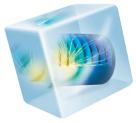

COMSOL Multiphysics®

Installation and Operations Guide

VERSION 4.3

COMSOL

COMSOL Multiphysics Installation and Operations Guide

Version: May 2012 COMSOL 4.3

Contact Information

Visit www.comsol.com/contact for a searchable list of all COMSOL offices and local representatives. From this web page, search the contacts and find a local sales representative, go to other COMSOL websites, request information and pricing, submit technical support queries, subscribe to the monthly eNews email newsletter, and much more.

If you need to contact Technical Support, an online request form is located at www.comsol.com/support/contact.

Other useful links include:

- Technical Support www.comsol.com/support
- Software updates: www.comsol.com/support/updates
- Online community: www.comsol.com/community
- Events, conferences, and training: www.comsol.com/events
- Tutorials: www.comsol.com/products/tutorials
- Knowledge Base: www.comsol.com/support/knowledgebase

Part No. CM010002

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Chapter 1: Introduction

Chapter 2: Installing and Running on Windows

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Chapter 4: Installing and Running on Mac OS X

1

Introduction

This chapter provides an overview of the contents of the *COMSOL Installation and Operations Guide* and some general tips for installing and running the COMSOL software standalone to best utilize the available computer resources.

In this chapter:

General Tips

Welcome to COMSOL® Multiphysics. Use this *Installation and Operations Guide* to install your COMSOL software products and start working with the packages. In addition to this manual, many other resources are available to help you get the most out of COMSOL products.

In this section:

General System Requirements for Windows, Linux, or Mac Computers

These requirements are common to all platforms:

- A DVD drive for installation
- TCP/IP activated
- At least 1 GB memory, but 4 GB per processor core or more is recommended.
- 1–4 GB of disk space, depending on the licensed products and installation options.
- Adobe Acrobat Reader 9 or 10 to view and print the COMSOL documentation in PDF format


Note

See Installing and Running on Windows, Installing and Running on Linux, or Installing and Running on Mac OS X for individual system requirements.

FLOATING NETWORK LICENSES

Floating network licenses are supported on heterogeneous networks of Windows, Linux, and Mac computers. Both the license manager and the COMSOL application can run on either Windows, Linux, or Mac, and a single computer can run both of them

Hardware Parameters that Affect Performance

- A 64-bit operating system is highly recommended.
- For a given hardware, the choice between Windows, MacOS, or Linux will not significantly affect performance.
- 4–8 GB physical RAM per core of the computer is recommended.
- Dual-socket or if possible four-socket nodes are recommended.
- A CPU with as fast a memory bus as possible is beneficial (QPI or HyperTransport bus). The numbers are often measured in GigaTransfers/Seconds (GT/s) and can be found on manufacturers' webpages or Wikipedia (see example below).
- As high memory bandwidth as possible is beneficial.
- If you can find information about number of memory channels, it should be as high as possible. This information can be more difficult to find.

COMSOL Release Notes

When **Help>COMSOL Documentation** is selected from the main menu, this electronic PDF document provides an overview of changes throughout the COMSOL product line since the previous release that require special attention with regards to backward compatibility.

Introduction to COMSOL Multiphysics and Online Help

To get an overview of COMSOL Multiphysics' capabilities and how to use them, see the *Introduction to COMSOL Multiphysics* document, included with the DVD media. It contains an overview of the major functionality in the 4.3 release and fully documented example models. Further, the full COMSOL documentation set is available on your computer in the COMSOL help resources and as a set of PDF files. You can also access context-sensitive dynamic help that provides help for all nodes in the Model Builder and windows on the COMSOL Desktop, including links to the full product documentation.

WHERE DO I ACCESS THE DOCUMENTATION AND MODEL LIBRARY?

A number of Internet resources provide more information about COMSOL Multiphysics, including licensing and technical information. The electronic

documentation, Dynamic Help, and the Model Library are all accessed through the COMSOL Desktop.

 *Important*	If you are reading the documentation as a PDF file on your computer, the blue links do not work to open a model or content referenced in a different guide. However, if you are using the online help in COMSOL Multiphysics, these links work to other modules, model examples, and documentation sets.

THE DOCUMENTATION

The *COMSOL Multiphysics User's Guide* and *COMSOL Multiphysics Reference Guide* describe all interfaces and functionality included with the basic COMSOL Multiphysics license. These guides also have instructions about how to use COMSOL Multiphysics and how to access the documentation electronically through the COMSOL Multiphysics help desk.

To locate and search all the documentation, in COMSOL Multiphysics:

- Press F1 for Dynamic Help,
- Click the buttons on the toolbar, or
- Select **Help>Documentation** () or **Help>Dynamic Help** () from the main menu

and then either enter a search term or look under a specific module in the documentation tree.

THE MODEL LIBRARY

Each model comes with documentation that includes a theoretical background and step-by-step instructions to create the model. The models are available in COMSOL as MPH-files that you can open for further investigation. You can use the step-by-step instructions and the actual models as a template for your own modeling and applications.

SI units are used to describe the relevant properties, parameters, and dimensions in most examples, but other unit systems are available.

To open the Model Library, select **View>Model Library** () from the main menu, and then search by model name or browse under a module folder name. Click to highlight any model of interest, and select **Open Model and PDF** to open both the model and the documentation explaining how to build the model. Alternatively, click the **Dynamic**

Help button ( ) or select **Help>Documentation** in COMSOL to search by name or browse by module.

The model libraries are updated on a regular basis by COMSOL in order to add new models and to improve existing models. Choose **View>Model Library Update** ( ) to update your model library to include the latest versions of the model examples.

If you have any feedback or suggestions for additional models for the library (including those developed by you), feel free to contact us at info@comsol.com.

CONTACTING COMSOL BY EMAIL

For general product information, contact COMSOL at info@comsol.com.

To receive technical support from COMSOL for the COMSOL products, please contact your local COMSOL representative or send your questions to support@comsol.com. An automatic notification and case number is sent to you by email.

COMSOL WEB SITES

Main Corporate web site	www.comsol.com
Worldwide contact information	www.comsol.com/contact
Technical Support main page	www.comsol.com/support
Support Knowledge Base	www.comsol.com/support/knowledgebase
Product updates	www.comsol.com/support/updates
COMSOL User Community	www.comsol.com/community

Technical Support

If any questions arise regarding COMSOL software products—whether concerning installation, licensing, modeling, applications, or other technical questions—do not hesitate to contact your local COMSOL representative or send your questions to support@comsol.com.

Further, at www.comsol.com/support you can find a broad range of technical support resources including the searchable COMSOL Knowledge Base.

Typographical Conventions

All COMSOL user's guides use a set of consistent typographical conventions that make it easier to follow the discussion, understand what you can expect to see on the graphical user interface (GUI), and know which data must be entered into various data-entry fields.

In particular, these conventions are used throughout the documentation:

CONVENTION	EXAMPLE
text highlighted in blue	Click text highlighted in blue to go to other information in the PDF. When you are using the online help desk in COMSOL Multiphysics, these links also work to other modules, model examples, and documentation sets.
boldface font	A **boldface** font indicates that the given word(s) appear exactly that way on the COMSOL Desktop (or, for toolbar buttons, in the corresponding tip). For example, the **Model Builder** window () is often referred to and this is the window that contains the model tree. As another example, the instructions might say to click the **Zoom Extents** button (), and this means that when you hover over the button with your mouse, the same label displays on the COMSOL Desktop.
Forward arrow symbol **>**	The forward arrow symbol **>** is instructing you to select a series of menu items in a specific order. For example, **Options>Preferences** is equivalent to: From the **Options** menu, choose **Preferences**.
`Code` (monospace) font	A `Code` (monospace) font indicates you are to make a keyboard entry in the user interface. You might see an instruction such as "Enter (or type) `1.25` in the **Current density** field." The monospace font also is an indication of programming code or a variable name.
Italic *`Code`* (monospace) font	An italic *`Code`* (monospace) font indicates user inputs and parts of names that can vary or be defined by the user.
Arrow brackets <> following the `Code` (monospace) or *`Code`* (italic) fonts	The arrow brackets included in round brackets after either a monospace `Code` or an italic *`Code`* font means that the content in the string can be freely chosen or entered by the user, such as feature tags. For example, `model.geom(<tag>)` where *<tag>* is the geometry's tag (an identifier of your choice). When the string is predefined by COMSOL, no bracket is used and this indicates that this is a finite set, such as a feature name.

KEY TO THE GRAPHICS

Throughout the documentation, additional icons are used to help navigate the information. These categories are used to draw your attention to the information based on the level of importance, although it is always recommended that you read these text boxes.

ICON	NAME	DESCRIPTION
	Caution	A Caution icon is used to indicate that the user should proceed carefully and consider the next steps. It might mean that an action is required, or if the instructions are not followed, that there will be problems with the model solution.
	Important	An Important icon is used to indicate that the information provided is key to the model building, design, or solution. The information is of higher importance than a note or tip, and the user should endeavor to follow the instructions.
	Note	A Note icon is used to indicate that the information may be of use to the user. It is recommended that the user read the text.
	Tip	A Tip icon is used to provide information, reminders, shortcuts, suggestions of how to improve model design, and other information that may or may not be useful to the user.
	See Also	The See Also icon indicates that other useful information is located in the named section. If you are working on line, click the hyperlink to go to the information directly. When the link is outside of the current PDF document, the text indicates this, for example See The Laminar Flow Interface in the *COMSOL Multiphysics User's Guide*. Note that if you are in COMSOL Multiphysics' online help, the link will work.

ICON	NAME	DESCRIPTION
	Model	The Model icon is used in the documentation as well as in COMSOL Multiphysics from the View>Model Library menu. If you are working online, click the link to go to the PDF version of the step-by-step instructions. In some cases, a model is only available if you have a license for a specific module. These examples occur in the COMSOL Multiphysics User's Guide. The Model Library path describes how to find the actual model in COMSOL Multiphysics, for example If you have the RF Module, see Radar Cross Section: Model Library path **RF_Module/Tutorial_Models/radar_cross_section**
Space Dimension		Another set of icons are also used in the Model Builder—the model space dimension is indicated by 0D , 1D , 1D axial symmetry  , 2D  , 2D axial symmetry  , and 3D  icons. These icons are also used in the documentation to clearly list the differences to an interface, feature node, or theory section, which are based on space dimension.

.

2

Installing and Running on Windows

This section provides detailed instructions for installing and running the COMSOL software on Windows. You also find complete system requirements and license manager information. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Windows. See also the COMSOL Support Knowledge Base on www.comsol.com/install for specific troubleshooting tips.

In this section you will find information about:

System Requirements

Note

For the most current system requirements, see www.comsol.com/products/requirements/

In this section:

See Also

.

System Requirements for Microsoft Windows

GENERAL SYSTEM REQUIREMENTS—WINDOWS

Use Automatic Updates to keep the Windows system up-to-date. Access it and turn it on from the Control Panel.

SYSTEM REQUIREMENTS—32-BIT WINDOWS VERSION

- The following 32-bit Windows operating systems are supported:
  - Windows 7
  - Windows Server 2008 R2
  - Windows Server 2008
  - Windows Vista
  - Windows Server 2003 with Service Pack 2 or later
  - Windows XP with Service Pack 3 or later
- Intel Pentium IV or AMD Athlon processor or later

SYSTEM REQUIREMENTS—64-BIT WINDOWS VERSION

- The following 64-bit Windows operating systems are supported:
  - Windows 7
  - Windows Server 2008 R2
  - Windows Server 2008
  - Windows HPC Server 2008 R2
  - Windows HPC Server 2008
  - Windows Vista
  - Windows Server 2003 x64 Edition with Service Pack 2 or later
  - Windows Compute Cluster Server 2003 with Service Pack 1or later
  - Windows XP Professional x64 Edition with Service Pack 2 or later
- A PC with one of these processors: AMD with AMD64 or Intel with EM64T

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons: drivers supporting OpenGL version 1.4 or DirectX version 9 on the local console are required. Alternatively, use software rendering. For using the **Optimize for Quality** setting in graphics preferences, OpenGL 2.0. Hardware rendering requires at least 24-bit color graphics. Software rendering also supports 16 bit color graphics.

LiveLink for MATLAB Requirements

LiveLink for MATLAB is compatible with MATLAB R2012a and MATLAB R2011b.

Products for CAD Interoperability

The following products support import of 3D CAD files on Windows platforms:

TABLE 2-1: PRODUCTS FOR CAD INTEROPERABILITY ON WINDOWS

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCTS
CAD Import Module	ACIS (SAT), IGES, Inventor, Parasolid, Pro/E, SolidWorks, and STEP	COMSOL Multiphysics
LiveLink for AutoCAD	same as above	COMSOL Multiphysics
LiveLink for Creo Parametric	same as above	COMSOL Multiphysics
LiveLink for Inventor	same as above	COMSOL Multiphysics

TABLE 2-1: PRODUCTS FOR CAD INTEROPERABILITY ON WINDOWS

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCTS
LiveLink for Pro/ENGINEER	same as above	COMSOL Multiphysics
LiveLink for SolidWorks	same as above	COMSOL Multiphysics
LiveLink for SpaceClaim	same as above	COMSOL Multiphysics
File Import for CATIA V5	CATIA V5	CAD Import Module, or a LiveLink product for a CAD package

See Table 2-2 for detailed version information on the supported file formats.

TABLE 2-2: 3D CAD FILE FORMATS SUPPORTED BY COMSOL PRODUCTS ON WINDOWS

FILE FORMAT (FILE EXTENSION)	SUPPORTED VERSION
Parasolid (.x_b, .x_t)	up to V24
ACIS or SAT (.sab, .sat)	up to R22
STEP (.step, .stp)	AP203, AP214
IGES (.iges, .igs)	up to 5.3
Autodesk Inventor part (.ipt)	6 to 11, 2008-2012
Autodesk Inventor assembly (.ipt)	11, 2008-2012
Creo Parametric (.prt, .asm)	1.0
Pro/ENGINEER (.prt, .asm)	16 to Wildfire 5
SolidWorks (.sldprt, .sldasm)	98-2012
CATIA V5 (.CATPart, .CATProduct)	R6 to R21

LIVELINK FOR AUTOCAD

LiveLink for AutoCAD is compatible with AutoCAD 2011 and AutoCAD 2012.

LIVELINK FOR CREO PARAMETRIC

LiveLink for Creo Parametric is compatible with Creo Parametric 1.0.

LIVELINK FOR INVENTOR

LiveLink for Inventor is compatible with Autodesk Inventor 2012 and Autodesk Inventor 2013.

LIVELINK FOR PRO/ENGINEER

LiveLink for Pro/ENGINEER is compatible with Wildfire 4.0 and Wildfire 5.0.

LIVELINK FOR SOLIDWORKS

LiveLink for SolidWorks is compatible with SolidWorks 2011 and 2012.

LIVELINK FOR SPACECLAIM

LiveLink for SpaceClaim requires SpaceClaim 2011+ or 2012, and the Data Exchange II module available from SpaceClaim.

Parallel System Requirements

COMSOL 4.3 supports shared-memory parallelism and distributed-memory parallelism on 32-bit and 64-bit Windows. Distributed-memory parallelism requires Windows Compute Cluster Server 2003 with Service Pack 1, Windows HPC Server 2008, or Windows HPC Server 2008 R2.

Internet Protocol Support

IPv4 and IPv6 are supported on all Windows platforms.

Installing COMSOL

In this section:

Before You Begin

- Check that the system meets all applicable requirements (see System Requirements for Microsoft Windows).
- Have the passcode or license file ready. A passcode has a form similar to:

```
FFFFFFFF-TYUS-123456-1234567-123456789
```

A passcode or a license file is required to install COMSOL 4.3. You should have received it in an email or letter from your sales representative. If neither a passcode nor a license file have been received, contact your local COMSOL representative.

Some COMSOL license types require that a license manager is installed before running a COMSOL software product. If COMSOL software is installed with a passcode, no license manager is needed. If it is installed with a license file, you need to install the license manager if the license file contains a line starting with the word SERVER. See License Manager Installation for instructions. The COMSOL software products and the license manager can be installed in any order.

Other COMSOL license types require a dongle (hardware lock). If you have received a dongle to use with the COMSOL software, please refer to `dongle/readme.txt` on the DVD for installation instructions.

An installation of earlier COMSOL versions on your computer is not affected by the COMSOL 4.3 installation except that double-clicking a Model MPH-file created with an earlier version of COMSOL will open in COMSOL 4.3. You can continue to use earlier versions or uninstall them independently of the COMSOL 4.3 installation.


Note

In this guide, the term COMSOL 4.3 refers not only to COMSOL Multiphysics 4.3 but also to any other members of the COMSOL product line.

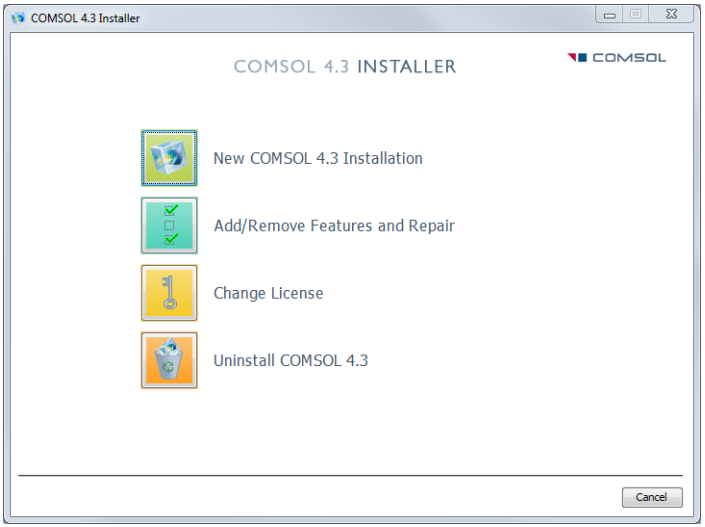
Installing COMSOL

1 Insert the COMSOL DVD into the DVD drive. The **COMSOL Setup** window should appear automatically; if not, run the file `setup.exe` on the installation DVD. When the **COMSOL 4.3 Installer** window appears:

- Click **New Installation** and proceed to Step 2 to make a new installation.
- Click **Add/Remove Features** and proceed to Step 4 to change or repair an existing installation. For example, use **Add/Remove Features** when adding or removing documentation files for products installed or when adding or removing a product that your license includes.
- Click **Change License** and proceed to Step 2 to update the license of an existing installation. Use this option when COMSOL is installed and to get a new license file. The installer then removes features/products not licensed any more and lets you go through the **Add/Remove Features** procedure to add or remove features for

the new license. If your trial license has expired you can use the **Change License** option to re-enable the old (paid) license.

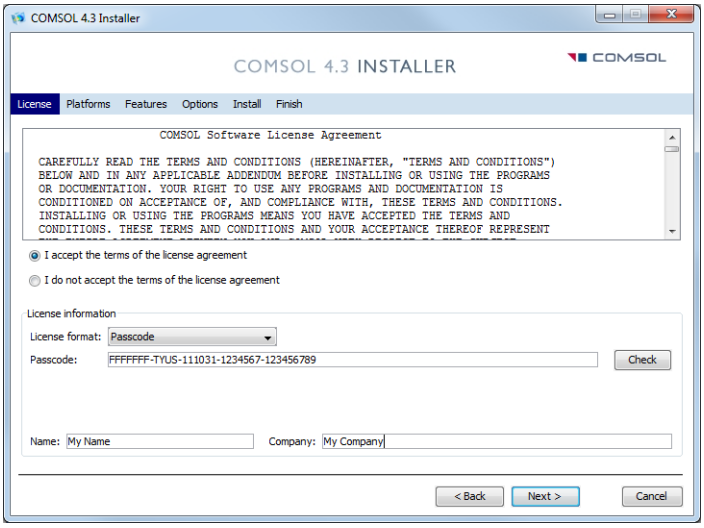
- Click **Uninstall COMSOL 4.3** to remove an existing installation.



Tip	Change the path to the existing installation by pressing the F1 key.

2 After reading the license agreement, click the **I accept the terms of the license agreement** button and specify the license. Use one of the following license formats:

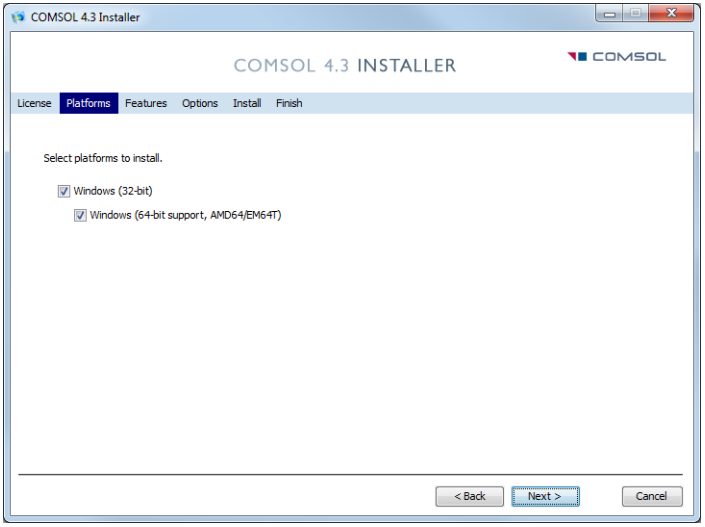
- **Passcode**: Enter your passcode, which is a series of characters and numbers that has a form similar to `FFFFFFFF-TYUS-123456-1234567-123456789`. The passcode is case sensitive.
- **License file**: Enter the path to an existing license file or click **Browse** to select the file `license.dat`.
- **Port number** and **Host name**: Enter the host name of an existing license server and its license server port number.
- **Three-server redundancy**: Enter the host names and license server port numbers of an existing three-server redundant configuration.



Note	If **Change License** was selected in Step 1, you can choose to use an existing paid license or trial license, or you can choose to specify a new license. Click **Next** and proceed to Step 4 if you change the license to a license with different products. Otherwise, proceed to Step 9.

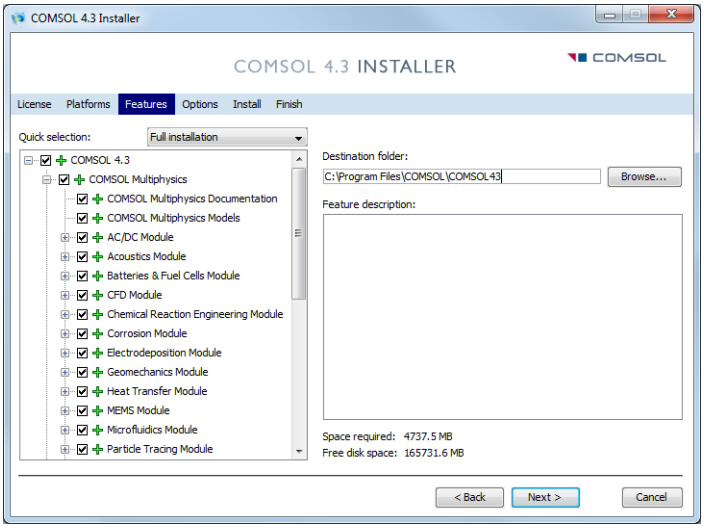
3 Click **Next**.

4 On the **Platforms** page, you can typically accept the default settings



5 Click **Next**.

6 Select the features to install and specify the path to the COMSOL installation directory.



Feature symbols:

— not currently installed, will be installed

— not currently installed, will not be installed

— currently installed, will not be updated

— currently installed, will be updated

— currently installed, will be removed

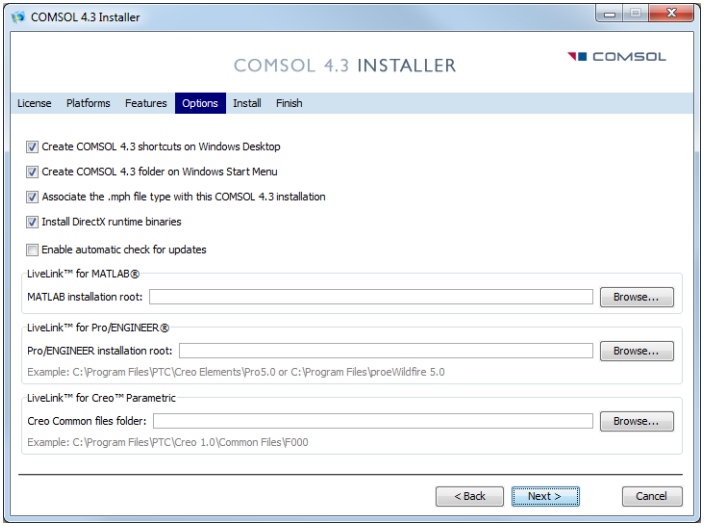
Note

If **Add/Remove Features** or **Change License** was selected in Step 1, the **Features** page includes a **Repair all selected features** check box.

7 Click **Next**.

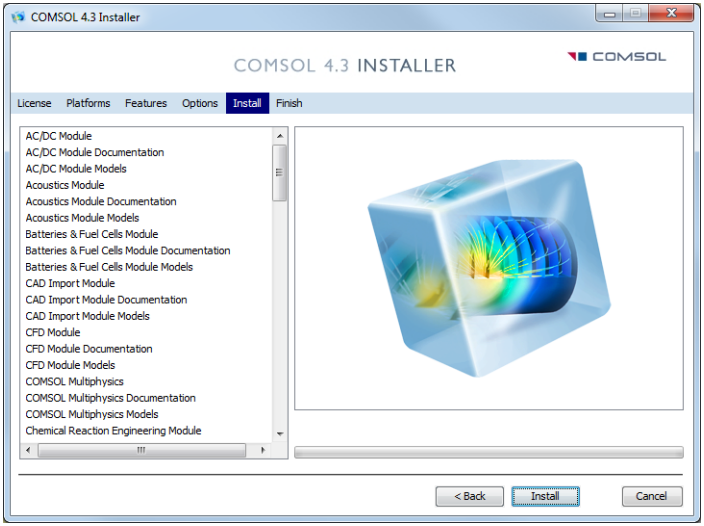
8 Set the installation options:

- Create COMSOL shortcuts on the Windows Desktop
- Create COMSOL shortcuts on the Windows Start Menu
- Associate the COMSOL Multiphysics model file type (`.mph` files) with the COMSOL installation. If this option is selected, you can open COMSOL models by double-clicking them.
- Clear the **Install DirectX runtime binaries** check box if you previously experienced problems using DirectX on your computer.
- For the LiveLink products for MATLAB, Pro/ENGINEER, and Creo Parametric specify the path to the MATLAB, Pro/ENGINEER, and Creo Parametric installations.

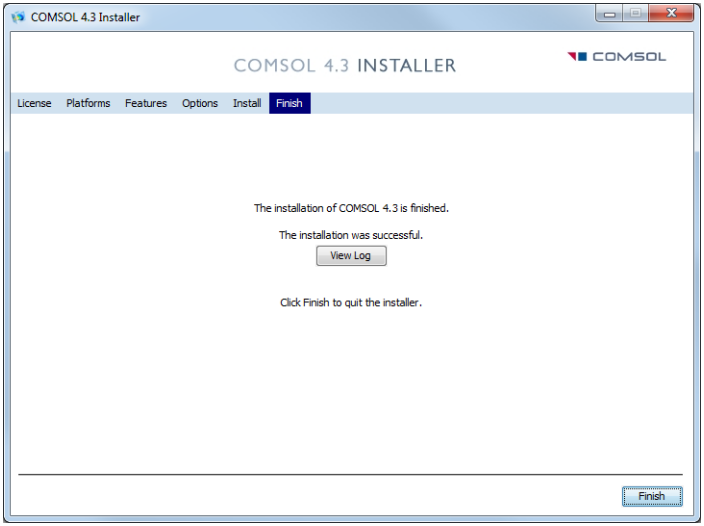


9 Click **Next**.

10 When you click **Install** the utility now installs or updates COMSOL. The installation process might take several minutes. The **Finish** page in Step 9 appears automatically when the installation process is finished.



11 This window appears when the installation is finished. Click **View Log** to open a window that shows the installation log. Click **Finish** to quit the installer.



Cluster Installation

The installation instructions above can be followed also for clusters, considering the following:

Make sure the head nodes has Windows HPC Server 2008 R2, Windows HPC Server 2008, or Windows Compute Cluster Server 2003 with Service Pack 1 or later. If you have Windows HPC Server 2008 R2 on the head node, the compute nodes may run Windows HPC Server 2008 R2 or Windows 7 with the Windows HPC Pack. If you run Windows HPC Server 2008 or Windows Compute Cluster Server 2003 with Service Pack 1or later on the head node, the compute nodes must run the same operating system as the head node.

License manager COMSOL requires a floating network license on clusters. Please check the license file for the CLUSTERNODE feature. The license manager needs to be accessible from all nodes in the cluster. Therefore it is often a good idea to have it run on the head node. See License Manager Installation on Windows.

Installation folder The COMSOL installation folder should be shared between all compute nodes and the head node.

Features During installation, make sure the **Cluster Components** feature is selected.

Access to Cluster If you work on a desktop PC, install COMSOL on that PC. Before you start, you need to install Windows HPC Pack on the PC. This software is free and shipped with the Windows Server operating system and enables you to access the cluster from your PC.

Automated Installation

You can install COMSOL using an automated installation process with minimal user interaction. An answer file then responds to questions while the installer is running. The answer file is a text file with a specific format that contains predefined settings that the COMSOL installer uses. Start the installation by running

```
<path to DVD>\setup.exe -s <answer file path>
```

where `<answer file path>` is the path to your answer file. A template answer file, `setupconfig.ini`, with detailed usage information is available on the DVD.

Removing (Uninstalling) the COMSOL Installation

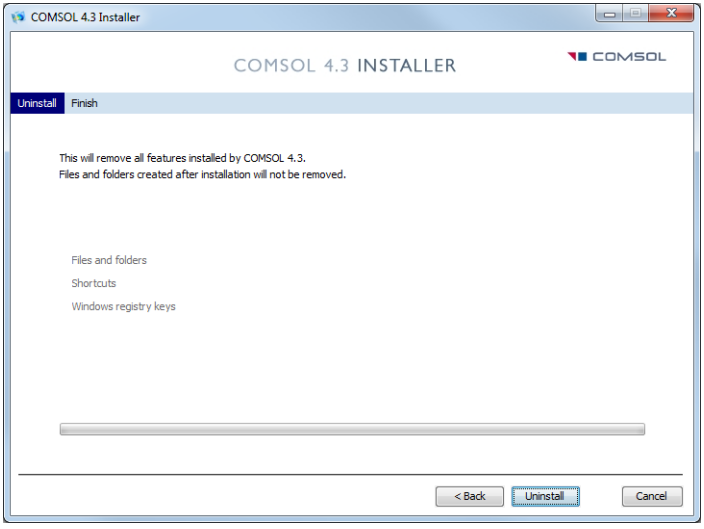
To remove a COMSOL installation from your system, use the COMSOL Uninstaller.

Note	The uninstaller deletes all COMSOL 4.3 files and directories on the system that were installed by the COMSOL installer. Additional files and folders created after installation are not removed.

Note	If COMSOL Multiphysics is run with MATLAB, close MATLAB before starting the uninstaller. If MATLAB is active, the utility cannot remove certain files.

You can start the COMSOL Uninstaller in three ways:

- From the Windows Start Menu, open the **Control Panel** and select **Uninstall a program**. Find COMSOL 4.3 in the list and select uninstall.
- From the Windows Start Menu under **COMSOL 4.3**, select **Uninstall COMSOL 4.3**.
- By inserting the COMSOL DVD and starting the COMSOL Uninstaller. Click **Uninstall COMSOL 4.3** to start removing the installation. Click **Finish** to quit the installer when the uninstallation is complete.



Automated Removal (Uninstallation) of COMSOL

You can automatically uninstall COMSOL by running

```
<path to COMSOL>\bin\win32\comsoluninstall <path to COMSOL> -s
```

where `<path to COMSOL>` is the path to the COMSOL installation directory.

Alternatively, you can also uninstall COMSOL using an answer file. The documentation on how to create such an answer file is in the template answer file, `setupconfig.ini`, which is available on the DVD. When an answer file is created for uninstalling, you start the uninstallation by running

```
<path to DVD>\setup.exe -s <answer file path>
```

where `<answer file path>` is the path to your answer file.

Configuring Model Library Update

Using the preferences described under Updates in the section Editing Preferences Settings in the *COMSOL Multiphysics User's Guide* you can configure proxy server settings as well as model and documentation directories for Model Library Update. See also Documentation and Model Library Root Directories for the related COMSOL options `-docdir` and `-modelsdir`.

Changing the Path to the MATLAB Installation

Change the path to the MATLAB installation in the user preferences you can access directly from the COMSOL Desktop. See the **LiveLink products** section in Editing Preferences Settings in the *COMSOL Multiphysics User's Guide*.

Adding the LiveLink Interface to SolidWorks

If you have acquired LiveLink for SolidWorks, the COMSOL Installer adds an add-in to SolidWorks called the **LiveLink for COMSOL (4.3)**. This add-in should appear in the SolidWorks user interface, listed in the **Add-Ins** dialog box, accessible from the **Tools** menu.

The connection between COMSOL and SolidWorks can fail if SolidWorks is installed after COMSOL or if you make manual changes to the Windows registry. In the case of such a failure, it is possible to set up the connection as follows:

1 Close SolidWorks if it is running on your computer.

2 Click the Start menu symbol in the lower-left corner of your Windows desktop.

3 Enter `cmd` in the **Start Search** field.

4 cmd.exe appears in the list of programs. Right-click on it and select **Run as administrator**.

5 In the command window that appears enter one of the following, depending on your operating system:


Important

Both commands need to be entered, and the complete command string must be written on a single row.

- on 32-bit Windows:

```
C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\SolidWorks\win32\
cslivelinksw.dll /codebase
C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\SolidWorks\win32\
cscomactivex.dll /codebase
```

- on 64-bit Windows:

```
C:\WINDOWS\Microsoft.NET\Framework64\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\SolidWorks\win64\
cslivelinksw.dll /codebase
C:\WINDOWS\Microsoft.NET\Framework64\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\SolidWorks\win64\
cscomactivex.dll /codebase
```

In the above `C:\Program Files\COMSOL\COMSOL43` is the local path to your COMSOL installation.

6 Open SolidWorks and on the **Tools** menu select **Add-Ins**.

7 In the **Add-Ins** dialog box that opens, make sure that the **LiveLink for COMSOL (4.3)** item is active by checking the appropriate check boxes.

Adding the LiveLink Interface to Autodesk Inventor

If you have purchased LiveLink for Inventor, the installer adds an add-in to Autodesk Inventor called the **LiveLink for COMSOL (4.3)**. This add-in should appear in the **Add-In Manager** dialog box which is accessible from the **Options** tab of the **Tools** panel in the Autodesk Inventor user interface.

In case the connection between COMSOL and Autodesk Inventor fails, it is possible to set up the connection as follows:

1 Close Autodesk Inventor if it is running on your computer.

2 Click the Start menu symbol in the lower-left corner of your Windows desktop.

3 Enter `cmd` in the **Start Search** field.

4 cmd.exe appears in the list of programs. Right-click on it and select **Run as administrator**.

5 In the command window that appears enter one of the following, depending on your operating system:


Important

The complete command string must be written on a single row.

- on 32-bit Windows:

```
C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\Inventor\win32
\cslivelinkinv.dll /codebase
```

- on 64-bit Windows:

```
C:\WINDOWS\Microsoft.NET\Framework64\v2.0.50727\RegAsm.exe
C:\Program Files\COMSOL\COMSOL43\ext\LiveLink\Inventor\win64\
cslivelinkinv.dll /codebase
```

In the above `C:\Program Files\COMSOL\COMSOL43` is the local path to the COMSOL installation.

6 Open Autodesk Inventor and check that the add-in **LiveLink for COMSOL (4.3)** appears and is loaded in the **Add-In Manager** dialog box.

Changing the Path to the Pro/ENGINEER Installation

If you have acquired the LiveLink for Pro/ENGINEER, you need to provide the installation path for Pro/ENGINEER during the install process. After the installation you can configure the interface to work with a different Pro/ENGINEER installation. Edit the file `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `C:\Program Files\COMSOL\COMSOL43`). In the file, change the line starting with

```
-Dcs.proeroot
```

to point to the root directory of the Pro/ENGINEER installation, typically

```
-Dcs.proeroot=C:\Program Files\proeWildfire 5.0
```

or

```
-Dcs.proeroot=C:\Program Files\PTC\Creo Elements\Pro5.0
```

for an installation of Creo Elements/Pro.

If you have installed both the LiveLink for Pro/ENGINEER and the LiveLink for Creo Parametric, you can use only one of those during a COMSOL Multiphysics modeling session. The default is to connect to Creo Parametric. To connect to Pro/ENGINEER locate the following line in the `comsol.ini` file

```
#-Dcs.useproe
```

and delete the # sign from the beginning of the line, then restart COMSOL. To connect to Creo Parametric again add the # sign to the beginning of the line

```
-Dcs.useproe
```

Changing the Path to the Creo Parametric Installation

If you have bought the LiveLink for Creo Parametric, you need to provide the path to the common files folder in the Creo Parametric installation during the install process. After the installation you can configure the interface to work with a different Creo Parametric installation. Edit the file `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `C:\Program Files\COMSOL43`). In the file, change the line starting with

```
-Dcs.creoproot
```

to point to the common files directory of the Creo Parametric installation, typically

```
-Dcs.creoproot=C:\Program Files\PTC\Creo 1.0\Common Files\F000
```

License Manager Installation

In this section you will find information about:

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. The computer where the license manager is installed is called the *license server* and any computer that has the COMSOL applications installed is called *clients*. COMSOL can be installed anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server *and* a client, holding both the license manager and COMSOL. The COMSOL license manager does *not* require a MATLAB license manager.

The license manager and COMSOL can be installed in any order. A full test of the installation cannot be done until both are installed.

COMSOL uses the FlexNet™ license manager version 11 from Flexera Software, Inc. for license management.


Note

FlexNet was formerly called FLEXlm.

System Requirements

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager, memory and graphics requirements are not necessary. The COMSOL license manager is completely independent of the MATLAB license manager.

Obtaining a FlexNet License File

To install a COMSOL license manager requires a FlexNet license file, `license.dat`. It looks something like this:

```
#-------------------------------------------------------------
# COMSOL 4.2a FNL License No: 1234567
# Visit www.comsol.com/install for latest installation instructions
#-------------------------------------------------------------
SERVER my_server 0050569e1b87 1718
USE_SERVER
VENDOR LMCOMSOL port=1719
FEATURE SERIAL LMCOMSOL 4.2 permanent uncounted \
    VENDOR_STRING=C,5701108 HOSTID=ANY BORROW=720 SN=1234567 TS_OK \
    SIGN=0C3A8BF6722E
INCREMENT COMSOL LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT HEATTRANSFER LMCOMSOL 4.2 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLIENTSERVER LMCOMSOL 4.2 permanent 4 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLUSTERNODE LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=U \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
```


Note

A COMSOL `license.dat` file is shipped with the COMSOL package. If the file has not been received, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name `<my_server>`, the hostid of the license server, and an optional port number.

Confirm that the license server name is the actual name of your license server; otherwise, change it by editing the file. The default port number (1718) can also be changed in the unlikely case that another program is already using that port number. If the default port number is being used, change it to another number between 1025 and 64,000.

The VENDOR line defines the name of the vendor daemon binary, LMCOMSOL.


Important

If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager.

To implement this requirement, make sure the VENDOR line in the license.dat file reads VENDOR LMCOMSOL port=1719 (the number can be any unused port number in the allowed range). Then configure the firewall to allow access to the chosen port numbers (in the example above, 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, contact your system administrator.


Caution

Do not modify anything in the license.dat file except license server name and (if necessary) port numbers or the license may not work.

The SERIAL line contains license information.

The INCREMENT (can also be FEATURE) lines contain a product name, version, expiration date, and the number of available licenses. The example file above shows that the user has a permanent COMSOL 4.2a license allowing four concurrent users of COMSOL Multiphysics and two concurrent users of the Heat Transfer Module. The number after "SIGN=" at the end of each INCREMENT line contains a license key. Long lines can be broken by a continuation character (\).

In the license.dat file has not been received, provide COMSOL with the hostid of your license server (for Windows, see Obtaining a Hostid, for Linux, see Obtaining a Hostid, and for Mac, see Obtaining a Hostid for instructions) and preferably the license server name. Have these ready when contacting your local COMSOL representative.

License Manager Installation on Windows

You only need to install the license manager if you have obtained a license file that starts with a line that contains the word `SERVER`.

The license server requires these components:

- COMSOL license manager files (FlexNet)
- License file (`license.dat`)

FLEXNET COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of four components:

- License manager daemon (`lmgrd.exe`)
- Vendor daemon (`LMCOMSOL.exe`)
- FlexNet utility program (`lmutil.exe`)
- FlexNet Control Panel (`lmtools.exe`)

The two daemons (`lmgrd.exe` and `LMCOMSOL.exe`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd.exe` daemon. That daemon in turn makes a request to the vendor daemon (`LMCOMSOL.exe`), which releases licenses according to information in `license.dat`. The utility program and Control Panel handle license-server management. For more information, select **Help>Documentation** from the main menu, and scroll to the bottom of the page to locate a PDF copy of the *FlexNet Licensing End Users Guide* (see Chapter 7).

INSTALLING THE LICENSE MANAGER FILES

Install the license manager only on the host(s) listed in `license.dat`.

If you want to install COMSOL on the same host as the license manager, first perform a complete COMSOL installation because that procedure installs the license manager files along with COMSOL. See Installing COMSOL for installation instructions. When finished, skip the remainder of this section and continue with Starting the License Manager.

To install only the COMSOL license manager files, follow these instructions:

1. Insert the DVD into the DVD drive.
2. Follow the installation instructions starting with Installing COMSOL until you reach the **Features** screen in Step 4.

3 In the list of products to install, select only the **License Manager** check box.

4 Continue from the **Features** screen in the installation instructions to complete the license manager file installation.

Automated License Manager Installation

Alternatively, the license manager can be installed using an automated installation process with minimal user interaction. See the section Automated Installation. Set `licmanager = 1` in the answer file to install the license manager.

STARTING THE LICENSE MANAGER

The license manager can be started manually, or it can run automatically as a service at boot.

Starting the Manager Automatically as a Service

To set up the license manager as a service from the FlexNet Control Panel:

1 Locate the `COMSOL43\license\win32` (32-bit Windows) or `COMSOL43\license\win64` (64-bit Windows) directory and run `lmtools.exe`.

2 On the **Service/License File** page choose **Configuration using Services**.


Important

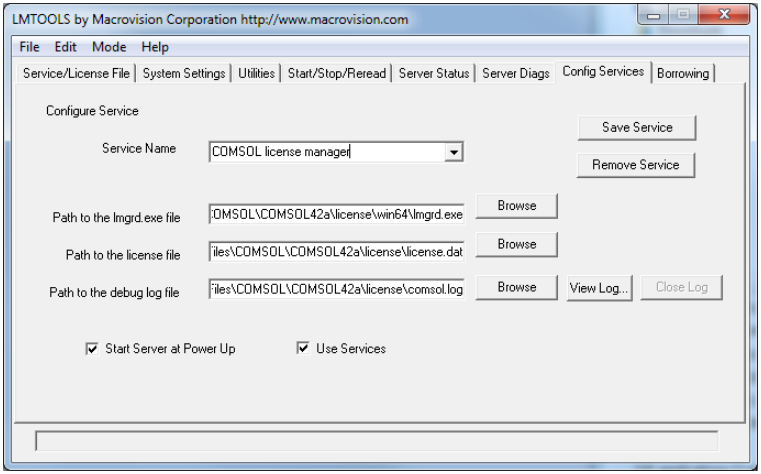
This step must be done every time the FlexNet Control Panel is started.

3 Click the **Configure Services** tab.

4 Make an entry in the **Service Name** field, for example, `COMSOL License Manager`.

5 Specify the full path to `lmgrd.exe`, `license.dat`, and the debug log file name of your choice.

6 Select the **Use Services** check box (this might not be possible on all platforms, but it is recommended) and then the **Start Server at Power Up** check box.



7 Click **Save Service**. The license manager now starts at boot. If you prefer, start the license manager directly by choosing **Start Server** on the **Start/Stop/Reread** page.

Starting the Manager Manually

To start the license manager manually, change to the `license\win32` (Windows) or `license\win64` (64-bit Windows) directory. Now, in a command window enter

```
lmgrd -c ..\license.dat -l ..\comsol43.log
```

The license manager is now ready to distribute licenses over the network. It writes debug information to the log file `COMSOL43\license\comsol43.log`.

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s), you can start using COMSOL.

Changing the License

If you have received a new license file—for example, when adding COMSOL products to an existing license—replace the current license file with the new one. Double-check the contents of this file to make sure it lists the products that the license includes.


Important

When the license file has changed, you must restart the license manager; otherwise, it continues to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager, follow these steps:

1. In the Windows Start menu, choose **COMSOL4.3>License Tools>LMTOOLS**.
2. In the FlexNet Control Panel, click, in turn, **Stop Server**, **ReRead License File**, and **Start Server**.

Obtaining a Hostid

If COMSOL is already installed on the license server, determine the hostid by executing the `lmhostid` command

```
COMSOL43/license/$arch/lmhostid
```

where `$arch` is `win32` (32-bit Windows) or `win64` (64-bit Windows).

If COMSOL is not installed, obtain a hostid using the: `ipconfig /all` command on the license server.

All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

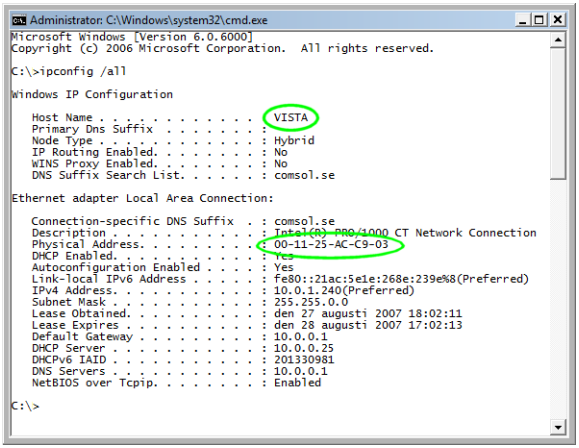
OBTAINING THE HOSTID

1. Open the Start menu and click **Run**.
2. Enter `cmd` and click **OK** and the command window opens.
3. Enter

   ```
   ipconfig /all
   ```

   and press Enter.

4 The FlexNet hostid is equal to the **Physical Address**, which is displayed in the next image, with the hyphens removed. For example, 00-11-25-AC-C9-03 becomes the hostid 001125ACC903.



Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/install for up-to-date information about installation and license issues.

TABLE 2-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com.
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `C:\Program Files\COMSOL43\license\comsol43.log` Please send the log file to `support@comsol.com` if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the lmgrd daemon and the LMCOMSOL daemon. If the problems remain, send the license manager log file to `support@comsol.com`. The log file is usually placed here: `C:\Program Files\COMSOL43\license\comsol43.log`

TABLE 2-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION

License error: -15. Cannot connect to license server system.	The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:
	`SERVER mylicserver 000123456789 1716`
	a license manager is required. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.
	Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.
	Check that the `license.dat` file on the COMSOL client computer points to the correct license server hostname. First, find the `license.dat` file in the COMSOL application folder:
	`C:\Program Files\COMSOL43\license\license.dat`
	Check that the first line has the correct license-server hostname. For example, if your license server hostname is `mylicserver`, the first row in the license.dat file should look like this:
	`SERVER mylicserver 000123456789 1716`
	If the COMSOL client computer does not recognize `mylicserver` as a proper hostname, it might help to instead use the fully qualified domain name (`mylicserver.mydomain.org`) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.
	Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:
	`C:\Program Files\COMSOL43\license\comsol43.log`
	NOTE: The log file is created by the license manager after it has been started.
	Please send the log file to support@comsol.com if you want help in interpreting the information.

TABLE 2-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, `LMCOMSOL.opt`. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the `license.dat` file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The `license.dat` file is located in the COMSOL application folder: `C:\Program Files\COMSOL43\license\license.dat`
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `C:\Program Files\COMSOL43\license\comsol43.log` NOTE: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

Running COMSOL

The installer adds the folder **COMSOL 4.3** to the **Start** menu under the **Programs** item. That folder contains a selection of the items in the following list depending on the licensed COMSOL software products you have:

- **COMSOL Multiphysics**: Opens COMSOL Multiphysics. A corresponding shortcut is added to the desktop.
- **COMSOL with MATLAB**: Starts MATLAB R2012a/R2011b and sets up all necessary paths. Also starts a COMSOL server connected to MATLAB. A corresponding shortcut is added to the desktop.
- **COMSOL Multiphysics Server**: Starts a COMSOL Multiphysics server that a COMSOL Multiphysics client can connect to.
- **Documentation**: A folder that contains COMSOL documentation shortcuts.

In this section:

Running COMSOL Multiphysics

You can run COMSOL Multiphysics by double-clicking the **COMSOL Multiphysics 4.3** icon on the desktop.

Alternatively, to activate COMSOL Multiphysics from the **Start** menu, point to **Programs**, then to **COMSOL 4.3**, and then click **COMSOL Multiphysics**.

Running COMSOL on Multicore and Multiprocessor Computers

By default, a COMSOL process uses all cores and all processors on your computer using shared-memory parallelism. It uses the system environment variable `NUMBER_OF_PROCESSORS` to determine the number of available cores and processors.


Note

To override this behavior, see Shared-Memory Options.

Running a Classkit License

The COMSOL installation program automatically installs a shortcut on the desktop that launches COMSOL using your classkit license.

Running COMSOL in Batch Mode

You can submit COMSOL batch jobs from the COMSOL Desktop and the command line. In the Model Builder, right-click on a **Study** node and select **Batch** to create batch jobs.


See Also

For command-line options, see COMSOL Batch Commands.

Running COMSOL on Clusters

You can launch COMSOL cluster jobs from the COMSOL Desktop and the command line. To run COMSOL on a cluster, you need to make the cluster feature visible: click the **Show** button ( ) and select **Advanced Study Options**. Then in the **Model Builder**, right-click a **Study** node and select **Cluster Computing** to create cluster jobs.

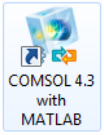

Note

Cluster computing requires an FNL (floating network) license.

See Also	For more information about how to run COMSOL in parallel on Windows clusters, see Running COMSOL in Parallel in the *COMSOL Multiphysics User's Guide* For command-line options, see COMSOL Cluster Commands.

Running COMSOL Multiphysics with MATLAB

To run COMSOL Multiphysics with MATLAB, double-click the **COMSOL 4.3 with MATLAB** icon on the desktop.



Alternatively, start COMSOL Multiphysics with MATLAB from the **Start** menu by pointing to **Programs**, then to **COMSOL 4.3**, and then select **COMSOL 4.3 with MATLAB**.

Tip	Running COMSOL Multiphysics with MATLAB starts a COMSOL server and a MATLAB Desktop. The COMSOL Desktop is not involved. For tutorial on using the LiveLink interface for MATLAB, see the *Introduction to the LiveLink for MATLAB*.

Note	Running COMSOL Multiphysics with MATLAB requires a LiveLink for MATLAB license.

The COMSOL Commands

Use a COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL commands is

```
<command> [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. On windows there are several different commands (See *<command>* in the command syntax) that can be combined with optional targets to achieve various results. The table below lists the major available commands and targets.:

TABLE 2-4: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
`comsol`	Run standalone COMSOL Multiphysics	
`comsolserver`	Start COMSOL Multiphysics server	
`comsol client`	Run COMSOL Multiphysics client	
`comsolbatch`	Run a COMSOL MPH-file or class file	
`comsolcompile`	Compile a Model Java-file	
`comsolcluster`	Run COMSOL Desktop on a cluster	Requires a floating network license (FNL)
`comsolclusterbatch`	Run COMSOL cluster version in batch mode	Requires a floating network license (FNL)
`comsolclusterserver`	Run COMSOL cluster server	Requires a floating network license (FNL)
`comsolserver matlab`	Start MATLAB and connect to a COMSOL server	Requires a LiveLink for MATLAB license
`comsol convertpre35a`	Convert 3.0–3.5 models	

The commands are available in 32-bit versions in the subdirectory `bin\win32` in the COMSOL installation directory, and in 64-bit versions in the subdirectory `bin\win64` in the COMSOL installation directory. The COMSOL installer sets up a few of the possible commands on your start menu and your desktop. To create additional

customized commands, you can create shortcuts including all argument and put them on your desktop. You can also issue COMSOL commands in a command window. To conveniently access the command in a command window, you need to set up the Windows path to include one the paths `bin\win32` or `bin\win64` in the COMSOL installation directory.

INI FILES

For each launcher file, there is a corresponding `.ini` file in the same directory. It is sometimes recommended that these files are edited. For example, you can add options to any of the above commands by modifying the corresponding ini file.To change the option `opt` to value `val`, add the line

```
-Dopt=val
```

to the file `comsol.ini`. Change the file `comsolbatch.ini` for `comsolbatch`, and similarly for the other COMSOL targets.

OPTIONS

You can enter various options after the COMSOL command and target. Table 2-5 lists the options (See `[<options>]` in the command syntax) available for all COMSOL commands. Always issue these options between the command and the target (if any).

TABLE 2-5: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-h`	Print general help	
`<target> -h`	Print target-specific help	
`-3drend ogl | dx9 | sw`	3D renderer: OpenGL, DirectX, or software rendering	
`-docroot <path>`	Specify custom path to the COMSOL documentation root directory.	See Documentation and Model Library Root Directories
`-modelsroot <path>`	Specify custom path to the COMSOL Model Library root directory.	See Documentation and Model Library Root Directories
`-np <no. of processors>`	Number of processors	See Shared-Memory Options
`-numasets <no. of sets>`	Number of NUMA sets	See Shared-Memory Options

TABLE 2-5: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-mpmode throughput | turnaround | owner`	Multiprocessor mode	See Shared-Memory Options
`-blas {auto} | mkl | acml | path`	BLAS library to use	See BLAS Options
`-blaspath <path>`	BLAS library path	See BLAS Options
`-ipv6`	Activate IPv6 support	
`-prefsdir <path>`	Preference directory	
`-tmpdir <path>`	Temporary file directory	
`-version`	Print COMSOL version	
`-version <target>`	Print target version	
`-ckl`	Use class-kit license	
`-autosave {on} | off`	Control saving of recovery files	
`-recoverydir <path>`	Path to recovery directories	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefsdir` option specifies the directory where COMSOL should store the preference file.

Documentation and Model Library Root Directories

In a default COMSOL installation, the documentation files are located in the directory `doc` under the installation root directory. You can use the `-docroot` option if you want to move the documentation directory to a different location. Similarly, use the `-modelsroot` option if you want to move the Model Library root directory `models` from its default location under the COMSOL installation root. Relocating the documentation and Model Library root directories can be useful for administering Model Library Update; see Configuring Model Library Update.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Use the option `-numasets` to control the number of Non-Uniform Memory Access node sets COMSOL should take into account. This is usually the number of processor sockets that the hardware is using.

Depending on how loaded the machine is, you can control how COMSOL uses the available processors. The following options are available:

TABLE 2-6: COMSOL MULTIPROCESSOR MODE OPTIONS

MPMODE OPTION	DESCRIPTION
`throughput`	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
`turnaround`	Typically provides the best performance when no other processes than COMSOL are active.
`owner`	Provides the highest performance in most cases.

You may need to experiment to find the options that work best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides for the following BLAS related options:

TABLE 2-7: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL for Intel processors, and ACML for AMD processors with SSE2 support, otherwise MKL. (This is the default option.)
mkl	Use the Intel MKL library.
acml	Use the AMD ACML library.
path	Use a BLAS library specified using the option `-blaspath` or the environment variable `COMSOL_BLAS_PATH`. The library must support the standard FORTRAN BLAS interface.

Both MKL and ACML are distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where `ARCH` is the architecture (`win32` or `win64`) or somewhere in the standard search path. Also provide the path to any sub-libraries needed by the library. Set the search path to point to the directory where the library is installed. To do so, use the environment variable `PATH`.

COMSOL COMMANDS

In additions to the options in Table 2-5, the standalone COMSOL command supports the following option.

TABLE 2-8: COMSOL COMMAND-LINE ARGUMENTS

COMSOL OPTIONS	DESCRIPTION
`-open <file>`	Open file

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The Windows syntax for the COMSOL server command is

```
comsolserver [<options>] [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 2-9: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTION	DESCRIPTION
`-user <user>`	Specify login name for a user
`-port <port>`	Specify a TCP/IP port to listen for connect attempts.
`-passwd reset|nostore`	Specify that you want to provide a new password.To avoid storing the new password on file use nostore
`-login {info}|force|never`	Ask for login information. `info` means that only missing information is asked for.
`-multi on|{off}`	Accept repeated client connections
`-silent`	Do not listen to standard input
`-graphics`	Start the server with graphics libraries. This displays plots on the server when you are connected with a client (that is, not with the COMSOL GUI).

Accessing the COMSOL Server Computer

The server computer can be accessed in several ways. If it is dedicated to a single person, you can sit down at that machine and log in on it. You can also connect to the server computer by using Remote Desktop. Start the COMSOL server from the **Start**

menu. If several people want to access a single Windows computer to run the COMSOL server, you must use Windows Terminal Server or another tool that allows multiple users to log in on the same Windows server. In some Windows versions, Microsoft provides a Telnet Server with which you can log in through a terminal window. When using a terminal window to log in on Windows, use the `comsolserver` command to start the COMSOL server.

Login Information

When a COMSOL Multiphysics server is started for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password in the **Connect to Server** dialog box. The software writes this login information in the subdirectory `.comsol/v43/login.properties` in your Windows home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Important

Always make sure that untrusted users cannot access the COMSOL login information. Protect the file `.comsol/v43/login.properties` in your home directory. This is important when running COMSOL Multiphysics in client/server mode. Alternatively, start the COMSOL server with the `-passwd nostore` option, and clear **Remember Password** when connecting to the server. This ensures that your login information is not stored on file.

Once a COMSOL Multiphysics server is started, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption

of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [<options>] client [<target arguments>]
```

The following target arguments are available for a COMSOL client command.

TABLE 2-10: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
`-port <port>`	Specify a TCP/IP port to connect to
`-server <server name>`	Specify server to connect to
`-open <file>`	Open file

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. Run both Model MPH-files and Model Java-files with the COMSOL batch command. Model Java-files need to be compiled before running.

The Windows syntax for the COMSOL batch command is

```
comsolbatch [<options>] [<target arguments>]
```

Its detailed target arguments are:

TABLE 2-11: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
`-inputfile <file name>`	Run a Model MPH-file or class file
`-outputfile <file name>`	Save a Model MPH-file using the given file name. If output is not given, the input file is overwritten with the output
`-job <job tag>`	The batch job to run
`-study <study tag>`	The study to compute
`-pname <parameter name>`	Comma-separated list of parameter names
`-plist <parameter value>`	Comma-separated list of parameter values
`-batchlog <file name>`	File to store log in
`-client`	Run as client

TABLE 2-11: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
`-host`	Connect to host
`-port`	Connect to port
`-graphics`	Start COMSOL batch with graphics libraries. This displays plots during analysis.
`-nosave`	Do not save the resulting model

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsolbatch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the `out.mph`.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compiles a Model Java-file for use by the COMSOL batch command or for loading class files into the GUI. The Windows syntax for the COMSOL compile command is

```
comsolcompile [<options>] [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available‘

TABLE 2-12: COMSOL CLUSTER TARGET ARGUMENTS

COMSOL COMPILE TARGET ARGUMENTS	DESCRIPTION
`-jdkroot <path>`	Path to the JDK root
`-classpathadd <classpath>`	Additional classpath
`-verbose`	Verbose output

COMSOL CLUSTER COMMANDS

All COMSOL cluster commands require a floating network license.

The Windows syntax for the COMSOL cluster command is

```
mpiexec -n <no. of nodes> <command> [<options>] [<target arguments>]
```

The following cluster commands are available:

TABLE 2-13: COMSOL CLUSTER TARGETS

COMSOL CLUSTER COMMANDS	DESCRIPTION
`comsolclusterbatch`	Run COMSOL on a cluster in batch mode
`comsolclusterserver`	Run COMSOL server on a cluster
`comsolcluster`	Run COMSOL Desktop on a cluster

The preferred way of starting COMSOL jobs is from the Job Configurations node in the COMSOL Desktop.


Model

Micromixer—Cluster Version: Model Library path **COMSOL_Multiphysics/Tutorial_Models/micromixer_cluster**

If you need to start COMSOL cluster jobs from the command line, the preferred way is to use the `comsolclusterbatch` command since the `comsolclusterserver` and `comsolcluster` commands require TCP/IP access from your client computer to the cluster node where COMSOL runs.

The Windows Configuration

- Make sure that Windows HPC Server 2008 or Windows Compute Cluster Server 2003 is installed. Running distributed COMSOL on other Windows versions is not supported.
- Make sure that the Windows HPC Server 2008 working directory is set to point to the `comsol` command directory (*`<path to COMSOL install directory>`*`\bin\win64`). The install directory must be shared between the nodes on your cluster.
- Also make sure that the Microsoft Visual Studio 2010 and 2008 Runtimes are installed on all nodes. They are called `vcredist_*.exe`. You can install them from the root directory of the DVD using the `clusrun` command for instance.
- Also make sure that all nodes that you intend to run COMSOL on have access to the license manager and that you can start COMSOL running in nondistributed mode. The nodes require access to the license manager in order to check out licenses.

Example of the COMSOL Batch Command

Schedule a job with the command

```
mpiexec -n -1 comsolclusterbatch.exe -np 2 -inputfile <filename>
```

to run a COMSOL batch on a number of computational nodes given by `mpiexec`. For further information about the `mpiexec` command and Windows HPC Server 2008, consult the documentation that was shipped with the product and the online manuals.

Example of the COMSOL Server Command

When a COMSOL server cluster job is created, a preference directory must be set and be reachable from all nodes to avoid problems with the server login; see The COMSOL Commands and Login Information. The preferences can be generated by starting COMSOL server once on the head node using the command

```
comsolserver.exe -prefsdir <prefsdir>
```

where *<prefsdir>* is a preference directory *common* to all nodes.

When the COMSOL server is started on the cluster, the port number is written to standard output, so a standard output file and a standard error file must be set for the cluster job. To start a COMSOL server, schedule a job with the following command:

```
mpiexec -n -1 comsolclusterserver.exe -np 2 -prefsdir <prefsdir>
```

The argument `-1` indicates that the number of computational nodes is decided at the `mpiexec` launch. You must be able to access the cluster node where the COMSOL server runs from the COMSOL client computer.

COMSOL MPI Options

The COMSOL cluster target arguments specify what MPI library to use and what Scalapack version to use. There are several implementations of MPI. COMSOL by default uses the Windows HPC Server 2008 or Windows CCS 2003 MPI libraries. COMSOL also supports most MPI implementations based on MPICH2. It is recommended that the default library is used. COMSOL also has a compatibility mode that is activated by adding the option `-mpi mpich2`. When using this option both the variables `PATH` and `LD_LIBRARY_PATH` must include the MPI implementation. It is also possible to use other MPI libraries based on MPICH2 using the option `-mpipath <path to shared library>`. The following target arguments are available for a COMSOL cluster commands.

TABLE 2-14: COMSOL CLUSTER TARGET ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
`-mpi {auto} | mpich2 | wccs2003 | whpc2008 | user | path`	MPI library to use
`-mpipath <path>`	MPI library path

TABLE 2-14: COMSOL CLUSTER TARGET ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
`-scalapack {auto} | mpich2 | wccs2003 | whpc2008 | user | path`	Scalapack library to use
`-scalapackpath <path>`	Scalapack library path

The Cluster Computing study allows you to set up a batch job for submission to a Windows HPC Server 2008 job scheduler or Windows Compute Cluster Server 2003 job scheduler. There are several settings that you can configure in the `comsol.ini` file to get default settings:

```
-Dcs.scheduler=<IP or network adress>
-Dcs.clusteruser=<Username on cluster>
-Dcs.rundir=<Where the model file is located on the cluster>
-Dcs.comsoldir=<Installation path to comsol on the cluster>
```

Additionally you can configure the commands:

```
-Dcs.precmd=<Command line>
-Dcs.postcmd=<Command line>
```

This adds commands prior to the `comsol` command and after the `comsol` command. You can add `{nn}` or `{perhost}` to any of these pre- or postcommands. This configures the Cluster Computing study to use the number of nodes and number of nodes on each host from the corresponding settings for the Cluster Computing study. For more information see the documentation for the Cluster Computing study in the *COMSOL Multiphysics Reference Guide*.

COMSOL MATLAB COMMAND

Use the COMSOL MATLAB command to access the COMSOL Java API through MATLAB. Type:

```
comsolserver matlab.
```

which launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server.

The following options are available for the `comsolserver matlab` command:

TABLE 2-15: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-mlroot <path>`	MATLAB installation directory
`-host <hostname>`	Connect to host
`-port <hostname>`	Connect to port
`-desktop`	Start with Desktop

TABLE 2-15: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-nodesktop`	Start without Desktop
`-mlnosplash`	Start without MATLAB splash screen
`-graphics`	Start the server with graphics libraries. This enables plotting on the server. Available only when running `comsolserver matlab [<options>]`.

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` command to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, enter

```
comsol [<options>] <input directory> <output directory> [log_file]
```

where *<input directory>* is the input directory, *<output directory>* is the output directory, and *[log_file]* is an optional log file. If the third argument is not provided, the log is printed on standard output.

TABLE 2-16: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-c35aroot <path>`	Installation path of COMSOL 3.5a

3

Installing and Running on Linux

This chapter provides detailed instructions for installing and running the COMSOL software on Linux. You also find complete system requirements and license manager information. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Linux. See also the COMSOL Support Knowledge Base on www.comsol.com/install for specific troubleshooting tips.

System Requirements


Note

For the most current system requirements, see www.comsol.com/products/requirements/

In this section:


See Also

.

COMSOL Multiphysics System Requirements for Linux

SYSTEM REQUIREMENTS—32-BIT LINUX

- GNU C Library version 2.3.6 or later
- Linux kernel 2.6.18 or later
- Intel Pentium IV or AMD Athlon processor or later.

SYSTEM REQUIREMENTS—64-BIT LINUX

- GNU C Library version 2.3.6 or later
- Linux kernel 2.6.18 or later
- A PC with one of these processors: AMD with AMD64 or Intel with EM64T.

OFFICIALLY SUPPORTED LINUX DISTRIBUTIONS

The following Linux distributions are officially supported by COMSOL:

PLATFORM	DISTRIBUTION
32-bit Linux	Debian 5.0, 6.0, OpenSUSE 11.3, RedHat Enterprise 5[a] and 6, Ubuntu 10.04 LTS
64-bit Linux	Debian 5.0, 6.0, OpenSUSE 11.3, RedHat Enterprise 5[1] and 6, Ubuntu 10.04 LTS

a. RedHat Enterprise 5 is only supported for server, batch, and cluster operation.

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons. Drivers supporting OpenGL version 1.4 are required. For using the **Optimize for Quality** setting in graphics preferences you need OpenGL 2.0. Prefer using drivers from you graphics card vendor. Alternatively, use software rendering; see Options. The Nouveau video driver is only supported for software rendering. Hardware rendering requires at least 24-bit color graphics. Software rendering also supports 16-bit color graphics.

LiveLink for MATLAB Requirements

LiveLink for MATLAB is compatible with MATLAB 2012a and 2011b.

Note

The programs `xterm` and `csh` are required.

The `xterm` program is necessary for the command `comsol server matlab`. The `csh` program is needed to call MATLAB functions from COMSOL.

To install the missing packages on Debian and Ubuntu, type

```
sudo apt-get install xterm csh
```

To install the missing packages on RedHat Enterprise and Fedora, type

```
sudo yum install xterm tcsh
```

To install the missing packages on OpenSUSE, type

```
sudo zypper install xterm tcsh
```

Products for CAD Interoperability

The following products support import of 3D CAD files on Linux platforms:

TABLE 3-1: PRODUCTS FOR CAD INTEROPERABILITY ON LINUX

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCT
CAD Import Module	ACIS (SAT), IGES, Parasolid, Pro/E, and STEP	COMSOL Multiphysics

See Table 3-2 for detailed version information on the supported file formats.

TABLE 3-2: 3D CAD FILE FORMATS SUPPORTED BY COMSOL PRODUCTS ON LINUX.

FILE FORMAT (FILE EXTENSION)	SUPPORTED VERSION
Parasolid (.x_b, .x_t)	up to V22
ACIS or SAT (.sab, .sat)	up to R21
STEP (.step, .stp)	AP203, AP214
IGES (.iges, .igs)	up to 5.3
Pro/ENGINEER (.prt, .asm)	16 to Wildfire 5
Creo Parametric (.prt, .asm)	1.0

Note

To import ACIS, SAT, STEP, IGES and Pro/ENGINEER files on a 64-bit linux system, the system must be able to run 32-bit programs.

Parallel System Requirements

COMSOL 4.3 supports shared-memory parallelism and distributed-memory parallelism for 32-bit and 64-bit Linux. For distributed-memory parallelism, COMSOL 4.3 supports Red Hat Enterprise Linux 5 and 6, and all computers in the cluster must use the same Linux version and should have similar hardware.

Internet Protocol Support

IPv4 and IPv6 are supported on all Linux platforms.

Installing COMSOL

In this section:

Before You Begin

Check that you have a license file `license.dat`, which you should have received by email. If you have not received a license file, contact your local COMSOL representative.

The license manager must be installed and started before running a COMSOL software product with the exception of trial licenses, which do not require a license manager. See License Manager Installation for instructions. You can install your COMSOL software products and the license manager in any order.

The installation program is an X-Windows application and needs access to an X-Windows display to run. Make sure that your DISPLAY variable is set up correctly and that you have access to an X-Windows display. Try the command `xclock` to test that the X-Windows display is working properly. To install your COMSOL software products in a system directory such as `/usr/local`, you might need to run the installation program as the root user. The COMSOL installer for Linux does not modify any files on your system outside the COMSOL installation directory.

Installing COMSOL

1. Insert the COMSOL 4.3 DVD into the DVD drive.
2. If the DVD is not mounted automatically by your operating system, use the `mount` command to mount it.
3. To start the installation, enter the command

```
sh drivepath/setup
```

where *drivepath* is the mount point of the DVD drive, for example, `/media/cdrom`.

You may have to mount the DVD with the option `-o exec` if your Linux mounts the DVD without execute options by default.

4. When the installer window appears, click **New Installation**.
5. Read the license agreement, select **I accept the terms of the license agreement**, specify **License information,** and then click **Next**.


Note

If you have a Named Single User License and you are installing the software on the license server a dialog box opens up and you are asked to enter the user to bind the license to.

6. Select the platforms that you want to install and click **Next**.
7. Select the features to install and specify the path to the COMSOL installation directory.
8. Click **Next**.
9. Specify the MATLAB root folder. MATLAB versions 2012a and 2011b work with COMSOL 4.3.
10. Click **Next**.
11. Click **Install** to start the installation.
12. When the installation process is finished the **Finish** window appears. If errors arose during installation, this window issues a notification. The installer also writes a log entry into the text file `comsolsetup.log`, which resides in the specified installation directory. Click **Finish** to quit the installer. Use the `unmount` and `eject` commands to unmount and eject the DVD. Some Linux configurations automatically unmount and eject the DVD when you press the DVD drive button.

The file `browser` in the `bin` directory attempts to start common web browsers. Edit the file in any text editor to adjust it for your preferred web browser. The variable `BROWSERS` in this file contains a list of web browsers in order of preference. The default list contains the following web browsers:

- Mozilla
- Firefox
- Konqueror

- Opera
- Netscape

If you, for example, want to make Opera the preferred web browser, put it first in the list.


Tip

To make sure all users can easily start COMSOL, include the `comsol43/bin` directory in all users' paths or make a symbolic link from `/usr/local/bin/comsol` to the `comsol` command (see the `ln` command).

Cluster Installation

The installation instructions can be followed also for clusters, considering the following:

License manager COMSOL requires a floating network license on clusters. Please check the license file for the CLUSTERNODE feature. The license manager needs to be accessible from all nodes in the cluster. Therefore it is often a good idea to have it run on the head node. See License Manager Installation.

Installation folder The COMSOL installation folder should be shared between all compute nodes and the head node.

Features During installation, make sure you select the **Cluster Components** feature.

Access to Cluster If you work on a computer not on the cluster, install COMSOL on that computer. Typically, you use a scheduler to launch jobs on the cluster. Make sure the scheduler client software is installed on the that computer. You can preconfigure the installation to use the scheduler by changing the comsol.ini file according to section MPI Options.

Removing (Uninstalling) the COMSOL Installation

The COMSOL 4.3 installation adds files only in the `comsol42` directory. To remove the COMSOL installation, simply delete the `comsol42` directory including all subdirectories.

Automated Installation

You can supply an answer file to the installer to run an unattended installation or to avoid the need of a display during the installation. The documentation on how to create an answer file is available in the template answer file, `setupconfig.ini`, which you find on the DVD. When you have created an answer file, start the installation by running

```
<path to DVD>/setup -s <answer file path>
```

where `<answer file path>` is the path to your answer file.

Configuring Model Library Update

Using the preferences described under Updates in the section Editing Preferences Settings in the *COMSOL Multiphysics User Guide* you can configure proxy server settings as well as model and documentation directories for Model Library Update. See also Documentation and Model Library Root Directories for the related COMSOL options `-docdir` and `-modelsdir`.

Changing the Path to the MATLAB Installation

Change the path to the MATLAB installation in the user preferences you can access directly from the COMSOL Desktop. See the **LiveLink products** section in Editing Preferences Settings in the *COMSOL Multiphysics User's Guide*.

License Manager Installation

In this section you will find the following information:

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. The computer where the license manager is installed is called the *license server* and any computer that has the COMSOL applications installed is called *clients*. COMSOL can be installed anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server ***and*** a client, holding both the license manager and COMSOL. The COMSOL license manager does ***not*** require a MATLAB license manager.

The license manager and COMSOL can be installed in any order. A full test of the installation cannot be done until both are installed.

COMSOL uses the FlexNet™ license manager version 11 from Flexera Software, Inc. for license management.


Note

FlexNet was formerly called FLEXlm.

System Requirements

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager, memory and graphics requirements are not necessary. The COMSOL license manager is completely independent of the MATLAB license manager.

Obtaining a FlexNet License File

To install a COMSOL license manager requires a FlexNet license file, `license.dat`. It looks something like this:

```
#-------------------------------------------------------------------
# COMSOL 4.2a FNL License No: 1234567
# Visit www.comsol.com/install for latest installation instructions
#-------------------------------------------------------------------
SERVER my_server 0050569e1b87 1718
USE_SERVER
VENDOR LMCOMSOL port=1719
FEATURE SERIAL LMCOMSOL 4.2 permanent uncounted \
    VENDOR_STRING=C,5701108 HOSTID=ANY BORROW=720 SN=1234567 TS_OK \
    SIGN=0C3A8BF6722E
INCREMENT COMSOL LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT HEATTRANSFER LMCOMSOL 4.2 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLIENTSERVER LMCOMSOL 4.2 permanent 4 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLUSTERNODE LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=U \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
```


Note

A COMSOL `license.dat` file is shipped with the COMSOL package. If the file has not been received, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name <*my_server*>, the hostid of the license server, and an optional port number.

Confirm that the license server name is the actual name of your license server; otherwise, change it by editing the file. The default port number (1718) can also be changed in the unlikely case that another program is already using that port number. If the default port number is being used, change it to another number between 1025 and 64,000.

The VENDOR line defines the name of the vendor daemon binary, LMCOMSOL.

If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager.

To implement this requirement, make sure the VENDOR line in the license.dat file reads VENDOR LMCOMSOL port=1719 (the number can be any unused port number in the allowed range). Then configure the firewall to allow access to the chosen port numbers (in the example above, 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, contact your system administrator.

Do not modify anything in the license.dat file except license server name and (if necessary) port numbers or the license may not work.

The SERIAL line contains license information.

The INCREMENT (can also be FEATURE) lines contain a product name, version, expiration date, and the number of available licenses. The example file above shows that the user has a permanent COMSOL 4.2a license allowing four concurrent users of COMSOL Multiphysics and two concurrent users of the Heat Transfer Module. The number after "SIGN=" at the end of each INCREMENT line contains a license key. Long lines can be broken by a continuation character (\).

In the license.dat file has not been received, provide COMSOL with the hostid of your license server (for Windows, see Obtaining a Hostid, for Linux, see Obtaining a Hostid, and for Mac, see Obtaining a Hostid for instructions) and preferably the license server name. Have these ready when contacting your local COMSOL representative.

License Manager Installation on Linux

You do not need to install the license manager if you are installing a trial version. The full version, however, always requires a running license manager on Linux.

You need the following components on the license server:

- COMSOL License Manager files (FlexNet)
- License file (`license.dat`).

COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of three components:

- License manager daemon (`lmgrd`)
- Vendor daemon (`LMCOMSOL`)
- FlexNet utility programs (`lmutil` and others)

The two daemons (`lmgrd` and `LMCOMSOL`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd` daemon. The `lmgrd` daemon in turn makes a request to the vendor daemon (`LMCOMSOL`) to release a license. The vendor daemon releases licenses according to information contained in `license.dat`. The utility programs are used for license-server management. For more information, select **Help>Documentation** from the main menu, and scroll to the bottom of the page to locate a PDF copy of the *FlexNet Licensing End Users Guide* (see Chapter 7).

INSTALLING THE LICENSE MANAGER FILES

The license manager should be installed only on the host(s) listed in `license.dat`.

If you want to install COMSOL on the same host as the license manager, first perform a complete COMSOL installation because that procedure automatically installs the license manager files along with COMSOL (see Installing COMSOL). When finished, skip the remainder of this section and continue at Starting the License Manager.

If you want to install only the COMSOL license manager files, follow these instructions:

1. Insert the DVD into the DVD drive.
2. To start the installation, enter the following command:

   ```
   /media/cdrom/setup
   ```

   depending on where `/media/cdrom` is the mount point of the DVD drive.

3 Continue according to the installation instructions starting with Installing COMSOL until the step where you see the **Features** screen.

4 In the list of products to install, select only the **License Manager** check box.

5 Resume the installation instructions with the **Features** screen to complete the license manager file installation.

Automated License Manager Installation

Alternatively, you can install the license manager using an automated installation process with minimal user interaction. See the section Automated Installation. Set `licmanager = 1` in the answer file to install the license manager.

LICENSE FILES FOR NAMED SINGLE USER LICENSE

If you have a *Named Single User License* the installer automatically creates an *options file* that binds the license to the named user. This section describes the format of the options file and how the `license.dat` file points to the options file.

Below is an example of an options file, `LMCOMSOL.opt`, for a user "philip" who has access to COMSOL Multiphysics, the Structural Mechanics Module, and the CAD Import Module. Notice that to access COMSOL Multiphysics, the options file must include both the COMSOL and the COMSOLGUI features.

```
INCLUDE COMSOL USER philip
INCLUDE COMSOLGUI USER philip
INCLUDE CADIMPORT USER philip
INCLUDE CADREADER USER philip
INCLUDE STRUCTURALMECHANICS USER philip
```

Each `INCLUDE` row in the `LMCOMSOL.opt` file has a corresponding `FEATURE` row in the `license.dat` file (with the `USER_BASED` keyword). The second item on each `FEATURE` row is the name of the feature for which you have a license.

The following table contains the feature names for all products in the COMSOL 4.3 product family:

TABLE 3-3: COMSOL 4.3 PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAMES
COMSOL Multiphysics	COMSOL
COMSOL Multiphysics GUI	COMSOLGUI
COMSOL Multiphysics floating network license	CLIENTSERVER, CLUSTERNODE
AC/DC Module	ACDC
Acoustics Module	ACOUSTICS

TABLE 3-3: COMSOL 4.3 PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAMES
Batteries & Fuel Cells Module	BATTERIESANDFUELCELLS
CAD Import Module	CADIMPORT, CADREADER
CFD Module	CFD
Chemical Reaction Engineering Module	CHEM
Electrodeposition Module	ELECTRODEPOSITION
Geomechanics Module	GEOMECHANICS
Heat Transfer Module	HEATTRANSFER
LiveLink for AutoCAD	LLAUTOCAD
LiveLink for Creo Parametric	LLCREOPARAMETRIC
LiveLink for Inventor	LLINVENTOR
LiveLink for MATLAB	LLMATLAB
LiveLink for Pro/ENGINEER	LLPROENGINEER
LiveLink for SolidWorks	LLSOLIDWORKS
LiveLink for SpaceClaim	LLSPACECLAIM
MEMS Module	MEMS
Optimization Module	OPTIMIZATION
Particle Tracing Module	PARTICLETRACING
Plasma Module	PLASMA
RF Module	RF
Structural Mechanics Module	STRUCTURALMECHANICS
Subsurface Flow Module	SUBSURFACEFLOW

The license.dat file needs to point to the options file. The path to the options file is indicated by the "options" keyword. If your options file is placed here:

```
/usr/local/comsol43/license/LMCOMSOL.opt
```

then the `VENDOR` row in `license.dat` should read

```
VENDOR LMCOMSOL options=/usr/local/comsol43/license/LMCOMSOL.opt
```

STARTING THE LICENSE MANAGER

You can start the license manager manually or it can run automatically at boot.

Starting the License Manager Manually

To start the license manager manually, make the `license/$arch` directory the current directory and enter

```
./lmgrd -c ../license.dat -l /var/tmp/comsol43.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol43.log`.

Starting the License Manager Automatically at Boot

Add Bourne shell commands to the appropriate boot script. You must be a superuser (root) to edit boot scripts.

Caution

For security reasons, it is recommended that the daemons is not started as root. Instead, use a dedicated `username` to start the license manager.

The procedure for editing boot scripts on each platform appears in the following table

TABLE 3-4: BOOT SCRIPT PROCEDURES

PLATFORM	PROCEDURE

SuSE Linux	The following instructions should work for SuSE Linux distributions, where `$arch` is either `glnx86` (32-bit Linux), or `glnxa64` (64-bit Linux).
	In the `comsol43/license/$arch` directory, enter the commands
	`cp rc.lm /etc/init.d/comsol43lm`
	`chmod 755 /etc/init.d/comsol43lm`
	Edit `/etc/init.d/comsol43lm`, replacing `dir` with the full path to the `$arch` platform directory, and replace `username` with an actual username.
	Now create the following link
	`cd /etc/init.d/rc5.d`
	`ln -s ../comsol43lm S91comsol43lm`

TABLE 3-4: BOOT SCRIPT PROCEDURES

PLATFORM	PROCEDURE
Debian Linux	The following instructions should work for Debian Linux distributions, where `$arch` is either `glnx86` (32-bit Linux), or `glnxa64` (64-bit Linux). Copy the file `comsol43/license/$arch/lm_comsol` to `/etc/init.d` Edit `/etc/init.d/lm_comsol`. Update the FP and MYUSER variables as indicated in the file. Use the utility `update-rc.d` to automatically update the system's init script links: `update-rc.d lm_comsol start 99 2 3 4 5 . stop 1 0 1 6 .` This means that the COMSOL license manager is started by runlevels 2, 3, 4, and 5, and stopped by runlevels 0, 1, and 6. Enter `man update-rc.d` for more information on init scripts.
Linux	The following instructions should work for most Linux distributions, where `$arch` is either `glnx86` (32-bit Linux) or `glnxa64` (64-bit Linux). Copy the file `comsol43/license/$arch/rc.lm` and paste it at the end of `/etc/rc.d/rc.local`. Replace '`dir`' in the code fragment with the full path to the `$arch` platform directory, and replace '`username`' with an actual username.

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s) you can start using COMSOL.

Changing the License

If you have received a new license file—for example, when adding COMSOL products to an existing license—replace your current license file with the new one. Double-check the contents of this file to make sure it lists the products that your license includes.

When you have changed the license file you must restart the license manager; otherwise, it will continue to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager, make the `license/$arch` directory under the COMSOL installation directory the current directory, then enter the following commands:

```
./lmdown -c ../license.dat
./lmgrd -c ../license.dat -l /var/tmp/comsol43.log
```

Obtaining a Hostid

If COMSOL is already installed on your license server, you can determine the hostid by executing the `lmhostid` command

```
comsol43/license/$arch/lmhostid
```

where `$arch` is `glnx86` (32-bit Linux) or `glnxa64` (64-bit Linux).

If COMSOL is not installed, you must obtain a hostid using the following command on the license server: `/sbin/ifconfig eth0`. Then remove colons from, for example, HWaddr 00:40:05:16:E5:25 (do not use the `hostid` command). All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/install for up-to-date information about installation and license issues.

TABLE 3-5: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com.
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `/var/tmp/comsol43.log` Please send the log file to `support@comsol.com` if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the lmgrd daemon and the LMCOMSOL daemon. If the problems remain, send the license manager log file to `support@comsol.com`. The log file is usually placed here: `/var/tmp/comsol43.log`

TABLE 3-5: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION

License error: -15. Cannot connect to license server system.	The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:
	`SERVER mylicserver 000123456789 1716`
	a license manager is required. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.
	Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.
	Check that the `license.dat` file on the COMSOL client computer points to the correct license server hostname. First, find the `license.dat` file in the COMSOL application folder:
	`/usr/local/comsol43/license/license.dat`
	Check that the first line has the correct license-server hostname. For example, if your license server hostname is `mylicserver`, the first row in the license.dat file should look like this:
	`SERVER mylicserver 000123456789 1716`
	If the COMSOL client computer does not recognize `mylicserver` as a proper hostname, it might help to instead use the fully qualified domain name (`mylicserver.mydomain.org`) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.
	Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:
	`/var/tmp/comsol43.log`
	NOTE: The log file is created by the license manager after it has been started.
	Please send the log file to support@comsol.com if you want help in interpreting the information.

TABLE 3-5: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, `LMCOMSOL.opt`. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the `license.dat` file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The `license.dat` file is located in the COMSOL application folder: `/usr/local/comsol43/license/license.dat`
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `/var/tmp/comsol43.log` Note: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

Running COMSOL

In this section you will find the following information:

Running COMSOL Multiphysics

Run the `comsol` command. If it is not available, ask your system manager to make it available to you. The `comsol` command is located in the `bin` folder in the COMSOL installation directory.

Running COMSOL on Multicore and Multiprocessor Computers

COMSOL uses all cores and all processors on your computer to run using shared-memory parallelism.


Note

To override this behavior, see Shared-Memory Parallel COMSOL in the *COMSOL Multiphysics User's Guide*.

Running a Classkit License

To start COMSOL using a classkit license, start COMSOL using the `-ckl` option, for example

```
comsol -ckl
```

Running COMSOL in Batch Mode

COMSOL batch jobs can be submitted from the COMSOL Desktop and the command line by right-clicking a **Study** node in the **Model Builder** and selecting **Batch**.


See Also

For command-line options, see COMSOL Batch Commands.

Running COMSOL on Clusters

COMSOL cluster jobs can be launched from the COMSOL Desktop and the command line. To run COMSOL on a cluster, the feature must be enabled by clicking the **Show** button ( ) and selecting **Advanced Study Options**. Then in the **Model Builder**, right-click a **Study** node and select **Cluster Computing** to create cluster jobs.


Note

Cluster computing requires an FNL (floating network) license.


See Also

For more information about how to run COMSOL in parallel on Linux clusters, see Running COMSOL in Parallel in the *COMSOL Multiphysics User's Guide*.

For command-line options, see COMSOL Cluster Commands.

Running COMSOL Multiphysics with MATLAB


Tip

Running COMSOL Multiphysics with MATLAB starts a COMSOL server and a MATLAB Desktop. No COMSOL graphical user interface is involved. For tutorial, see the *LiveLink for MATLAB User's Guide*.

To launch MATLAB and connect it to a COMSOL server, run the command

```
comsol server matlab
```

The COMSOL Commands

Use the COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL command is

```
comsol [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. The comsol command can be combined with optional targets to achieve various results. The table below lists the command and targets.:

TABLE 3-6: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
`comsol`	Run standalone COMSOL Multiphysics	
`comsol server`	Start COMSOL Multiphysics server	
`comsol client`	Run COMSOL Multiphysics client	
`comsol batch`	Run a COMSOL MPH-file or class file	
`comsol compile`	Compile a Model Java-file	
`comsol server matlab`	Start MATLAB and connect to a COMSOL server	Requires LiveLink for MATLAB license
`comsol convertpre35a`	Convert 3.0–3.5 models	
`comsol mpd`	Run the COMSOL multiprocessing daemon	Requires CLUSTERNODE license

The `comsol` command is located in the `bin` folder in the COMSOL installation directory.

INI FILES

There is a number of `.ini` files in the subdirectories `glnx86` and `glnxa64` in the `bin` directory. It is sometimes recommended that you edit these files. For example, you can add options to any of the above commands by modifying the corresponding `ini` file. To change the option `opt` to value `val`, add the line

```
-Dopt=val
```

to the file `comsol.ini`. Change the file `comsolbatch.ini` for `comsol batch`, and similarly for the other COMSOL targets.

OPTIONS

You can enter various options after the COMSOL command and target. Table 3-7 lists the options (See `[<options>]` in the command syntax) available for all comsol commands. Always issue these options between the command and the target (if any).

TABLE 3-7: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-h`	Print general help	
`<target> -h`	Print target-specific help	
`-32`	Run 32-bit COMSOL	
`-64`	Run 64-bit COMSOL	
`-3drend ogl | sw`	3D renderer: OpenGL or software rendering	
`-docroot <path>`	Specify custom path to the COMSOL documentation root directory.	See Documentation and Model Library Root Directories
`-modelsroot <path>`	Specify custom path to the COMSOL Model Library root directory.	See Documentation and Model Library Root Directories
`-np <no. of processors>`	Number of processors	See Shared-Memory Options
`-numasets <no. of sets>`	Number of NUMA sets	See Shared-Memory Options
`-mpmode throughput | turnaround | owner`	Multiprocessor mode	See Shared-Memory Options
`-blas {auto} | mkl | acml | path`	BLAS library to use	See BLAS Options
`-blaspath <path>`	BLAS library path	See BLAS Options
`-ipv6`	Activate IPv6 support	
`-nn <no. of processors>`	Number of nodes	See COMSOL Cluster Commands
`-nnhost <no. of processors>`	Number of nodes on each host	See COMSOL Cluster Commands

TABLE 3-7: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-f <path>`	Path to hostfile	See COMSOL Cluster Commands
`-mpi {auto}` | intel | `mpich2` | `wccs2003` | `whpc2008` | `user` | `path`	MPI library to use	See COMSOL Cluster Commands
`-mpipath <path>`	MPI library path	See COMSOL Cluster Commands
`-mpiroot <path>`	MPI library root path	See COMSOL Cluster Commands
`-mpirsh {rsh}` | `ssh`	Use rsh or ssh when booting MPD	See COMSOL Cluster Commands
`-mpibootstrap {ssh}` | `rsh` | `fork` | `slurm` | `ll` | `lsf` | `sge` | `jmi`	Set bootstrap server for Hydra	See COMSOL Cluster Commands
`-mpibootstrapexec <path>`	Executable used by bootstrap server	See COMSOL Cluster Commands
`-mpienablex`	Enable Xlib forwarding	See COMSOL Cluster Commands
`-mpd`	Use MPD instead of Hydra launcher	See COMSOL Cluster Commands
`-scalapack {auto}` | `mpich2` | `wccs2003` | `whpc2008` | `user` | `path`	Scalapack library to use	See COMSOL Cluster Commands
`-scalapackpath <path>`	Scalapack library path	See COMSOL Cluster Commands
`-clustersimple`	Simple startup of cluster	See COMSOL Cluster Commands
`-prefsdir <path>`	Preference directory	
`-tmpdir <path>`	Temporary file directory	
`-version`	Print COMSOL version	
`-version <target>`	Print target version	
`-ckl`	Use class-kit license	
`-forcegcc`	Force load of GCC libraries	
`-forcecomsolgcc`	Force load of GCC libraries shipped with COMSOL	

TABLE 3-7: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-autosave <{on}|off>`	Control saving of recovery files	
`-recoverydir <path>`	Path to recovery directories	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefsdir` option specifies the directory where COMSOL should store the preference file.

Documentation and Model Library Root Directories

In a default COMSOL installation, the documentation files are located in the directory `doc` under the installation root directory. You can use the `-docroot` option if you want to move the documentation directory to a different location. Similarly, use the `-modelsroot` option if you want to move the Model Library root directory `models` from its default location under the COMSOL installation root. Relocating the documentation and Model Library root directories can be useful for administering Model Library Update; see Configuring Model Library Update.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Use the option `-numasets` to control the number of Non-Uniform Memory Access node sets COMSOL should take into account. This is usually the number of processor sockets that the hardware is using.

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. The following options are available:

TABLE 3-8: COMSOL MULTIPROCESSOR MODE OPTIONS

MPMODE OPTION	DESCRIPTION
`throughput`	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
`turnaround`	Typically provides the best performance when no other processes than COMSOL are active.
`owner`	Provides the highest performance in most cases.

You may need to experiment to find the options that work best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides for the following BLAS related options:

TABLE 3-9: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL for Intel processors, and ACML for AMD processors with SSE2 support, otherwise MKL. (This is the default option.)
mkl	Use the Intel MKL library
acml	Use the AMD ACML library
path	Use a BLAS library specified using the option `-blaspath` or the environment variable `COMSOL_BLAS_PATH`. The library must support the standard FORTRAN BLAS interface.

Both MKL and ACML are distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where `ARCH` is the architecture (`glnx86` or `glnxa64`) or somewhere in the standard search path. You must also provide the path to any sublibraries needed by the library. You can also set the search path to point to the directory where the library is installed. To do so, use the environment variable `LD_LIBRARY_PATH`.

GCC Options

By default COMSOL uses the GCC libraries installed on the system. If COMSOL is unable to start, COMSOL will attempt to use the GCC libraries shipped with COMSOL. To force COMSOL to use the shipped GCC libraries, use the `-forcecomsolgcc` option. The option `-forcegcc` is mainly intended for use together with the LiveLink interface for MATLAB; use it if you are unable to make function call backs to MATLAB.

COMSOL COMMANDS

In additions to the options in Table 3-7, the standalone COMSOL command supports the following option.

TABLE 3-10: COMSOL COMMAND-LINE ARGUMENTS

COMSOL OPTIONS	DESCRIPTION
`-open <file>`	Open file

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The syntax for the COMSOL server command is

```
comsol [<options>] server [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 3-11: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTIONS	DESCRIPTION
`-user <user>`	Specify login name for a user
`-port <port>`	Specify a TCP/IP port to listen for connect attempts.
`-passwd <reset/nostore>`	Specify that you want to provide a new password. To avoid storing the new password on file use <nostore>
`-login <{info}/force/never>`	Ask for login information. `info` means that only missing information is asked for.
`-multi on | {off}`	Accept repeated client connections
`-silent`	Do not listen to standard input
`-graphics`	Start the server with graphics libraries. This will display plots on the server when you are connected with a client (that is, not with the COMSOL GUI).

Accessing the COMSOL Server Computer

To access the computer running the COMSOL server simply log in on the server computer by using `ssh` or a similar command, then enter the `comsol server` command.

Login Information

When you start a COMSOL Multiphysics server for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password in the **Connect to Server** dialog box. The software writes this login information in the subdirectory `.comsol/v43/login.properties` in your home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Important	Always make sure that untrusted users cannot access the COMSOL login information. Protect the file `.comsol/v43/login.properties` in your home directory. This is important when using COMSOL Multiphysics' client/server feature. Alternatively, start the COMSOL server with the `-passwd nostore` option, and clear **Remember Password** when connecting to the server. This ensures that your login information is not stored on file.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [<options>] client [<target arguments>]
```

The following target arguments are available for a COMSOL client command.

TABLE 3-12: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
`-port <port>`	Specify a TCP/IP port to connect to
`-server <server name>`	Specify server to connect to
`-open <file>`	Open file

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. You can run both Model MPH files and Model Java-files with the COMSOL batch command. Model Java-files need to be compiled before running.

The syntax for the COMSOL batch command is

```
comsol [<options>] batch [<target arguments>]
```

Its detailed target arguments are:

TABLE 3-13: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH OPTIONS	DESCRIPTION
`-inputfile <file name>`	Run a Model MPH-file or class file
`-outputfile <file name>`	Save a Model MPH-file using the given file name. If output is not given, the input file will be overwritten with the output
`-job <job tag>`	The batch job to run
`-study <study tag>`	The study to compute
`-pname <parameter name>`	Comma separated list of parameter names
`-plist <parameter value>`	Comma separated list of parameter values
`-batchlog <file name>`	File to store log in
`-client`	Run as client
`-host`	Connect to host
`-port`	Connect to port
`-graphics`	Start COMSOL batch with graphics libraries. This will display plots during postprocessing.
`-nosave`	Do not save the resulting model

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsol batch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the `out.mph`.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compiles a Model Java-file for use by the COMSOL batch command or for loading class files into the GUI. The syntax for the COMSOL compile command is

```
comsol [<options>] compile [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available‘

TABLE 3-14: COMSOL COMPILE OPTIONS

COMSOL COMPILE OPTIONS	DESCRIPTION
`-jdkroot <path>`	Path to the JDK root
`-classpathadd <classpath>`	Additional classpath
`-verbose`	Verbose output

COMSOL CLUSTER COMMANDS

Use the COMSOL command with the option `-nn <no. of nodes>` to run COMSOL on clusters.

The syntax for the COMSOL cluster command is

```
comsol -nn <no. of nodes> [<options>] [<target>] [<target arguments>]
```

The following cluster commands are available:

TABLE 3-15: COMSOL CLUSTER TARGETS

COMSOL CLUSTER COMMANDS	DESCRIPTION
`comsol -nn <nn> batch`	Run COMSOL on a cluster in batch mode
`comsol -nn <nn> server`	Run COMSOL server on a cluster
`comsol -nn <nn>`	Run COMSOL Desktop on a cluster

The preferred way of starting COMSOL cluster jobs is from the Study node in the COMSOL Desktop. If you need to start COMSOL cluster jobs from the command line, the preferred way is to use the `comsol -nn <nn> batch` command since the `comsol -nn <nn> server` and `comsol -nn <nn>` commands require TCP/IP access from your client computer to the cluster node where COMSOL runs.

Running on Linux

As of version 4.3, COMSOL uses Hydra by default to initialize the MPI environment. Hydra is more scalable than MPD and it does not require any additional commands to launch.

To launch COMSOL with Hydra use the command line

```
comsol -nn <number of computer nodes> -f <filename>
```

The file <*filename*> should contain the host names of the computer nodes that you intend to use. You can find out the hostname of each node from the Linux command `hostname`. Each node should be listed on a separate line in the file. You can also list the IP address of each node. The file may contain more computer nodes than you actually intend to use. You can set the remote node access mechanism that is used for connecting using the switch `-mpibootstrap`. The valid options are `ssh`, `rsh`, `fork`, `slurm`, `ll`, `lsf`, `sge` and `jmi`. This is important if the cluster only supports a different remote node access mechanism than `ssh` because `ssh` is the default protocol used. Use the switch `-mpibootstrapexec` to set the path to the remote node access mechanism such as `/usr/bin/ssh`. Use `-mpienablex` to enable Xlib forwarding. Xlib forwarding is off by default.

Previously there was a shorthand for performing the COMSOL MPI environment initialization and starting COMSOL. The `-clustersimple` option is still supported but is equivalent to the Hydra command by default, for example

```
comsol -nn 4 -clustersimple
```

You should usually run COMSOL in batch mode. Use the command

```
comsol -clustersimple batch -inputfile input.mph -outputfile
output.mph
```

It allows the Intel MPI library to automatically detect the number of nodes that were scheduled to the program. Restricting the number of processes with the `-nn` switch allows COMSOL to combine MPI with multithreading. This is the most efficient way to run COMSOL.

Using the MPD launcher

Before version 4.3 the MPI environment was launched by MPD. You can still use MPD if you use the switch -mpd but it is recommended that you use Hydra.

In order to start MPI, have a file named `.mpd.conf` in your home directory to which you alone have access. This file should contain the single line

```
secretword = <your secret word here>
```

On Intel MPI shipped with COMSOL, the `.mpd.conf` file is optional.

Below, the details of the individual cluster commands are described.

Before you start COMSOL, you must initialize the MPI environment. A so called multiprocessing daemon (MPD) must run on each computer node that you intend to use. To start MPD on several computer nodes, enter

```
comsol -nn <number of computer nodes> mpd boot -f <filename>
```

The file <*filename*> should contain the host names of the computer nodes that you intend to use. You can find out the hostname of each node from the Linux command `hostname`. Each node should be listed on a separate line in the file. You can also list the IP address of each node. The file may contain more computer nodes than you actually intend to use. As an alternative to using the `-f` <*filename*> option, you can put the list of computer nodes in a file named `mpd.hosts` in your home directory. You can set the protocol that is used for connecting using the switch `-mpirsh`. The valid options are `rsh` and `ssh`. This is important if the cluster only supports `ssh` because `rsh` is the default protocol used. Make sure that all nodes were booted by listing them with the command

```
comsol mpd trace
```

Start distributed COMSOL with the `-nn` option. For example, enter

```
comsol -nn <number of computational nodes> -mpd server
```

to start a COMSOL server running on a specific number of computational nodes. The number of computational nodes can exceed the number of computer nodes. Use the `-nnhost` option if you want to force several computational nodes on a computer node. Avoid starting more computational nodes than the total number of processors that you have available. When you have finished using distributed COMSOL, you should take down all the MPDs. Enter the command

```
comsol mpd allexit
```

to stop all MPDs. To obtain more information about the `comsol mpd` commands, add the `-h` option to the commands, for example, `comsol mpd boot -h`.

Start MPD on a single computer with the command

```
comsol mpd mpd &
```

This is useful when running all computational nodes on a single multiprocessor computer or when you have difficulties attaching computational nodes because of firewalls. In the second case you can start an MPD on each node and attach them by specifying the main port and host. Use

```
comsol mpd trace -l
```

and

```
comsol mpd mpd --port <the port number reported> --host <the
    hostname reported>
```

You can also start COMSOL with the `-clustersimple` option. This option automatically starts and terminates the MPD daemon. It uses the `mpd.hosts` file in your home directory to determine what computational nodes to use.

Starting Distributed COMSOL—Linux Examples

Make sure that COMSOL is able to start on all nodes where you intend to run COMSOL.


Important

Each node requires access to the license manager. If the node is unable to check out a license, it aborts the startup process.

A simplified version is used when the `-clustersimple` switch is set or the Hydra launcher is used. An example follows. Start four computational nodes on hosts listed in the file `hosts` using distributed COMSOL and simplified start:

```
comsol -nn 4 -clustersimple -f hosts alternatively
comsol -nn 4 -clustersimple -f hosts server alternatively
comsol -nn 4 -clustersimple -f hosts batch -inputfile in.mph -outputfile
out.mph
```

where `-clustersimple` is optional for Hydra.

If you use MPD. Start an MPD on a single computer. Then start distributed COMSOL on two computational nodes (on the same host) each using three processors, and finally stop the MPD:

```
comsol mpd mpd &
comsol -nn 2 -np 3 -mpd alternatively
comsol -nn 2 -np 3 -mpd server alternatively
comsol -nn 2 -np 3 -mpd batch -inputfile in.mph -outputfile out.mph
comsol mpd allexit
```

The example above could be used if you have a very small model with a very large amount of parametric steps, where using `mpd` on a single computer might be beneficial.

Start three MPDs on computer nodes with hostnames defined in the file `myhosts`. Each line in the file should specify the host address or IP-address of a node. Make sure the MPDs were correctly booted. Then start a distributed COMSOL server on three computational nodes, and finally stop the MPDs. First make sure that you can connect to all the computers with `ssh` without having to use your password (see the man pages for `ssh`). Also make sure that all computers have access to the same COMSOL installation and that they are using the same Linux version. There are two options for

starting a session. One more detailed and one shorthand version. An example of the detailed version:

```
comsol -nn 4 mpd boot -f myhosts
comsol mpd trace
comsol -nn 4 -mpd alternatively
comsol -nn 4 -mpd server alternatively
comsol -nn 4 -mpd batch -inputfile in.mph -outputfile out.mph
comsol mpd allexit
```

MPI Options

There are several implementations of MPI. COMSOL is shipped with the Intel MPI library but should also support most MPI implementations based on MPICH2. It is recommended that you use the default Intel MPI library. For running COMSOL on a computer that has MPICH2 installed, COMSOL also has a compatibility mode that you can activate by adding the option `-mpi mpich2`. When using this option both the variables `PATH` and `LD_LIBRARY_PATH` must include your MPI implementation. It is also possible to use other MPI libraries based on MPICH2 using the option `-mpipath` <*path to shared library*> and -mpiroot <*path to root of mpi library installation*>. Table 3-7 lists the MPI related options, `-mpi`, `-mpipath`, `-scalapack`, and `-scalapackpath`. Additionally the comsol MPI arguments are configurable inside the comsol start script. To configure comsol to work with a job scheduler through the Cluster Computing study you can set the options

```
-Dcs.precmd=<Command line>
-Dcs.postcmd=<Command line>
```

in the `comsol.ini` file. This will add commands prior to the `comsol` command and after the `comsol` command. You can add `{nn}` or `{perhost}` to any of these pre- or postcommands. This configures the Cluster Computing study to use the number of nodes and number of nodes on each host from the corresponding settings for the Cluster Computing study. For more information see the documentation for the Cluster Computing study in the *COMSOL Multiphysics Reference Guide*.

Troubleshooting Distributed COMSOL and MPI

The Hydra launcher is the main MPI environment from version 4.3. The syntax for Hydra commands is

```
comsol [<options>] hydra [<Hydra command>] [<target arguments>]
```

TABLE 3-16: COMSOL HYDRA COMMANDS

COMSOL MPD COMMANDS	DESCRIPTION
`cleanup`	Run mpicleanup command
`tune`	Run mpitune command

Use the `-h` switch for more information about each command.

The MPD daemon can be used in several ways to troubleshoot problems with the comsol MPI environment. The syntax for MPD commands is

```
comsol [<options>] mpd [<MPD command>] [<target arguments>]
```

TABLE 3-17: COMSOL MPD COMMANDS

COMSOL MPD COMMANDS	DESCRIPTION
`boot`	Run mpdboot command
`mpd`	Run mpd command
`exit`	Run mpdexit command
`allexit`	Run mpdallexit command
`cleanup`	Run mpdcleanup command
`trace`	Run mpdtrace command
`check`	Run mpdcheck command
`ringtest`	Run mpdringtest command
`listjobs`	Run mpdlistjobs command
`sigjob`	Run mpdsigjob command
`killjobs`	Run mpdkilljobs command
`tune`	Run mpdtune command
`help`	Run mpdhelp command

Use `-h` switch for more information about each command.

Comsol is shipped with the Intel MPI library, but should be compatible with most MPICH2 compatible MPI libraries. To download the latest version of Intel MPI library runtime visit http://software.intel.com/en-us/intel-mpi-library. To run comsol with another version of Intel MPI or other MPI library set `-mpiroot` to the root path of the MPI library and `-mpipath` to the dynamically loaded library that should be used. The default of the Intel MPI library is to use `ssh` as communication protocol. If you require another communication protocol use the option `-mpibootstrap <protocol>`. If you are using a scheduler the Intel MPI library is

often able to detect the environments it is running from using the `-clustersimple` switch and you do not need to set up a hosts file. The Intel MPI library automatically tries to detect the best option for communication and uses InfiniBand if it detects it.

If comsol aborts during start make sure that all nodes are able to access the license manager and that comsol can be started on each node when not running distributed.

For more verbose information about the startup process when using Hydra, use `-mpiarg -verbose` or set the environment variable `I_MPI_DEBUG` to a value greater than 0.

When using MPD, use `comsol mpd check` command to display important information. For more verbose information about the startup process from the MPD daemon use the `-v` and/or `-d` switches or set the environment variable `I_MPI_DEBUG` to a value greater than 0. If the MPD is booted and comsol is not starting make sure that the MPI environment is working for instance by running the `comsol mpd tune` command.

COMSOL MATLAB COMMAND

Use the COMSOL MATLAB command to access the COMSOL Java API through MATLAB. Type:

```
comsol server matlab [<options>]
```

which launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server.

The following options are available for the `comsol server matlab` command:

TABLE 3-18: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-mlroot <path>`	MATLAB installation directory
`-host <hostname>`	Connect to host
`-port <hostname>`	Connect to port
`-desktop`	Start with Desktop
`-nodesktop`	Start without Desktop
`-mlnosplash`	Start without MATLAB splash screen
`-graphics`	Start the server with graphics libraries. This enables plotting on the server. Available only when running `comsol server matlab [<options>]`.

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` command to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, enter

```
comsol [options] <input directory> <output directory> [log file]
```

where `<input directory>` is the input directory, `<output directory>` is the output directory, and `[log file]` is an optional log file. If you do not provide the third argument, the log is printed to the standard output.

TABLE 3-19: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-c35aroot <path>`	Installation path of COMSOL 3.5a

4

Installing and Running on Mac OS X

This chapter provides detailed instructions for installing the COMSOL software on Mac OS X. You also find license manager information and options for running COMSOL. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Mac OS X. See also the COMSOL Support Knowledge Base on www.comsol.com/install for specific troubleshooting tips.

In this chapter:

System Requirements

Note

For the most current system requirements, see www.comsol.com/products/requirements/

In this section:

See Also

.

COMSOL Multiphysics System Requirements for Mac OS X

SYSTEM REQUIREMENTS—INTEL 32-BIT PROCESSOR

- Mac OS X 10.5, 10.6, or 10.7
- Java 1.5 or 1.6

SYSTEM REQUIREMENTS—INTEL 64-BIT PROCESSOR

- Mac OS X 10.5, 10.6, or 10.7
- Java 1.5 or 1.6

JAVA AVAILABILITY

In Mac OS X 10.5 and 10.6 Java is included by default. In Mac OS X 10.7 Java needs to be downloaded and installed.

- Open **Finder**>**Applications**>**Utilities**. Open Java Preferences. If Java is not installed on the system, you will be asked to do so.

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons: drivers supporting OpenGL version 1.4 are required. Alternatively, use software rendering.

LiveLink for MATLAB Requirements

LiveLink for MATLAB is compatible with MATLAB 2012a and 2011b for Mac OS X.

Products for CAD Interoperability


Important

The CAD Import Module requires 64-bit Mac OS X.

The following products support import of 3D CAD files on OS X:

TABLE 4-1: PRODUCTS FOR CAD INTEROPERABILITY ON OS X

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCT
CAD Import Module	ACIS (SAT), IGES, Parasolid, Pro/E, and STEP	COMSOL Multiphysics

See Table 4-2 for detailed version information on the supported file formats.

TABLE 4-2: 3D CAD FILE FORMATS SUPPORTED BY COMSOL PRODUCTS ON MAC OS X.

FILE FORMAT (FILE EXTENSION)	SUPPORTED VERSION
Parasolid (.x_b, .x_t)	up to V22
ACIS or SAT (.sab, .sat)	up to R21
STEP (.step, .stp)	AP203, AP214
IGES (.iges, .igs)	up to 5.3
Pro/ENGINEER (.prt, .asm)	16 to Wildfire 5
Creo Parametric (.prt, .asm)	1.0

Parallel System Requirements

COMSOL 4.3 supports shared-memory parallelism on 32-bit and 64-bit Mac OS X. Distributed-memory parallelism is not supported.

Internet Protocol Support

IPv4 is supported on all Mac OS X platforms.

Installing COMSOL

In this section:

Before You Begin

- Check that the system meets all applicable requirements (see COMSOL Multiphysics System Requirements for Mac OS X).
- Have the passcode or license file ready. A passcode has a form similar to:

```
FFFFFFFF-TYUS-123456-1234567-123456789
```

New users can find the passcode or the license file in an email or letter from your sales representative. If a passcode or a license file has not been received, contact your local COMSOL representative.

Some COMSOL license types require that a license manager is installed before running a COMSOL software product. If COMSOL software is installed with a passcode, no license manager is needed. If it is installed with a license file, the license manager needs to be installed if the license file contains a line starting with the word SERVER. See License Manager Installation for instructions. The COMSOL software products and the license manager can be installed in any order.

If your Macintosh contains an old COMSOL (FEMLAB) installation, the COMSOL 4.3 installer does not remove it; it only removes the MATLAB path to the old COMSOL. The old version can be kept as well as uninstalled before or after installing COMSOL 4.3.

Installing COMSOL 4.3


Important

COMSOL does not work if the path to the COMSOL folder, or the name of the COMSOL folder itself, contain spaces.

1. Insert the COMSOL 4.3 DVD into the DVD drive. Launch the **COMSOL Installer** application from the Finder. The **COMSOL 4.3 Installer** window appears.
2. To proceed, see the instructions for Windows in the section Installing COMSOL. The procedure is the same for Mac OS X.


Note

You cannot browse to the MATLAB installation directory directly. You need to enter it manually. MATLAB is installed in the /Applications directory, for example, as /Applications/MATLAB_R2012a.app.

Removing (Uninstalling) the COMSOL Installation

The COMSOL 4.3 installation adds files only in the `COMSOL43` folder. To remove the COMSOL installation, delete the `COMSOL43` folder including all subfolders.

Automated Installation

COMSOL can be installed using an automated installation process with minimal user interaction. The documentation on how to create an answer file is available in the template, `setupconfig.ini`, which is on the DVD. When an answer file is created, start the installation by running

```
<path to DVD>/setup -s <answer file path>
```

where `<answer file path>` is the path to the answer file.

Configuring Model Library Update

Using the preferences described under Updates in the section Editing Preferences Settings in the *COMSOL Multiphysics User Guide* you can configure proxy server settings as well as model and documentation directories for Model Library Update. See

also Documentation and Model Library Root Directories for the related COMSOL options `-docdir` and `-modelsdir`.

Changing the Path to the MATLAB Installation

Change the path to the MATLAB installation in the user preferences you can access directly from the COMSOL Desktop. See the section **LiveLink products** in Editing Preferences Settings in the *COMSOL Multiphysics User's Guide*.

License Manager Installation

In this section:

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. The computer where the license manager is installed is called the *license server* and any computer that has the COMSOL applications installed is called *clients*. COMSOL can be installed anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server *and* a client, holding both the license manager and COMSOL. The COMSOL license manager does *not* require a MATLAB license manager.

The license manager and COMSOL can be installed in any order. A full test of the installation cannot be done until both are installed.

COMSOL uses the FlexNet™ license manager version 11 from Flexera Software, Inc. for license management.


Note

FlexNet was formerly called FLEXlm.

System Requirements

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager, memory and graphics requirements are not necessary. The COMSOL license manager is completely independent of the MATLAB license manager.

Obtaining a FlexNet License File

To install a COMSOL license manager requires a FlexNet license file, `license.dat`. It looks something like this:

```
#-------------------------------------------------------------
# COMSOL 4.2a FNL License No: 1234567
# Visit www.comsol.com/install for latest installation instructions
#-------------------------------------------------------------
SERVER my_server 0050569e1b87 1718
USE_SERVER
VENDOR LMCOMSOL port=1719
FEATURE SERIAL LMCOMSOL 4.2 permanent uncounted \
    VENDOR_STRING=C,5701108 HOSTID=ANY BORROW=720 SN=1234567 TS_OK \
    SIGN=0C3A8BF6722E
INCREMENT COMSOL LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT HEATTRANSFER LMCOMSOL 4.2 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLIENTSERVER LMCOMSOL 4.2 permanent 4 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2011 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLUSTERNODE LMCOMSOL 4.2 permanent 4 SUPERSEDE DUP_GROUP=U \
    ISSUED=6-JUN-2011 BORROW=720 SN=1234567 SIGN=123456789ABC
```


Note

A COMSOL `license.dat` file is shipped with the COMSOL package. If the file has not been received, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name *<my_server>*, the hostid of the license server, and an optional port number.

Confirm that the license server name is the actual name of your license server; otherwise, change it by editing the file. The default port number (1718) can also be changed in the unlikely case that another program is already using that port number. If the default port number is being used, change it to another number between 1025 and 64,000.

The VENDOR line defines the name of the vendor daemon binary, LMCOMSOL.


Important

If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager.

To implement this requirement, make sure the VENDOR line in the license.dat file reads VENDOR LMCOMSOL port=1719 (the number can be any unused port number in the allowed range). Then configure the firewall to allow access to the chosen port numbers (in the example above, 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, contact your system administrator.


Caution

Do not modify anything in the license.dat file except license server name and (if necessary) port numbers or the license may not work.

The SERIAL line contains license information.

The INCREMENT (can also be FEATURE) lines contain a product name, version, expiration date, and the number of available licenses. The example file above shows that the user has a permanent COMSOL 4.2a license allowing four concurrent users of COMSOL Multiphysics and two concurrent users of the Heat Transfer Module. The number after "SIGN=" at the end of each INCREMENT line contains a license key. Long lines can be broken by a continuation character (\).

In the license.dat file has not been received, provide COMSOL with the hostid of your license server (for Windows, see Obtaining a Hostid, for Linux, see Obtaining a Hostid, and for Mac, see Obtaining a Hostid for instructions) and preferably the license server name. Have these ready when contacting your local COMSOL representative.

License Manager Installation on Mac OS X

The license manager only needs to be installed if a license file has been obtained that starts with a line containing the word `SERVER`. The following components are needed on the license server:

- COMSOL License Manager files (FlexNet)
- License file (`license.dat`)

COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of three components:

- License manager daemon (`lmgrd`)
- Vendor daemon (`LMCOMSOL`)
- FlexNet utility programs (`lmutil` and others)

The two daemons (`lmgrd` and `LMCOMSOL`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd` daemon. The `lmgrd` daemon in turn makes a request to the daemon (`LMCOMSOL`) to release a license. The vendor daemon releases licenses according to the information contained in `license.dat`. The utility programs are used for license-server management. For more information on FlexNet management, see Chapter 7 in the *FlexNet Licensing End Users Guide*, available as a part of the FlexNet documentation and from the COMSOL Help Desk.

INSTALLING THE LICENSE MANAGER FILES


Important

You should install the license manager only on the host(s) listed in `license.dat`.

To install COMSOL on the same host as the license manager, first complete a COMSOL installation—this automatically installs the license manager files along with COMSOL (see Installing COMSOL). When finished, skip the remainder of this section and continue at Starting the License Manager.

If you want to install only the COMSOL license manager files, follow these instructions:

1 Insert the COMSOL 4.3 DVD into the DVD drive.

2 Follow the instructions starting with Installing COMSOL 4.3 until the **Features** screen is reached.

3 In the list of products to install, select only the **License Manager** check box.

4 Continue from the **Features** screen in the installation instructions to complete the license manager file installation.

Automated License Manager Installation

Alternatively, install the license manager using an automated installation process with minimal user interaction. See Automated Installation. Set `licmanager = 1` in the answer file to install the license manager.

STARTING THE LICENSE MANAGER

Either start the license manager manually or let it run automatically at startup.

Starting the License Manager Manually

To start the license manager manually:

1 Launch the **Terminal** application.

2 Change directory to the `license/maci32` directory

```
cd /Applications/COMSOL43/license/maci32
```

3 Then enter

```
./lmgrd -c ../license.dat -l /var/tmp/comsol43.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol43.log`.

Starting the License Manager Automatically at Startup

A folder `COMSOL_Lmgr` located in the folder `COMSOL43/license/maci32` holds a script that can automatically start the license manager when you start the computer.By installing and configuring this folder, the license manager does not need to be started manually.

1 Go to the top level `/Library` folder on your startup disk.

2 In the `Library` folder, create a folder `StartupItems` if it does not already exist.

3 Move or copy the folder `COMSOL_Lmgr` to the `StartupItems` folder.

4 Open the file `COMSOL_Lmgr` in a text editor, for example, TextEdit.

5 Edit the line

`FP=<COMSOLPATH>`

by replacing `<COMSOLPATH>` with the path to the COMSOL folder. If COMSOL is installed in the `Applications` folder this path is

```
FP=/Applications/COMSOL43
```

6 Edit the line

`USERNAME=<username>`

by replacing `<username>` with your username.


Note

To run the `COMSOL_Lmgr` file it must have the correct file permission that include executable permission for the `root` user. To make sure that it has the correct permission, enter the following commands:

```
sudo chown root:wheel /Library/StartupItems/COMSOL_Lmgr/
COMSOL_Lmgr
sudo chmod 0755 /Library/StartupItems/COMSOL_Lmgr/
COMSOL_Lmgr
```

Restart the computer to test the license manager installation. During startup a message **Starting COMSOL License Manager** should appear.

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s) you can start using COMSOL.

Changing the License


Note

If you have received a new license file—for example, when adding COMSOL products to an existing license—replace your current license file with the new one. Double-check the contents of this file to make sure it lists the products that your license includes.

When a license file is changed, the license manager must be restarted; otherwise, it will continue to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager:

1 Launch the **Terminal** application.

2 Change directory to the `license/maci32` directory

```
cd /Applications/COMSOL43/license/maci32
```

3 Enter the commands

```
./lmdown -c ../license.dat
./lmgrd -c ../license.dat -l /var/tmp/comsol43.log
```

Obtaining a Hostid

If COMSOL is already installed on your license server, you can determine the hostid by executing the `lmhostid` command

```
COMSOL43/license/$arch/lmhostid
```

where `$arch` is `maci32` (32-bit Mac OS X) or `maci64` (64-bit Mac OS X).

If COMSOL is not installed, a hostid must be obtained using the procedure in Obtaining the Hostid on Mac OS X.


Tip

All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

OBTAINING THE HOSTID ON MAC OS X

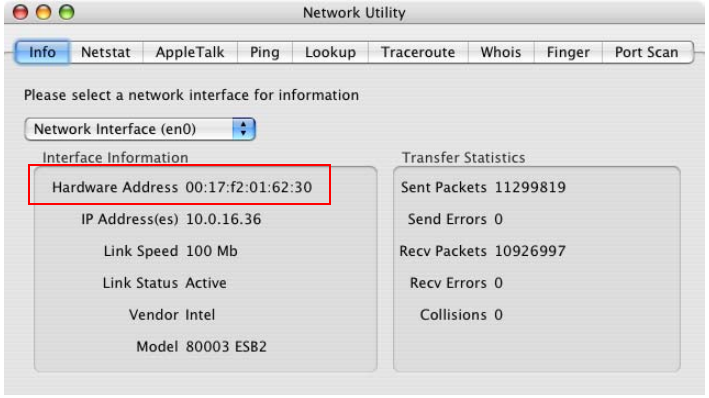
1 Launch the application **Network Utility** found in the **Applications/Utilities** folder.

2 Click the **Info** tab to the left.

3 Select **Network Interface (en0)**. This corresponds to your Ethernet card.

4 The hostid is the **Hardware Address**—as shown in the figure below, but with the colons (:) removed. If you plan to install on a Mac laptop with a wireless network

card, report the hardware address for both **Network Interface (en0)** and **Network Interface (en1)**.



Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/install for up-to-date information about installation and license issues.

TABLE 4-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com.
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `/var/tmp/comsol43.log` Please send the log file to `support@comsol.com` if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the lmgrd daemon and the LMCOMSOL daemon. If the problems remain, send the license manager log file to `support@comsol.com`. The log file is usually placed here: `/var/tmp/comsol43.log`

TABLE 4-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION

License error: -15. Cannot connect to license server system.	The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:
	`SERVER mylicserver 000123456789 1716`
	a license manager is required. Please refer to the section License Manager Installation for instructions how to install and start the COMSOL license manager.
	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.
	Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.
	Check that the `license.dat` file on the COMSOL client computer points to the correct license server hostname. First, find the `license.dat` file in the COMSOL application folder:
	`/Applications/COMSOL43/license/license.dat`
	Check that the first line has the correct license-server hostname. For example, if your license server hostname is `mylicserver`, the first row in the license.dat file should look like this:
	`SERVER mylicserver 000123456789 1716`
	If the COMSOL client computer does not recognize `mylicserver` as a proper hostname, it might help to instead use the fully qualified domain name (`mylicserver.mydomain.org`) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.
	Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:
	`/var/tmp/comsol43.log`
	NOTE: The log file is created by the license manager after it has been started.
	Please send the log file to support@comsol.com if you want help in interpreting the information.

TABLE 4-3: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, `LMCOMSOL.opt`. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the `license.dat` file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The `license.dat` file is located in the COMSOL application folder: `/Applications/COMSOL43/license/license.dat`
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: `/var/tmp/comsol43.log` Note: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

Running COMSOL

In this section:

The COMSOL Applications


Caution

The COMSOL applications do not work if moved outside the COMSOL folder. Create an alias if, for example, a desktop icon is required.

These applications provide different ways to run COMSOL:

- **COMSOL Multiphysics**—this is the primary application to run the software. It launches COMSOL Multiphysics as a standalone application.
- **COMSOL Multiphysics (Classkit License)**—this application launches COMSOL Multiphysics using a classkit license.
- **COMSOL with MATLAB**—use this application when you license the interface between COMSOL Multiphysics and MATLAB.


Note

The COMSOL with MATLAB application requires that you use Apple's X11 application together with MATLAB. The X-Windows application OroborOSX is not supported.


Note

On Mac OS X 10.6 Snow Leopard you need to quit the Terminal application prior to run the COMSOL with MATLAB application.

- **COMSOL Multiphysics Server**—this application launches the **Terminal** application and starts a COMSOL Multiphysics server in a terminal window.

Running COMSOL from a Terminal Window

COMSOL can also be launched from a terminal window using the shell script `COMSOL43/bin/comsol`.

To run the `comsol` command more easily, include the `COMSOL43/bin` directory in the path or make a symbolic link from `/usr/bin/comsol` to the `comsol` script. Those with administrator privileges can create a symbolic link with the command

```
sudo ln -s /Applications/COMSOL43/bin/comsol /usr/bin/comsol
```

(assuming COMSOL is installed in the `Applications` folder). This command asks for a password before creating the link.

The `comsol` command must not be moved from the `COMSOL43/bin` folder. The COMSOL applications also use this script.

The **COMSOL with MATLAB** application requires that you use Apple's X11 application together with MATLAB. The X-Windows application OroborOSX is not supported.

Running a Classkit License

To start COMSOL using a classkit license, start COMSOL using the `-ckl` option, for example

```
comsol -ckl
```

Running COMSOL on Multicore and Multiprocessor Computers

By default, a COMSOL process uses all cores and all processors on your computer using shared-memory parallelism. It uses the system environment variable `NUMBER_OF_PROCESSORS` to determine the number of available cores and processors.


Note

To override this behavior, see Shared-Memory Options.

Running COMSOL in Batch Mode

COMSOL batch jobs can be submitted from the COMSOL Desktop and the command line by right-clicking a **Study** node in the **Model Builder** and selecting **Batch**.


See Also

For command-line options, see COMSOL BATCH-specific arguments.

The COMSOL Commands

Use the COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL command is

```
comsol [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. The comsol command can be combined with optional targets to achieve various results. The table below lists the command and targets.

TABLE 4-4: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
`comsol`	Run standalone COMSOL Multiphysics	
`comsol server`	Start COMSOL Multiphysics server	
`comsol client`	Run COMSOL Multiphysics client	
`comsol batch`	Run a COMSOL MPH file or class file	
`comsol compile`	Compile a Model Java file	
`comsol server matlab`	Start MATLAB and connect to a COMSOL server	Requires LiveLink for MATLAB license
`comsol convertpre35a`	Convert 3.0–3.5 models	

The `comsol` command is located in the `bin` folder in the COMSOL installation directory.

INI FILES

There is a number of `.ini` files in the subdirectories `maci32` and `maci64` in the `bin` directory. It is sometimes recommended that you edit these files. For example, you can add options to any of the above commands by modifying the corresponding ini file. To change the option `opt` to value `val`, add the line

```
-Dopt=val
```

to the file `comsol.ini`. Change the file `comsolbatch.ini` for `comsol batch`, and similarly for the other COMSOL targets.

OPTIONS

You can enter various options after the COMSOL command and target. Table 4-5 lists the options (See `[<options>]` in the command syntax) available for all comsol commands. Always issue these options between the command and the target (if any).

TABLE 4-5: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-h`	Print general help	
`<target> -h`	Print target-specific help	
`-32`	Run 32-bit COMSOL	
`-64`	Run 64-bit COMSOL	
`-3drend ogl | sw`	3D renderer: OpenGL or software rendering	
`-docroot <path>`	Specify custom path to the COMSOL documentation root directory.	See Documentation and Model Library Root Directories
`-modelsroot <path>`	Specify custom path to the COMSOL Model Library root directory.	See Documentation and Model Library Root Directories
`-np <no. of processors>`	Number of processors	See Shared-Memory Options
`-mpmode throughput | turnaround | owner`	Multiprocessor mode	See Shared-Memory Options
`-blas {auto} | mkl | acml | path`	BLAS library to use	See BLAS Options
`-blaspath <path>`	BLAS library path	See BLAS Options
`-ipv6`	Activate IPv6 support	
`-prefsdir <path>`	Preference directory	
`-tmpdir <path>`	Temporary file directory	
`-version`	Print COMSOL version	
`-version <target>`	Print target version	
`-ckl`	Use classkit license	

TABLE 4-5: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
`-autosave <{on}|off>`	Control saving of recovery files	
`-recoverydir <path>`	Path to recovery directories	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefsdir` option specifies the directory where COMSOL should store the preference file.

Documentation and Model Library Root Directories

In a default COMSOL installation, the documentation files are located in the directory `doc` under the installation root directory. You can use the `-docroot` option if you want to move the documentation directory to a different location. Similarly, use the `-modelsroot` option if you want to move the Model Library root directory `models` from its default location under the COMSOL installation root. Relocating the documentation and Model Library root directories can be useful for administering Model Library Update; see Configuring Model Library Update.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. The following options are available:

TABLE 4-6: COMSOL MULTIPROCESSOR MODE OPTIONS

MPMODE OPTION	DESCRIPTION
`throughput`	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
`turnaround`	Typically provides the best performance when no other processes than COMSOL are active.
`owner`	Provides the highest performance in most cases.

You may need to experiment to find the options that work best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides the following BLAS-related options:

TABLE 4-7: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL.
mkl	Use the Intel MKL library.
path	Use a BLAS library specified using the option `-blaspath` or the environment variable `COMSOL_BLAS_PATH`. The library must support the standard FORTRAN BLAS interface.

MKL is distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where `ARCH` is the architecture (`maci32` or `maci64`) or somewhere in the standard search path. You must also provide the path to any sublibraries needed by the library. You can also set the search path to point to the directory where the library is installed. To do so, use the environment variable `DYLD_LIBRARY_PATH`.

COMSOL COMMANDS

In additions to the options in Table 4-5, the standalone COMSOL command supports the following option.

TABLE 4-8: COMSOL COMMAND-LINE ARGUMENTS

COMSOL OPTIONS	DESCRIPTION
`-open <file>`	Open file

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The syntax for the COMSOL server command is

```
comsol [<options>] server [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 4-9: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTIONS	DESCRIPTION
`-user <user>`	Specify login name for a user
`-port <port>`	Specify a TCP/IP port to listen for connect attempts.
`-passwd reset|nostore`	Specify that you want to provide a new password.To avoid storing the new password on file use <nostore>
`-login {info}|force|never`	Ask for login information. `info` means that only missing information is asked for.
`-multi on|{off}`	Accept repeated client connections
`-silent`	Do not listen to standard input

Accessing the COMSOL Server Computer

To access the computer running the COMSOL server simply log in on the server computer by using `ssh` or a similar command, then enter the `comsol server` command.

Login Information

When you start a COMSOL Multiphysics server for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password on the settings page in the **Model Navigator**, which opens when you start the COMSOL Multiphysics client. The software writes this login information in the file `login.properties`. The login information is located in `Library/Preferences/COMSOL/v43/login.properties` in your home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Important

Always make sure that untrusted users cannot access the COMSOL login information. Protect the file `Library/Preferences/COMSOL/v43/login.properties`. This is important when using COMSOL Multiphysics' client/server feature. Alternatively, start the COMSOL server with the `-passwd nostore` option, and clear **Remember Password** when connecting to the server. This ensures that your login information is not stored on file.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [<options>] client [<target arguments>]
```

The following target arguments are available for a COMSOL client command.

TABLE 4-10: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
`-port <port>`	Specify a TCP/IP port to connect to
`-server <server name>`	Specify server to connect to
`-open <file>`	Open file

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. You can run both Model MPH files and Model Java files with the COMSOL batch command. Model Java files need to be compiled before running.

The syntax for the COMSOL batch command is

```
comsol [<options>] batch [<target arguments>]
```

Its detailed target arguments are:

TABLE 4-11: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH OPTIONS	DESCRIPTION
`-inputfile <file name>`	Run a Model MPH-file or class file
`-outputfile <file name>`	Save a Model MPH-file using the given file name. If output is not given, the input file will be overwritten with the output
`-job <job tag>`	The batch job to run
`-study <study tag>`	The study to compute
`-pname <parameter name>`	Comma-separated list of parameter names
`-plist <parameter value>`	Comma-separated list of parameter values
`-batchlog <file name>`	File to store log in
`-client`	Run as client
`-host`	Connect to host
`-port`	Connect to port
`-nosave`	Do not save the resulting model

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsol batch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the `out.mph`.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compiles a model Java file for use by the COMSOL batch command or for loading class files into the GUI. The syntax for the COMSOL compile command is

```
comsol [<options>] compile [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available‘

TABLE 4-12: COMSOL COMPILE OPTIONS

COMSOL COMPILE OPTIONS	DESCRIPTION
`-jdkroot <path>`	Path to the JDK root
`-classpathadd <classpath>`	Additional classpath
`-verbose`	Verbose output

COMSOL MATLAB COMMAND

Use the COMSOL MATLAB command to access the COMSOL Java API through MATLAB. Type:

```
comsol server matlab [<options>]
```

which launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server.

The following options are available for the `comsol server matlab` command:

TABLE 4-13: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-mlroot <path>`	MATLAB installation directory
`-host <hostname>`	Connect to host
`-port <hostname>`	Connect to port
`-desktop`	Start with Desktop
`-nodesktop`	Start without Desktop
`-mlnosplash`	Start without MATLAB splash screen

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` command to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, enter

```
comsol [<options>] <input directory> <output directory> [<logfile>]
```

where *<input directory>* is the input directory, *<output directory>* is the output directory, and `[<logfile>]` is an optional log file. If you do not provide the third argument, the log is printed on standard output.

TABLE 4-14: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
`-c35aroot <path>`	Installation path of COMSOL 3.5a

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