tree. Enter the filename 3D_Data_1.tdm and click **Save**.

**End of Exercise 11-2**

The D3Data.tdm data set, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Additional Exercise

If you have time, complete the following exercise.

1. Select DIAdem SCRIPT. Navigate to the Helix_Solution.vbs script in the C:\Exercises\DIAdem Basics\ folder and load the script. The script completes the steps in Exercise 11-1 and shows the various alternatives for displaying 3D triple data. Have a closer look at the script to see how it was programmed.

2. Navigate to the Semiconductor_solution.vbs script in the C:\Exercises\DIAdem Basics\ folder and load the script. The script completes the steps in Exercise 11-2 and shows the various alternatives for displaying 3D matrix data. Have a closer look at the script to see how it was programmed.
Exercise 11-3

Objective: Displaying Measured Data Three-Dimensionally

In the following exercise you load the data file D3Display_1.tdm with the vehicle data rpm, torque, and temperature. In a 3D axis system you display the temperatures in relation to the rpm and the torque.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal.

3. Navigate to the D3Display_1.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select DIAdem REPORT.

5. Delete the existing layout.

6. Select Settings»Layout parameters and select Number-oriented as the Channel reference.

Click OK.

7. Open the 3D axis system function bar and select a Simple 3D axis system.
8. Drag open the axis system to cover the entire worksheet.
9. Double-click the 3D axis system to open the dialog box for curve and axis definition.
10. Click **New entry** and define a spike display as shown in the following figure:

![New curve definition dialog box](image)

Click **OK** to close all the dialog boxes.

The report looks like this:

![3D Data Display](image)

**End of Exercise 11-3**

The D3Display_1.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAadem Basics\ folder.
Exercise 11-4

Objective: Modifying the Angle

In the following exercise you modify the rotation angle and the inclination for a different view of an axis system.

1. Select DIAdem REPORT.

2. Select the axis system in the report from the last exercise. Reduce the size of the axis system.

3. Select Copy in the shortcut menu for the axis system.

4. Then select Paste in the shortcut menu.

5. Position the copied axis system to the right of the first axis system.

6. Double-click the copied axis system to open the dialog box for curve and axis definition. Change the display mode of the original data to Symbol and select triple as the structure:

7. Click Curve param and enter * as the symbol.
Click **OK**.

8. Click **Axis definition** and modify the projection angles as shown in the following figure:

9. Click **Numbers** and select **Determine rel. position automatically** for all three axes.

Click **OK** to close all the dialog boxes.
The report looks like this:

![3D Data Display](image)

**End of Exercise 11-4**

The D3Display_2.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise 11-5

Objective:  Mathematical Analysis - 3D Envelope Curves

In the following exercise you calculate an envelope curve that describes the boundary range of the measured data. The temperature data in the Data Portal are not equidistant. However, equidistant data is required for surface display.

1. Select DIAdem ANALYSIS.

2. Open the 3D Surface functions function bar and select Envelope curves.

3. Check the dialog box parameters as shown in the following figure:

   ![Envelope curves dialog box](image)

   Click **Execute** to calculate the envelope curve.

4. Select DIAdem REPORT.

5. Double-click the left axis system to open the dialog box for curve and axis definition.

6. Click **New entry** to define the envelope curve as shown in the following figure:

   ![New curve definition dialog box](image)

   Click **OK**.
7. Click **OK**.

8. Repeat steps 5 and 6 for the axis system on the right.

   The report looks like this:

   ![3D Data Display Diagram](image)

**End of Exercise 11-5**

The D3Display_3.tdr layout and the D3Display_2.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Exercise 11-6

Objective: Mathematical Analysis - 3D Interpolation

In the following exercise you interpolate a value triple and the result is a regular matrix. You then display the matrix as a surface in a new axis system.

1. Select DIAdem ANALYSIS.

2. Open the 3D surface functions function bar and select Interpolation of a matrix.

3. Set the dialog box parameters as shown in the following figure:

4. Click Method to select the interpolation method as shown in the following figure:

   ![Interpolation Method Dialog]

   Click OK.

5. Click Output points to specify a grid with 20*25 evaluation points:
   - Select X-values and Calculate evaluation points. Enter 20.
   - Select Y-values and Calculate evaluation points. Enter 25.
6. Click **Analysis** to set the evaluation mode as shown in the following figure:

Click **OK**.

7. Click **Execute** to calculate the interpolation.

8. Select **DIAdem REPORT**.

9. Open the **3D axis system** function bar and select a **Simple 3D axis system**.

10. Drag open and position the axis system at the bottom of the worksheet.

11. Double-click the new 3D axis system to open the dialog box for curve and axis definition.

12. Click **New entry** and define a surface display as shown in the following figure:
Click **OK** to close all the dialog boxes.

13. Position the axis system in the worksheet as shown at the end of the exercise.

The report looks like this:

![3D Data Display Diagram](image)

**End of Exercise 11-6**

The `D3Display_4.tdr` layout and the `D3Display_3.tdm` data file, which contain the solution for this exercise, are in the `C:\Solutions\DIAdem Basics` folder.
Exercise 11-7

Objective: Mathematical Analysis - 3D Contours

In the following exercise you create a channel with temperature values. You then calculate the contours for these temperatures, to display the temperature distribution as a characteristic curve field.

1. In the Data Portal, open the shortcut menu for the channel group D3Display_1, and select New>Channel.
2. Enter Isolines as the name.

Click OK.

3. Select DIAdem VIEW.

4. Open the Predefined screen partitioning function bar and select One channel table with all channels.

The channel table displays the contents of all the channels in the Data Portal.

5. In the channel table, enter the channel values 10, 20, 30, 40, 50, 60, 70 for the new Isolines channel:

6. Select DIAdem ANALYSIS.

7. Open the 3D surface functions function bar and select Contour calculation.
8. Set the dialog box parameters as shown in the following figure:

9. Click **Bound.curve** and check the settings.

Click **OK**.

10. Click **Execute** to calculate the contour.

11. Select **DIAdem REPORT**.

12. Double-click the upper right 3D axis system to open the dialog box for curve and axis definition.

13. Click **New entry** and define the isolines as shown in the following figure:
Click **OK** to close all the dialog boxes.

The report looks like this:

![3D Data Display Screenshot]

**End of Exercise 11-7**

The D3Display_5.tdr layout and the D3Display_4.tdm data file, which contain the solution for this exercise, are in the C:\Solutions\DIAdem Basics\ folder.
Summary, Tips, and Tricks

- For 3D display, DIAdem reads the data as a matrix or as a triple. A value triple consists of three data channels: one data channel each for the x, y, and z-values. A matrix consists of an x-channel, a y-channel, and several z-channels.

- The display mode in the 3D axis system depends on the data structure. DIAdem requires the data as a matrix for the display modes Surface, Waterfall, Bars and 2D matrix, and DIAdem can use the data as matrices and triples in the display modes Spikes and Symbol.

- Use 3D tables for numeric display of the matrix structure of 3D data. To display 3D data as triples, list the three data channels in a 2D table. Each line has a triple.
Appendix A
Evaluating Crash Data

Introduction

In this lesson you will learn how to evaluate data from crash tests.

DIAdem contains many basic mathematical functions for standardized crash test evaluation, such as integration, differentiation, statistics functions, and digital filtering. DIAdem also provides the Calculator for free calculation of resultant acceleration values. The DIAdem Crash Analysis Toolset includes a number of special crash analysis functions.

To document and present the results, use the extensive graphic display functions in DIAdem REPORT.

You Will Learn About:

A. Working with the Crash Analysis Functions
A. Working with the Crash Analysis Functions

The functions in the Crash Analysis Toolset adhere to the calculation regulations in the SAE, ISO, and NHTSA specifications.

**Resultant**
This function calculates the resultant acceleration from the acceleration values in the x, y and z-directions.

**Filtering**
This function filters a signal with specific limit frequencies and tolerance bands for the lowpasses: CFC_60, CFC_180, CFC_600, CFC_1000, FIR_100, CFC_Free. DIAdem continues the signal to be filtered at the start and at the end mirror-inverted to the first and last channel value, to eliminate the transient response of the filter.

**HIC**
The HIC (Head Injury Criterion) value is a normed maximum integral value of the head acceleration. The function calculates either the value HIC, HIC36 or HIC15, and the start and end times of the interval in which DIAdem determines the HIC. DIAdem requires a time channel and the associated acceleration values for the calculation. DIAdem uses the resultant from the head acceleration in the x, y and z-directions as the acceleration.

**HPC**
The HPC value (Head Performance Criterion) is a normed maximum integral value of the head acceleration. The function calculates either the value HPC, HPC36 or HPC15, and the start and end times of the interval in which DIAdem determines the HPC. DIAdem requires a time channel and the associated acceleration values for the calculation. DIAdem uses the resultant from the head acceleration in the x, y and z-directions as the acceleration.

**HCD**
The HCD (Head Contact Duration) value is a normed maximum integral value of the head acceleration. The HCD formula is the same as the HIC formula except that DIAdem only uses the contact intervals to determine the HCD value. For the calculation DIAdem requires a time channel with linear partitioning and an acceleration channel.

**X ms**
This function calculates the maximum acceleration value that was exceeded for at least x milliseconds during the crash test. X is a free parameter. X=3ms is usually used (3ms value). DIAdem saves the start time of the
X ms value as the result. DIAdem requires a time channel and the associated acceleration values for the calculation.

**X g**
This function calculates the total time that the acceleration signal exceeded the specified value $X[g]$ ($g$ is gravity acceleration). DIAdem can specify this value either as a whole or in parts. For the calculation DIAdem requires a time channel with linear partitioning and an acceleration channel.

**VC**
This function calculates an injury criterion for the chest area (Viscous Criterion). For the calculation DIAdem requires the measured chest deformation signal of the chest and the associated time channel. The deformation constant for the dummy type is included in the calculation.

**TTI**
This function calculates an injury criterion for the chest area with side impact (Thorax Trauma Index). For the calculation DIAdem requires the acceleration values of the upper and lower ribs and the acceleration values of the spine.

**TI**
This function calculates an injury criterion for the lower leg area (Tibia Index). For the calculation DIAdem requires one channel each with the bending moments around the x and y-axes, and the axial force of pressure in the z-direction. The input channels must be filtered with CFC600.

**Time At Level**
This function calculates the maximum period of time during which a signal exceeds a specific lower threshold. For the calculation, DIAdem requires the signal to be examined, the associated time signal, and the positive and negative limit curves.

**NIC**
This function calculates an injury criterion for the neck area (Neck Injury Criterion). For the calculation DIAdem requires a time channel and a channel with the forces. The input channels must be filtered with CFC600.

**NIC Rear Impact**
This function calculates an injury criterion for the neck in rear impact (Neck Injury Criterion). For the calculation DIAdem requires the channels with the acceleration values of the first spinal vertebra and of the first chest vertebra, and the time channel.
NIJ
The NIJ value (Normalized Neck Injury Criterion) includes the four neck criteria, NTE (Tension Extension), NTF (Tension Flexion), NCE (Compression Extension), and NCF (Compression Flexion). For the calculation DIAdem requires the axial forces in z-direction at the head/neck point, the bending moment in y-direction at the top of the neck, and the associated time channel.

FFC
This function calculates the force on the thigh (Femur Force Criterion). For the calculation DIAdem requires the axial pressure force and the associated time channel. The input channels must be filtered with CFC600.

PulseLimit
This function checks whether an acceleration is within a specific corridor. DIAdem requires the acceleration values, the associated time channel, and the channels that specify the upper and lower limit curves.

Acomp
Calculates the average acceleration during the compression phase (Average Acceleration During Compression Phase). For the calculation DIAdem requires the unfiltered acceleration values and the associated time channel.

MinMax
This function calculates the times of the first minimum and the first maximum in the specified data channel.

Time Area Copy
This function copies a specific time range and the associated channel values into new channels.

Crash Analysis Results
DIAdem stores the results of the various crash functions in new channels in the Data Portal or in variables. You can display the variables in message boxes, use the variables in formulas, or document the variables in tables and text in your report.

For the complete evaluation of a crash test, you can create scripts that run the calculations automatically and generate a standardized report. You also can use scripts to automate dummy calibrations and limit value checks.
Select **Examples»Viewing, Presenting, Automating»User Templates»DIAdem ANALYSIS** in the contents tree of the DIAdem help for two examples of crash test data evaluation that also create reports:

- **CRASH Analysis**
  
  This example evaluates the horizontal, vertical, and lateral head acceleration measured on a dummy. The report shows the graphic of the head acceleration and lists the values for the HIC, HIC15, and HIC36 value, and the 3ms acceleration.

- **Crash Evaluation Based on the MME Standard**
  
  This example evaluates measurement data from a vehicle safety test based on the ISO MME standard (Multimedia Data Exchange Format) and creates a report. The example loads an MME data set, evaluates the frontal or side impact tests, displays the result preview as a graphic and a list of the characteristic values, and creates reports for PowerPoint and Excel.
Appendix A  Evaluating Crash Data

Exercise A-1

Objective: Eliminating an Offset in Crash Values

A crash test records signals with offset. You eliminate this offset to ensure that the data is processed correctly.

In the following exercise you copy the first 50 measured values of the x, y, and z-acceleration into new channels. You calculate the mean values of these data channels to determine and subtract the respective offset.

1. Select DIAdem NAVIGATOR.

2. **Delete** the data in the Data Portal without saving the data.

3. Navigate to the Crash_1.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. In the Data Portal, open the shortcut menu for the channel group Crash_1 and select **New»Channel**.

   Set the parameters as shown in the following figure to specify three new channels:

   ![](image)

   Click **OK**.

5. Select DIAdem VIEW.

6. Open the **Predefined screen partitioning** function bar and select **One channel table with all channels**.

   The channel table lists the data of all the data channels in the Data Portal.

7. Click A_head_hor in the first table cell of the second channel and select all the data in the channels A_head_hor, A_head_ver, and A_head_lat, up to table cell 50 of the A_head_lat channel.

8. Select **Copy** in the shortcut menu.
9. Click the first table cell in the new Channel_01 channel and select Paste in the shortcut menu.

10. Select DIAdem ANALYSIS.

11. Open the Statistics functions function bar and select Statistical characteristic values to calculate the arithmetic mean.

12. Click the three points next to Channels to select the channels shown in the following figure.

![](image)

Click OK.

13. Click All off and set the dialog box parameters as shown in the following figure:

![](image)

Click Execute.

14. Click the Calculator in the toolbar.
15. Enter the following formula in the entry field:
   \[ \text{Ch('A\_head\_hor\_noff'):=A\_head\_hor'-ChD(1,'Arithm\_mean')} \]

   Click \text{Calculate}.

16. Calculate the following formulas in the same way:
   \[ \text{Ch('A\_head\_ver\_noff'):=A\_head\_ver'-ChD(2,'Arithm\_mean')} \]
   \[ \text{Ch('A\_head\_lat\_noff'):=A\_head\_lat'-ChD(3,'Arithm\_mean')} \]

   Close the Calculator.

17. Select \text{DIAdem REPORT}.

18. Click \text{Load layout} without saving the layout.

19. Navigate to the \text{Crash\_1.tdr} layout in the \text{C:\Exercises\DIAdem Basics} folder and load the prepared layout.
The report looks like this:

![Graph of three lines with labels: A_Lat, A_Long, A_Vel for Time in seconds]

**End of Exercise A-1**

The Crash_1.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Appendix A   Evaluating Crash Data

Exercise A-2  Evaluating Dummy-Head Acceleration

In the following exercise you use a CFC 1000 filter to filter head acceleration measured for a dummy head in x, y, and z-directions (horizontal, vertical, lateral). You then determine the resultant and calculate the HIC, the 3 ms value, and the maximum value.

1. Select DIAdem ANALYSIS.

2. Open the Crash analysis functions function bar and select Filtering to filter the A_head_hor_noff channel with the CFC 1000 lowpass filter as shown in the following figure:

   ![Filtering Setup]

   Click Execute.

3. Repeat step 2 with the channels A_head_ver_noff and A_head_lat_noff.

4. Click the Calculator in the toolbar.

5. Enter the following variable assignment in the entry field:
   \[ CN(12) := 'A\_head\_hor\_f1000' \]

   ![Calculator]

   Click Calculate.
6. Repeat step 5 for channels 13 and 14:

   \[
   \text{CN(13)} := 'A\_head\_ver\_f1000' \\
   \text{CN(14)} := 'A\_head\_lat\_f1000' \\
   \]

   Close the Calculator.

7. Open the Crash analysis functions function bar and select Resultant. Set the channels as shown in the following figure:

   ![Resultant Channel Setup]

   Click Execute.

8. Open the Crash analysis functions function bar and select Head Injury Criterion to calculate the HIC value. Set the parameters as shown below:

   ![HIC Calculation]

   Click Execute.

9. Open the Crash analysis functions function bar and select x-ms calculation to calculate the 3 ms value. Set the parameters as shown below:

   ![x-ms Calculation]

   Click Execute.
10. Open the **Basic mathematic functions** function bar and select **Peak search** to determine the maximum value and the associated time value.

![Peak search dialog box]

Click **Execute**.

11. Select **DIAdem REPORT**.

12. Click **Load layout** without saving the current layout.

   Navigate to the prepared layout **Crash_2.tdr** in the
   C:\Exercises\DIAadem Basics\ folder and load the layout.

13. Select the result channels **X_Peak** and **Y_Peak** in the Data Portal and
    drag and drop the channels into the bottom axis system.

14. Double-click the axis system to open the dialog box for curve and axis
    definition.

    Select the **Line and symbol display mode** for the channel pair
    **X_Peak** and **Y_Peak**.
15. Click Curve param and select the blank Line style. Specify the Marker and the Symbol as shown in the following figure:
16. Click **Symbol** and set the parameters as shown in the following figure:

![Parameters for 2D symbols dialog box]

Click **OK** to close all the dialog boxes.

17. Double-click the prepared text in the text field to open the dialog box for text parameters and check the settings:

- **Value:** `@str(XmsAcceleration,'d.d')` at `@str(XmsTimeBegin,'d.d')` ms
- **Date:** `@DataSetDate`
- **Operator:** `@DataSetAuthor`
- **Test No.:** `@DataSetTitle`
End of Exercise A-2

The Crash_2.vbs script, which contains the solution for this exercise, is in the C:solutions\DIAdem Basics\ folder.
Exercise A-3  
**Objective:** Displaying the Data Scaled

In the following exercise you display the resultant calculated in the previous exercise scaled. Scaled display is useful for comparing different results.

1. Select **DIAdem REPORT**.

2. Select **Settings»Layout parameters** and set scaled display as shown in the following figure:

![Layout parameters dialog box](image)

Click **OK**. DIAdem makes the axis system smaller.

3. Double-click the axis system to open the dialog box for curve and axis definition.
4. Click **Axis definition** and select **Units per unit length** for Scaling defined by:
5. Click **Scaling** and set fixed scaling for the x-axis as shown in the following figure:

![Scaling dialog box](image)

6. Select **Y-axis** and set the dialog box parameters as shown in the following figure:

![Y-axis scaling dialog box](image)

Click **OK** to close all the dialog boxes.

7. Position the axis system in the worksheet and resize the axis system as shown in the following figure:
The report looks like this:

![Graph showing crash data analysis]

**End of Exercise A-3**

The Crash_3.tdr layout, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise A-4

Objective: Creating an AVS Diagram

AVS diagrams show the acceleration, velocity, and displacement over time.

In the following exercise you use a CFC 60 filter to filter the vehicle delay values. You use multiple integration to specify the velocity and the displacement from the filtered values. You then display the acceleration, the velocity, and the displacement in one axis system with separate y-axes.

1. Select DIAdem NAVIGATOR.

2. Delete the data in the Data Portal without saving the data.

3. Navigate to the Crash_4.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

4. Select DIAdem ANALYSIS.

5. Open the Crash analysis functions function bar and select Filtering. Set the parameters for filtering data with a CFC 60 filter as shown in the following figure:

   ![Filtering Parameter Setup](image)

   Click Execute.

6. Click the Calculator in the toolbar.

7. Enter the following formula in the entry field to convert the signal, which was measured in g, to the unit m/s²:

   \[ \text{Ch('A\_tun\_hor\_si'):='FilteredSignal' * 9.81} \]
Appendix A Evaluating Crash Data

8. Open the **Basic mathematic functions** function bar and select **Integration** to specify the velocity from the delay. Check the parameters as shown below:

Click **Calculate** and **Close** the Calculator.

9. Click the **Calculator** in the toolbar.

10. Enter the following formula in the entry field to assign the channel name **Velocity** to the result channel:

```
CN('Y_Integral'):='Velocity'
```

Click **Calculate**.
11. Enter the following formula in the entry field to subtract the values of the Velocity channel from the impact velocity values. The first comment line of the data set properties contains the velocity at the time of impact.

\[ \text{Ch('Abs\_velocity')} := \text{val(DataSetComment(1))} - 'Velocity' \]

Click **Calculate** and **Close** the Calculator.

12. Open the **Basic mathematic functions** function bar and select **Integration**. Check the parameters as shown in the following figure:

Click **Execute**.

13. Click the **Calculator** in the toolbar.

14. Enter the following formula in the entry field to assign the channel name Displacement to the result channel:

\[ \text{CN('Y\_Integral')} := 'Displacement' \]
15. Enter the following formula in the entry field to convert the signal, which was measured in meters, to the unit millimeters:

\[ Ch('\text{Displacement}_\text{mm}') := '\text{Displacement}' \times 1000 \]

Click **Calculate**.

16. Select **DIAdem REPORT**.

17. Click **Load layout** without saving the current layout.

N\text{avigate to the Crash}_4.tdr layout in the C:Exercises\DIAdem Basics folder and load the prepared layout.

18. Double-click the axis system to open the dialog box for curve and axis definition.

19. Click **Subaxes** and then click **New axis** twice to define two additional y-axes as shown in the following figure:
Click **OK**.

20. Assign the subaxes to the three curves as shown in the following figure:

21. Click **Axis definition**.

22. Click **Scaling** to enter the fixed scaling for the first y-subaxis as shown in the following figure:
23. Click **Labeling** and select **Y-axis** to check the labeling for the additional y-axes.

   - **Subaxis 2 X-1/Y-2**: Velocity [m/s]
   - **Subaxis 3 X-1/Y-3**: Displacement [mm]

   Click **OK** to close all the dialog boxes.

24. Click **Save layout as**.

   Open the C:\Exercises\DIAdem Basics\ folder and save the layout as AVS.tdr.
The report looks like this:

![Graph]

## End of Exercise A-4

The Crash_4.vbs script, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
Exercise A-5

Objective: Inspecting the Signal for Exceeded Limits

In the following exercise you check the calculated velocity. You manually enter the limits and display the velocity and the boundary curve in an axis system. This determines whether the signal is in the specified corridor.

1. In the Data Portal, open the shortcut menu for the channel group Crash_4 and select New>Channel.
   Set the parameters as shown in the following figure to specify two new channels:

   ![Create new channel in the channel group Crash_4](image)

   Click OK.

2. Select DIAdem VIEW.

3. Open the Predefined screen partitioning function bar and select One channel table with all channels.

4. In the channel table for the new channels Channel_01 and Channel_02, enter the channel names CorrX and CorrY and the channel values shown in the following figure:

   ![Channel properties](image)

5. Select DIAdem REPORT.

6. Click Load layout.

   Navigate to the Crash_5.tdr layout in the C:\Exercises\DIAdem Basics\ folder and load the layout.
7. Select the channels \texttt{CorrX} and \texttt{CorrY} in the Data Portal and drag and drop these two data channels into the axis system.

8. Double-click the axis system to open the dialog box for curve and axis definition and select the second curve:

![Curve and axis definition dialog box](image1)

9. Click \textit{Curve param} to select the line style as shown in the following figure:

![Curve parameters dialog box](image2)
Click **OK** to close all the dialog boxes.

10. Select **DIAdem NAVIGATOR**.

11. Select the channels **CorrX** and **CorrY** in the Data Portal to save these data for other evaluations.

12. Drag and drop the selected channels to the **MyTraining** data storage tree. Enter the filename **MyCorridor.tdm**.

Check whether the checkbox **Only elements selected in the Data Portal** is selected, and click **Save**.

13. Select **DIAdem REPORT**.
The report looks like this:

![Graph of crash evaluation](image)

**End of Exercise A-5**

The Crash_5a.tdr layout, which contains the solution for this exercise, is in the `C:\Solutions\DIAdem Basics\` folder.
Exercise A-6

Objective: Automating the Corridor Check

In the following exercise you automate the process of checking the velocity signal for certain limit ranges. You display the boundary curve, the signal, and the results in a report.

To mathematically compare the velocity with the corridor curve, the two signals must have a common x-channel. Interpolate the missing values in the corridor curve.

1. Select DIAdem SCRIPT.
2. Click Enable recording mode in the toolbar.
3. Comment the script.
4. Select DIAdem NAVIGATOR.
5. Delete the data in the Data Portal without saving the data.
6. Navigate to the data files Crash_6.tdm and Corridor.tdm in the C:\Exercises\DIAdem Basics\ folder and drag and drop the files into the Data Portal.
7. Select DIAdem ANALYSIS.
8. Open the Curve fitting functions function bar and select Linear mapping. Set the parameters as shown in the following figure:

Click **Execute**.

9. Select **DIAdem REPORT**.

10. Click **Load layout**.

    Navigate to the Crash_6.tdr layout in the C:\Exercises\DIAdem Basics\ folder and load the layout.

11. Select **DIAdem SCRIPT**.

12. Click **Disable recording mode** in the toolbar.

    The TeachIn(1).vbs script appears in the script editor.

13. Enter the following instructions after the mapping function call:

    ```
    Call ChnMapLinCalc(3,4,1,5,1,"const. value",NoValue,_
    "analogue")
    Call FormulaCalc("Ch('Difference'):= 'Lin_Image'-"&_"_
    "Velocity'")
    If CMin("Difference") < 0 Then
        T1= "Velocity is not OK!"
    Else
        T1= "Velocity is OK!"
    End If
    ...
    ```

    The Crash_6.tdr report uses the T1 variable to display the results contained in the command lines, in the report.

14. Click **Save file as**.

    Open the C:\Exercises\DIAdem Basics\ folder and save the script as CrashTraining.vbs.

15. Click **Run script** in the toolbar to test the CrashTraining.vbs script.
The report looks like this:

![Crash Evaluation Graph](image)

The associated CrashTraining.vbs script contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad("Crash_6.tdm","","")
Call DataFileLoad("Corridor.tdm","","")
Call ChnMapLinCalc(3,4,1,5,1,"const. value",NoValue,_
"analogue")
Call FormulaCalc("Ch('Difference'):= 'Lin_Image'-"&_ 
"'Velocity'")
If CMin("Difference") < 0 Then
  T1= "Velocity is not OK!"
Else
  T1= "Velocity is OK!"
End If
Call PicLoad("Crash_6.tdr")
Call PicUpdate()
```

**Note** For clarity, the scripts do not have comment lines.

**End of Exercise A-6**

The Crash_6.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise A-7

Objective: Using the Corridor Check for any Data Sets

In the following exercise you add a file selection dialog box to the script from the last exercise, to enable you to select and check any number of data files.

1. Select DIAdem SCRIPT.
2. Edit the CrashTraining.vbs script.
3. Add the following instructions at the beginning of the script:
   
   Call FileNameGet("Navigator","FileRead")
   If (DlgState = "IDOk") Then
   
   ...  
   
4. Add the following instruction at the end of the script:
   
   ... End If

5. Replace the Crash_6 parameter of the DataFileLoad command by the FileDlgName variable:
   
   ... Call DataFileLoad(FileDlgName,"",""
   Call DataFileLoad("Corridor.tdm","","")

6. Click Save file as.

   Open the C:\Exercises\DIAdem Basics\ folder and save the modified script as CrashTraining.vbs.

7. Click Run script in the toolbar to test the CrashTraining.vbs script.

   Navigate to the data files Crash_6a.tdm and Crash_6b.tdm in the C:\Exercises\DIAdem Basics\ folder and use these data files to check the script.
If you load the Crash_6b.tdm data file the report looks like this:

![Crash Evaluation Chart]

The associated CrashTraining.vbs script contains the following instructions:

```vbs
Call FileNameGet("Navigator","FileRead")
If (DlgState = "IDOk") Then
    Call DataDelAll(1)
    Call DataFileLoad(FileDlgName,"",""
    Call DataFileLoad("Corridor.tdm","","")
    Call ChnMapLinCalc(3,4,1,5,1,"const. value",NoValue,_
                       "analogue")
    Call FormulaCalc("Ch('Difference'):= 'Lin_Image'-'Velocity'")
    If CMin("Difference") < 0 Then
        T1= "Velocity is not OK!"
    Else
        T1= "Velocity is OK!"
    End If
    Call PicLoad("Crash_6.tdr")
    Call PicUpdate()
End If
```

**End of Exercise A-7**

The Crash_7.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise A-8

Objective: Finding a Trigger and Isolating a Signal Range

In a crash test, the vehicle impact time recording does not trigger.

In the following exercise you use the `find` function to specify the time of the vehicle impact. You isolate a signal section that is 200 ms wide, starting from this trigger.

1. Select DIAdem SCRIPT.

2. Click Enable recording mode in the toolbar.

3. Comment the script and click OK.

4. Select DIAdem NAVIGATOR.

5. Delete the data in the Data Portal without saving the data.

6. Navigate to the Crash_8.tdm data file in the C:\Exercises\DIAdem Basics\ folder and drag and drop the file into the Data Portal.

7. Select DIAdem VIEW.

8. Click the Calculator in the toolbar.

9. Enter the following formula in the entry field to check the horizontal head acceleration `A_head_x` for a value that is greater than 10 g:
   \[ L1 := \text{find} (\text{abs}'A_{\text{head}_x}') > 10 \]
   Click Calculate.
10. Enter the following formula in the entry field to determine the associated time:

\[ R1 := \text{ChD}(L1, 'Time_1') \]

Click **Calculate**.

11. Enter the following formula in the entry field to determine the actual impact time. The impact is 5 ms before the 10 g threshold is exceeded:

\[ L2 := \text{find}('Time_1' > R1 - 0.005) \]

Click **Calculate**.

12. Enter the following formula in the entry field to determine the end time of the range to be isolated:

\[ L3 := \text{find}('Time_1' > R1 - 0.005 + 0.200) \]
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Click **Calculate** and **Close** the Calculator.

13. In the Data Portal, open the shortcut menu for the channel group **Crash_8** and select **New»Channel**.

Set the parameters as shown in the following figure to create four new channels:

Click **OK**.

14. Open the **Predefined screen partitioning** function bar and select **One channel table with all channels**.

15. Click table cell 222 (L2) of the first channel **Time_1** and select all the data in the channels **Time_1**, **A_head_x**, **A_head_y**, and **A_head_z**, up to table cell 1778 (L3) of the **A_head_z** channel.

16. Select **Copy** in the shortcut menu.

17. Click the first table cell in the new **Channel_01** channel and select **Paste** in the shortcut menu.

18. Select **DIAdem SCRIPT**.

19. Click **Disable recording mode** in the toolbar.
20. Edit the recorded script and replace the last two instructions for copying data with the following instruction for copying blocks:

```vbs
Call DataBlCopy("1-4",L2,L3-L2+1,"5-8",1)
```

21. Add the following lines after the last instruction:

```vbs
CN(5) = "Time"
CN(6) = "A_head_hor"
CN(7) = "A_head_ver"
CN(8) = "A_head_lat"
```

22. Click **Save file as**.

Open the C:\Exercises\DIAdem Basics\ folder and save the script as Trigger.vbs.

23. Click **Run script** in the toolbar to test the Trigger.vbs script.

Navigate to the Crash_8.tdr layout in the C:\Exercises\DIAdem Basics\ folder to check the script.

The associated script Trigger.vbs contains the following instructions:

```vbs
Call DataDelAll(1)
Call DataFileLoad("Crash_8.tdm","","")
L1 = find("abs('A_head_x') > 10")
R1 = ChD(L1, "Time_1")
L2 = find("'Time_1' > (R1-0.005)")
L3 = find("'Time_1' > ((R1-0.005)+0.200")
Call ChnAlloc("Channel_01",1024,4,DataTypeFloat64,"Numeric",1,5)
Call DataBlCopy("1-4",L2,L3-L2+1,"5-8",1)
CN(5) = "Time"
CN(6) = "A_head_hor"
CN(7) = "A_head_ver"
CN(8) = "A_head_lat"
```

**End of Exercise A-8**

The Crash_8.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Exercise A-9

Objective: Calculating a Dummy-Head Evaluation for a Section of the Signal

In the following exercise you add a dummy-head evaluation of the isolated signal to the script from the last exercise.

1. Select DIAdem SCRIPT.

2. Click Open file.
   Navigate to the prepared script Crash_2.vbs in the C:\Exercises\DIAdem Basics\ folder and load the script.

3. Create the following procedure from the Crash2.vbs script and change the channel references as shown in the following figure:

   Sub Do_Head
   Call ChnCFCCalc(5,6,12,"CFC_1000",0,"EndPoints",10)
   CN(12) = "A_head_hor_f1000"

   Call ChnCFCCalc(5,7,13,"CFC_1000",0,"EndPoints",10)
   CN(13) = "A_head_ver_f1000"

   Call ChnCFCCalc(5,8,14,"CFC_1000",0,"EndPoints",10)
   CN(14) = "A_head_lat_f1000"

   Call ChnXYZAbsValue(12,13,14,15)
   Call ChnHICCalc(5,15,0,0,1,0,0)
   Call ChnXMSCalc(5,15,3,0,"in one peak")
   Call ChnPeakFind(5,15,16,17,1,"Max.Peaks","Amplitude")

   Call PicLoad("Crash_9.tdr")
   Call PicUpdate()
   End Sub

4. Select these instructions.

5. Click Copy in the toolbar.

6. Select File»Close to close the modified script, without saving the script.

7. Click the tab at the bottom of the script editor to switch to the Trigger.vbs script.

8. Click Paste in the toolbar to add the copied instructions at the beginning of the Trigger.vbs script.
9. Group the instructions into the following procedure `Get_Section`:

```vbs
Sub Get_Section
    Call DataDelAll(1)
    Call DataFileLoad("Crash_8.tdm","",""
    L1 = find("abs('A_head_x') > 10")
    R1 = ChD(L1,"Time_1")
    L2 = find("'Time_1' > (R1-0.005)"
    L3 = find("'Time_1' > ((R1-0.005)+0.200"
    Call ChnAlloc("Channel_01",1024,4,DataTypeFloat64,_,
        "Numeric",1,5)
    Call DataBlCopy("1-4",L2,(L3-L2)+1,"5-8",1)
    CN(5) = "Time"
    CN(6) = "A_head_hor"
    CN(7) = "A_head_ver"
    CN(8) = "A_head_lat"
End Sub
```

10. Add the following instructions for starting the procedure, at the end of the script:

```vbs
...  
Call Get_Section()
Call Do_Head()
```

11. Click **Save file as**.

   Open the `C:\Exercises\DIAdem Basics\` folder and save the script as `Crash.vbs`.

12. Click **Run script** in the toolbar to test the `Crash.vbs` script.

   The associated script `Crash.vbs` contains the following instructions:

```vbs
Sub Do_Head()
    Call ChnCFCFiltCalc(5,6,12,"CFC_1000",0,"EndPoints",10)
    CN(12) = "A_head_hor_f1000"
    Call ChnCFCFiltCalc(5,7,13,"CFC_1000",0,"EndPoints",10)
    CN(13) = "A_head_ver_f1000"
    Call ChnCFCFiltCalc(5,8,14,"CFC_1000",0,"EndPoints",10)
    CN(14) = "A_head_lat_f1000"
    Call ChnXYZAbsValue(12,13,14,15)
    Call ChnHICCalc(5,15,0,0,1,0,0)
    Call ChnXMSCalc(5,15,3,0,"in one peak")
    Call ChnPeakFind(5,15,16,17,1,"Max.Peaks","Amplitude")
    Call PicLoad("Crash_9.tdr")
    Call PicUpdate()
End Sub
```

'.................................................
Sub Get_Section()
    Call DataDelAll(1)
    Call DataFileLoad("Crash_8.tdm","","")
    L1 = find("abs('A_head_x') > 10")
    R1 = ChD(L1,"Time_1")
    L2 = find("'Time_1' > (R1-0.005)"")
    L3 = find("'Time_1' > ((R1-0.005)+0.200)"")
    Call ChnAlloc("Channel_01",1024,4,DataTypeFloat64,_
    "Numeric",1,5)
    Call DataBlCopy("1-4",L2,(L3-L2)+1,"5-8",1)
    CN(5) = "Time"
    CN(6) = "A_head_hor"
    CN(7) = "A_head_ver"
    CN(8) = "A_head_lat"
End Sub

'..................................................
Call Get_Section()
Call Do_Head()

End of Exercise A-9
The Crash_9.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAdem Basics\ folder.
Appendix A Evaluating Crash Data

Exercise A-10
Objective: Localizing All the Events in the Signal.

In the following exercise you modify the script from the last exercise to run the script repeatedly. You extend the mathematical functions that you use to specify the curve characteristics and to isolate a certain event, so that you can find and evaluate all the relevant sections.

1. Select DIAdem SCRIPT.

2. Delete the following instructions from the Do_Head procedure.

   ...  
   Call PicLoad("Crash_9.tdr")
   Call PicUpdate()
   ...

3. Modify the Get_Section procedure as shown in the following script, to enable you to start the find function at a variable position:

   Sub Get_Section
   L1 = find("abs('A_head_x') > 10", L5)
   R1 = ChD(L1, "Time_1")
   L2 = find("'Time_1' > (R1-0.005)", L5)
   L3 = find("'Time_1' > ((R1-0.005)+0.200", L5)
   Call DataBlCopy("1-4",L2,L3-L2+1,"5-8",1)
   Call FormulaCalc("Ch(5) := Ch(5)-ChD(1,5)")
   CN(5) = "Time"
   ...
   End Sub

4. Specify the following Def_Picture procedure after the Do_Head procedure to display the partial results in a report. The procedure stops the script until the user presses any key.

   Sub Def_Picture
   Call GraphObjOpen("2DAxis2")
   D2ConstX(4) = Chd(L2,"Time_1")
   D2ConstX(5) = Chd(L3,"Time_1")
   Call GraphObjClose("2DAxis2")
   Call PicUpdate()
   End Sub
5. After the Def_Picture procedure, add the following instructions, which load the data from a turnover test and load the associated layout:

   ...  
   Call PicLoad("Crash_10.tdr")

   Call DataDelAll(1)
   Call DataFileLoad("Crash_10.tdm")

   Call Get_Section()
   ...  

6. Specify the following loop, which localizes all the events in the signal:

   ...  
   L5 = 1
   Do
       Call Get_Section()
       Call Do_Head()
       Call Def_Picture()
       L5 = L3
   Loop Until (find("abs('A_head_x') > 10", L5)) = 0

7. Click Save file as.
   Open the C:\Exercises\DIAdem Basics\ folder and save the script as Crash.vbs.

8. Click Run script in the toolbar to test the Crash.vbs script.
   Click the space bar to continue the script.

The associated script Crash.vbs contains the following instructions:

```vbs
Sub Get_Section()
    L1 = find("abs('A_head_x') > 10", L5)
    R1 = ChD(L1, "Time_1")
    L2 = find("'Time_1' > (R1-0.005)", L5)
    L3 = find("'Time_1' > ((R1-0.005)+0.200", L5)
    Call DataBlCopy("1-4",L2,(L3-L2)+1,"5-8",1)
    Call FormulaCalc("Ch(5) := Ch(5)-ChD(1,5)")

    CN(5) = "Time"
    CN(6) = "A_head_hor"
    CN(7) = "A_head_ver"
    CN(8) = "A_head_lat"
End Sub
```

'.................................................
Sub Do_Head()
    Call ChnCFCFiltCalc(5, 6, 12, "CFC_1000", 0, "EndPoints", 10)
    CN(12) = "A_head_hor_f1000"
    Call ChnCFCFiltCalc(5, 7, 13, "CFC_1000", 0, "EndPoints", 10)
    CN(13) = "A_head_ver_f1000"
    Call ChnCFCFiltCalc(5, 8, 14, "CFC_1000", 0, "EndPoints", 10)
    CN(14) = "A_head_lat_f1000"
    Call ChnXYZAbsValue(12, 13, 14, 15)
    Call ChnHICCalc(5, 15, 0, 0, 1, 0, 0)  
    Call ChnXMSCalc(5, 15, 3, 0, "in one peak")
    Call ChnPeakFind(5, 15, 16, 17, 1, "Max.Peaks", "Amplitude")
End Sub

Sub Def_Picture
    Call GraphObjOpen("2DAxis2")
    D2ConstX(4) = Chd(L2, "Time_1")
    D2ConstX(5) = Chd(L3, "Time_1")
    Call GraphObjClose("2DAxis2")
    Call PicUpdate()
End Sub

Call PicLoad("Crash_10.tdr")
Call DataDelAll(1)
Call DataFileLoad("Crash_10.tdm")

L5 = 1
Do
    Call Get_Section()
    Call Do_Head()
    Call Def_Picture()
    L5 = L3
Loop Until (find("abs('A_head_x') > 10", L5)) = 0
When the script runs through the first time, the report looks like this:

![Image of a chart showing acceleration and reaction force over time with a summary of peak acceleration and HIC values.]  

**End of Exercise A-10**

The Crash_10.vbs script, which contains the solution for this exercise, is in the C:\Solutions\DIAadem Basics\ folder.
Summary, Tips, and Tricks

- DIAdem contains many basic mathematical functions for standardized crash test evaluation, such as integration, differentiation, statistics functions, and digital filtering. DIAdem also provides the Calculator for free calculation of resulting acceleration values.

- The DIAdem Crash Analysis Toolset includes a number of special crash analysis functions.

- To document and present the results, use the extensive graphic display functions in DIAdem REPORT.

- DIAdem stores the results of the various crash functions in new channels in the Data Portal or in variables. You can display the variables in message boxes, use the variables in formulas, or document the variables in tables and text in your report.

- For the complete evaluation of a crash test, you can create scripts that run the calculations automatically and generate a standardized report. You also can use scripts to automate dummy calibrations and limit value checks.