

# COMSOL INSTALLATION AND OPERATIONS GUIDE

**VERSION 3.4**



#### How to contact COMSOL:

##### Benelux

COMSOL BV  
Röntgenlaan 19  
2719 DX Zoetermeer  
The Netherlands  
Phone: +31 (0) 79 363 4230  
Fax: +31 (0) 79 361 4212  
info@femlab.nl  
www.femlab.nl

##### Denmark

COMSOL A/S  
Diplomvej 376  
2800 Kgs. Lyngby  
Phone: +45 88 70 82 00  
Fax: +45 88 70 80 90  
info@comsol.dk  
www.comsol.dk

##### Finland

COMSOL OY  
Arabianranta 6  
FIN-00560 Helsinki  
Phone: +358 9 2510 400  
Fax: +358 9 2510 4010  
info@comsol.fi  
www.comsol.fi

##### France

COMSOL France  
WTC, 5 pl. Robert Schuman  
F-38000 Grenoble  
Phone: +33 (0)4 76 46 49 01  
Fax: +33 (0)4 76 46 07 42  
info@comsol.fr  
www.comsol.fr

##### Germany

FEMLAB GmbH  
Berliner Str. 4  
D-37073 Göttingen  
Phone: +49-551-99721-0  
Fax: +49-551-99721-29  
info@femlab.de  
www.femlab.de

##### Italy

COMSOL S.r.l.  
Via Vittorio Emanuele II, 22  
25122 Brescia  
Phone: +39-030-3793800  
Fax: +39-030-3793899  
info.it@comsol.com  
www.it.comsol.com

##### Norway

COMSOL AS  
Søndre gate 7  
NO-7485 Trondheim  
Phone: +47 73 84 24 00  
Fax: +47 73 84 24 01  
info@comsol.no  
www.comsol.no

##### Sweden

COMSOL AB  
Tegnérsgatan 23  
SE-111 40 Stockholm  
Phone: +46 8 412 95 00  
Fax: +46 8 412 95 10  
info@comsol.se  
www.comsol.se

##### Switzerland

FEMLAB GmbH  
Technoparkstrasse 1  
CH-8005 Zürich  
Phone: +41 (0)44 445 2140  
Fax: +41 (0)44 445 2141  
info@femlab.ch  
www.femlab.ch

##### United Kingdom

COMSOL Ltd.  
UH Innovation Centre  
College Lane  
Hatfield  
Hertfordshire AL10 9AB  
Phone: +44-(0)-1707 284747  
Fax: +44-(0)-1707 284746  
info.uk@comsol.com  
www.uk.comsol.com

##### United States

COMSOL, Inc.  
1 New England Executive Park  
Suite 350  
Burlington, MA 01803  
Phone: +1-781-273-3322  
Fax: +1-781-273-6603

COMSOL, Inc.  
10850 Wilshire Boulevard  
Suite 800  
Los Angeles, CA 90024  
Phone: +1-310-441-4800  
Fax: +1-310-441-0868

COMSOL, Inc.  
744 Cowper Street  
Palo Alto, CA 94301  
Phone: +1-650-324-9935  
Fax: +1-650-324-9936

info@comsol.com  
www.comsol.com

For a complete list of international  
representatives, visit  
www.comsol.com/contact

##### Company home page

www.comsol.com

##### COMSOL user forums

www.comsol.com/support/forums

### *COMSOL Installation and Operations Guide*

© COPYRIGHT 1994–2007 by COMSOL AB. All rights reserved

Patent pending

The software described in this document is furnished under a license agreement. The software may be used or copied only under the terms of the license agreement. No part of this manual may be photocopied or reproduced in any form without prior written consent from COMSOL AB.

COMSOL, COMSOL Multiphysics, COMSOL Reaction Engineering Lab, and FEMLAB are registered trademarks of COMSOL AB. COMSOL Script is a trademark of COMSOL AB.

Other product or brand names are trademarks or registered trademarks of their respective holders.

Version:                      October 2007                      COMSOL 3.4

# C O N T E N T S

## Chapter 1: Installing the COMSOL Software

<b>General Tips</b>	<b>2</b>
COMSOL Multiphysics Quick Start and Online Help . . . . .	2
Technical Support . . . . .	2
Typographical Conventions . . . . .	2
 <b>System Requirements</b>	 <b>4</b>
General Requirements. . . . .	4
COMSOL Multiphysics System Requirements for Microsoft Windows. . . . .	4
COMSOL Multiphysics System Requirements for Linux and Sun . . . . .	5
COMSOL Multiphysics System Requirements for Mac . . . . .	6
Optional MATLAB Add-On Requirements . . . . .	7
CAD Import Modules Platform Support . . . . .	7
COMSOL Script System Requirements . . . . .	8
 <b>Installing COMSOL on Windows</b>	 <b>9</b>
Before You Begin . . . . .	9
Installing COMSOL 3.4 . . . . .	9
Automated Installation of COMSOL 3.4 . . . . .	16
Removing (Uninstalling) the COMSOL Installation . . . . .	16
Automated Removal (Uninstallation) of COMSOL 3.4. . . . .	18
Changing the Path to the MATLAB Installation. . . . .	18
Adding the SolidWorks Live Connection to the CAD Import Module. . . . .	18
 <b>Installing COMSOL on Linux and Sun</b>	 <b>19</b>
Before You Begin . . . . .	19
Installing COMSOL 3.4 . . . . .	19
Removing (Uninstalling) the COMSOL Installation . . . . .	21
Using the Unattended Installer and Installing Without a Display . . . . .	21
Changing the Path to the MATLAB Installation. . . . .	21
 <b>Installing COMSOL on Macintosh</b>	 <b>22</b>
Before You Begin . . . . .	22

Installing Java 3D and Java Advanced Imaging . . . . .	22
Installing COMSOL 3.4 . . . . .	23
Removing (Uninstalling) the COMSOL Installation . . . . .	23
Changing the Path to the MATLAB Installation. . . . .	23
<b>License Manager Installation</b>	<b>24</b>
Before You Begin . . . . .	24
License Manager Installation on Windows . . . . .	26
License Manager Installation on Linux and Sun. . . . .	28
License Manager Installation on the Mac . . . . .	33
Obtaining a Hostid . . . . .	35
<b>Troubleshooting License Errors</b>	<b>38</b>

## Chapter 2: Running COMSOL

<b>Running COMSOL on Windows</b>	<b>42</b>
Running COMSOL Multiphysics . . . . .	42
Running COMSOL Script. . . . .	43
Running COMSOL Multiphysics with MATLAB . . . . .	43
<b>Running COMSOL on Linux/Sun</b>	<b>44</b>
Running COMSOL Multiphysics . . . . .	44
Running COMSOL Script. . . . .	44
Running COMSOL Multiphysics with MATLAB . . . . .	44
Considerations on Linux . . . . .	45
<b>Running COMSOL on Mac OS X</b>	<b>46</b>
The COMSOL Applications . . . . .	46
Running COMSOL Multiphysics from a Terminal Window . . . . .	47
<b>The COMSOL Command</b>	<b>48</b>
<b>The COMSOL Multiphysics Client/Server Architecture</b>	<b>53</b>
Standalone COMSOL Multiphysics . . . . .	53
Running COMSOL Script. . . . .	53

Running COMSOL Multiphysics with MATLAB . . . . . 53

Running COMSOL Multiphysics as a Client/Server Application . . . . . 54

**Running COMSOL Multiphysics**

**Client/Server** . . . . . **57**

Advantages of Using COMSOL Multiphysics Client/Server . . . . . 57

Running COMSOL Multiphysics Client/Server . . . . . 57

Connecting Standalone COMSOL Multiphysics to a Server . . . . . 60

**Login Information and Security** . . . . . **62**

Login Information . . . . . 62

Client/Server Security Issues . . . . . 62

**Running COMSOL in Parallel** . . . . . **63**

Parallel COMSOL . . . . . 63

COMSOL and BLAS . . . . . 65

**INDEX** . . . . . **67**



# Installing the COMSOL Software

This chapter provides detailed instructions for installing the COMSOL software for all different platforms and license types. You also find complete system requirements and license manager information. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD/CDs provides the basic instructions for installation on the Windows, Mac, and Linux/Sun platforms. Also see the COMSOL Support Knowledge Base on [www.comsol.com](http://www.comsol.com) for specific troubleshooting tips.

# General Tips

Welcome to COMSOL® 3.4! Use this *Installation and Operations Guide* to install your COMSOL software products and start working with the packages. In addition to this manual, we supply many other resources to help you get the most out of COMSOL products. Among them are:

## *COMSOL Multiphysics Quick Start and Online Help*

---

The easiest way for new users to get an overview of COMSOL Multiphysics' capabilities and how to use them is to read the *COMSOL Multiphysics Quick Start and Quick Reference* manual. Also see the *COMSOL 3.4 New Feature Highlights* document, included with the DVD/CD media, for an overview of the major new features in the 3.4 release. Further, the full COMSOL documentation set is available on your computer in the COMSOL help resources and as a set of PDF files. To get started with COMSOL Script, have a look at the *COMSOL Script User's Guide*.

## *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](mailto:support@comsol.com).

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

## *Typographical Conventions*

---

All COMSOL manuals use a set of consistent typographical conventions that should make it easy for you to follow the discussion, realize what you can expect to see on the screen, and know which data you must enter into various data-entry fields. In particular, you should be aware of these conventions:

- A **boldface** font of the shown size and style indicates that the given word(s) appear exactly that way on the COMSOL graphical user interface (for toolbar buttons in the corresponding tooltip). For instance, we often refer to the **Model Navigator**, which is the window that appears when you start a new modeling session in



COMSOL; the corresponding window on the screen has the title **Model Navigator**. As another example, the instructions might say to click the **Multiphysics** button, and the boldface font indicates that you can expect to see a button with that exact label on the COMSOL user interface.

- The names of other items on the graphical user interface that do not have direct labels contain a leading uppercase letter. For instance, we often refer to the Draw toolbar; this vertical bar containing many icons appears on the left side of the user interface during geometry modeling. However, nowhere on the screen will you see the term “Draw” referring to this toolbar (if it were on the screen, we would print it in this manual as the **Draw** menu).
- The symbol > indicates a menu item or an item in a folder in the **Model Navigator**. For example, **Physics>Equation System>Subdomain Settings** is equivalent to: On the **Physics** menu, point to **Equation System** and then click **Subdomain Settings**. **COMSOL Multiphysics>Heat Transfer>Conduction** means: Open the **COMSOL Multiphysics** folder, open the **Heat Transfer** folder, and select **Conduction**.
- A Code (monospace) font indicates keyboard entries in the user interface. You might see an instruction such as “Type 1.25 in the **Current density** edit field.” The monospace font also indicates COMSOL Script codes.
- An *italic* font indicates the introduction of important terminology. Expect to find an explanation in the same paragraph or in the Glossary. The names of books in the COMSOL documentation set also appear using an italic font.

# System Requirements

## *General Requirements*

---

These requirements are common to all platforms:

- A CD-ROM or DVD drive for installation
- TCP/IP on all platforms when using a license server
- Adobe Acrobat Reader 5.0 or greater to view and print the COMSOL documentation in PDF format

The actual disk space needed varies with the size of the partition and the optional installation of online help files. The COMSOL installer informs you of hard-disk space requirements for a particular installation.

### **GENERAL SYSTEM RECOMMENDATIONS**

We recommend at least 1 GB of memory. The solutions of a few examples in the Model Library require substantially more than 1 GB of memory and some even a 64-bit platform.

### **FLOATING NETWORK LICENSES**

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

## *COMSOL Multiphysics System Requirements for Microsoft Windows*

---

### **SYSTEM REQUIREMENTS—32-BIT WINDOWS VERSION**

- Windows 2000, Windows XP, or Windows Vista
- Pentium III or later
- OpenGL 1.1 from Microsoft or an accelerator that supports OpenGL 1.1, or DirectX version 8.0 or later. The graphics card should have at least 32 MB of memory.

### **SYSTEM REQUIREMENTS—64-BIT WINDOWS VERSION**

- Windows XP Professional x64 Edition or Windows Vista

- A PC with one of these processors: AMD with AMD64 or Intel with EM64T.
- A graphics card with at least 32 MB of memory

## *COMSOL Multiphysics System Requirements for Linux and Sun*

### SYSTEM REQUIREMENTS

Standalone COMSOL Multiphysics, the COMSOL Multiphysics client, and the COMSOL Multiphysics server are available in 32- and 64-bit versions as indicated in the table:

TABLE 1-1: SYSTEM REQUIREMENTS FOR LINUX AND SUN PLATFORMS

PLATFORM	OPERATING SYSTEM	PROCESSOR
32-bit Linux	Linux 2.4.x kernel, glibc-2.2.5 or later	Pentium III or later
64-bit Linux	Linux 2.4.x kernel, glibc-2.3.2 or later	AMD with AMD64 or Intel with EM64T
Itanium	Linux 2.4.x kernel, glibc-2.3.2 or later	Itanium 2
Sun	Solaris 8, 9, 10	UltraSPARC II or later

**Note:** On the Itanium 2 only the 64-bit COMSOL Multiphysics server is available. Here you must run the COMSOL Multiphysics client on a COMSOL Multiphysics platform other than Itanium using a floating network license to access the COMSOL Multiphysics server.

The following Linux distributions are officially supported by COMSOL:

PLATFORM	DISTRIBUTION
32-bit Linux	Debian 3.0, 3.1, RedHat Enterprise 4, Fedora Core 5, SUSE 10.1
64-bit Linux	SUSE 9.0, 9.3, and 10.1, RedHat Enterprise 4 (AMD64/Intel EM64T), Fedora Core 5
Itanium	Debian 3.1 (IA-64), RedHat Enterprise 4 (Itanium)

In addition, see the graphics requirements in the following sections.

### *Linux Graphics Requirements*

You can use any of the following XFree86 and graphics-driver configurations:

- XFree86 4.1 or later with XFree86's Mesa library and DRI (Direct Rendering Infrastructure)

- XFree86 4.1 with NVIDIA driver 1.0-2880 or later
- XFree86 4.1 with ATI Fire GL2/3/4 drivers X4.1.0-1.9.16 or later. In order to get hardware acceleration with the Fire GL2/3/4 driver, set the environment variable `LD_PRELOAD=/usr/lib/libGL.so` before starting COMSOL (for example, `LD_PRELOAD=/usr/lib/libGL.so comsol`). According to ATI, this step is not necessary starting with the 1.9.19 driver.
- XFree86 4.1 with an official Mesa library (not XFree86's library). You can obtain it at <http://www.mesa3d.org/>. Use this configuration if you cannot or do not want to use DRI.
- XFree86 3.3.6 with Mesa 3.1 or later

#### *Sun Graphics Requirements*

Frame Buffer with OpenGL support (XVR-500, XVR-1000, XVR1200, XVR-4000, Expert3D, Elite3D, Creator3D, or PGX).

OpenGL 1.2.2 for Solaris or later. Depending on the type of frame buffer, a higher OpenGL version might be needed; for instance, XVR-1000 requires OpenGL 1.2.3.

### *COMSOL Multiphysics System Requirements for Mac*

---

#### **SYSTEM REQUIREMENTS—INTEL PROCESSOR**

- Mac OS X 10.4.8
- Java 1.5 or later (part of the Mac OS X installation)

#### **SYSTEM REQUIREMENTS—POWERPC PROCESSOR**

- Mac OS X 10.3.1, 10.4
- Java 1.4 or later (part of the Mac OS X installation)
- Java 3D and Java Advanced Imaging
- BSD Subsystem (part of the Mac OS X installation)

#### **SYSTEM REQUIREMENTS FOR COMSOL DESKTOP—POWERPC PROCESSOR**

- Mac OS X 10.4.5
- Java 2 Standard Edition (J2SE) 5.0 Release 4.

## Optional MATLAB Add-On Requirements

The following chart indicates available MATLAB interfaces in COMSOL 3.4.

TABLE I-2: MATLAB COMPATIBILITY CHART

PLATFORM	7.0	7.0.1	7.0.4	7.1	2006A/B	2007A/B
Windows, 32 bit	√	√	√	√	√	√
Windows, 64 bit					√	√
Linux, 32 bit	√	√	√	√	√	√
Linux, 64 bit		√	√	√	√	√
Linux, Itanium						
Sun, 32 bit	√	√	√	√	√	
Sun, 64 bit						√ <sup>a</sup>
Mac, Power PC	√	√	√	√	√	√
Mac, Intel						√

a. The CAD Import Module is not compatible with use of the interface to MATLAB 2007a/b on Sun.

## CAD Import Modules Platform Support

Find the platform support for products in the CAD Import Module family in the following table:

TABLE I-3: CAD IMPORT MODULE SYSTEM REQUIREMENTS

PRODUCT	REQUIRED PRODUCTS	PLATFORM SUPPORT
CAD Import Module	COMSOL Multiphysics	Windows, Linux, <sup>a</sup> Sun <sup>b</sup>
CATIA V4 Import Module	CAD Import Module	Windows, Linux, <sup>a</sup> Sun <sup>b</sup>
CATIA V5 Import Module	CAD Import Module	Windows
Inventor Import Module	CAD Import Module	Windows
Pro/E Import Module	CAD Import Module	Windows, Linux, <sup>a</sup> Sun <sup>b</sup>
VDA-FS Import Module	CAD Import Module	Windows, Linux, <sup>a</sup> Sun <sup>b</sup>

a. Only 32-bit Linux and 64-bit Linux are supported. The Itanium platform is not supported.

b. On Sun, the CAD Import Module is not compatible with use of the interface to MATLAB 2007a/b (64 bit only).

The SolidWorks Live Connection has been tested with SolidWorks 2005 SP5.0, SolidWorks 2006 SP0 and SP5.1, SolidWorks 2007 SP0 and SP4.0, and SolidWorks 2008 SP0. It is available on Windows 2000, Windows XP, Windows XP x64, Windows Vista Business and Ultimate (32 bit only). Supported on the Windows XP x64

platform are connections between SolidWorks 64 bit and COMSOL Multiphysics 64 bit, as well as between SolidWorks 32 bit and COMSOL Multiphysics 32 bit.

### *COMSOL Script System Requirements*

---

The system requirements of COMSOL Script are similar to those for COMSOL Multiphysics except that COMSOL Script is not available on the Itanium platform.

# Installing COMSOL on Windows

## *Before You Begin*

---

- Check that your system meets all applicable requirements (see “COMSOL Multiphysics System Requirements for Microsoft Windows” on page 4).
- Have your passcode or license file ready. A passcode has a form similar to:

FFFFFF-CUSV-123456-1234567-123456789

You need a passcode or a license file to install COMSOL 3.4. You should have received it in an email or letter from your sales representative. If you have not received a passcode or a license file, contact your local COMSOL representative.

Some COMSOL license types require that you also install a license manager before running a COMSOL software product. If you install COMSOL software with a passcode, no license manager is needed. If you install it 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” on page 24 for instructions. You can install your COMSOL software products and the license manager in any order.

An installation of earlier COMSOL versions on your computer is not affected by the COMSOL 3.4 installation except that double-clicking a Model MPH-file created with an earlier version of COMSOL will open it in COMSOL 3.4. You can continue to use earlier versions or uninstall them independently of the COMSOL 3.4 installation.

---

**Note:** In this manual, the term COMSOL 3.4 refers not only to COMSOL Multiphysics 3.4 but also to any other members of the COMSOL product line including COMSOL Script, the COMSOL Reaction Engineering Lab, and all add-on modules and labs.

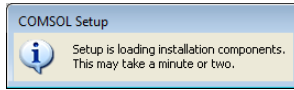
---

## *Installing COMSOL 3.4*

---

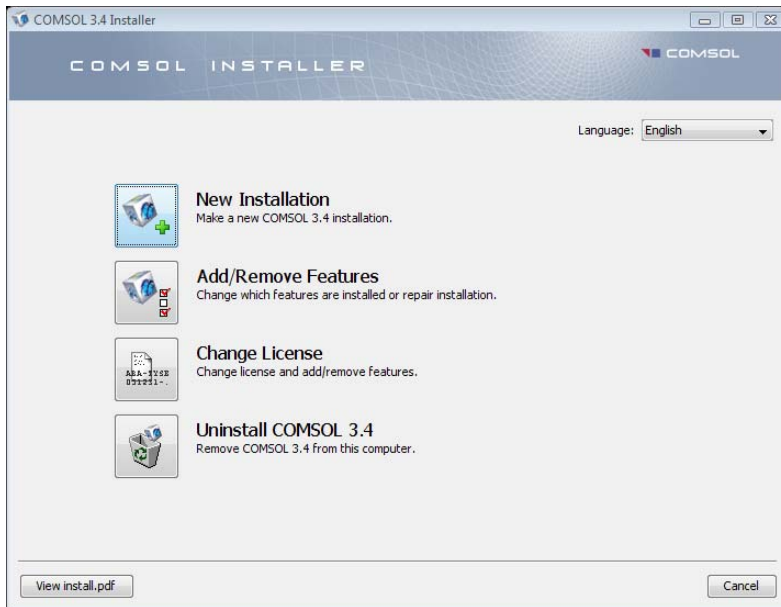
- 1 Insert the COMSOL 3.4 DVD/CD 1 into the CD-ROM drive. The **COMSOL Setup** window should appear automatically; if not, run the file `setup.exe` on the

installation CD. Note that you might need to run `setup_<language code>.exe` for some languages that require special fonts.



When the installation components have been loaded, the **COMSOL Setup** window is replaced by the **COMSOL 3.4 Installer** window. To continue:

- 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 you add or remove documentation files for products installed or when you want to add or remove a product that your license includes.
- Click **Change License** and proceed to Step 2 to update license of an existing installation. Use this option when you have COMSOL 3.4 installed and 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 3.4** to remove an existing installation.





---

**Note:** You can change the path to the existing installation by pressing the F1 key.

---

2 Once you have read the license agreement, click the **I accept the terms of the license agreement** button and specify the license. You can 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-CUSV-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.

The screenshot shows the 'COMSOL 3.4 Installer' window with the 'License' tab selected. The window title is 'COMSOL 3.4 Installer'. The main content area displays the 'COMSOL AB Software License Agreement'. The agreement text includes a warning to read terms before installation and a list of terms, starting with '1. License Grant. During the term of this License Agreement ("Agreement"), COMSOL ("we", "us", "our") grants to licensee ("you", "your") a non-exclusive, non-transferable, limited license to install, run, use, ...'. Below the agreement, there are two radio buttons: 'I accept the terms of the license agreement' (selected) and 'I do not accept the terms of the license agreement'. Under 'License information', there is a 'License format' dropdown menu set to 'Passcode', a 'Passcode' text field containing 'FFFFFFF-CUSV-123456-1234567-123456789', and a 'Check' button. At the bottom, there are 'Name' and 'Company' text fields, both containing 'My Name' and 'My Company' respectively. At the very bottom, there are three buttons: 'View install.pdf', '< Back', and 'Next >', and a 'Cancel' button on the right.

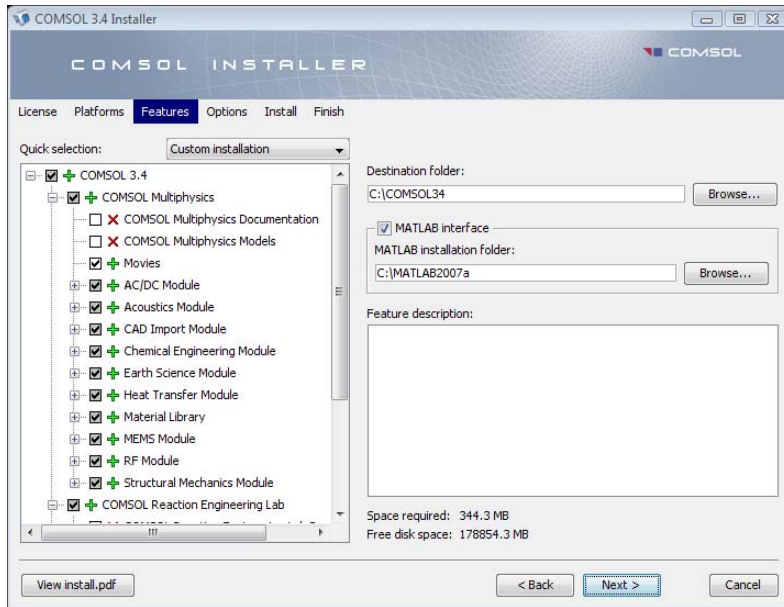
---

**Note:** If you clicked **Change License** 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 Select the features to install and specify the path to the COMSOL installation directory. Select **MATLAB Interface** and specify the MATLAB root folder if you want

the ability to run COMSOL using the MATLAB interface. MATLAB versions 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, 2007a, and 2007b work with COMSOL 3.4.



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

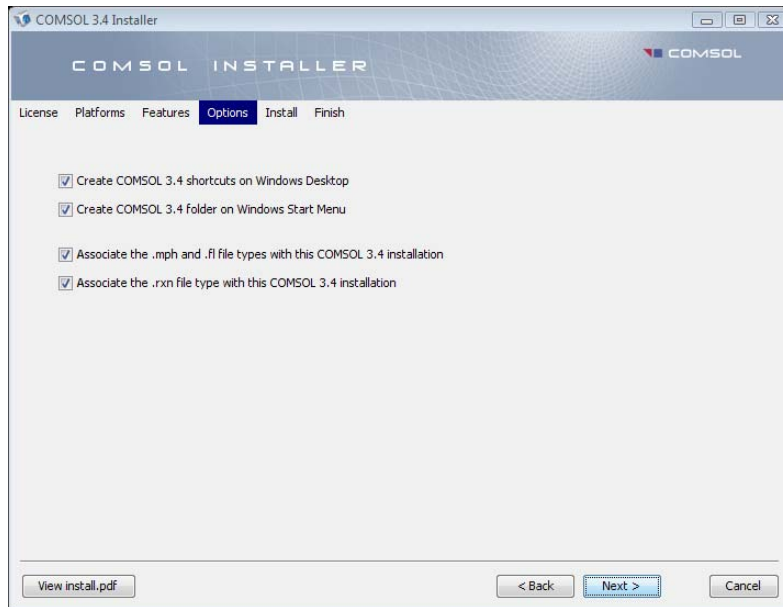
---

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

---

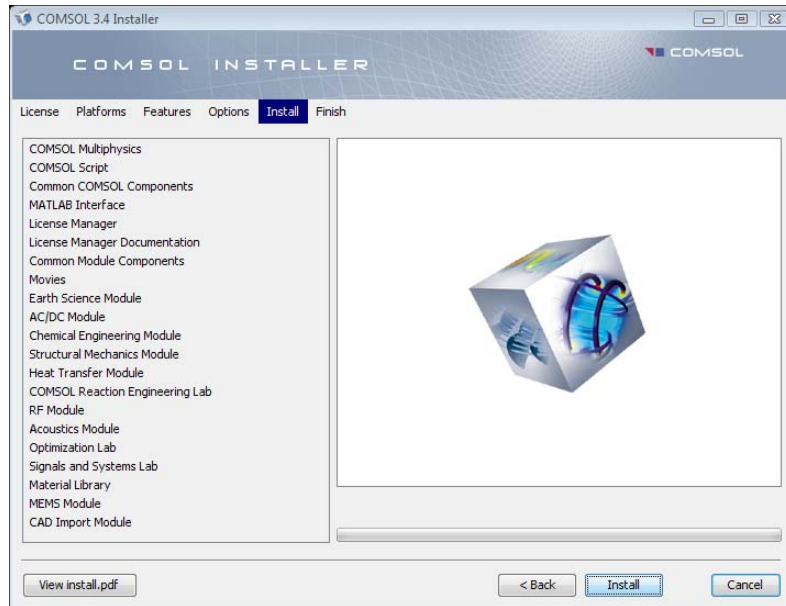
**5** Click **Next**.

- 6 Set the installation options. Here you can choose whether or not you want:
- COMSOL shortcuts on the Windows desktop
  - COMSOL shortcuts on the Windows Start menu
  - to associate the COMSOL model file type (.mph files) with the COMSOL installation. If you choose this option you can open COMSOL models by double-clicking them.
  - to associate the COMSOL Reaction Engineering Lab model file type (.rxn files) with the COMSOL installation. If you choose this option you can open COMSOL Reaction Engineering Lab models by double-clicking them.

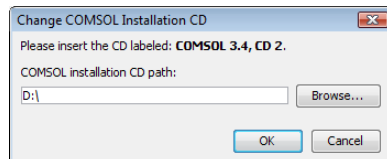


- 7 Click **Next**.

- 8 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.



Be prepared to eject CD 1 from the CD-ROM drive if the following dialog box appears. Follow the instructions in the dialog box, insert CD 2, CD 3, CD 4, CD 5, or CD 6, and then click **OK**.

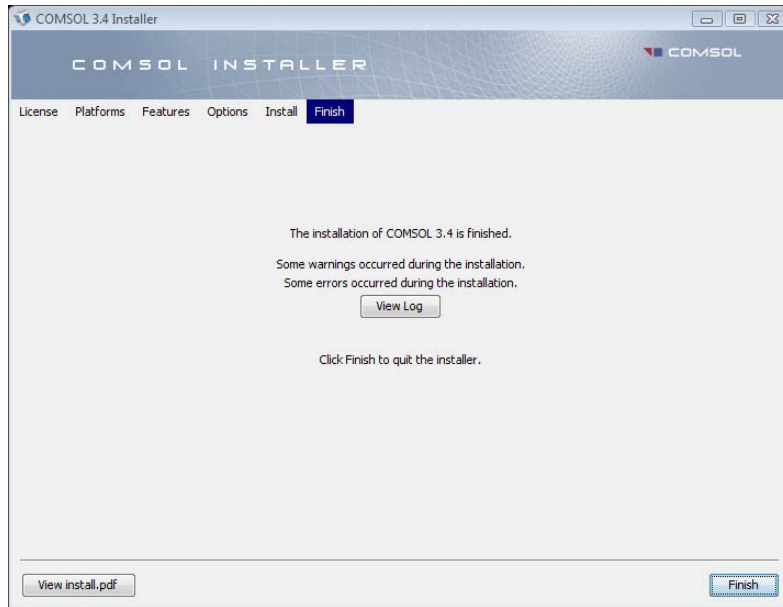


---

**Note:** Whether or not you will be asked for CD 2, CD 3, CD 4, CD 5, or CD 6 depends on your license and on the features selected in Step 4.

---

- 9 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.



### *Automated Installation of COMSOL 3.4*

---

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 CD 1>\setup.exe -s <answer file path>
```

A template answer file, `setup.ini`, with detailed usage information is available on CD 1.

### *Removing (Uninstalling) the COMSOL Installation*

---

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

---

**Note:** The uninstaller deletes all COMSOL 3.4 files and directories on the system that were installed by the COMSOL installer. Files and folders created after installation are not removed.

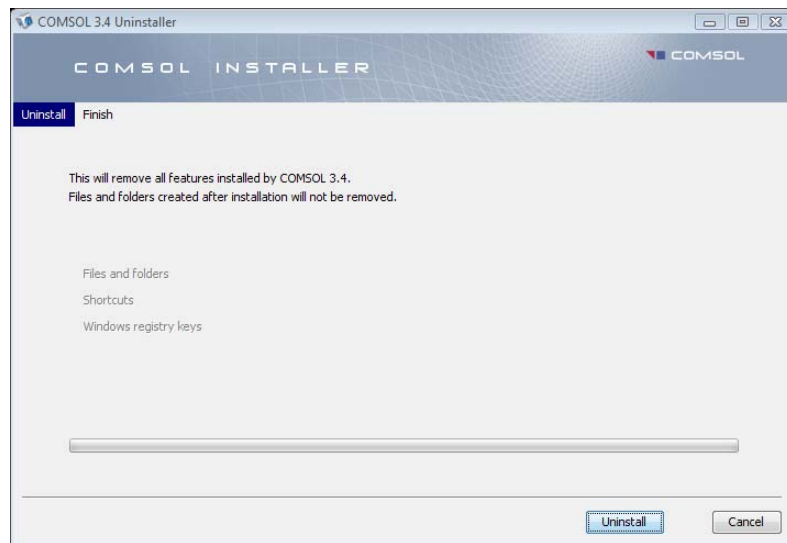
---

## STARTING THE UNINSTALLER

To start the COMSOL uninstaller, use either of these methods:

- On the Windows Start menu point to **Programs** and then to **COMSOL 3.4**. Click **Uninstall COMSOL 3.4**.
- On the Windows Start menu, point to **Settings**, then click **Control Panel**. Double-click **Add/Remove Programs**. Select **COMSOL 3.4** from the list.

## RUNNING THE UNINSTALLER



Click **Uninstall** to start removing the installation. Click **Finish** to quit the installer when the deinstallation is complete.

---

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

---

### *Automated Removal (Uninstallation) of COMSOL 3.4*

---

Similar to how you can automate the installation, 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, `setup.ini`, which is available on CD 1. When you have created an answer file for uninstalling, you start the uninstallation by running

```
<path to CD 1>\setup.exe -s <answer file path>
```

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

### *Changing the Path to the MATLAB Installation*

---

Edit the file `comsol.opts` in the `bin` directory under the COMSOL root directory (typically `C:\COMSOL34`). In the file, change the line that starts with `mlroot=` to point to the root directory of your MATLAB installation.

### *Adding the SolidWorks Live Connection to the CAD Import Module*

---

If you have bought the CAD Import Module, the COMSOL Installer adds an add-in to SolidWorks called the **COMSOL Multiphysics Interface**. This add-in should appear on the SolidWorks user interface in the **Add-Ins** list that appears under 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 In SolidWorks, go to the **File** menu and choose **Open**.
- 2 In the **Files of type** list select **Add-Ins (\*.dll)**.
- 3 Load the file `flswinterface.dll` from the directory `lib\win32` under the COMSOL 3.4 installation directory.



# Installing COMSOL on Linux and Sun

## *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” on page 24 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 thus 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 and Sun does not modify any files on your system outside the COMSOL installation directory.

## *Installing COMSOL 3.4*

---

- 1 Insert the COMSOL 3.4 CD 1 or DVD into the CD-ROM/DVD drive.
- 2 If the CD or DVD is not mounted automatically by your operating system, use the `mount` command to mount it.

---

**Note:** If you are installing from CDs, make sure not to connect to a directory on CD 1 or open files on it. If you do so while installing the software, you will be unable to unmount and eject CD 1 and continue the installation with CD 2, CD 3, CD 4, CD 5, and CD 6 (depending on the license, not all CDs might be required).

---

- 3 To start the installation, enter the command

```
sh drivepath/setup
```

where *drivepath* is the mount point of the CD-ROM/DVD drive, for example, `/mnt/cdrom`.

- 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 will open up at this point and you will be 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. If you want the ability to run COMSOL using the MATLAB interface, select **MATLAB Interface** and specify the MATLAB root folder. MATLAB versions 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, 2007a, and 2007b work with COMSOL 3.4.
- 8 Click **Next**.
- 9 Click **Install** to start the installation.

The installation process might take several minutes. If you are installing from CDs, be prepared to unmount and eject CD 1 from the CD-ROM drive when the corresponding dialog box appears. Use the `unmount` and `eject` commands to unmount and eject the CD. Some Linux and Sun configurations will automatically unmount and eject the CD when you press the CD drive button. Insert CD 2, CD 3, CD 4, CD 5, or CD 6, make sure it is mounted, and click **OK**.

- 10 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 CD or DVD. Some Linux and Sun configurations will automatically unmount and eject the CD or DVD when you press the CD or DVD drive button.

The file `browser` in the `doc` 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:

- 1 Mozilla
- 2 Firefox

3 Konqueror

4 Opera

5 Netscape

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

---

**Note:** To make sure all users can easily start COMSOL, include the `comsol34/bin` directory in all users' paths or make a symbolic link from `/usr/local/bin/comsol` to the `comsol` command (see the `ln` command).

---

---

### *Removing (Uninstalling) the COMSOL Installation*

---

The COMSOL 3.4 installation adds files only in the `comsol34` directory. To remove the COMSOL installation, simply delete the `comsol34` directory including all subdirectories.

---

### *Using the Unattended Installer and Installing Without a Display*

---

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 documented in the template answer file, `setup.ini`, which is available on CD 1. When you have created an answer file, you start the uninstallation by running

```
<path to CD 1>\setup.exe -s <answer file path>
```

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

---

### *Changing the Path to the MATLAB Installation*

---

Open the file `comsol` in the `bin` directory under the COMSOL installation directory. In the file, change the line that starts with `m1root=` to point to the root directory of your MATLAB installation.

# Installing COMSOL on Macintosh

## *Before You Begin*

---

- Check that your system meets all applicable requirements (see “COMSOL Multiphysics System Requirements for Mac” on page 6).
- Have your passcode or license file ready. A passcode has a form similar to:

FFFFF-CUSV-123456-1234567-123456789

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

Some COMSOL license types require that you also install a license manager before running a COMSOL software product. If you install COMSOL software with a passcode, no license manager is needed. If you install it 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” on page 24 for instructions. You can install your COMSOL software products and the license manager in any order.

If your Macintosh contains an old COMSOL (FEMLAB) installation, the COMSOL 3.4 installer does not remove it; it merely removes the MATLAB path to the old COMSOL version. You can keep the old version if desired as well as uninstall it before or after installing COMSOL 3.4.

## *Installing Java 3D and Java Advanced Imaging*

---

COMSOL requires Java 3D and Java Advanced Imaging from Apple. It is included in Mac OS X 10.4, but for Mac OS X 10.3 it must be installed separately. You can download this software update from

[http://www.apple.com/downloads/macosx/apple/macosx\\_updates/java3dandjavaadvancedimagingupdate.html](http://www.apple.com/downloads/macosx/apple/macosx_updates/java3dandjavaadvancedimagingupdate.html)

To install this software after the download:

- 1 If the disk image was not mounted automatically following the download, mount it by double-clicking the disk image file **Java3D\_and\_JAI.dmg**.
- 2 Double-click the file **Java3D\_and\_JAI.mpkg** to launch the installer. Follow the instructions to install the software update.

## *Installing COMSOL 3.4*

---

**Note:** 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 3.4 DVD/CD 1 into the CD-ROM drive. Launch the **COMSOL Installer** application from the Finder. The **COMSOL 3.4 Installer** window appears.
- 2** To proceed, see the instructions for Windows in the section “Installing COMSOL 3.4” on page 9. The procedure is the same for the Mac.

## *Removing (Uninstalling) the COMSOL Installation*

---

The COMSOL 3.4 installation adds files only in the **COMSOL34** folder. To remove the COMSOL installation, simply delete the **COMSOL34** folder including all subfolders.

## *Changing the Path to the MATLAB Installation*

---

Edit the file `comsol` in the `bin` directory under the COMSOL installation directory. In the file, change the line that starts with `m1root=` to point to the root directory of your MATLAB installation.

# License Manager Installation

The license manager supports a heterogeneous network of Windows, Linux, Sun, and Mac computers. Both the license manager and a COMSOL application can run on either Windows, Linux, Sun, or Mac platforms. We refer to the computer where the license manager is installed as the *license server* and any computers where the COMSOL applications are installed as *clients*. You can install COMSOL 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.

To install a license manager, start by following the instructions in the section “Before You Begin” that follows immediately. Then, depending on the platform, go to the following sections:

---

## LICENSE MANAGER INSTALLATION SECTIONS

---

“License Manager Installation on Windows” on page 26

---

“License Manager Installation on Linux and Sun” on page 28

---

“License Manager Installation on the Mac” on page 33

---

You can install the license manager and COMSOL in any order. You cannot perform a full test of the installation until you have installed both.

COMSOL uses the FLEXnet™ license manager version 10.8 from Macrovision Corporation for license management. (Note that FLEXnet was formerly called FLEXlm.)

## *Before You Begin*

---

### SYSTEM REQUIREMENTS

Before starting the installation process, check that your system meets all necessary requirements (see page 4). They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager you need not consider memory and graphics requirements. The COMSOL license manager is completely independent of the MATLAB license manager.

## OBTAINING A FLEXNET LICENSE FILE

To install a COMSOL license manager you need a FLEXnet license file, `license.dat`. It looks something like this:

```
SERVER my_server 00b0d05d1635 1718
USE_SERVER
VENDOR LMCOMSOL
FEATURE SERIAL LMCOMSOL 3.4 permanent uncounted \
  VENDOR_STRING=T,7F3F3 HOSTID=DEMO SN=123456789 \
  SIGN=123456789ABC
INCREMENT COMSOL LMCOMSOL 3.4 permanent 10 DUP_GROUP=UH \
  SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 3.4 permanent 10 DUP_GROUP=UH \
  SIGN=123456789ABC
INCREMENT ChEM LMCOMSOL 3.4 permanent 5 DUP_GROUP=UH \
  SIGN=123456789ABC
INCREMENT EM LMCOMSOL 3.4 permanent 5 DUP_GROUP=UH \
  SIGN=123456789ABC
INCREMENT SME LMCOMSOL 3.4 permanent 5 DUP_GROUP=UH \
  SIGN=123456789ABC
```

As noted earlier, you should have received a COMSOL `license.dat` file with the COMSOL package. If you have not received it, contact your local COMSOL representative or send a request to [support@comsol.com](mailto: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.

Make sure that the license server name is the actual name of your license server; otherwise, change it by editing the file. You can also change the default port number (1718). This is necessary in the unlikely case that another program is already using that port number. If it becomes necessary to change the port number, any unused number between 1025 and 64,000 is valid.

---

**Note:** Only the license server name and the port number should change. Do not modify anything else in the `license.dat` file or your license will not work.

---

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

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 just given shows that the user has a permanent COMSOL 3.4 license allowing ten concurrent users of

COMSOL Multiphysics and five concurrent users of the Chemical Engineering Module, the Electromagnetics Module, and the Structural Mechanics Module. The number after “SIGN=” at the end of each INCREMENT line contains a license key. To break up long lines use the continuation character (\).

In the event you have not received the `license.dat` file, you must provide us with the hostid of your license server (see “Obtaining a Hostid” on page 35 for instructions) and preferably your license server name. Please have them 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`)

#### **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 on FLEXnet management, see Chapter 7 in the *FLEXnet Licensing End Users Guide* available from the COMSOL Help Desk.

#### **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 the section “Installing COMSOL on Windows” on page 9 for installation instructions. When finished, skip the remainder of this section and continue with “Starting the License Manager” on page 27.

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

- 1 Insert the distribution disk CD 1 into the CD-ROM drive.
- 2 Follow the installation instructions starting on page 9 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.

#### STARTING THE LICENSE MANAGER

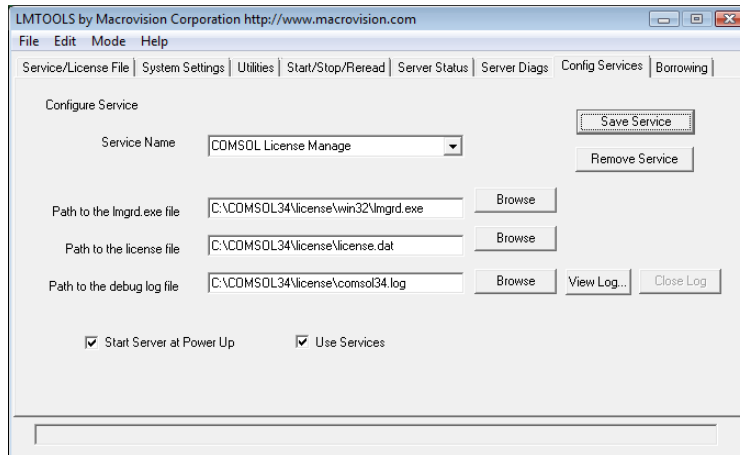
You can start the license manager manually, or it can run automatically as a service at boot.

##### *Starting the Manager Automatically as a Service*

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

- 1 Locate the `comsol134\license\win32` directory and run `lmtools.exe`.
- 2 On the **Service/License File** page choose **Configuration using Services**. Note that you must perform this step every time you start the FLEXnet Control Panel.
- 3 Click the **Configure Services** tab.
- 4 Make an entry in the **Service Name** edit field, for example, COMSOL License Manager.
- 5 Specify the full path to `lmgrd.exe`, `license.dat`, and the debug log file 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` directory. Now, in a command window enter

```
lmgrd -c ..\license.dat -l ..\comsol34.log
```

The license manager is now ready to distribute licenses over the network. It writes debug information to the log file `comsol34\license\comsol34.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.

#### *License Manager Installation on Linux and Sun*

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 and Sun.

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 on FLEXnet management, see Chapter 7 in the *FLEXnet Licensing End Users Guide*, which is available on the COMSOL 3.4 Help Desk.

## 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 the section “Installing COMSOL on Linux and Sun” on page 19). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 31.

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

- 1 Insert CD 1 into the CD-ROM drive.
- 2 To start the installation, enter the following command:  

```
/mnt/cdrom/setup
```

depending on where `/mnt/cdrom` is the mount point of the CD-ROM drive.
- 3 Continue according to the installation instructions on page 23 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.

## LICENSE FILES FOR NAMED SINGLE USER LICENSE

If you have a *Named Single User License* the installer automatically creates a so-called *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 with COMSOL Script, 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; for COMSOL Script, the options file must include the SCRIPT and SCRIPTPROMPT features.

```
INCLUDE COMSOL USER philip
INCLUDE COMSOLGUI USER philip
INCLUDE SCRIPT USER philip
INCLUDE SCRIPTPROMPT USER philip
INCLUDE CADIMPORT USER philip
INCLUDE SME 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 3.4 product family:

TABLE 1-4: COMSOL 3.4 PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAME
COMSOL Multiphysics	COMSOL
COMSOL Multiphysics GUI	COMSOLGUI
COMSOL Multiphysics floating network license	CLIENTSERVER
COMSOL Script	SCRIPT
COMSOL Script command prompt	SCRIPTPROMPT
COMSOL Reaction Engineering Lab	REACTION
AC/DC Module	EM
Acoustics Module	ACO
CAD Import Module	CADIMPORT
Chemical Engineering Module	ChEM
Earth Science Module	ES
Heat Transfer Module	HT

TABLE I-4: COMSOL 3.4 PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAME
MEMS Module	MEMS
RF Module	RF
Structural Mechanics Module	SME
Signals & Systems Lab	SIGNAL
Optimization Lab	OPTLAB

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/comsol34/license/LMCOMSOL.opt
```

then the VENDOR row in license.dat should read

```
VENDOR LMCOMSOL options=/usr/local/comsol34/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/comsol34.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file /var/tmp/comsol34.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.

---

**Note:** We do not recommended that you start the daemons as root for security reasons. 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 I-5: BOOT SCRIPT PROCEDURES

PLATFORM	PROCEDURE
Sun	<p>Copy the file <code>comsol34/license/sol2/rc.lm</code> and paste it at the beginning of <code>/etc/init.d/lmgrd</code>. Create this file if it does not already exist.</p> <p>Edit <code>/etc/init.d/lmgrd</code>, replacing 'dir' in the code fragment with the full path to the <code>sol2</code> platform directory, and replace 'username' with an actual username.</p> <p>If the file (link) <code>/etc/rc3.d/S171lmgrd</code> does not exist, create it with the commands</p> <pre>cd /etc/rc3.d ln -s /etc/init.d/lmgrd S171lmgrd</pre>
SuSE Linux	<p>The following instructions should work for SuSE Linux distributions, where <code>\$arch</code> is either <code>glnx86</code> (32-bit Linux), or <code>glnxa64</code> (64-bit Linux).</p> <p>In the <code>comsol34/license/\$arch</code> directory, type the commands</p> <pre>cp rc.lm /etc/init.d/comsol34lm chmod 755 /etc/init.d/comsol34lm</pre> <p>Edit <code>/etc/init.d/comsol34lm</code>, replacing <code>dir</code> with the full path to the <code>\$arch</code> platform directory, and replace <code>username</code> with an actual username.</p> <p>Now create the following link</p> <pre>cd /etc/init.d/rc5.d ln -s ../comsol34lm S91comsol34lm</pre>
Debian Linux	<p>Copy the file <code>comsol34/license/\$arch/lm_comsol</code> to <code>/etc/init.d</code></p> <p>Edit <code>/etc/init.d/lm_comsol</code>. Update the <code>FP</code> and <code>MYUSER</code> variables as indicated in the file. Use the utility <code>update-rc.d</code> to automatically update the system's init script links:</p> <pre>update-rc.d lm_comsol start 99 2 3 4 5 . stop 1 0 1 6 .</pre> <p>This means that the COMSOL license manager is started by runlevels 2, 3, 4, and 5, and stopped by runlevels 0, 1, and 6. Type <code>man update-rc.d</code> for more information on init scripts.</p>
Linux	<p>The following instructions should work for most Linux distributions, where <code>\$arch</code> is either <code>glnx86</code> (32-bit Linux), <code>glnxa64</code> (64-bit Linux), or <code>glnxi64</code> (Itanium).</p> <p>Copy the file <code>comsol34/license/\$arch/rc.lm</code> and paste it at the end of <code>/etc/rc.d/rc.local</code>.</p> <p>Replace 'dir' in the code fragment with the full path to the <code>\$arch</code> platform directory, and replace 'username' with an actual username.</p>

## STARTING COMSOL

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

### *License Manager Installation on the Mac*

---

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`.

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 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

You should 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 automatically installs the license manager files along with COMSOL (see the section “Installing COMSOL on Macintosh” on page 22). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 34.

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

- 1 Insert the COMSOL 3.4 CD 1 into the CD-ROM drive.
- 2 Follow the installation instructions starting on page 23 until you reach the **Features** screen.
- 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 (page 9) to complete the license manager file installation.

## STARTING THE LICENSE MANAGER

You can either start the license manager manually or let it run automatically at startup.

### *Starting the License Manager Manually*

To start the license manager manually, perform these steps:

- 1 Launch the **Terminal** application.
- 2 Change directory to the `license/macosx` directory  

```
cd /Applications/COMSOL34/license/macosx
```
- 3 Then enter  

```
./lmgrd -c ../license.dat -l /var/tmp/comsol34.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol34.log`.

### *Starting the License Manager Automatically at Startup*

A folder `COMSOL_Lmgr` located in the folder `COMSOL34/license/macosx` holds a script that can automatically start the license manager when you start the computer. By installing and configuring this folder, there is no need to start the license manager 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/COMSOL34
```

- 6 Edit the line



USERNAME=<username>

by replacing <username> with your username.

To test the license manager installation restart the computer. 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.

### *Obtaining a Hostid*

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

`COMSOL34/license/$arch/lmhostid`

where `$arch` is either `win32` (Windows), `win64` (64-bit Windows), `glnx86` (32-bit Linux), `glnxa64` (64-bit Linux), `glnxi64` (Itanium), `sol2` (Sun), or `macosx` (Mac).

If COMSOL is not installed, you must obtain a hostid using OS commands as described in the following table:

TABLE I-6: HOSTIDS FOR THE SUPPORTED PLATFORMS

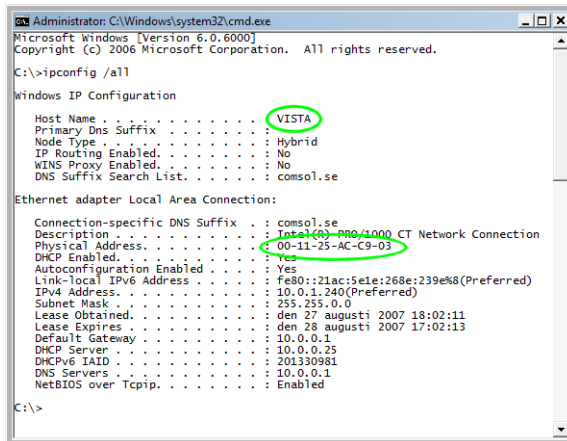
PLATFORM	HOSTID	TYPE THIS COMMAND ON THE LICENSE SERVER:	EXAMPLE
Linux	Ethernet address	<code>/sbin/ifconfig eth0</code> and remove colons from HWaddr 00:40:05:16:E5:25 (do not use the hostid command)	00400516E525
Sun	32-bit hostid	<code>hostid</code>	170a3472
Windows	Ethernet address	<code>ipconfig /all</code> (remove hyphens from the physical address 00-50-02-84-A3-28)	00500284A328
Mac	Ethernet address	see below	00039377F4AC

FLEXnet uses different machine identifications for different architectures. For example, all Sun Microsystems machines have a unique hostid whereas other machines do not. For this reason, some 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 WINDOWS

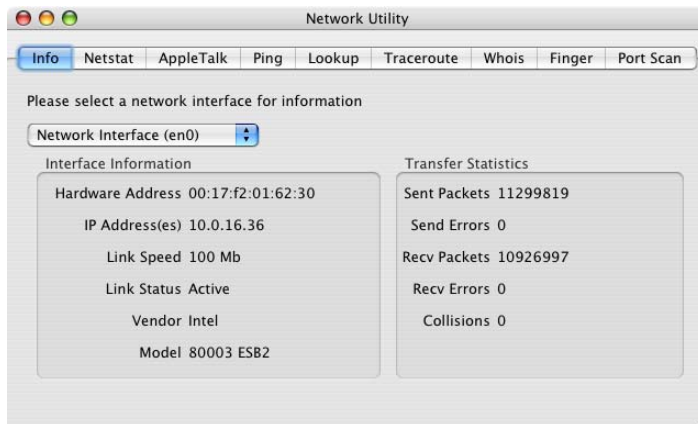
- 1 Open the Start menu and click **Run**.
- 2 Type cmd and click **OK** and the command window opens.
- 3 Type  
`ipconfig /all`  
and press Enter.
- 4 The FLEXnet hostid is equal to the **Physical Address**, which is displayed in the next image, with the hyphens removed.



## OBTAINING THE HOSTID ON A MACINTOSH

- 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**, which is displayed in the following image, with the colons removed. If you plan to install on a Macintosh laptop with a wireless

network card, please 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.

TABLE 1-7: 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.	<p>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:</p> <p>Windows: C:\COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log</p> <p>Please send the log file to support@comsol.com if you want help in interpreting the information.</p> <p>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” in the COMSOL Installation Guide for instructions how to install and start the COMSOL license manager.</p>
License error: -12. Invalid returned data from license server system.	<p>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.</p> <p>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.</p> <p>If the problems remain, send the license manager log file to support@comsol.com. The log file is usually placed here:</p> <p>Windows: C:\COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log</p>

TABLE I-7: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -15. Cannot connect to license server system.	<p>The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>a license manager is required. Please refer to the section “License Manager Installation” in the COMSOL Installation Guide for instructions how to install and start the COMSOL license manager.</p> <p>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.</p> <p>Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.</p> <p>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:</p> <p>Windows: C:\COMSOL34\license\license.dat Linux/Sun: /usr/local/comsol34/license/license.dat Mac: /Applications/comsol34/license/license.dat</p> <p>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:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>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.</p> <p>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:</p> <p>Windows: C:\COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log</p> <p>NOTE: The log file is created by the license manager after it has been started.</p> <p>Please send the log file to support@comsol.com if you want help in interpreting the information.</p>

TABLE 1-7: 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: Windows: C:\COMSOL34\license\license.dat Linux/Sun: /usr/local/comsol34/license/license.dat Mac: /Applications/comsol34/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: Windows: C:\COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.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

This chapter describes the various options for running the COMSOL software products on the supported platforms.

# Running COMSOL on Windows

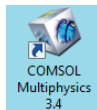
The installer adds the folder **COMSOL 3.4** to the **Start** menu under the **Programs** item. That folder contains a selection of the items in the following list depending on the licensed COMSOL software products you have:

- **COMSOL Multiphysics:** Opens COMSOL Multiphysics. A corresponding shortcut is added to the desktop.
- **COMSOL Script:** Starts a COMSOL Script prompt. To start the COMSOL Multiphysics GUI from within COMSOL Script, run `comsol` at the command prompt. A corresponding shortcut is added to the desktop.
- **COMSOL with MATLAB:** Starts MATLAB 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, or 2007a and sets up all necessary paths, and then it opens the COMSOL Multiphysics graphical user interface. If you quit COMSOL Multiphysics you can launch it again by typing `comsol` at the MATLAB command prompt. A corresponding shortcut is added to the desktop.
- **COMSOL Multiphysics Client:** Starts a COMSOL Multiphysics client for connecting to a COMSOL Multiphysics server (see the section “Running COMSOL Multiphysics Client/Server” on page 57).
- **COMSOL Multiphysics Server:** Starts a COMSOL Multiphysics server that a COMSOL Multiphysics client can connect to (see the section “Running COMSOL Multiphysics Client/Server” on page 57).
- **Uninstall COMSOL 3.4.**
- **Documentation:** A folder that contains COMSOL documentation shortcuts.

## *Running COMSOL Multiphysics*

---

You can run COMSOL Multiphysics by double-clicking the **COMSOL Multiphysics 3.4** icon on the desktop.



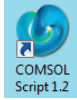
Alternatively, to activate COMSOL Multiphysics from the **Start** menu, point to **Programs**, then to **COMSOL 3.4**, and then click **COMSOL Multiphysics**.



## Running COMSOL Script

---

You can run COMSOL Script by double-clicking the **COMSOL Script 1.2** icon on the desktop.



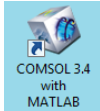
Alternatively, to activate COMSOL Script from the **Start** menu, point to **Programs**, then to **COMSOL 3.4**, and then click **COMSOL Script**.

Use the command `comsolbatch.exe` in the directory `bin` under the COMSOL 3.4 installation directory to run COMSOL Script in batch mode. For example, use `comsolbatch "inv([1 2; 3 5])"` to compute the inverse of the matrix  $\begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}$ .

## Running COMSOL Multiphysics with MATLAB

---

To run COMSOL Multiphysics with MATLAB, double-click the **COMSOL 3.4 with MATLAB** icon on the desktop.



Alternatively, start COMSOL Multiphysics with MATLAB from the **Start** menu by pointing to **Programs**, then to **COMSOL 3.4**, and then select **COMSOL with MATLAB**.

### THE CLASSPATH FILE AND ITS LOCATION

The `classpath.txt` file specifies which Java class path to use inside MATLAB. When starting COMSOL Multiphysics with MATLAB, COMSOL Multiphysics copies `classpath.txt` from the `toolbox\local` directory under the MATLAB installation to the directory specified as the **Start in** directory for the **COMSOL with MATLAB** shortcut. It then writes some extra lines to this file to include the Java class paths that COMSOL Multiphysics needs. Therefore you must have write access to the **Start in** directory when starting MATLAB using the `comsol` command. To change the **Start in** directory:

- 1 Right-click the **COMSOL with MATLAB** shortcut and choose **Properties**.
- 2 On the **Shortcut** page, type the path to the starting directory into the **Start in** edit field.
- 3 Click **OK**.

# Running COMSOL on Linux/Sun

## *Running COMSOL Multiphysics*

---

Run the `comsol` command. If it is not available, ask your system manager to make it available to you.

## *Running COMSOL Script*

---

Run the command

```
comsol script
```

If it is not available, ask your system manager to make it available to you.

## *Running COMSOL Multiphysics with MATLAB*

---

Run the command

```
comsol matlab
```

to launch MATLAB with paths setup to run COMSOL Multiphysics functions.

Run the command

```
comsol matlab multiphysics
```

to launch the COMSOL Multiphysics user interface from within the MATLAB environment.

The script `comsol` creates a file `classpath.txt` that MATLAB requires, and it places that file in the current directory. Therefore you must have write access to this directory when starting MATLAB using the `comsol` command.

---

**Note:** To be able to run 64-bit COMSOL on Linux/Sun, make sure that you have installed the 64-bit support for your platform.

---

## *Considerations on Linux*

---

COMSOL has been compiled to run on certain older versions of Linux. COMSOL will not automatically detect these older Linux version so you need to tell COMSOL about this yourself. These versions do not have full parallel support.

### **32 BIT LINUX**

To run comsol on a Linux version with glibc version lower than 2.3.2, you need to run COMSOL with the `-gcc323` option. Type `comsol -gcc323` to start COMSOL.

### **64 BIT LINUX**

To run comsol on a Linux version with glibc version lower than 2.3.4, you need to run COMSOL with the `-gcc332` option. Type `comsol -gcc332` to start COMSOL.

# Running COMSOL on Mac OS X

## *The COMSOL Applications*

---

The following five applications allow you to run COMSOL as described in the following sections.

---

**Note:** None of the COMSOL applications work if you move them outside the COMSOL folder. Create an alias if, for example, you want a desktop icon.

---

- **COMSOL Multiphysics** application

This is the primary application to run the software. It launches COMSOL Multiphysics as a standalone application.

- **COMSOL Script** application

This is the primary application to run the software. It launches COMSOL Script as a standalone application.

- **COMSOL with MATLAB** application

Use this application when you want to use the interface between COMSOL Multiphysics and MATLAB. This application first launches MATLAB and then the COMSOL Multiphysics graphical user interface. If you quit COMSOL Multiphysics you can launch it again by typing `comsol` at the MATLAB command prompt.

---

**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.

---

- **COMSOL Multiphysics Client** application

This application launches a COMSOL Multiphysics client that connects to a COMSOL Multiphysics server (see the section “Running COMSOL Multiphysics Client/Server” on page 57).

- **COMSOL Multiphysics Server** application

This application launches the **Terminal** application and starts a COMSOL Multiphysics server in a terminal window (see “Running COMSOL Multiphysics Client/Server” on page 57).

### *Running COMSOL Multiphysics from a Terminal Window*

---

You can also launch COMSOL Multiphysics from a terminal window using the shell script `COMSOL34/bin/comsol`. See the section “Running COMSOL on Linux/Sun” on page 44 for options available in the `comsol` command.

To run the `comsol` command more easily, include the `COMSOL34/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/COMSOL34/bin/comsol /usr/bin/comsol
```

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

---

**Note:** The `comsol` command must not be moved from the `COMSOL34/bin` folder. The COMSOL applications also use this script.

---

# The COMSOL Command

Use the `comsol` command to start COMSOL products with detailed start-up options. This command works similarly on all platforms, but there are differences in availability and options. On non-Windows platforms, you can start all COMSOL products with the `comsol` command. On Windows there are some differences: you must use different commands to start 32- and 64-bit applications, and you need special commands to start terminal-based products (see availability in the following chart).

The general syntax of the `comsol` command is:

```
comsol [options] [product] [product arguments] [expression]
```

where [...] indicates something optional:

TABLE 2-1: COMSOL OPTIONS

COMSOL OPTION	DESCRIPTION	AVAILABILITY
-32	Use a 32-bit data model if available	In Windows, use <code>comsol.exe</code>
-64	Use a 64-bit data model if available	In Windows, use <code>comsol64.exe</code> . Not available on Mac
-blas <{auto}/mk1/atlas/sunperf/path/acml>	BLAS library to use	See section “COMSOL and BLAS” on page 65
-h	Print general help	
-h <product>	Print product-specific help	
-np <no. of processors>	Number of processors	Not available on Mac
-mpmode <throughput/turnaround/owner>	Multiprocessor mode	See “Optimizing Processor Usage” on page 63.
-tmpdir <path>	Temporary file directory	
-version	Print COMSOL version	
-version <product>	Print product version	

We support the 64-bit option on Linux, Itanium, and Sun platforms. On Windows, use the `comsol.exe` and `comsol64.exe` commands to start 32- and 64-bit products, respectively. For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files.

The available COMSOL products are:

TABLE 2-2: COMSOL PRODUCTS

PRODUCT	DESCRIPTION	AVAILABILITY
multiphysics	Run standalone COMSOL Multiphysics	
server	Run COMSOL Multiphysics server	This is the only product available on the Itanium platform. In Windows use <code>comsolserver.exe</code> or <code>comsolserver64.exe</code>
client	Run COMSOL Multiphysics client	
script	Run COMSOL Script	In Windows, optionally use <code>comsolscript.exe</code> or <code>comsolscript64.exe</code>
batch	Evaluate expression or run M-file in batch mode	In Windows, use <code>comsolbatch.exe</code> or <code>comsolbatch64.exe</code>
reaction	Run COMSOL Reaction Engineering Lab	In Windows, optionally use <code>comsolreaction.exe</code> or <code>comsolreaction64.exe</code>
matlab	Run COMSOL in MATLAB	
ffi	Compile foreign function	In Windows, use <code>comsolffi.exe</code> or <code>comsolffi64.exe</code>

From within COMSOL Multiphysics, COMSOL Script, and COMSOL Reaction Engineering Lab, you can start any other product by clicking its name in the **File** menu. This means the products run within the same process and that they can intercommunicate. Never start products separately if you want to make them communicate later on. From within COMSOL Script and MATLAB you can start the COMSOL Multiphysics graphical user interface and the COMSOL Multiphysics server by using the M-file `comsol.m`. For more information about the COMSOL Multiphysics client/server architecture, see the section “Running COMSOL Multiphysics Client/Server” on page 57.

## GENERAL COMSOL PRODUCT COMMAND-LINE ARGUMENTS

TABLE 2-3: COMSOL PRODUCT COMMAND-LINE ARGUMENTS

PRODUCT	PRODUCT OPTION	DESCRIPTION
multiphysics, reaction, script	-open	Open model file
server,client	-port	Server port number.
server	-multi <on {off}>	Accept multiple clients
server	-login <{info}/force/ never>	Show login dialog box

*Example:*

Start COMSOL Server and COMSOL Client, explicitly choosing a port number, enabling multiple ports, and indicating that you want to provide a new passcode to the COMSOL Server.

```
comsol server -login force -port 4711 -multi on
comsol client -port 4711
```

## COMSOL SCRIPT OPTIONS

The general syntax for the command to start COMSOL Script is

```
comsol [options] script [product arguments]
```

Its detailed product arguments are:

TABLE 2-4: COMSOL SCRIPT-SPECIFIC ARGUMENTS

COMSOL SCRIPT ARGUMENTS	DESCRIPTION	AVAILABILITY
multiphysics	Run COMSOL Multiphysics within COMSOL Script	
server	Run COMSOL server within COMSOL Script	
-desktop	Use COMSOL desktop interface	
-gui	Use graphical user interface	
-term	Use terminal interface	In Windows, use comsolterm.exe or comsolterm64.exe



TABLE 2-4: COMSOL SCRIPT-SPECIFIC ARGUMENTS

COMSOL SCRIPT ARGUMENTS	DESCRIPTION	AVAILABILITY
-ws <motif/gtk>	Determine window system to use	Available only on Linux
<expression>	Evaluate expression within COMSOL Script	

*Example*

An example of using the `comsol script` command on Linux is

```
comsol script -desktop -ws motif <expression>
```

It starts COMSOL Script within the COMSOL desktop environment, selects the Motif window system, and evaluates the expression before starting.

**MATLAB ARGUMENTS**

The command `comsol matlab [options]` starts MATLAB with the COMSOL paths set up. Run the command `comsol matlab multiphysics` to also launch the COMSOL Multiphysics user interface.

Similarly, `comsol matlab path [options]` starts MATLAB with the COMSOL path set up.

The command `comsol matlab server [options]` starts MATLAB with the COMSOL path set up and starts a COMSOL Multiphysics server.

The command `comsol matlab reaction [options]` starts MATLAB and the COMSOL Reaction Engineering Lab graphical user interface.

The full list of options for `comsol matlab` are:

TABLE 2-5: COMSOL MATLAB-SPECIFIC ARGUMENTS

MATLAB ARGUMENTS	DESCRIPTION
{path}	Set up COMSOL path within MATLAB
multiphysics	Run COMSOL Multiphysics within MATLAB
server	Run COMSOL server within MATLAB
reaction	Run COMSOL Reaction Engineering Lab within MATLAB

TABLE 2-5: COMSOL MATLAB-SPECIFIC ARGUMENTS

MATLAB ARGUMENTS	DESCRIPTION
-ml <option>	Start MATLAB using the specified option
-mlr <expression>	Evaluate expression in MATLAB after COMSOL within MATLAB has started
-mlroot <directory>	Specify root directory for MATLAB installation
-D<debugger>	Run MATLAB in debugger; no COMSOL paths set
<expression>	Evaluate expression within COMSOL Script

*Examples:*

Start MATLAB without the MATLAB desktop and without the MATLAB splash screen and run mycomsolscript.

```
comsol matlab path -ml -nodesktop -ml -nosplash -mlr mycomsolscript
```

Run COMSOL Multiphysics with MATLAB using MATLAB installed in /usr/local/MyMatlab.

```
comsol matlab multiphysics -mlroot /usr/local/MyMatlab
```

**PERMANENTLY CHANGING THE MATLAB OPTIONS**

You can add the MATLAB startup options to the file `comsol.opts` (on Windows) or `comsol` (on the Linux, Sun, and Macintosh platforms). On the line that starts with the string `mlargs=`, add the MATLAB startup options that you want to use. For example,

```
mlargs=-nodesktop -nosplash
```

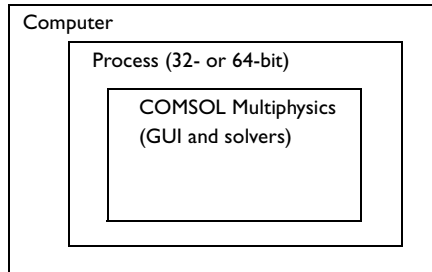
starts COMSOL Multiphysics with MATLAB without showing the MATLAB splash screen and providing MATLAB without the desktop environment.

# The COMSOL Multiphysics Client/Server Architecture

## *Standalone COMSOL Multiphysics*

---

The most straightforward way of running COMSOL Multiphysics is as a standalone application. Standalone COMSOL Multiphysics 3.4 can run as a 32-bit application on Windows, Linux, Sun, and Mac.



In addition, COMSOL Multiphysics can run in 64-bit mode as a standalone application on 64-bit Windows plus 64-bit Linux and Sun.

## *Running COMSOL Script*

---

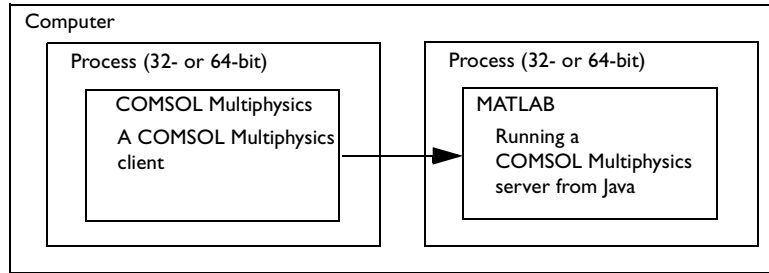
COMSOL Script runs in 32-bit mode on all platforms on Windows, Linux, Sun, and Mac. In addition it can run in 64-bit mode on 64-bit Windows plus 64-bit Linux and Sun. COMSOL Script typically runs in the same process as COMSOL Multiphysics.

## *Running COMSOL Multiphysics with MATLAB*

---

COMSOL Multiphysics can run together with MATLAB on the same machine using COMSOL Multiphysics' client/server architecture. The COMSOL Multiphysics server runs on the Java engine within MATLAB, while the COMSOL Multiphysics graphical user interface runs as a separate application. COMSOL Multiphysics starts

automatically in this configuration when you run COMSOL Multiphysics with MATLAB.



MATLAB can currently run in 32-bit mode on Windows, Linux, Sun, and Mac, which means that COMSOL Multiphysics with MATLAB also runs in 32-bit mode within MATLAB on those platforms. In addition, COMSOL Multiphysics with MATLAB can run in 64-bit mode on 64-bit Windows with MATLAB 2006a, 2006b, and 2007a and on 64-bit Linux with MATLAB 7.0.1, 7.0.4, 7.1, 2006a, 2006b, and 2007a and on Sun with MATLAB 2007a.

### *Running COMSOL Multiphysics as a Client/Server Application*

---

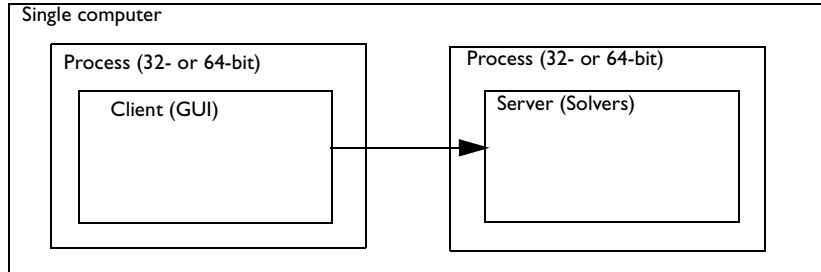
The COMSOL Multiphysics client runs as a 32-bit application on all platforms for which we distribute the software: Windows, Linux, Sun, and the Mac. In addition, the COMSOL Multiphysics client can run as a 64-bit application on 64-bit Windows plus 64-bit Linux and Sun.

#### **THE COMSOL MULTIPHYSICS SERVER**

The COMSOL Multiphysics server can run as a 32-bit application on Windows, Linux, Sun, and Mac. The COMSOL server is available as a 64-bit application on 64-bit Windows, 64-bit Linux, Itanium, and Sun.

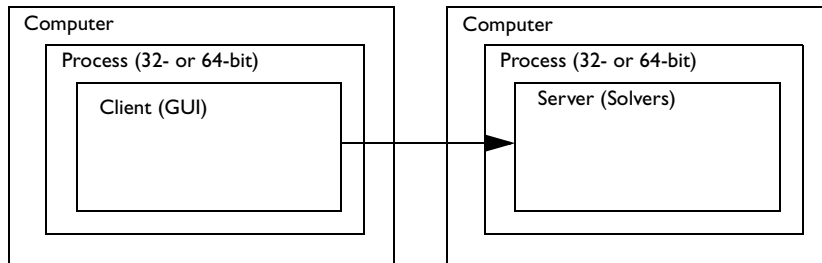
## **RUNNING COMSOL MULTIPHYSICS CLIENT/SERVER ON THE SAME COMPUTER**

Both the COMSOL Multiphysics client and the COMSOL Multiphysics server can run on the same computer and with all available license types: named user license (NSL), CPU locked license (CPU), and floating network license (FNL).



## **RUNNING COMSOL MULTIPHYSICS CLIENT/SERVER ON DIFFERENT COMPUTERS**

The COMSOL Multiphysics client and COMSOL Multiphysics server can also run on different computers, but this configuration requires a floating network license (FNL).

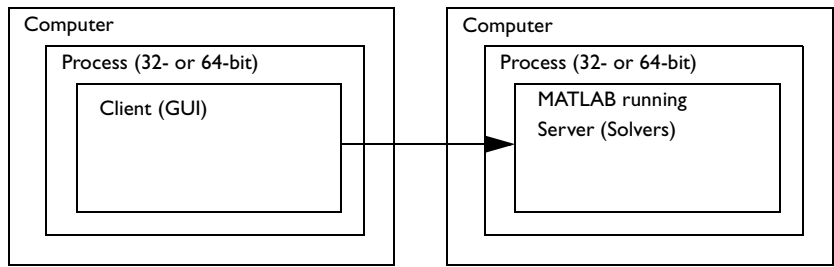


This is the only way to run the COMSOL Multiphysics server on the Itanium platform because neither the COMSOL Multiphysics client nor standalone COMSOL Multiphysics are available for this platform.

## **RUNNING COMSOL MULTIPHYSICS CLIENT AND COMSOL MULTIPHYSICS SERVER IN MATLAB**

It is also possible to run the COMSOL Multiphysics server in MATLAB without starting the COMSOL Multiphysics graphical user interface. In this configuration you can access a COMSOL Multiphysics server running within MATLAB on a remote

computer. This configuration also requires a floating network license (FNL) for COMSOL Multiphysics.



# Running COMSOL Multiphysics Client/Server

The COMSOL Multiphysics graphical user interface can run in a separate process as a client to a COMSOL Multiphysics server. The COMSOL Multiphysics client uses a TCP/IP connection to connect to the COMSOL Multiphysics server. The client and server need not run on the same platform. You must have a floating network license (FNL) to run the COMSOL Multiphysics server and the COMSOL Multiphysics client on separate computers.

You can also use the COMSOL Multiphysics client/server when running COMSOL Multiphysics with MATLAB. To do so, start a COMSOL Multiphysics client on a separate computer and connect to a COMSOL Multiphysics server started from within a MATLAB process.

## *Advantages of Using COMSOL Multiphysics Client/Server*

---

The COMSOL Multiphysics client/server configuration frees your desktop computer of lengthy computations, dispatching your jobs to a dedicated computer. The computer that runs the COMSOL Multiphysics server could have more memory and a faster CPU than your desktop computer.

Note, too, that running the COMSOL Multiphysics server and the COMSOL Multiphysics client separately on the same computer increases the total memory available to solve problems. This is particularly interesting because the 32-bit limit on addressable memory can be the limiting factor for complex models. The COMSOL Multiphysics server components do not use the memory required for the graphical user interface, freeing that memory for the actual computations on the server.

## *Running COMSOL Multiphysics Client/Server*

---

### **STARTING COMSOL MULTIPHYSICS SERVER**

When you have access to the Windows desktop, start the COMSOL Multiphysics server from the **Start** menu. Go to **Programs**, select **COMSOL 3.4**, and then **Client/Server**. If starting the COMSOL Multiphysics server from a terminal window in Windows, use the command `C:\COMSOL34\bin\comsolserver.exe`.

On Linux and Sun, use the `comsol server` command to start a COMSOL Multiphysics server.

On the Mac, use the **COMSOL Multiphysics Server** application, or if you are logging on to the Mac from another computer, use the `comsol server` command in the terminal window.

#### STARTING A COMSOL MULTIPHYSICS CLIENT

To start a COMSOL Multiphysics client under Windows, use the **Start** menu. Go to **Programs**, select **COMSOL 3.4**, and then **Client/Server**. To start a client on Linux and Sun use the `comsol client` command. On Mac OS X use the **COMSOL Multiphysics Client** application.

#### ACCESSING THE COMSOL MULTIPHYSICS SERVER COMPUTER

To access the COMSOL Multiphysics server computer under Linux, Sun, or Mac OS X, simply log in on the server computer by using `ssh`, `rlogin`, or `telnet`, then enter the `comsol server` command. When running the COMSOL Multiphysics server within MATLAB on Linux and Sun, you need access to the X-Windows display pointed to by the `DISPLAY` variable. On Mac OS X, you need access to the Mac desktop, that is, you must be logged on from the Mac OS X computer console in order to run the COMSOL Multiphysics server within MATLAB.

On Windows you can access the server computer 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 NetMeeting or Remote Desktop (Windows XP). Start the COMSOL Multiphysics server from the **Start** menu. If several people want to access a single Windows computer to run the COMSOL Multiphysics 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 Multiphysics server.

#### INITIALIZING THE COMSOL MULTIPHYSICS SERVER

The first time you start a COMSOL Multiphysics server on a computer, a dialog box asks for a user name and password. A terminal window without access to a display does not allow you to open this dialog box, so you cannot use a terminal window when initially logging on to the server computer. The easiest method is to sit down at the computer and log in on it the first time you start the COMSOL Multiphysics server. Enter a user name and password, and then select the **Remember password** check box.



You can now connect through a terminal window the next time you want to run the COMSOL Multiphysics server.

#### **PORT NUMBER**

The COMSOL Multiphysics server requires that each user log in and start the COMSOL Multiphysics server manually. The COMSOL Multiphysics server prints a port number in the terminal window. In the COMSOL Multiphysics client, go to the **Model Navigator**, click the **Settings** tab, and provide the computer name and a port number. If you have identical home directories on the server and client and you start the COMSOL Multiphysics client after the COMSOL Multiphysics server has been started, the COMSOL Multiphysics client can obtain the computer name and port number from the `.comsol` directory in your home directory. If the COMSOL Multiphysics client has not determined the computer name and port number, you must enter them manually.

#### **SAVING AND LOADING MODELS ON THE SERVER**

For large models run on the 64-bit COMSOL Multiphysics server, memory available on the client might not be sufficient to save the model. Therefore we have implemented the ability to load and save a model directly on the computer where the COMSOL Multiphysics server is running. Please note that the file systems accessible on the COMSOL Multiphysics server might be different than the ones where your COMSOL Multiphysics client is running. These options are available when you are running COMSOL Multiphysics client/server on different computers by going to the **File** menu and choosing **Open** and **Save As**.

#### **RUNNING THE COMSOL MULTIPHYSICS SERVER WITHIN MATLAB REMOTELY**

On Windows and the Macintosh you must have access to a display to run MATLAB. Thus to run the COMSOL Multiphysics server within MATLAB on a remote Windows or Macintosh computer, you must sit down at the computer and log in, or you need a remote login tool with display capabilities such as NetMeeting or Remote Desktop.

On Linux and Sun you can start MATLAB remotely as long as you have access to a display pointed to by the `DISPLAY` variable. Start the COMSOL Multiphysics server within MATLAB by typing `comsol server`. You must start MATLAB in Windows by using **COMSOL with MATLAB** on the **Start** menu, on a Mac by running the **COMSOL with MATLAB** application, or on Linux and Sun platforms by typing the command `comsol matlab`.

## *Connecting Standalone COMSOL Multiphysics to a Server*

---

It is not necessary to set up a client-server connection from the start when you run COMSOL Multiphysics. You can connect COMSOL Multiphysics running in standalone mode to a COMSOL Multiphysics server or to MATLAB at any time. To do this use the **Client/Server/MATLAB** menu in the **File** menu.

When a standalone version of COMSOL Multiphysics is connected to a server, data the solvers need is transferred to the server, and the previously standalone COMSOL Multiphysics becomes a COMSOL Multiphysics client.

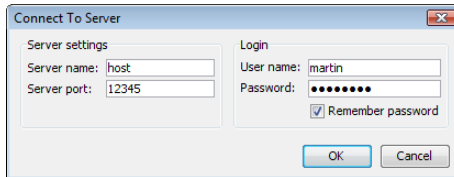
### **CONNECTING TO MATLAB**

To connect to MATLAB, use the menu item **Connect to MATLAB**. This launches MATLAB and starts a server in MATLAB. Then the standalone COMSOL Multiphysics is connected to this server.

The **Connect to MATLAB** menu item always launches a new MATLAB session. To connect to an already running session of MATLAB, first go to MATLAB and issue the command `comsol server`. This starts a COMSOL Multiphysics server in MATLAB. Then use the **Connect to Server** menu item to connect to this server.

### **CONNECTING TO A SERVER**

To connect to a COMSOL Multiphysics server, use the menu item **Connect to Server**. This opens a dialog box where you can enter the server and login information.



The user name and password are the ones you used when starting the server, and the port number is printed by the server when it is started.

### **DISCONNECTING FROM A SERVER**

You can close the connection to the server or MATLAB using the menu item **Disconnect from Server/MATLAB**. Doing so transfers all data from the server to the client and makes it a standalone version of COMSOL Multiphysics.

Keep in mind that if you close the connection from a server running on another computer and the client computer has less memory, there might not be enough

memory on the client computer for all data. This can in particular happen if you have a large model open at the time you close the connection. The solution data resides on the server. This data is transferred to the client, and there must be enough memory on the client computer to complete this transfer.

# Login Information and Security

## *Login Information*

---

When you start a COMSOL Multiphysics server for the first time, the **Set Login Information** window appears. 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 subdirectory `.comsol/ver34/login` in your home directory. On Mac OS X this login information is located in `Library/Preferences/COMSOL/ver34/login` 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.

Always make sure that untrusted users cannot access the COMSOL login information. Thus you must protect the file `.comsol/ver34/login` in your home directory. This is important when using COMSOL Multiphysics' client/server feature.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. By default, only a single COMSOL Multiphysics client can connect to a server. If you disconnect from the server, you must once again run the `comsol server` command to make further connections. 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.

# Running COMSOL in Parallel

The parallel sections of COMSOL are based on the parallel shared memory model. Most multiple-processor machines and dual-core/multicore machines support the shared memory model; however, it is not supported by clusters. The solvers, assembly, and meshing in COMSOL Multiphysics and the linear algebra functions in COMSOL Script benefit from parallelism.

## *Parallel COMSOL*

---

### **NUMBER OF PROCESSORS THAT COMSOL USES**

On Linux and Sun, the COMSOL software runs on one processor by default. On Windows, COMSOL uses the environment variable `NUMBER_OF_PROCESSORS`. If you have a parallel machine that COMSOL supports, you can override the default with the switch `-np <number of processors>`.

---

**Note:** You can set the environment variable `COMSOL_NUM_THREADS` instead. It is overridden by the switch `-np`.

---

---

**Note:** On processors with hyperthreading, `NUMBER_OF_PROCESSORS` is set to the number of hyperthreads. On computers with hyperthreading processors, you provide the actual number of processors with one of the techniques above.

---

---

**Note:** MATLAB 2007a supports multiple processors. The support is activated in the **General** settings under **File>Preferences**. The settings override the processor settings in COMSOL.

---

### **OPTIMIZING PROCESSOR USAGE**

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. Apart from the default mode there are three modes of operation

that you control with the switch `-mpmode <multiprocessor mode>`. The *throughput mode* (`-mpmode throughput`) is expected to give the best performance when several different processes are running actively at the same time as COMSOL. The *turnaround mode* (`-mpmode turnaround`) and *owner mode* (`-mpmode owner`) typically provide the best performance when no other processes than COMSOL are active. The owner mode provides the highest performance in most cases, but the only way to find out is to experiment with the different modes.

---

**Note:** You can set the environment variable `COMSOL_MP_MODE` instead. It is overridden by the switch `-mpmode`.

---

### **BENEFITS OF RUNNING COMSOL IN PARALLEL**

A significant part of the parallel speedup in computations comes from functions of the type BLAS (basic linear algebra subprogram; see the next section). If you want to run the software in parallel, it is important that the BLAS library you use supports parallelism. The MKL and Sun performance libraries run in parallel.

---

**Note:** These libraries run in parallel but they might not be the best choice for your processor type.

---

The direct solvers UMFPACK and TAUCS both benefit from BLAS. On Linux and Windows, you can also use the parallel sparse direct linear solver PARDISO, which is parallel independently of which BLAS library you use. All iterative solvers and smoothers except Incomplete LU are parallelized. Some smoothers have blocked versions. The blocked versions are usually more parallel than the nonblocked versions. The matrix assembly stage also runs in parallel. Usually the speedup depends on the problem size; problems using a lot of memory usually have better speedup.

All dense linear algebra operations in COMSOL Script benefit from BLAS. In addition, many sparse linear algebra operations in COMSOL Script run in parallel independently of BLAS.

The free mesher in 3D runs in parallel over the faces and subdomains of the geometry object being meshed. For this reason, the speedup when running on several processors depends strongly on the domain partitioning of the corresponding geometry. Meshing a geometry with only one subdomain, such as an imported CAD part, gives almost no

speedup at all. On the other hand, meshing a geometry with several subdomains, such as an imported CAD assembly with many parts, can give significant speedup, especially if the number of elements in the mesh is large.

Running in parallel usually requires extra memory. If you run out of memory, try to set the `-np` switch to a lower number. The speedup depends on the processor load. For instance, if your system has  $m$  processors and  $n$  of them are used by other active programs, do not set the `-np` switch to a number that is greater than  $m - n$ . The reason is that the programs compete for the same resources, which slows all of them considerably.

### *COMSOL and BLAS*

---

BLAS is a set of functions for basic linear algebra operations. Vendors often supply BLAS libraries optimized for their hardware. A large portion of the computational engine in COMSOL relies on BLAS. Included with COMSOL are the BLAS libraries MKL (Math Kernel Library) optimized for Intel processors and ATLAS (Automatically Tuned Linear Algebra Software). On Mac OS X, COMSOL relies on vecLib, which is installed on the system. AMD also supplies a BLAS library called ACML (AMD Core Math Library), which you can download from <http://developer.amd.com/acml.jsp>. Sun provides the Sun Performance Library with Sun Studio. Use the Sun Studio 11 version on 64-bit Solaris and the Sun Studio 8 version on 32-bit Solaris. On Linux, Windows, and Sun, you can also supply your own BLAS library optimized for your hardware. By default COMSOL automatically tries to detect an appropriate BLAS library. The defaults in COMSOL are:

- MKL on Intel processors (Linux and Windows).
- ATLAS on AMD processors (Linux and Windows except Windows 64-bit where MKL is used). If ACML is installed and appropriately set up COMSOL uses it instead.
- ATLAS on Sun.
- vecLib on Mac OS X.

You can override the default with the switch `-blas`. Valid options to the `-blas` switch are:

- `auto`—same as not using the switch (Linux, Windows, Sun)
- `mk1`—selects the MKL library (Linux, Windows)
- `atlas`—selects the ATLAS library (Linux, Windows, Sun)

- `acml`—selects the ACML library (Linux, Windows)
- `sunperf`—selects the Sun Performance Library (Sun)
- `path`—tries to load the library specified by the environment variable `COMSOL_BLAS_PATH`. The library must support the standard FORTRAN BLAS interface (Linux, Windows, Sun)

If the library you want to use is unavailable or incorrectly installed, COMSOL switches back to the default library.

---

**Note:** Instead of starting COMSOL with the `-blas` switch, you can set the environment variable `COMSOL_BLAS_LIBRARY`. The switch `-blas` overrides the environment variable.

---

#### USING A DIFFERENT BLAS LIBRARY THAN THE DEFAULT

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 `COMSOL34/lib/ARCH` where `ARCH` is the architecture (`glnx86`, `glnxa64`, `glnxi64`, `win32`, `win64`, `sol2`, or `sol64`) or somewhere in the standard search path.

---

**Note:** You must also provide the path to any sublibraries needed by the library. ACML requires `libg2c.so` on Linux, for instance.

---

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` on Linux and Sun (`LD_LIBRARY_PATH_64` on 64-bit Sun), or the environment variable `PATH` on Windows.

If you use the Sun Performance Library on Sun, that vendor recommends you change the default stack size to 4 MB for 32-bit Solaris and 8 MB for 64-bit Solaris. COMSOL assumes that Sun Performance Library is installed in `/opt/SUNWsprow/`. Otherwise you must provide the search path.



# I N D E X

- A**
  - ACML 65
  - add feature 10
  - ATLAS 65
  - automated installation 16
  - automated uninstallation 18
- B**
  - batch
    - COMSOL Script 43, 49
  - BLAS libraries 65
    - for parallel speedup 64
  - boot script 32
  - Bourne shell commands 31
  - browser
    - Linux and Sun file 20
- C**
  - CAD Import Module, platform support
    - for 7
  - change license 10
  - classpath file
    - on Linux and Sun 44
    - on Windows 43
  - client 24
  - client/server
    - running COMSOL Multiphysics as 57
    - running COMSOL Multiphysics with
      - MATLAB as 57
    - security issues with 62
  - COMSOL
    - documentation 2
    - installing on Linux and Sun 19
    - installing on Macintosh 22
    - installing on Windows 9
    - online help 2
    - running on Linux and Sun 44
    - running on Macintosh 46
    - running on Windows 42
    - technical support 2
    - uninstalling on Linux and Sun 21
    - uninstalling on Macintosh 23
    - uninstalling on Windows 16
  - comsol command 44
  - COMSOL Multiphysics
    - running with MATLAB as client/server
      - 57
    - Start menu items 63
  - COMSOL Multiphysics server
    - accessing 58
    - initializing 58
    - running within MATLAB remotely 59
  - COMSOL Script
    - batch 43, 49
    - system requirements 8
  - comsol.opts
    - setting MATLAB startup options 52
    - specifying the MATLAB path 18, 21, 23
  - comsolbatch.exe 43
  - connecting standalone COMSOL Multiphysics 60
  - connecting to server 60
- D**
  - daemon
    - license manager 26, 29, 33
    - starting 31
    - vendor 26, 29, 33
  - disconnecting from server 60
  - documentation 2
- E**
  - Ethernet address 35
- F**
  - FLEXIm 24
  - FLEXnet 24
    - control panel 26
    - license server 26, 29, 33
    - Licensing End Users Guide 26, 29, 33
    - management 26, 29, 33

- utility program 26, 29, 33
- floating network license 24
- floating network license support
  - heterogeneous network 4
- G** graphics requirements, Linux 5
- H** hostid 35
  - in license file 25
  - Linux 35
  - Macintosh 35
  - of license server 26
  - Windows 35
- hyperthreading 63
- I** initializing a COMSOL Multiphysics server 58
- installation
  - floating network license 24
  - Linux and Sun license server 28
  - Macintosh license manager 33
  - on Linux 19
  - on Macintosh 22
  - on Sun 19
  - on Windows 9
  - Windows license server 26
- Intel processor, for Macs 6
- L** license errors, troubleshooting 38
- license file 19, 25
- license manager
  - FLEXnet 24
  - installing files 26
  - starting 27, 31, 34
- license manager daemon 26, 29, 33
- license manager files 26
- license manager installation
  - Linux and Sun 28
  - Macintosh 33
  - Windows 26
- license server
  - definition of 24
  - license server files 26, 29, 33
  - license.dat 25
- Linux
  - graphics requirements 5
  - hostid 35
  - installing COMSOL on 19
  - running COMSOL on 44
  - system requirements 5
- lmgrd 29, 33
- lmgrd.exe 26
- lmhostid 35
- lmutil 29, 33
- lmutil.exe 26
- loading on server 59
- log file 28, 31, 34
- login information 62
- M** Mac OS X 6
- machine identification 35
- Macintosh
  - hostid 35
  - installing COMSOL on 22
  - license manager installation 33
  - running COMSOL on 46
  - system requirements 6
- Macs with Intel processor 6
- MATLAB
  - changing path to 18, 21, 23
  - connecting to 60
  - disconnecting from 60
  - requirements 7
  - running COMSOL Multiphysics on
    - Linux and Sun with 44
    - running COMSOL Multiphysics on Macintosh with 46
    - running COMSOL Multiphysics on Windows with 43
  - setting startup options for 52

- Mesa library 6
  - meshing, running in parallel 64
  - Microsoft Windows
    - hostid 35
    - installing COMSOL on 9
    - running COMSOL on 42
    - system requirements 4
    - Windows 2000 4
    - Windows Vista 4
    - Windows XP 4
  - MKL (Math Kernel Library) 65
- N** named single user license 20, 30
- O** obtaining a license file 25
  - online help 2
  - OpenGL 4, 6
  - optimizing processor usage 63
  - options file 30
  - owner mode, for multiprocessor usage 64
- P** parallel, running COMSOL in 63
  - PARDISO 64
  - passcode
    - format of 9, 22
  - Pentium III 4
  - port number 25
    - for COMSOL Multiphysics server 59
  - PowerPC processor, for Macs 6
  - processor usage, optimizing 63
  - processors
    - number of that COMSOL uses 63
    - Pentium III 4
    - UltraSPARC 5
- R** remove feature 10
  - root 31
- S** saving on server 59
  - security issues
    - in client/server mode 62
  - server
    - connecting to 60
    - disconnecting from 60
    - saving models on 59
  - shared memory model 63
  - Solaris 5
  - SolidWorks Live Connection 7, 18
  - Start menu, COMSOL Multiphysics folder 63
  - Sun
    - installing COMSOL on 19
    - running COMSOL on 44
    - system requirements 5
  - Sun Performance Library 65
  - system recommendations 4
  - system requirements
    - for running COMSOL Script 8
    - general 4
    - Linux and Sun 5
    - Macintosh 6
    - Windows 4
- T** TCP/IP 4
  - technical support 2
  - throughput mode, for multiprocessor usage 64
  - turnaround mode, for multiprocessor usage 64
  - typographical conventions 2
- U** UltraSPARC 5
  - unattended installation 16
  - unattended uninstallation 18
  - uninstalling COMSOL
    - on Linux and Sun 21
    - on Macintosh 23
    - on Windows 16
  - utility program 26, 29, 33
- V** vecLib 65

vendor daemon 26, 29, 33

**W** web browsers, for Linux and Sun 20

Windows Vista 4

Windows XP Professional x64 Edition 4

Windows. See Microsoft Windows