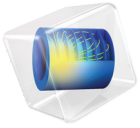

COMSOL Multiphysics

Installation Guide

6.4

COMSOL

COMSOL Multiphysics Installation Guide

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Protected by patents listed on www.comsol.com/patents, or see Help > About COMSOL Multiphysics on the File menu in the COMSOL Desktop for less detailed lists of U.S. Patents that may apply. Patents pending.

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Version: COMSOL 6.4

Contact Information

Visit the Contact COMSOL page at www.comsol.com/contact to submit general inquiries or search for an address and phone number. You can also visit the Worldwide Sales Offices page at www.comsol.com/contact/offices for address and contact information.

If you need to contact Support, an online request form is located on the COMSOL Access page at www.comsol.com/support/case. Useful links:

- Support Center: www.comsol.com/support
- Product Download: www.comsol.com/product-download
- Product Updates: www.comsol.com/product-update
- COMSOL Blog: www.comsol.com/blogs
- Discussion Forum: www.comsol.com/forum
- Events: www.comsol.com/events
- COMSOL Video Gallery: www.comsol.com/videos
- Support Knowledge Base: www.comsol.com/support/knowledgebase
- Learning Center: www.comsol.com/support/learning-center

Part number: CM010002

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Before You Begin

Welcome to the *COMSOL Multiphysics Installation Guide*, which provides instructions on how to install COMSOL Multiphysics® and its add-on products. In addition to this manual, several online resources are available which are relevant for installation:

- System Requirements: www.comsol.com/system-requirements
- Support Knowledge Base: www.comsol.com/support/knowledgebase
- Support Center: www.comsol.com/support
- COMSOL Software License Agreement: www.comsol.com/sla
- Product Download: www.comsol.com/product-download
- Product Updates: www.comsol.com/product-update
- COMSOL Video Gallery: www.comsol.com/videos
- Learning Center: www.comsol.com/support/learning-center

Installation Media Options

There are four installation media options for COMSOL 6.4:

- Installation over the internet:
  - This option requires internet access from the computer where COMSOL is to be installed.
- Installation from a downloaded DVD or DMG image:
  - This option requires internet access from any computer for downloading the DVD image file (`.iso` file extension, for Windows® and Linux®) or DMG image file (`.dmg` file extension, for macOS).
- Installation from a DVD given to you by a COMSOL representative:
  - This option requires access to a DVD reader on the computer where COMSOL Multiphysics is to be installed.
- Installation from a USB Flash Drive given to you by a COMSOL representative:
  - This option requires a USB port on the computer where COMSOL is to be installed.

Installation using any of these four options is explained later in this document.

System Requirements

COMSOL Multiphysics is a cross-platform software that runs on the Windows®, macOS, and Linux® operating systems. A variety of hardware platforms are supported, including graphics cards. Before installing, make sure your computer meets the current requirements listed at: www.comsol.com/system-requirements.

The system requirements page also lists compatible software versions for:

- External function C compiler
- COMSOL API when used with Java®
- LiveLink™ *for* MATLAB®
- LiveLink™ *for* Simulink®
- LiveLink™ *for* Excel®
- CAD Import Module
- Design Module
- LiveLink™ *for* SOLIDWORKS®
- LiveLink™ *for* Inventor®
- LiveLink™ *for* AutoCAD®
- LiveLink™ *for* Revit®
- LiveLink™ *for* PTC® Creo®Parametric™
- LiveLink™ *for* Solid Edge®
- File Import *for* CATIA® V5

Previous Installations

Previous installations of COMSOL are not affected by your new COMSOL 6.4 installation, except that double-clicking a Model MPH file will open it in the latest installation (unless otherwise specified). You can continue to use other versions or uninstall them independently of the latest installation.

In this guide, the term COMSOL 6.4 refers not only to COMSOL Multiphysics 6.4 but also to any of the add-on products, as well as COMSOL Server 6.4 and its add-ons.

Software License Agreement

For the complete software license agreement with details on the license conditions, please refer to the COMSOL Software License Agreement. The PDF can be downloaded at www.comsol.com/sla. The license agreement is also available in your installation folder.

- On Windows, it is located at:

  `C:\Program Files\COMSOL\COMSOL64\Multiphysics\doc\pdf\COMSOL_Multiphysics\COMSOL_SoftwareLicenseAgreement.pdf`

  and can also be accessed from the Windows Start menu, under **COMSOL Multiphysics 6.4** > **COMSOL Documentation**.
- On macOS, it is located at:

  `/Applications/COMSOL64/Multiphysics/doc/pdf/COMSOL_Multiphysics/COMSOL_SoftwareLicenseAgreement.pdf`
- On Linux, it is located in the installation directory, for example:

  `/usr/local/comsol64/multiphysics/doc/pdf/COMSOL_Multiphysics/COMSOL_SoftwareLicenseAgreement.pdf`

License Types

There is a variety of license options, and the steps involved when installing can differ depending on which license type you have acquired. No license type restricts usage to just one operating system but you are able to choose to install on either Windows, macOS, or Linux. A COMSOL Multiphysics model file saved on one platform can be opened on another. Certain license types come with restrictions; make sure you know which license type you have before proceeding with the installation.

All COMSOL licenses allow for multicore/multiprocessor shared-memory computing. How many cores or processors you can utilize is only limited by your hardware configuration and operating system. You can control the number of cores and processors in use from the **Computing** > **Multicore** page in the **Preferences** window.

For a full description and definition of the different license types, see the *COMSOL Software License Agreement*. All of the license types may not be available in your region.

COMSOL Multiphysics

The following is an overview of the license types for COMSOL Multiphysics:

Named Single User License (NSL)

The COMSOL Multiphysics software may be installed and operated on up to four (4) individual computers, provided it is only accessible to, and operated by, a single licensed user designated by us as the Named User for that license and provided that the Named User may concurrently use the software on only two (2) of those computers at any given time. For each computer, there is no restriction on the number of simultaneous sessions that the Named User may run.

Locked Single User License (CPU)

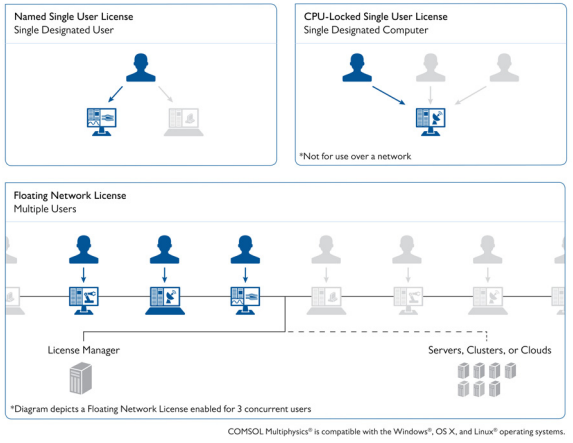
You can install the COMSOL Multiphysics software on one designated computer and different users can take turns using the software on that computer, one user at a time. There is no restriction on the number of simultaneous sessions that the one user may run. The CPU version of the software may not be accessed or used over a network or remotely.

Floating Network License (FNL)

Licensed per concurrent user, you can install the software on as many machines on your network as needed within your country or territory. The COMSOL Multiphysics software can run on local computers, with the network used only for license authentication. Alternatively, you can run the software on a remote computer over your network. Support for remote computing includes using Windows® Remote Desktop. In addition, this license type allows access to the COMSOL computational engine using a client. For example, you can run the graphical user interface on an inexpensive local machine, while offloading the heavy computations to a remote high-end machine. Cluster and cloud computing is supported on Windows® and Linux® platforms. For local use, there is no restriction on the number of simultaneous sessions for one concurrent user. With respect to cluster computing and cluster sweeps, a single model may be run on multiple compute nodes with no restriction on the number of compute nodes.

Class Kit License (CKL)

Up to 30 teachers and students can run the software for classroom purposes over the school's network where they access the license on-campus or through a secure remote connection.



COMSOL Compiler

The COMSOL Compiler is available under the following license types: Named Single User License (NSL), CPU-Locked Single User License (CPU), and Floating Network License (FNL). All those license types are described in the section above on COMSOL Multiphysics.

COMSOL Server

The following is an overview of the license types for COMSOL Server:

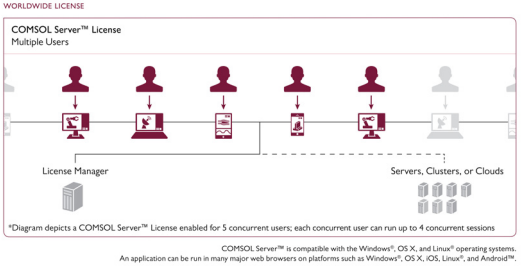
COMSOL Server License (CSL)

Licensed on a concurrent user basis. Each concurrent user may run up to four concurrent applications. The CSL version of the software enables you to run applications built with the Application Builder. The CSL allows you to host and run those applications within your organization and also to those outside your organization who time share your concurrent user slots, worldwide. Applications can be accessed through a major web browser on a variety of operating systems or a COMSOL client for the Windows® operating system. See www.comsol.com/system-requirements for detailed requirements.

Academic Server License (ASL)

Licensed on a 300 concurrent user basis, each concurrent user may run up to four concurrent applications. The ASL version of the software enables you to run applications built with the Application Builder. The ASL allows you to host and

run those applications for students, faculty, and staff of your academic institution or of any other academic institution, worldwide.



License Management Tools

The FlexNet® License Manager Software

Depending on your region and operating system, any of the above license types may require that the FlexNet® license manager software is installed and started before running a COMSOL product. The FlexNet® license manager is bundled with any COMSOL installation. You can view the contents of the license file (`license.dat`) that you received from your COMSOL representative by opening it with a text editor. If the file contains a line starting with the word SERVER, the license manager is required. For a Floating Network License, the purpose of the license manager is to count the number of concurrent users and to give an error message if the number of users exceeds the licensed number of concurrent users. Depending on your region and operating system, the license manager might also be needed for a Single User License. In that case, the purpose of the license manager is to lock the COMSOL session to a COMSOL authorized computer. See License Manager Installation on Windows for more information. The COMSOL software products and the license manager can be installed in any order, except if you are installing based on a port number and hostname. In that case, the license manager software needs to be installed and started before installing COMSOL.

We recommend that you use the license manager bundled with COMSOL 6.4. Using a license manager bundled with earlier COMSOL versions might work, but we recommend that you use the license manager from the latest COMSOL version. Use the license manager from the latest COMSOL version also for earlier COMSOL versions if possible. See the www.comsol.com/system-requirements for detailed requirements.

Dongle Hardware Lock

Depending on your region and operating system, any of the above license types might require a dongle (hardware lock). If you have received a dongle to use with COMSOL, please refer to instructions given to you by your COMSOL representative.

COMSOL Access

COMSOL Access is a service provided by COMSOL that gives you access to additional content on www.comsol.com and allows you to:

- Download products
- Update products (restricted to customers with an active subscription)
- Edit contact and license information
- Access the Knowledge Base (unabridged access to all parts is restricted to customers with an active subscription)
- Contact technical support
- Manage event registrations
- Manage abstract submissions to the COMSOL Conference
- Access to the COMSOL Exchange online model sharing
- Participate in the Community Discussion Forum

Registering with COMSOL Access is required for product download and installation.

Installation over the Internet

Installation of a Trial License over the Internet

A trial license can be given to you with the intention to test the software without any payment obligation for noncommercial and nonproduction use. This option is not available in all regions.

Installation of a Single User Trial License requires a license passcode. A passcode has a form similar to:

```
9FFF3FFFF7F5-TYUS-140917-17074436-384661755
```

This is usually sent to you by a COMSOL representative by email. Once you locate your passcode, follow these steps to prepare for download and installation:

1. Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.
2. If you have not already created a COMSOL Access account, you are prompted to create it. When you have created the account, you can enter your license passcode to associate it with your account information.

   If you already created a COMSOL Access account, you can associate the license file with your account on the COMSOL Access page under Manage Licenses at www.comsol.com/access/licenses.
3. Follow the web-based instructions to download the software.
4. Continue with the instructions in the section Downloading and Installing the COMSOL Software.

A license passcode can also be used for class kit licenses (CKL).

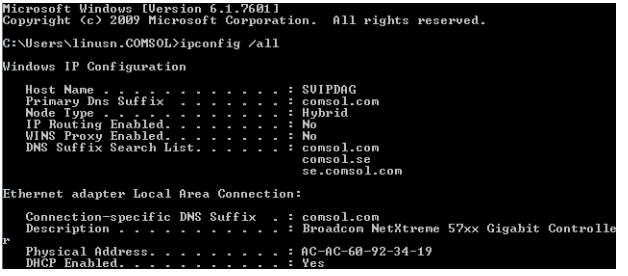
Installation of a Paid-for License over the Internet

Installation of any paid-for license on Windows requires a license file that is sent to you by your COMSOL representative by email. To be able to generate the license file, information about your hardware is needed in the form of a hostid (host ID). The hostid is used to lock the license to your hardware and needs to be sent by you to a COMSOL representative prior to the license file being generated.

Obtaining the Hostid

Follow these steps to obtain a hostid:

1. Open the Windows Command Prompt (`cmd`).
2. At the command line, type `ipconfig /all` and press Enter. The output should look similar to this:



3. The hostid you are looking for is here called Physical Address, also known as Ethernet address or MAC address.

Obtaining the Hostname

If you have been informed by your COMSOL representative that you need to run a license manager for your installation, then you also need the Host Name (see the screenshot above). If your network administrator prefers to use a fixed IP address for this particular computer, that IP address can be optionally used in place of the Host Name. For more information on license manager installation see License Manager Installation on Windows.

Hostid for PCs with Wireless Adapters

If you plan to install on a computer with a wireless network adapter, you need the physical address of both the wireless and the Ethernet adapter.

If the COMSOL representative asks you for the hard disk serial number instead of the hostid, type `vol` at the Windows command line prompt. The output should look similar to this:

```
Volume Serial Number is 2C9F-5930
```

Obtaining the License File from a COMSOL Representative

Send the hostid information, as well as hostname, if applicable, in an email to your COMSOL representative, who responds with an email including an attached license file (`license.dat`). Save this file to any location on your computer. You need to refer to it during installation.

The license file is a text file and below is an example of the contents of a `license.dat` file for a Single User License on Windows. In this example, the licensed products are COMSOL Multiphysics, Particle Tracing Module, Subsurface Flow Module, and LiveLink™ *for* Excel®.

```
#----------------------------------------------------------------
# COMSOL 6.4 NSL License No: 1234567 Windows/Mac
# Visit www.comsol.com/install for latest installation instructions
#----------------------------------------------------------------
FEATURE SERIAL LMCOMSOL 6.4 permanent uncounted \
          VENDOR_STRING=C,18000100200 HOSTID=ANY sort=100 \
          SN=1234567 TS_OK SIGN=8045890A6FE4
FEATURE COMSOL LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc" PLATFORMS="x64_n x64_mac arm64_mac" \
          SN=2076312 SIGN=E607EB680852
FEATURE PARTICLETRACING LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc" PLATFORMS="x64_n x64_mac arm64_mac" \
          SN=2076312 SIGN=3835733C6290
FEATURE SUBSURFACEFLOW LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc" PLATFORMS="x64_n x64_mac arm64_mac" \
          SN=2076312 SIGN=3A9BA162C9E4
FEATURE LLEXCEL LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc" PLATFORMS="x64_n x64_mac arm64_mac" \
          SN=2076312 SIGN=EE9C11E44356
FEATURE COMSOLGUI LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc" PLATFORMS="x64_n x64_mac arm64_mac"\
          SN=2076312 SIGN=0D0A83382550
```

A Single User License file can normally not be edited in any way by the user and has to be identical to the one sent to you by a COMSOL representative. If you were sent a license file that requires a license manager, then minor edits are required. For information on the type of license file required for installations using a license manager, see The License File and The License Features.

Registering with COMSOL Access

Once you have saved your license file, follow these steps to register or login to COMSOL Access to start the installation:

1. Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.
2. If you have not already created a COMSOL Access account, you are prompted to create it. When you have created the account, point to your license file (`license.dat`) to associate it with your account information.

   If you already have a COMSOL Access account, you can associate the license file with your account under Manage Licenses at www.comsol.com/access/licenses.
3. Continue with the instructions in the next section.

1. Go to the web page www.comsol.com/product-download. To download the COMSOL installer, you must first create a COMSOL Access account as described in the section Installation over the Internet.
2. You are now given the options of downloading the COMSOL online installer or the COMSOL offline installer (an ISO image).

If you have problems downloading (such as **Error downloading file. Connection refused: connect**), please review this knowledge base entry: www.comsol.com/support/knowledgebase/1149. If you still have problems, contact your local COMSOL representative or technical support: www.comsol.com/support.

Starting the Online Installer for Installation over the Internet

Start the COMSOL Installer by running the downloaded file `COMSOL64_win.exe`. The COMSOL 6.4 Installer window should now appear. Next, continue with the instructions in the section Running the COMSOL Installer.

Installation from Downloaded ISO Image

1. Download the ISO image. The default image, `COMSOL64_dvd.iso`, is too large to burn to disc. For installations that require physical discs, download the files `COMSOL64_dvd_1.iso`, `COMSOL64_dvd_2.iso` and `COMSOL64_dvd_3.iso` instead.
2. If you have downloaded the single ISO image, you will need to mount it directly. In all supported Windows versions, this can be done by right-clicking the ISO image, selecting **Mount** and then continuing with the installation as if the files were on a DVD. If you have downloaded the split ISO images, you will need to burn them to discs. In all supported Windows versions, you can burn a disc by right-clicking the ISO image and selecting **Burn to disc**.

Installing from a DVD or Mounted DVD Image

Once you have inserted the COMSOL DVD into the DVD drive (or mounted the image), the COMSOL Installer window should appear automatically; if not, run the file `setup.exe` on the installation DVD. The COMSOL 6.4 Installer window should now appear. Now continue with the instructions in the section Running the COMSOL Installer.

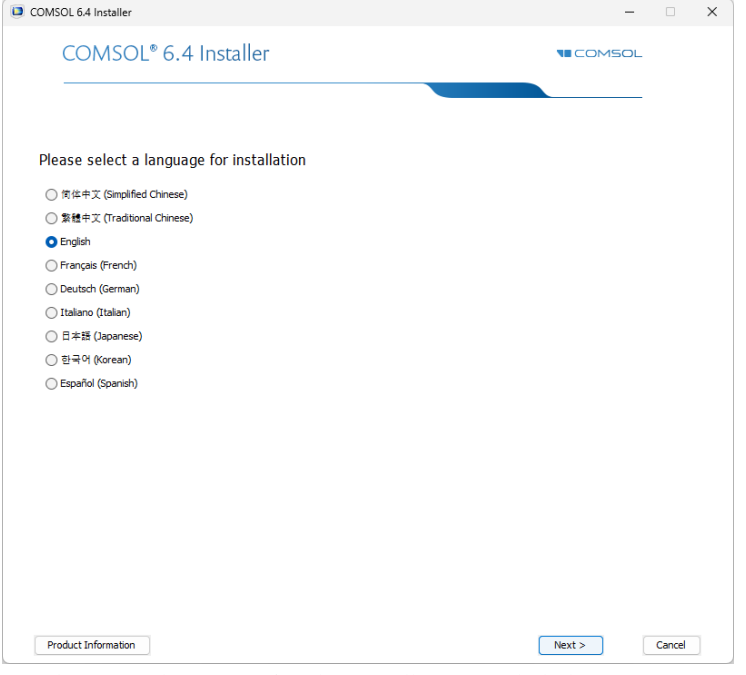
Installation from a USB Flash Drive

If you have received a USB Flash Drive from a COMSOL representative, insert the USB Flash Drive into a USB port on your computer. The COMSOL Installer window should appear automatically; if not, run the file `setup.exe` on the USB Flash Drive. The COMSOL 6.4 Installer window should now appear. Now continue with the instructions in the section Running the COMSOL Installer.

Running the COMSOL Installer

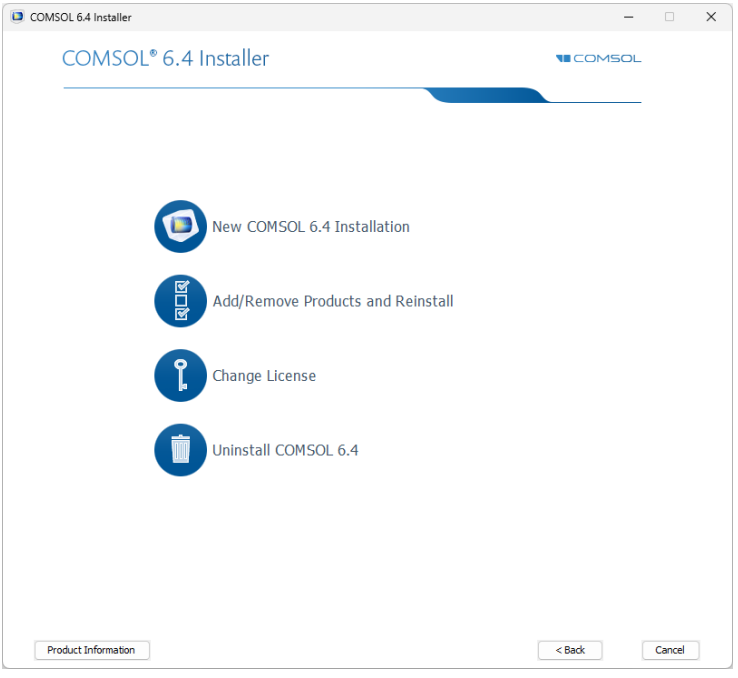
The steps for running the COMSOL Installer are independent of the installation media. Once the installer has started, continue with the instructions in this section.

Language Page



1 Select your language for the installation and click **Next**. You might also need to install fonts for the languages that you want to use when running COMSOL.

Main Page



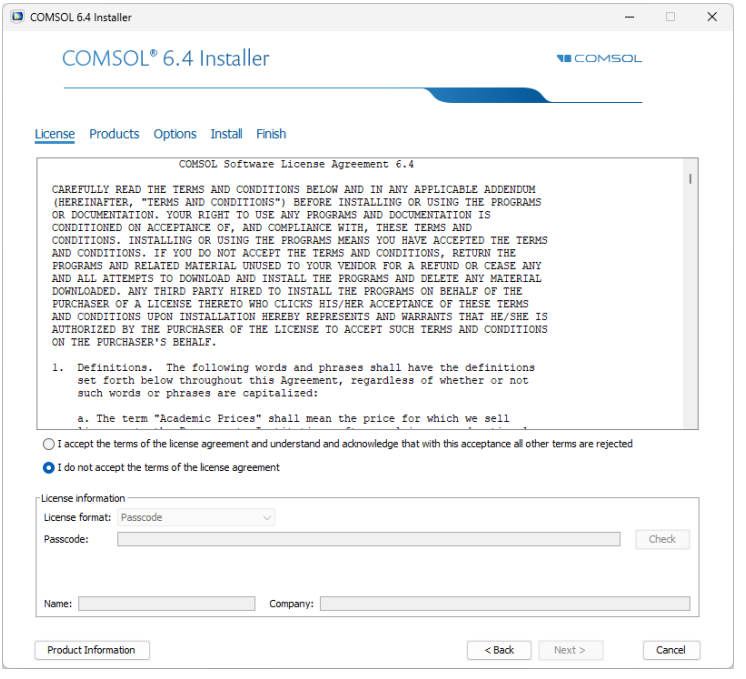
2 In the COMSOL Installer, select one of the following options:

- Click **New COMSOL 6.4 Installation** and proceed to Step 3 (License Page).
- Click **Add/Remove Products and Reinstall** and proceed to Step 5 (Platform Page) to change or repair an existing installation. For example, use Add/Remove Products and Reinstall to add or remove documentation files for installed products, or to add or remove a product that your license includes.
- Click **Change License** and proceed to Step 3 (License Page) to update the license of an existing installation. Use this option when COMSOL is installed and you get a new license file. The installer will remove products not licensed any more and let you go through the Add/Remove Products procedure to add or remove products for the new license. If your trial license has expired, you can use the Change License option to reenable a paid license.
- Click **Uninstall COMSOL 6.4** to remove an existing installation. For instructions on this option, see Removing (Uninstalling) the COMSOL Installation.

You can specify the path of an existing installation by pressing F1.

License Page

3 For a new installation or a license change, the following is displayed:

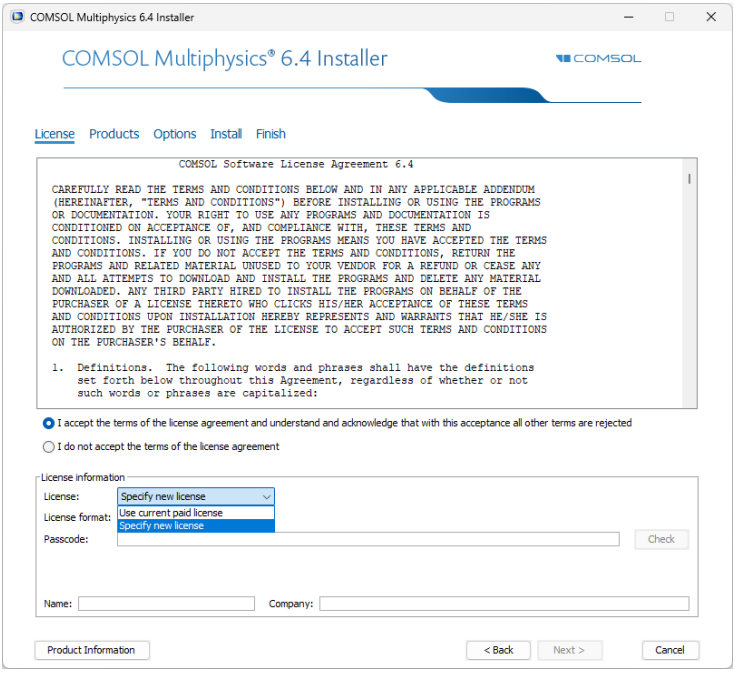


After reading the license agreement, click the **I accept the terms of the license agreement** button and specify the license. Choose one of the following license formats from the **License format** list, depending on which license you have:

- **Passcode**: Use this option for a Single-User Trial License or Class Kit License. Enter your passcode, which is a case-sensitive series of characters and numbers with a form similar to `FFFFFFFFFFFF-TYUS-123456-1234567-123456789`.
- **License file**: Use this option for any type of regular paid-for license installation. Enter the path to a license file or click **Browse** to select the file `license.dat`. This file is sent to you by a COMSOL representative, typically by email.
- **Port number** and **Hostname**: Use this option if your license administrator has given you a port number and hostname for a license manager for COMSOL that is running on your organization's network. Enter the **Hostname** of the server running the license manager and its license manager port number.
- **Three-server redundancy**: Use this option if your license administrator has given you three port numbers and hostnames for the three-server redundancy license manager option. Enter the hostnames and license server port numbers of the three-server redundant configuration.

Change License

If **Change License** was selected in Step 2, first select **Use current paid license**, to use an existing license, or **Specify new license**, to use a new license, from the **License** list.

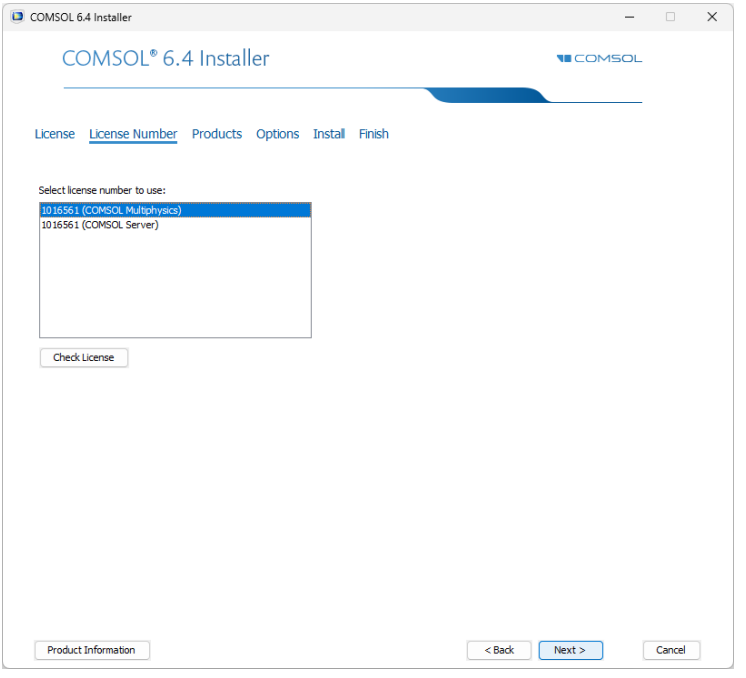


Click **Next** and proceed to Step 5 if you want to change to a license with different products. Otherwise, proceed to Step 10.

4 Click **Next**.

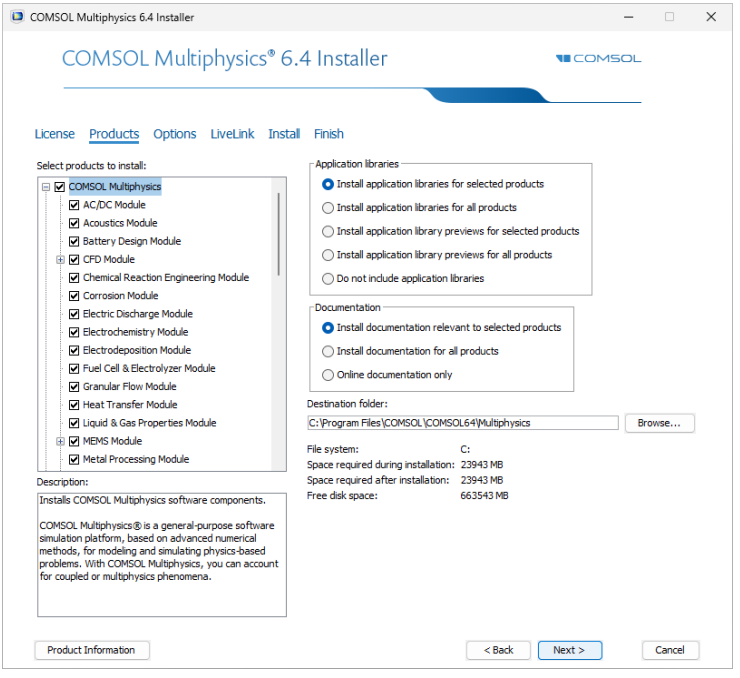
You can also automate a license change. If you specify a new license in `setupconfig.ini` and set `installdir` to an existing comsol installation directory (the installed version must match the version of the setup program), the installer will use the new license and add or remove products as needed to match the new license. See the description of the Installer Mode inside the `setupconfig.ini` file.

License Number Page



This page only appears if you have a license file corresponding to several different licenses (a so-called merged license file). From the list of license numbers, select the one you want to install. Both COMSOL Multiphysics licenses and COMSOL Server licenses can appear here. The license number you choose will determine which products are available on the next page.

PRODUCTS PAGE



5 Select the COMSOL products to install, which applications and documentation to install, and specify the path to the COMSOL installation folder.

All products that your license includes are selected by default.

For more information about installing and configuring the CUDA Toolkit for use with COMSOL Multiphysics, see: www.comsol.com/learn/cudatoolkit.

For more information about setting up the Chatbot functionality, see: www.comsol.com/learn/chatbot.

The **License Manager** checkbox is also selected. Depending on your region and operating system, the license type may require that the license manager is installed and started before running COMSOL (see License Management

Tools). In some cases, however, the license manager is installed automatically during the COMSOL installation.

From the options under **Application libraries**, choose one of the following:

- **Install application libraries for selected products** (the default) to install the application libraries for the licensed products that you have selected.
- **Install application libraries for all products** to install the application libraries for all COMSOL products.
- **Install application library previews for selected products** to install previews of the application libraries for the licensed products that you have selected.
- **Install application library previews for all products** to install previews of all application files in the application libraries for all COMSOL products.
- **Do not include application libraries** to not install any application libraries. Selected applications can be downloaded via Application Library Update.

From the options under **Documentation**, choose one of the following:

- **Install documentation relevant to selected products** (the default) to install the documentation for the licensed products that you have selected. For some products, documentation for other relevant products is also installed, so that you get access to documentation for functionality included in the licensed products but covered in other products' documentation.
- **Install documentation for all products** to install the documentation for all COMSOL products. You can then view and search all COMSOL documentation, even for products not included in your license.
- **Online documentation only** to not install any documentation. You can still view documentation and access context help using online documentation provided by COMSOL, but no documentation files are installed on your computer.

Under Destination folder, a default installation destination is suggested; for Windows, typically `C:\Program Files\COMSOL\COMSOL64\Multiphysics`. Click **Browse** or type another destination directory if needed.

If **Change License** was selected earlier (for an existing installation), make sure that all the relevant product checkboxes are selected. If the new license adds products that were not included in the original installation and the checkboxes for those products are not selected, the license information will be correct but the software components needed to use the products will be missing.

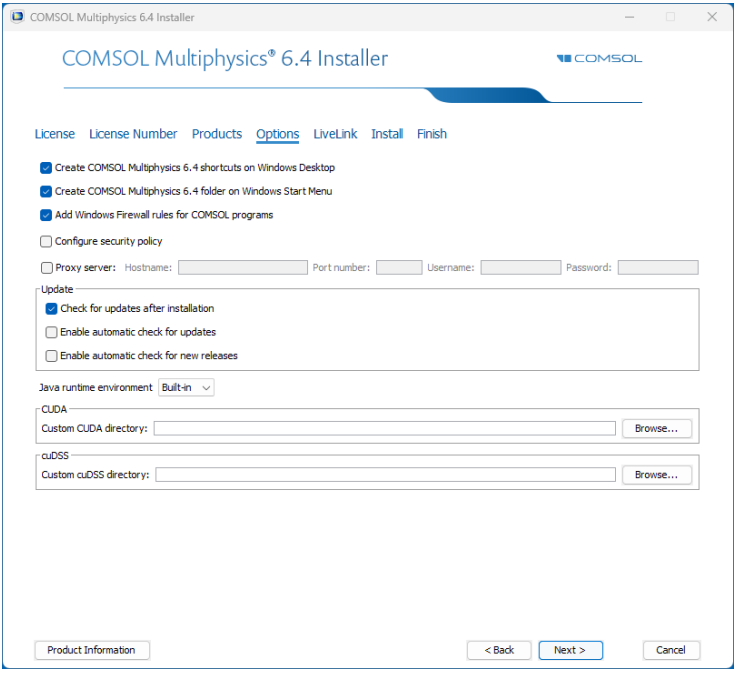
Add/Remove Products and Reinstall

- If **Add/Remove Products and Reinstall** or **Change License** was selected in Step 2, the Products page includes a **Reinstall selected and installed products** checkbox. Select this to reinstall selected products that are already installed.
- The options for application libraries and documentation can also be changed.

You can also add, remove, and repair COMSOL products from the installed instance by running the setup executable in the installation directory. If needed, the installer can either download the files from the internet or use the original DVD (or disk image).

6 Click **Next**.

OPTIONS PAGE: FIRST SECTION



7 On this page, you can set the following installation options:

- **Create COMSOL Multiphysics 6.4 shortcuts on Windows Desktop**.
- **Create COMSOL Multiphysics 6.4 folder on Windows Start Menu**.
- **Add Windows Firewall rules for COMSOL programs**. This checkbox adds firewall rules that allow COMSOL server programs to open ports and communicate over the network. If you clear this checkbox, you might get a warning from the Microsoft Firewall when you start a COMSOL server program, or a COMSOL server program might not work as expected.
- **Configure security policy**. If you select this option, a later page in the installer provides security options that you can either set permanently or as user defaults; see Security Page. If you set a permanent security policy, the security settings in the **Preferences** window will be read-only.
- If you want to use a proxy server, specify the hostname, port number, and, if required, a username and password. If you do not enter a port number, the

installer will use port 443 (the default port for the HTTPS protocol.) These settings do not appear for offline installation methods.

The following options are available under **Update**:

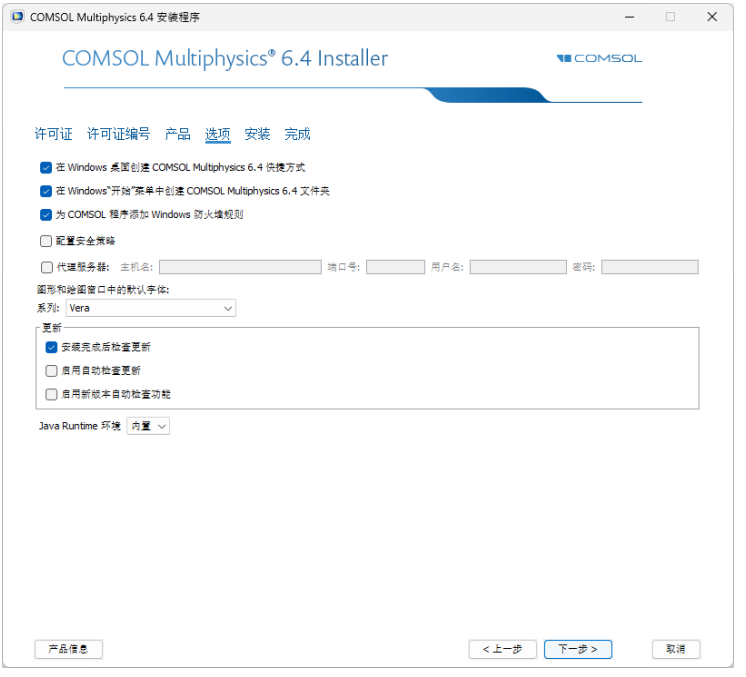
- **Check for updates after installation**. This option is selected by default. The installer will apply all available updates (if any) for the installed version.
- **Enable automatic check for updates**. Select this checkbox if you want COMSOL to automatically check for available product updates at startup.
- **Enable automatic check for new releases**. Select this checkbox if you want COMSOL to automatically check for new full releases at startup.
- By default, COMSOL 6.4 uses an included Java 21 runtime, indicated by the **Built-in** setting in the **Java runtime environment** list. If you want to run COMSOL with another Java 21 runtime that you have licensed and installed, specify its location in the **Location** field by first choosing **Custom**.

The CUDA and cuDSS sections are available in the case that **GPU Compute Components** was selected on the **Products** page, but **NVIDIA CUDA® Toolkit** and/or **NVIDIA CUDA® Direct Sparse Solver** were not.

- If a compatible NVIDIA CUDA® Toolkit is already installed on the system, specify the installation directory in the **Custom CUDA directory** field to enable GPU hardware acceleration. This path can also be changed on the **Computing** > **GPU Acceleration** page in the **Preferences** window. For more information about installing the CUDA Toolkit for use with COMSOL Multiphysics, see www.comsol.com/learn/cudatoolkit.
- If a compatible NVIDIA CUDA® Direct Sparse Solver library is already installed on the system, specify the installation directory in the **Custom cuDSS directory** field to enable the GPU-accelerated direct sparse solver. This path

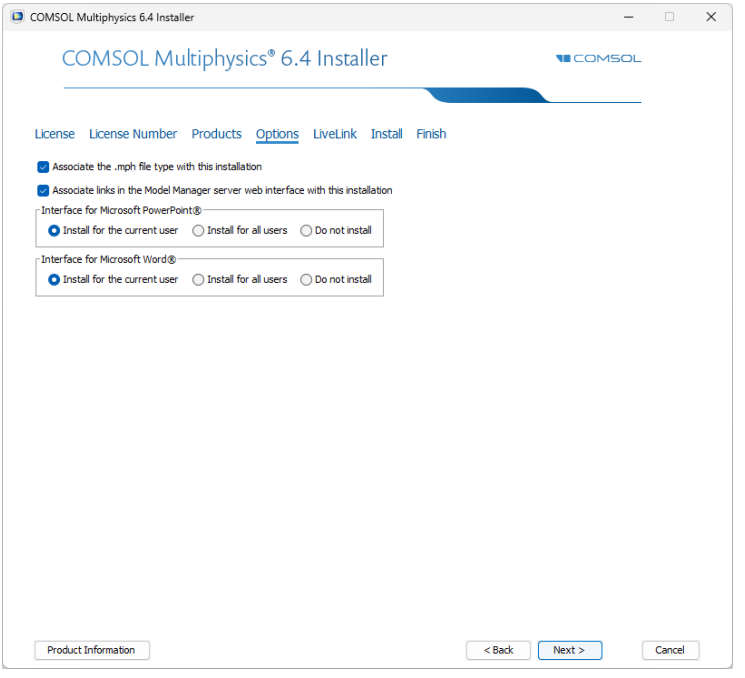
can also be changed on the **Computing** > **GPU Acceleration** page in the **Preferences** window.

- Non-Latin (Asian) language installations have the option to select a different default font family, such as one that has an appropriate set of Asian characters.



8 Click **Next**.

OPTIONS PAGE: SECOND SECTION



9 On this page, you can set the following installation options:

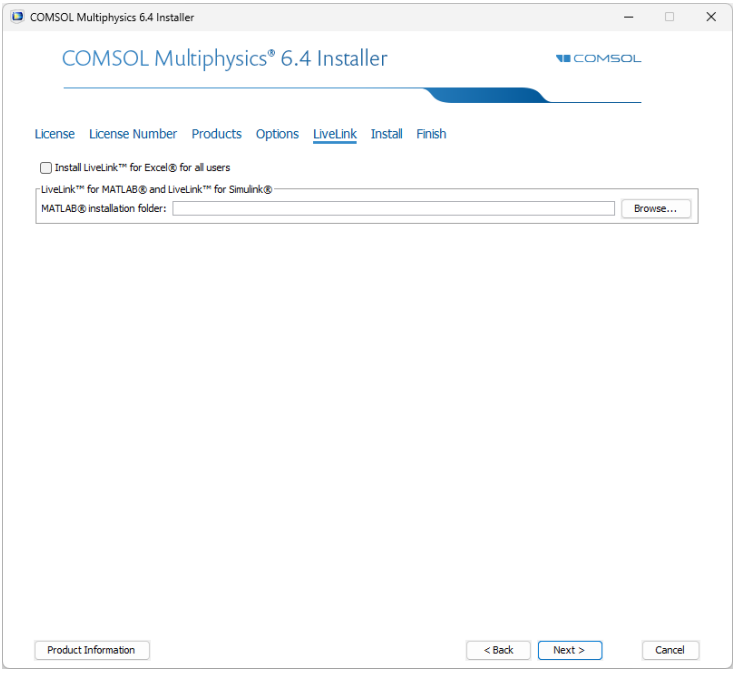
- **Associate the .mph file type with this installation**. If this checkbox is selected, you can open COMSOL models by double-clicking them.
- **Associate links in the Model Manager server web interface with this installation**. If this checkbox is selected, you can open COMSOL models directly from the web interface of a Model Manager server.
- For the interface for Microsoft PowerPoint®, which makes it possible to interactively update PowerPoint presentations with COMSOL images and tables, choose **Install for the current user**, **Install for all users**, or **Do not install**.
- For the interface for Microsoft Word®, which makes it possible to interactively update Word documents with COMSOL images and tables, choose **Install for the current user**, **Install for all users**, or **Do not install**.

10 Click **Next**.

Custom Java 21 runtimes must be OpenJDK based and of at least the same minor version as the built-in one. If the runtime includes a subset of JDK modules, at least the following must be included:

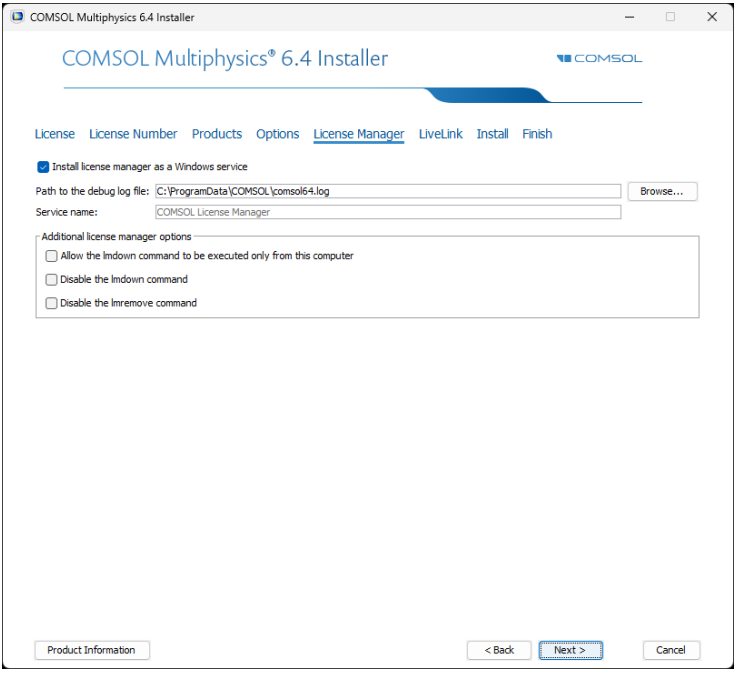
- `java.*`
- `jdk.accessibility`
- `jdk.attach`
- `jdk.charsets`
- `jdk.crypto.*`
- `jdk.dynalink`
- `jdk.httpserver`
- `jdk.javadoc`
- `jdk.jdi`
- `jdk.jdwp.agent`
- `jdk.jshell`
- `jdk.jsobject`
- `jdk.localedata`
- `jdk.management`
- `jdk.naming.*`
- `jdk.net`
- `jdk.nio.mapmode`
- `jdk.random`
- `jdk.sctp`
- `jdk.security.*`
- `jdk.unsupported`
- `jdk.xmld.dom`
- `jdk.zipf`

LiveLink Page



- The **LiveLink** page contains installation settings for the LiveLink™ products:
  - **Install LiveLink™ for Excel® for all users**. If you select this checkbox, the installation of LiveLink™ *for* Excel® is global to the machine and is available no matter which user is logged on. Otherwise, the installation is only available to the current user.
  - For the products LiveLink™ *for* MATLAB® and LiveLink™ *for* Simulink®, specify the path to the MATLAB installation folder. This path can be changed on the **LiveLink Connections** page in the **Preferences** window.

License Manager Page



12 The **License Manager** page appears if the License Manager was selected on the Products page and your computer is designated to be the license server. If this page does not appear, you can manage the license server using LMTOOLS; see Starting the License Manager. This page contains the following options:

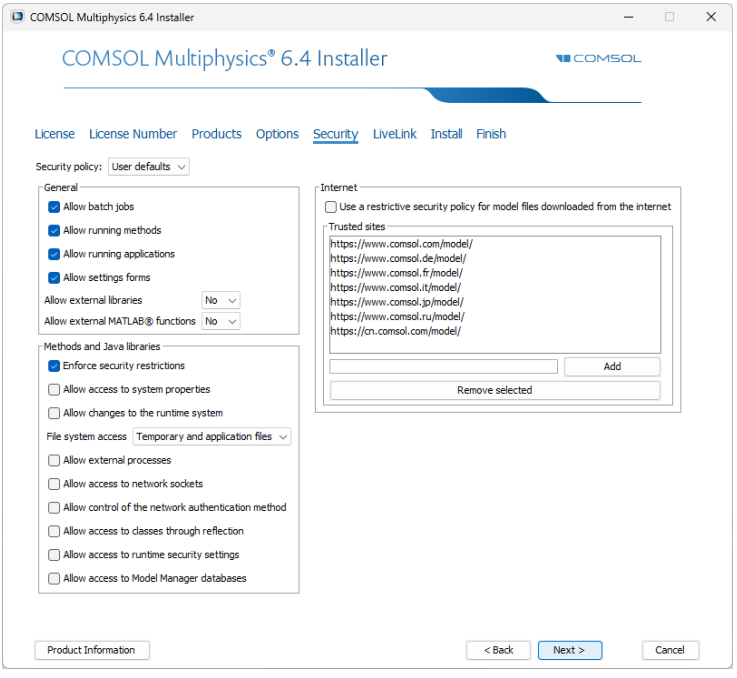
- The **Install license manager as a Windows service** checkbox is selected by default; if you clear the checkbox, the license manager must be started manually and will not be available as a Windows service.
- The **Path to the debug log file** field contains a file path to the location of the license manager debug log file. Click **Browse** to choose another file path.
- The **Service name** field shows the service name, for information only.
- The **Additional license manager options** section contains the following options:

  Select the **Allow the lmdown command to be executed only from this computer** checkbox to restrict the access to the `lmdown` command, which you can use to shut down the license manager, to this computer only.

  Select the **Disable the lmdown command** checkbox to make the `lmdown` command unavailable.

  Select the **Disable the lmremove command** checkbox to make the `lmremove` command, which you can use to remove a user's license, unavailable.

SECURITY PAGE



13 The **Security** page appears if you selected the **Configure security policy** checkbox. The COMSOL software includes security settings for controlling access to, for example, system properties, file systems, and runtime security settings from

methods and external libraries, primarily for use in applications created using the Application Builder.

In the **Security policy** list, select **User defaults** (the default) or **Permanent** to control if the settings made on this page will be possible to change or set permanently after the installation is finished.

The following security settings are available in the **General** section (the top four checkboxes are selected by default):

- Select the **Allow batch jobs** checkbox to allow batch jobs. This restriction affects the Batch, Batch Sweep, Cluster Computing, and Cluster Sweep nodes in the COMSOL Desktop model tree.
- Select the **Allow running methods** checkbox to allow running applications that include methods. If you clear this checkbox, it is not possible to run methods in applications.
- Select the **Allow running applications** checkbox to allow running applications in general. If you clear this checkbox, it is not possible to run any applications.
- Select the **Allow settings forms** checkbox to allow settings forms and dialog forms in the Model Builder. If you clear this checkbox, an error message appears if you try to create a new settings form or show a dialog form.
- From the **Allow external libraries** list, select **No** (the default), **Yes**, or **Ask** to control if external C libraries can be called from methods in an application, either directly or by asking first.
- From the **Allow external MATLAB® functions** list, select **No** (the default), **Yes**, or **Ask** to control if functions written in MATLAB (requires LiveLink™ *for* MATLAB®) can be called, either directly or by asking first.

In the **Methods and Java libraries** section, the **Enforce security restrictions** checkbox is selected by default. The following settings are available for easing parts of the restrictions on methods and Java libraries (none selected by default):

- Select the **Allow access to system properties** checkbox to read and write system properties. For example, `System.getProperty("cs.np")` can be used to determine how many cores COMSOL Multiphysics is currently using.
- Select the **Allow changes to the runtime system** checkbox to allow methods and Java libraries to change the runtime system — for instance, by modifying class loaders.
- From the **File system access** list, select **Temporary and application files** (the default) to restrict methods and Java libraries to only have access to such files,

or select **All files** to allow methods and Java libraries to access all files that you have permissions to access on the file system.

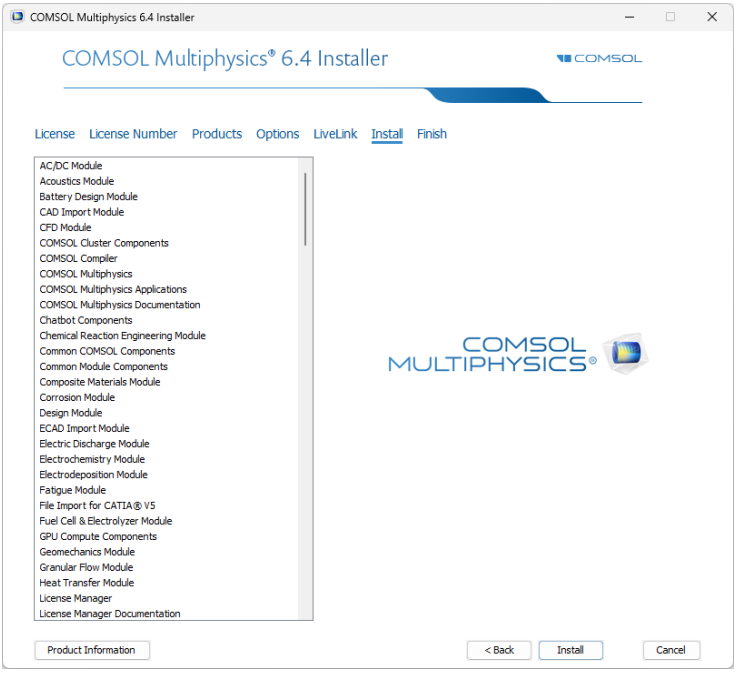
- Select the **Allow external processes** checkbox to allow applications to start external processes on the computer. This includes using the built-in `executeOS()` method.
- Select the **Allow access to network sockets** checkbox to allow methods and Java libraries to open sockets for network access.
- Select the **Allow control of the network authentication method** checkbox to allow methods and Java libraries to control the network authentication method used.
- Select the **Allow access to classes through reflection** checkbox to allow access to all members in a class through reflection.
- Select the **Allow access to runtime security settings** checkbox to allow methods and Java libraries to access security settings.
- Select the **Allow access to Model Manager databases** checkbox to allow methods and Java libraries to access Model Manager databases, including both reading and writing data.

To allow methods and Java libraries to run with security completely disabled, clear the **Enforce security restrictions** checkbox and, in the **General** section, select the **Allow external processes** checkbox.

In the **Internet** section, select the **Use a restrictive security policy for model files downloaded from the internet** checkbox to use a restrictive security policy (Mark of the Web) for model and app files downloaded from the internet. In the **Trusted sites** section, you can add and remove internet sites that you want COMSOL Multiphysics to consider trusted when the restrictive security policy is enabled. By default, the list of trusted sites contains all the COMSOL Application Gallery web pages.

14 Click **Next**.

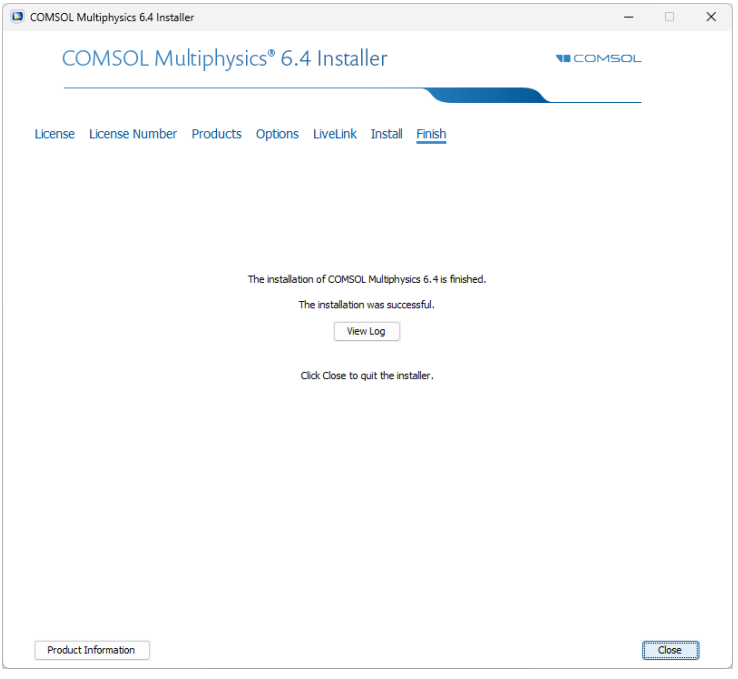
INSTALL PAGE



15 When you click **Install** the utility will install or update COMSOL. The installation process can take several minutes. If you are installing over the internet, the installation time depends on your internet connection speed. The **Finish** page appears when the installation process is finished.

FINISH PAGE

16 This window appears when the installation is finished.



If warnings or errors were detected, click **View Log** to open a window that shows the installation log. Contact technical support if you encountered any errors, and remember to send the log file along with your technical support inquiry.

17 Click **Close** to quit the installer.

For information on how to run COMSOL Multiphysics after installation, see Running COMSOL Multiphysics on Windows. If you are installing on macOS, see Running COMSOL Multiphysics on macOS. If you are installing on Linux, see Running COMSOL Multiphysics on Linux.

Removing (Uninstalling) the COMSOL Installation

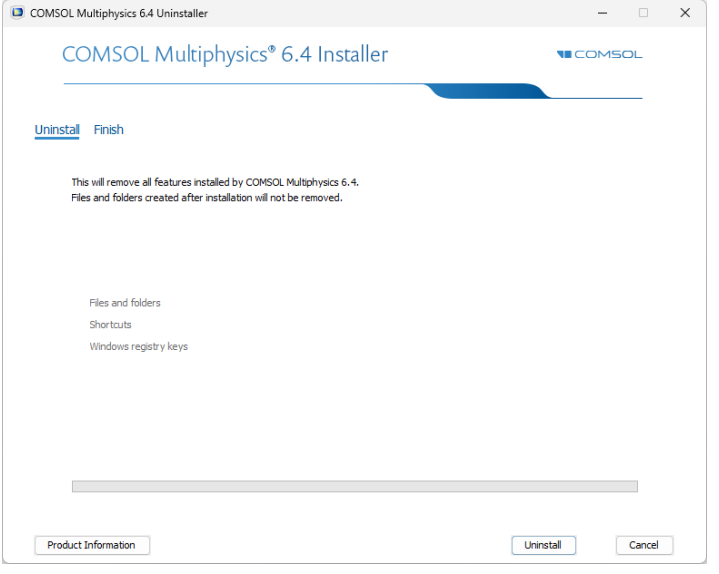
To remove a COMSOL installation from your system, you can use the COMSOL Installer's uninstallation option. The uninstaller deletes all COMSOL files and

directories on the system that were installed by the COMSOL installer. Additional files and folders created after installation are not removed.

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

You can start the COMSOL Uninstaller in a few different ways:

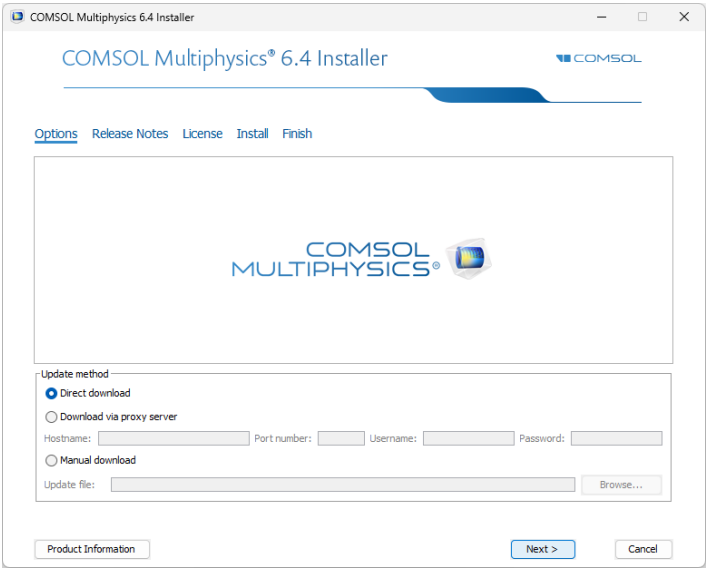
- From the Windows Start Menu, open **Settings** and select **Apps**. Find COMSOL Multiphysics 6.4 in the list and select **Uninstall**.
- From the Windows Start Menu, under COMSOL Multiphysics 6.4, select **COMSOL Launchers** > **Uninstall**.
- Insert the COMSOL DVD and start the COMSOL Uninstaller. Click **Uninstall COMSOL 6.4** to start removing the installation. Click **Close** to quit the installer when the uninstallation is complete.



Installing Software Updates

COMSOL provides software updates that improve the software and correct issues. To check if an update is available, choose **Check For Product Updates** from the **Help** menu. To check for updates automatically each time you start COMSOL Multiphysics, select the **Check for product updates at launch** checkbox on the **Updates** page in the **Preferences** window.

If an update is available, an **Update** dialog appears. Click **Direct Download** to download the update directly, or click **Product Information** to open the COMSOL website where you can read about and download the update. When the update installation starts (close any running instance of COMSOL first) you see the following installation window:



If a COMSOL process is running when you start an update installation, you must instead first choose one of the following options:

- **Cancel**: Stop the update process.
- **Try Again**: Restart the update process (after closing all COMSOL processes.)
- **Continue Anyway**: Proceed with the upgrade, ignoring any running instances of COMSOL.

You can use **Direct download** (the default) or **Download via proxy server**. If you download via a proxy server, specify the hostname and port number for the proxy and, if required, a username and password.

When selecting **Manual download**, you point to a DAT-file that you download from www.comsol.com/product-update. This page contains details and options for manual download of the update.

Alternatively, you can launch the update installer without checking for updates from inside COMSOL Multiphysics. To do this, from the Windows Start Menu under COMSOL Multiphysics 6.4, select **COMSOL Launchers** > **Update**.

Automated Updates

You can update the COMSOL software using an automated update process with minimal user interaction by using the previously mentioned DAT-file. Consult www.comsol.com/product-update for detailed instructions.

Automated Installation

You can install the COMSOL software using an automated installation process with minimal user interaction. This method requires installation from a DVD or DVD image and an answer file.

The answer file is a text file with a specific format that contains predefined settings for the COMSOL installer. If non-ASCII characters are used, the answer file is expected to be UTF-8 encoded by default, but UTF-16 is also supported if the file starts with a byte order mark (BOM).

A template answer file, `setupconfig.ini`, with detailed usage information is available on the DVD. Create a copy of this file and customize it with a text editor.

When the answer file is ready, start the installation by running

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

where *<answer file path>* is the full path to your answer file.

Automated Removal (Uninstallation) of COMSOL

You can also uninstall COMSOL with an answer file by following these steps:

1. Edit the answer file and set `installmode` to `uninstall`.
2. Set `installdir` to the path of the installation you want to remove.
3. Run `<path to COMSOL>\bin\win64\setup.exe -s <answer file path>`

where *<answer file path>* is the full path to your answer file. If you are running this command in a command prompt (for example, `cmd`), make sure that the current working directory is outside the COMSOL installation directory.

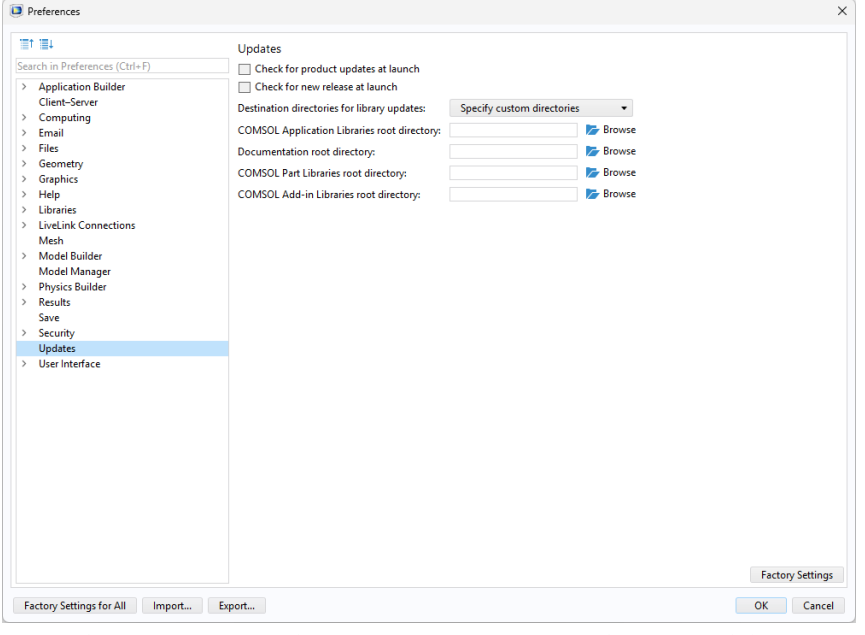
Product Updates and Library Updates

COMSOL periodically releases product updates with improvements and corrections to reported problems. By default, COMSOL Multiphysics does not check for updates at startup. You can activate this feature in the **Updates** page of the **Preferences** window.

The Application Libraries for the COMSOL products are updated on a regular basis by COMSOL. To open the **Application Library Update** window, from the **File** > **Help** menu (Windows users) or from the **Help** menu (macOS and Linux users), select **Update COMSOL Application Libraries**.

This connects you to the COMSOL Application Library Update website where you can access the latest updates. This includes files that have been added or improved since the latest product release.

In a similar way, you can also update the COMSOL Part Libraries. To open the **Part Library Update** window, from the **File** > **Help** menu (Windows users) or from the **Help** menu (macOS and Linux users), select **Update COMSOL Part Libraries**.



Using the **Preferences** window, you can set custom application and documentation directories for Application Library Update, a custom part directory for Part Library Update, and a custom add-in directory for Add-in Library Update. See the *COMSOL Multiphysics Reference Manual* for more information, including command-line options for the Application Libraries and Part Libraries.

LiveLink™ *for* Excel® Installations

If you have licensed LiveLink™ *for* Excel®, the installer registers an add-in with Excel. When the add-in is active, several tools for working with a COMSOL Multiphysics model from an Excel worksheet are accessible from a COMSOL tab in the Excel ribbon. You can, for example, extract model definitions and results. You can also change model definitions in the worksheet, then update and recompute the model.

Whenever you open a COMSOL Multiphysics model from Excel, a COMSOL Multiphysics server is started where the model is loaded. The data transfer between Excel and the COMSOL Multiphysics server application is performed using a TCP/IP communication protocol, which accepts only local connections.

LiveLink™ *for* AutoCAD® Installations

If you have licensed LiveLink™ *for* AutoCAD®, the installer registers an add-in with AutoCAD. When the add-in is active a COMSOL Multiphysics tab appears in AutoCAD.

The add-in enables two modes of setting up simulations based on the AutoCAD design:

- In one mode you can run AutoCAD and the COMSOL Desktop side-by-side and synchronize the geometry between the two. This mode enables running parametric sweeps, as well as parameter optimizations using an optimization solver (available with a license for the Optimization Module).
- In offline synchronization mode you can save a synchronization file using the add-in inside AutoCAD. You can then load the synchronization file into the COMSOL Desktop running on a different computer from the CAD software. This mode enables single synchronizations and parametric sweeps.

If the COMSOL Multiphysics tab does not appear, run the COMSOL Installer to repair the installation (see www.comsol.com/support/knowledgebase/1221 for instructions).

You can also install and register the add-in with AutoCAD by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing AutoCAD designs for synchronization, saving files for offline synchronization, and running simulation apps that synchronize geometry.

LiveLink™ *for* Inventor® Installations

If you have licensed LiveLink™ *for* Inventor®, the installer registers an add-in for Autodesk Inventor called LiveLink for COMSOL (6.4). This add-in should appear in the Add-In Manager dialog that is accessible from the Options tab of the Tools panel in the Autodesk Inventor user interface.

The add-in provides tools for preparing your Inventor design for simulation with COMSOL Multiphysics. For example, you can set up dimensional parameters that, together with the geometry, are synchronized with the COMSOL Multiphysics model.

The add-in enables several modes of setting up simulations based on the Inventor design:

- In one mode you can run Inventor and the COMSOL Desktop side-by-side and synchronize the geometry between the two. This mode enables running parametric sweeps, as well as parameter optimizations using an optimization solver (available with a license for the Optimization Module).
- In another mode you can work with COMSOL Multiphysics simulations inside Inventor. This latter mode is called the One-Window interface.
- In offline synchronization mode you can save a synchronization file using the add-in inside Autodesk Inventor. You can then load the synchronization file into the COMSOL Desktop running on a different computer from the CAD software. This mode enables single synchronizations and parametric sweeps.

If COMSOL Multiphysics cannot connect to Inventor, run the COMSOL Installer to repair the installation, see www.comsol.com/support/knowledgebase/1221 for instructions.

You can also install and register the add-in with Inventor by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing Inventor designs for synchronization, saving files for offline synchronization, and running simulation apps that synchronize geometry.

LiveLink™ *for* PTC® Creo® Parametric™ Installation

If you have licensed LiveLink™ *for* PTC® Creo® Parametric™, the installer registers an add-in for PTC Creo Parametric called the LiveLink for COMSOL (6.4). This add-in should appear in the Auxiliary Applications dialog that is accessible from the Tools tab, Utilities group in the PTC Creo Parametric user interface.

The add-in provides tools for preparing your PTC Creo Parametric design for simulation with COMSOL Multiphysics. For example, you can set up dimensional parameters that, together with the geometry, are synchronized with the COMSOL Multiphysics model. You can access the functionality provided by the add-in on the COMSOL Multiphysics tab in the PTC Creo Parametric user interface.

The add-in enables two modes of setting up simulations based on the PTC Creo Parametric design:

- In one mode you can run PTC Creo Parametric and the COMSOL Desktop side-by-side and synchronize the geometry between the two. This enables running parametric sweeps, as well as parameter optimizations using an optimization solver (available with a license for the Optimization Module)
- In offline synchronization mode you can save a synchronization file using the add-in inside PTC Creo Parametric. You can then load the synchronization file into the COMSOL Desktop running on a different computer from the CAD software. This mode enables single synchronizations and parametric sweeps.

If COMSOL Multiphysics cannot connect to PTC Creo Parametric, run the COMSOL Installer to repair the installation (see www.comsol.com/support/knowledgebase/1221 for instructions).

You can also install and register the add-in with PTC Creo Parametric by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing PTC Creo Parametric designs for synchronization, saving files for offline synchronization, and running simulation apps that synchronize geometry.

LiveLink™ *for* Revit® Installations

If you have licensed LiveLink™ *for* Revit®, the installer registers an add-in for Autodesk Revit. When the add-in is loaded a tab called COMSOL Multiphysics appears in Revit. Here, you find tools for preparing your project for simulation with COMSOL Multiphysics. For example, you can select the architectural elements and rooms that will take part in the synchronization.

The add-in enables setting up simulations based on a Revit project by synchronizing geometry between Revit and the COMSOL Desktop when these are run side-by-side.

The COMSOL Multiphysics tab will not appear if the add-in cannot be loaded by Revit. This can happen if, for example, the COMSOL installation is moved to a different location. To restore the add-in run the COMSOL Installer to repair the installation (see www.comsol.com/support/knowledgebase/1221 for instructions).

You can also install and register the add-in with Revit by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing Revit projects for synchronization, and running simulation apps that synchronize geometry.

LiveLink™ *for* Solid Edge® Installations

If you have licensed LiveLink™ *for* Solid Edge®, the installer registers an add-in for Solid Edge called LiveLink for COMSOL (6.4). This add-in should appear in the Add-In Manager dialog that is accessible in the Solid Edge user interface if you click the Applications button, and then select Add-Ins from the menu.

When the add-in is active a COMSOL Multiphysics tab appears in Solid Edge. The add-in enables two modes of setting up simulations based on the Solid Edge design:

- In one mode you can run Solid Edge and the COMSOL Desktop side-by-side and synchronize the geometry between the two. This enables running parametric sweeps, as well as parameter optimizations using an optimization solver (available with a license for the Optimization Module)
- In offline synchronization mode you can save a synchronization file using the add-in inside Solid Edge. You can then load the synchronization file into the COMSOL Desktop running on a different computer from the CAD software. This mode enables single synchronizations and parametric sweeps.

If COMSOL Multiphysics cannot connect to Solid Edge, run the COMSOL Installer to repair the installation (see www.comsol.com/support/knowledgebase/1221 for instructions), or manually register the add-in according to the steps from the following link “Error: Failed to connect to Solid Edge”:

www.comsol.com/support/knowledgebase/1160.

You can also install and register the add-in with Solid Edge by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing Solid Edge designs for synchronization, saving files for offline synchronization, and running simulation apps that synchronize geometry.

If you have licensed LiveLink™ *for* SOLIDWORKS®, the installer registers an add-in for SOLIDWORKS called LiveLink for COMSOL (6.4). This add-in should appear in the SOLIDWORKS user interface, listed in the Add-Ins dialog, accessible from the Tools menu.

The add-in provides tools for preparing your SOLIDWORKS design for simulation with COMSOL Multiphysics. For example, you can create selections on the geometry and set up dimensional parameters. Those selections and parameters, together with the geometry, are synchronized with the COMSOL Multiphysics model.

The add-in enables two modes of setting up simulations based on the SOLIDWORKS design:

- In one mode you can run SOLIDWORKS and the COMSOL Desktop side-by-side and synchronize the geometry between the two. This enables running parametric sweeps, as well as parameter optimizations using an optimization solver (available with a license for the Optimization Module).
- In offline synchronization mode you can save a synchronization file using the add-in inside SOLIDWORKS. You can then load the synchronization file into the COMSOL Desktop running on a different computer from the CAD software. This enables single synchronizations and parametric sweeps.

If COMSOL Multiphysics cannot connect to SOLIDWORKS, run the COMSOL Installer to repair the installation (see www.comsol.com/support/knowledgebase/1221 for instructions), or manually reregister the add-in by following the steps from the following link: www.comsol.com/support/knowledgebase/1122.

You can also install and register the add-in with SOLIDWORKS by installing the COMSOL Client, available for download from www.comsol.com. Such an installation enables the functionality for preparing SOLIDWORKS designs for synchronization, saving files for offline synchronization, and running simulation apps that synchronize geometry.

Cluster Installation

COMSOL Multiphysics supports two mutual modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations, including cluster support. This section is dedicated to distributed-memory parallel installation.

COMSOL Multiphysics can distribute computations on compute clusters using the MPI model. One large problem can be distributed across many compute nodes. Also, parametric sweeps can be distributed with individual parameter cases distributed to each cluster node.

Prerequisites

The cluster installation instructions assume that you have a fully operational and tested Windows cluster with the Windows Server 2016, Windows Server 2019, or Windows Server 2022 operating system and that you are a fully qualified system administrator, with administration access rights to the cluster head node and compute nodes. A compatible version of Microsoft® HPC Pack for your version of Windows Server is required.

License Manager

COMSOL Multiphysics requires a Floating Network License for running on clusters. Please check the license file for the `CLUSTERNODE` feature, which needs to be present to enable the cluster computing functionality. The license manager needs to be accessible from all nodes in the cluster. Therefore it is often a good idea to have it run on the head node.

Installation Folder

The COMSOL Multiphysics installation folder should be shared between all compute nodes and the head node. The installation of the COMSOL software is only needed on the head node. Alternatively, the software can be installed on `C:\` on each compute node. Typically, the installation directory is accessed through a UNC (uniform naming convention) path on the Windows private network that is only seen by the compute nodes that belong to the cluster.

Installation Procedure

In addition to the normal installation steps as outlined under Installing on Windows, this section includes specific information for cluster installations.

During installation, on the **Products** page (see Products Page) ensure that you select the **COMSOL Cluster Components** checkbox under **Select products to install**.

For the installation directory that you specify in the **Destination folder** text field, remember to share the installation directory with the compute nodes after installation.

If you installed COMSOL Multiphysics on a shared directory, you need to install Microsoft Visual Studio® runtime libraries on each compute node. (See www.comsol.com/support/knowledgebase/1083 for instructions.)

ACCESS TO CLUSTER (WINDOWS SERVER ONLY)

If you work on a desktop PC, install COMSOL on that PC. Before you start, you need to install Microsoft® HPC Pack on the PC. This software is free and enables you to access the cluster from your PC.

CHECKING THE INSTALLATION

After the cluster installation has finished, make the following checks to make sure that the installation is working:

- Make sure that the COMSOL installation directory is shared between all the compute nodes and the head node on a shared network disk.
- Make sure that the license manager is reachable from all compute nodes.
  - If you have firewalls activated, open any relevant TCP ports for the license check from the nodes.
  - For more information, see www.comsol.com/support/knowledgebase/903
- To check that a node is OK, open a remote desktop session to the compute node, then start `\\headnode\COMSOL\bin\win64\comsol.exe` (assuming `\\headnode\COMSOL` is the shared installation directory). If the COMSOL Desktop starts without license errors, the license management works fine. If not, check the firewall (see above). If you get other errors, you may need to install runtime libraries on the compute nodes.

For more information on installing and running COMSOL Multiphysics on clusters, see Running COMSOL Multiphysics on Clusters and the *COMSOL Multiphysics Reference Manual*.

License Manager Installation on Windows

Depending on your region and operating system, you might be required to install and run the FlexNet® license manager in order to run COMSOL Multiphysics.

What Is the FlexNet® License Manager?

COMSOL uses the FlexNet® license manager software for license management.

The license manager comes bundled with any COMSOL installation. The COMSOL software products and the license manager can be installed in any order, unless you are installing based on a port number and hostname. In that case, the license manager software needs to be installed and started before installing COMSOL. You should use the version of the license manager that is shipped with the newest version of COMSOL installed on your system.

Installation of any paid-for license on Windows requires a license file (`license.dat`), which is sent to you by a COMSOL representative by email. You can view the contents of the license file by opening it with a text editor or word processing software. If the file contains a line starting with the word SERVER, then the license manager is required. For a Floating Network License, the purpose of the license manager is to count the number of concurrent users and to give an error message if the number exceeds the licensed amount. Depending on your region and operating system, the license manager might also be needed for Single User Licenses. In that case, the purpose of the license manager is to lock a COMSOL session to a computer that is authorized by COMSOL.

The FlexNet® license manager software supports a heterogeneous network of Windows, Linux, and macOS computers. Both the license manager and the COMSOL software can run on either Windows, Linux, or macOS platforms. In this context, the computer where the license manager is installed is called the license server and any computer that has the COMSOL products installed is called a client. Any type of networked computer can function as a license server, such as a laptop, desktop, workstation, or centrally located server. COMSOL can be installed anywhere, typically on a local PC or on a server where users access the program over the network. A single computer can function as both license server and client, holding both the license manager and COMSOL.

Even though the license manager and COMSOL can be installed in any order, a full test of the installation cannot be done until both are installed.

System Requirements for the FlexNet® License Manager

Before starting the installation process, check that your system meets all necessary requirements as listed at: www.comsol.com/system-requirements. If you are running the license manager on a license server where you do not intend to run the COMSOL software, the system only needs to meet the listed hardware and operating system requirements. The memory and graphics requirements do not need to be met because the license manager is not as resource intensive as the COMSOL software.

About MAC Addresses

As licenses are based on MAC addresses, MAC address randomization is not supported.

FlexNet® License Manager Software Components

The license manager consists of four software components:

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

The license server manager (`lmgrd.exe`) and the vendor daemon (`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 license server manager (`lmgrd.exe`). The license server manager then makes a request to the vendor daemon (`LMCOMSOL.exe`), which releases licenses according to information in the `license.dat` file. The FlexNet utility program (`lmutil.exe`) is used for handling license server management tasks, with the FlexNet Control Panel (`lmtools.exe`) as its optional graphical user interface.

FlexNet® License Manager Documentation

For detailed information on the FlexNet® license manager software, select **File** > **Help** > **Documentation**, and scroll to the bottom of the page to locate a PDF copy of the *FlexNet Publisher License Administration Guide*.

You can also find the guide in your installation directory. The default location is

```
C:\Program Files\COMSOL\COMSOL64\Multiphysics\doc\pdf\COMSOL_Multiphysics\
FlexNet
```

Note: This PDF file is only available if you have locally installed documentation.

The License File and The License Features

The license file has the same structure on all platforms. In this section, the most important parts of the license file are explained. Below is an example of the contents of a `license.dat` file:

```
#-----------------------------------------------------------------
# COMSOL 6.4 FNL License No: 1234567
# Visit www.comsol.com/install for latest installation instructions
#-----------------------------------------------------------------
SERVER apollo.thecompany.com 0050569e1b87 1718
USE_SERVER
VENDOR LMCOMSOL port=1719
FEATURE SERIAL LMCOMSOL 6.4 permanent uncounted \
    VENDOR_STRING=C,5701108 HOSTID=ANY BORROW=720 SN=1234567 TS_OK \
    SIGN=0C3A8BF6722E
INCREMENT COMSOL LMCOMSOL 6.4 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2012 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 6.4 permanent 4 SUPERSEDE DUP_GROUP=UHD \
    ISSUED=6-JUN-2012 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT HEATTRANSFER LMCOMSOL 6.4 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2012 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLIENTSERVER LMCOMSOL 6.4 permanent 4 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2012 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT CLUSTERNODE LMCOMSOL 6.4 permanent 4 SUPERSEDE DUP_GROUP=U \
    ISSUED=6-JUN-2012 BORROW=720 SN=1234567 SIGN=123456789ABC
INCREMENT COMSOLBATCH LMCOMSOL 6.4 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2012 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
INCREMENT HEATTRANSFERBATCH LMCOMSOL 6.4 permanent 2 SUPERSEDE \
    DUP_GROUP=UHD ISSUED=6-JUN-2012 BORROW=720 SN=1234567 \
    SIGN=123456789ABC
```

THE COMMENT LINES

Comment lines can be included in the license file by starting them with the hash symbol `#`. These lines have no effect on the license server or client.

THE SERVER LINE

In the `license.dat` file, the line starting with `SERVER` should contain:

- The hostname of the license server. In the example above, the hostname is `apollo.thecompany.com`. This name can be edited by the user.
- The hostid of the license server. In the example above, the hostid is `0050569e1b87`. This number cannot be edited by the user.
- A port number. In the example above, the port number is 1718. This number can be edited by the user.

Confirm that the license server hostname is the actual name of your license server (the computer that you intend to run the license manager on); otherwise, change it by editing the file. The default port number (1718) can be changed if another program is already using it (you will get an error message indicating this when starting the license manager). If the default port number 1718 is in use, change it to any other number between 1025 and 64,000.

THE USE_SERVER LINE

The `USE_SERVER` line, with no arguments, does not impact the license manager but has implications for the client. When a COMSOL client sees the `USE_SERVER` line, it ignores everything in the license file except the preceding `SERVER` lines and transfers checkout validation to the vendor daemon. This means that if you are running COMSOL on one computer, and the license manager on a different computer, your license file can only contain two lines: the `SERVER` line and the `USE_SERVER` line.

THE VENDOR LINE

The `VENDOR` line defines the name of the `LMCOMSOL` vendor daemon. This name cannot be changed. The vendor daemon is a process that has to be running together with the license manager and is automatically started when the license manager is started. The `LMCOMSOL` vendor daemon requires its own port number. In the example above, the default port number 1719 is shown.

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

Using the example license file above, configure the firewall to allow access to the port numbers 1718 and 1719. If you have chosen other port numbers and modified the `license.dat` file accordingly, configure the firewall to allow access to your chosen port numbers. If you are unsure about which port numbers are free or how to enable firewall port access, contact your system administrator.

You cannot modify anything in the `license.dat` file except the license server name and (if necessary) port numbers, or the license might not work.

THE SERIAL LINE

The `SERIAL` line contains information on the license type, license number, and the products included in the license.

THE INCREMENT AND FEATURE LINES, AND LICENSE FEATURES

The `INCREMENT` or `FEATURE` lines contain a license feature name, version, expiration date, and the number of available licenses. The example file above shows that the user has a perpetual (permanent) COMSOL 6.4 Floating Network License allowing four concurrent users of COMSOL Multiphysics and two concurrent users of the Heat Transfer Module. Borrowing is enabled and `BORROW=720` sets a time limit to 720 hours. "`SN=`" shows the license's serial number. The number after "`SIGN=`" at the end of each `INCREMENT` line contains a license key. Long lines can be broken by a continuation character (\).

The License Feature Names

The following table contains the license feature names for all products in the COMSOL 6.4 product suite (see also additional information about license features below the table):

PRODUCT	FEATURE NAME
COMSOL Multiphysics	`COMSOL`, `COMSOLUSER`, `COMSOLGUI`, `MODELMANAGER`[a], `CHATBOT`[b]
COMSOL Multiphysics Floating Network License[c]	`CLIENTSERVER`, `CLUSTERNODE`, `MODELMANAGERSERVER`
COMSOL Server	`COMSOLSERVER`, `COMSOLUSER`
COMSOL Compiler	`COMSOLCOMPILER`
AC/DC Module	`ACDC`
Acoustics Module	`ACOUSTICS`
Battery Design Module	`BATTERYDESIGN`
CAD Import Module	`CADIMPORT`, `CADIMPORTUSER`, `CADREADER`

PRODUCT	FEATURE NAME
CFD Module	CFD
Chemical Reaction Engineering Module	CHEM
Composite Materials Module	COMPOSITEMATERIALS
Corrosion Module	CORROSION
Design Module	DESIGN, CADIMPORT, CADIMPORTUSER, CADREADER
ECAD Import Module	ECADIMPORT
Electric Discharge Module	ELECTRICDISCHARGE
Electrochemistry Module	ELECTROCHEMISTRY
Electrodeposition Module	ELECTRODEPOSITION
Fatigue Module	FATIGUE
File Import for CATIA V5	CATIA5
Fuel Cell & Electrolyzer Module	FUELCELLANDELECTROLYZER
Geomechanics Module	GEOMECHANICS
Granular Flow Module	GRANULARFLOW
Heat Transfer Module	HEATTRANSFER
Liquid & Gas Properties Module	LIQUIDANDGASPROPERTIES
LiveLink™ *for* AutoCAD®	LLAUTOCAD, CADIMPORT, CADIMPORTUSER, CADREADER
LiveLink™ *for* PTC® Creo® Parametric™	LLCREOPARAMETRIC, CADIMPORT, CADIMPORTUSER, CADREADER
LiveLink™ *for* Excel®	LLEXCEL
LiveLink™ *for* Inventor®	LLINVENTOR, CADIMPORT, CADIMPORTUSER, CADREADER
LiveLink™ *for* MATLAB®	LLMATLAB
LiveLink™ *for* Revit®	LLREVIT, CADIMPORT, CADIMPORTUSER, CADREADER
LiveLink™ *for* Simulink®	LLSIMULINK
LiveLink™ *for* Solid Edge®	LLSOLIDEDGE, CADIMPORT, CADIMPORTUSER, CADREADER
LiveLink™ *for* SOLIDWORKS®	LLSOLIDWORKS, CADIMPORT, CADIMPORTUSER, CADREADER
Material Library	MATLIB
MEMS Module	MEMS
Metal Processing Module	METALPROCESSING

PRODUCT	FEATURE NAME
Microfluidics Module	MICROFLUIDICS
Mixer Module	MIXER
Molecular Flow Module	MOLECULARFLOW
Multibody Dynamics Module	MULTIBODYDYNAMICS
Nonlinear Structural Materials Module	NONLINEARSTRUCTMATERIALS
Optimization Module	OPTIM
Particle Tracing Module	PARTICLETRACING
Pipe Flow Module	PIPEFLOW
Plasma Module	PLASMA
Polymer Flow Module	POLYMERFLOW
Porous Media Flow Module	POROUSMEDIAFLOW
Ray Optics Module	RAYOPTICS
RF Module	RF
Rotordynamics Module	ROTORDYNAMICS
Semiconductor Module	SEMICONDUCTOR
Structural Mechanics Module	STRUCTURALMECHANICS
Subsurface Flow Module	SUBSURFACEFLOW
Uncertainty Quantification Module	UQ
Wave Optics Module	WAVEOPTICS

a. Not included in Class Kit licenses.

b. Adds chatbot components for communication with an AI system.

c. Additional license features for COMSOL Multiphysics when installed using a floating network license (FNL).

COMSOL Multiphysics License Features

Each COMSOL Desktop process checks out a `COMSOL` feature, a `COMSOLUSER` feature, and a `COMSOLGUI` feature. The `COMSOLGUI` feature is checked out by a COMSOL Desktop process. The `COMSOL` feature is checked out by all COMSOL Multiphysics processes, whether it has a GUI or not. The `COMSOLUSER` feature is checked out to count the number of distinct COMSOL Multiphysics users.

When you use functionality that requires an add-on product, license features corresponding to that product will be checked out.

If you run an attached batch job from COMSOL Desktop, the `COMSOL` feature and add-on product features are passed along from COMSOL Desktop to the batch job. When the batch job is finished, or when you detach from the batch job, COMSOL Desktop takes back the licenses.

When you run distributed jobs on a cluster, the CLUSTERNODE feature is checked out from each node.

COMSOL Multiphysics Batch License Features

For floating network licenses, a separate set of batch features are available for COMSOL Multiphysics and the licensed add-on products. This means that you in some cases can continue to use COMSOL Multiphysics locally while running batch jobs on remote computers and clusters.

With COMSOL Desktop, you can use batch features by selecting the **Use batch license** checkbox in the **Cluster Sweep** and **Cluster Computing** nodes. From the command line, you can use the option `-usebatchlic` to use batch license features.

Batch jobs will check out a batch feature, and when you use functionality that requires an add-on product, batch features corresponding to that product will be checked out as well.

The name of the batch feature for COMSOL Multiphysics is COMSOLBATCH, and for an add-on product it is, for example, RFBATCH for the RF Module. In general, BATCH is appended to the feature name corresponding to the add-on product.

A concurrent user can run an unlimited number of distinct batch processes using a single license as long as the models in those jobs only differ by parameter values, as defined in the Model Builder under **Global Definitions** > **Parameters**. This is implemented by computing a hash value based on model object features using the hash value as vendor value for the DUP_GROUP=UV keyword.

The CLUSTERNODE feature is checked out when batch features are used. When you run distributed jobs on a cluster, the CLUSTERNODE feature is also checked out from each node.

COMSOL Multiphysics Server License Features

A COMSOL Multiphysics server process will not check out any license features until you connect to it. When you connect using only the COMSOL API it will check out a COMSOL feature and a COMSOLUSER feature, as well as features corresponding to the add-on products that you use. If you connect to the COMSOL Multiphysics server from COMSOL Desktop, all license features that have been checked out from the desktop will be passed from COMSOL Desktop to the COMSOL Multiphysics server, including the COMSOLGUI feature. When you disconnect from the COMSOL Multiphysics server, the license features will be passed back from the server to COMSOL Desktop.

In addition to the above, when you connect to a COMSOL Multiphysics server from a remote computer, the COMSOL Multiphysics server checks out a CLIENTSERVER feature. The CLIENTSERVER feature is available for floating network

licenses. When you run distributed jobs on a cluster, the CLUSTERNODE feature is checked out from each node.

CAD-Specific License Features

For add-on products that use the CAD kernel, the CADIMPORT feature is always checked out, in addition to the feature corresponding to the add-on product. For example, when you use the Design Module, the CADIMPORT feature is checked out in addition to the DESIGN feature.

The CADIMPORTUSER feature is checked out to count the number of distinct CADIMPORT users, including Desktop users and batch users for floating network licenses.

Under certain circumstances a single CADREADER feature may also be checked out when using CAD functionality.

Class Kit License Features

If you have a Class Kit license for academic use, and enable it by using the -ckl option, CKL features will be checked out.

The name of the Class Kit license feature for COMSOL Multiphysics is COMSOLCKL, and for add-on products it is, for example, RFCKL for the RF Module. In general, CKL is appended to the feature name for the corresponding add-on product.

COMSOL Server License Features

Each COMSOL Server process checks out a COMSOLSERVER feature and there is no limitation on the number of such checkouts. When you start running applications with COMSOL Server, the server checks out CSL and CSLU features corresponding to the add-on products. The CSL features are used to allow each user to run four applications, and the CSLU features are used to count the number of users.

The COMSOLUSERCSL feature will also be checked out to keep track of distinct COMSOL Server users.

The name of the COMSOL Server feature for COMSOL Multiphysics is COMSOLCSL, and for add-on products it is, for example, RFCSL for the RF Module. In general, CSL is appended to the feature name for the corresponding add-on product.

The name of the COMSOL Server user feature for COMSOL Multiphysics is COMSOLCSLU, and for add-on products it is, for example, RFCSLU for the RF Module. In general, CSLU is appended to the feature name for the corresponding add-on product.

COMSOL Server Batch Job License Features

You can launch batch jobs from applications run with COMSOL Server. Batch jobs can only be started from running applications and not from the command line. The application always uses COMSOL Server batch license features. The batch jobs will check out a `COMSOLUSERCSL` feature as well.

The name of the batch feature for COMSOL Server is `COMSOLBACSL`, and for add-on products it is, for example, `RFBACSL` for the RF Module. In general, `BACSL` is appended to the feature name for the corresponding add-on product.

A concurrent user can run an unlimited number of distinct batch processes using a single license as long as the models in those jobs only differ by parameter values, as defined in the Model Builder under **Global Definitions** > **Parameters**. This is implemented by computing a hash value based on model object features using the hash value as vendor value for the `DUP_GROUP=UV` keyword.

The `COMSOLUSERCSL` feature will also be checked out to keep track of distinct COMSOL Server batch job users.

The `CLUSTERNODECSL` feature is checked out when the BACSL license features are used. When you run distributed jobs on a cluster, the `CLUSTERNODECSL` feature is also checked out from each node.

COMSOL Compiler License Features

A COMSOL Compiler license enables you to compile stand-alone applications based on models created with COMSOL Multiphysics and most add-on products. When you use COMSOL Compiler, compiler license features for COMSOL Multiphysics and all allowed add-on products are checked out.

The name of the compiler feature for COMSOL Multiphysics is `COMSOLCOMPILER`, and for add-on products it is, for example, `RFCOMPL` for the RF Module. In general, `COMPL` is appended to the feature name for the corresponding add-on product.

Idle Timeout of Licenses

For information about the `TIMEOUT` and `TIMEOUTALL` settings, see the *FlexNet Publisher License Administration Guide*. See also the following section.

Configuring FlexNet License Features

It is possible for the license administrator to configure how the license manager handles license features. To do so, create an options file (usually called `LMCOMSOL.opt`) in the format described in the *FlexNet Publisher License Administration Guide*. Additionally, COMSOL has made the following decisions that cannot be overridden by the license administrator:

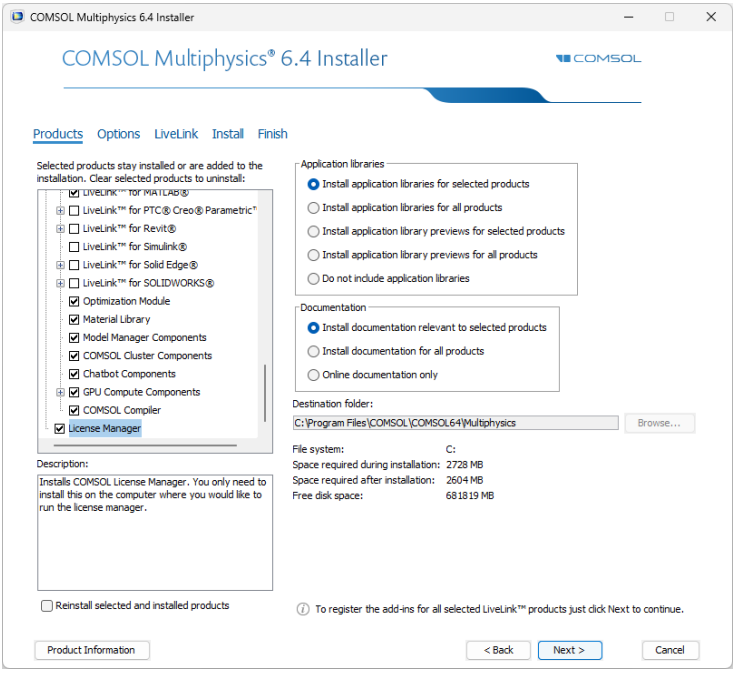
- `VENDOR_STRING` is used for determining license pools.

- Borrowed licenses can be returned early.
- Fully qualified domain name matching is not used.
- Minimum `LINGER` time is 0.
- `TIMEOUT` is supported. The minimum idle time is 900 seconds (15 minutes). If `TIMEOUT` or `TIMEOUTALL` is not specified, idle licenses are never timed out.
- Each new license request scans all the license servers.
- The `FLEXLM_DIAGNOSTICS` environment variable is supported.
- The `LM_LICENSE_FILE` and `LMCOMSOL_LICENSE_FILE` environment variables are supported, except when running the installer, since the installer needs full control of which license file is being used. Note that COMSOL internally sets `LMCOMSOL_LICENSE_FILE` to `COMSOL64/Multiphysics/license/license.dat` if `LMCOMSOL_LICENSE_FILE` has not already been set by the user.
- License files are not case sensitive.

Installing the License Manager

The license manager components are automatically installed when installing COMSOL Multiphysics unless otherwise specified on the Products page of the COMSOL Installer; see Products Page. In some cases, the license manager is also automatically configured to run as a service. The checkbox for the license manager

components can be found last in the list of software components, as seen in the picture below:



If you do not intend to run the license manager on the computer for which you are installing COMSOL software products, you can clear this checkbox during installation.

If you want to install COMSOL on the same computer as the license manager, first perform a complete COMSOL installation including the license manager software components. When finished, skip the remainder of this section and continue with Starting the License Manager.

To install only the license manager, follow the installation instructions for COMSOL earlier in this document and, on the Products page, clear all checkboxes except the one for the license manager.

If you want to install the license manager on a computer where running the COMSOL Installer is inconvenient, please contact COMSOL Support for access to the files needed for installing only the license manager.

AUTOMATED LICENSE MANAGER INSTALLATION

The license manager can also be installed via the automated installation process; see Automated Installation. Set `licmanager = 1` in the answer file to install the license manager. To automatically configure the license manager to run as a service

on Windows, use `licmanager.service = 1` in the `setupconfig.ini` file and provide values for the other `licmanager.service.*` lines.

Starting the License Manager

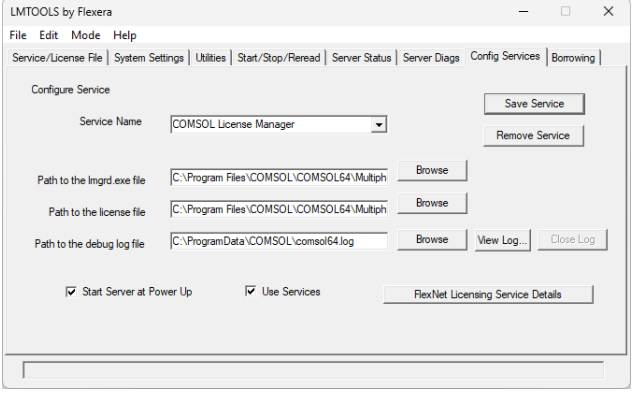
The license manager can be started manually, or it can be configured to start automatically as a service each time the computer is rebooted.

The installer can set up the license manager to start automatically; if it did, you can skip the following section.

STARTING THE MANAGER AUTOMATICALLY AS A SERVICE

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

1. Locate the `COMSOL64\Multiphysics\license\win64` folder and run `lmtools.exe`. Alternatively, run **LMTOOLS** from the Windows **Start** menu, available under **COMSOL Multiphysics 6.4** > **COMSOL Launchers** > **LMTOOLS**.
2. On the **Service/License File** page choose **Configuration using Services**.
3. Click the **Configure Services** tab.



4. Make an entry in the **Service Name** field, for example, `COMSOL License Manager`.
5. Specify the full paths to `lmgrd.exe` and `license.dat` by browsing to their locations on your hard drive. The default location for `lmgrd.exe` is `C:\Program Files\COMSOL\COMSOL64\Multiphysics\license\win64\lmgrd.exe`, and for the

license file, it is `C:\Program Files\COMSOL\COMSOL64\Multiphysics\license\license.dat`. For the debug log file, you can use any name of your choice, for example, `comsol64.log`. The default file path to the location of the license manager debug log file is `C:\ProgramData\COMSOL\comsol64.log`.

Make sure your Windows user account has read/write permissions for the folder of the debug log file, or the file will not be created.

6 Select the **Use Services** checkbox (might not be possible on all platforms, but is recommended when available) and then the **Start Server at Power Up** checkbox.

7 Click **Save Service**. The license manager now starts at automatically when you reboot the license server computer. If you want to start the license manager right away without restarting the license server computer, click **Start Server** on the **Start/Stop/Reread** page of the FlexNet Control Panel.

Starting the License Manager Manually

To start the license manager manually, browse to the `license\win64` folder. Now, in a Windows command window enter

```
lmgrd -c ..\license.dat -l ..\comsol64.log
```

The license manager is now ready to distribute licenses over the network. It writes debug information to the log file `COMSOL64\Multiphysics\license\comsol64.log`.

Verifying That the License Manager Is Running

Once you start the license manager, it is good practice to verify that the license manager service is running. Start the Windows Task Manager and go to the Services page. Check that the `LMCOMSOL` service is running.

Starting COMSOL Multiphysics

After the installation is complete and the license server manager and vendor daemon are running on the license server, you can start using the COMSOL

products. For more information on how to run COMSOL Multiphysics, see Running COMSOL Multiphysics on Windows.

Changing the License

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

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

RESTARTING THE LICENSE MANAGER

To restart the license manager, follow these steps:

1. In the Windows Start menu, choose **COMSOL Multiphysics 6.4** > **COMSOL Launchers** > **LMTOOLS**.
2. In the FlexNet Control Panel, click, in this order, **Stop Server** and **Start Server**.

OBTAINING A HOSTID

If you need to verify the hostid of the license server, you can follow the steps for Obtaining the Hostid. Alternatively, if COMSOL is already installed on the license server, you can determine the hostid by running the `lmhostid` command

```
COMSOL64/Multiphysics/license/win64/lmutil lmhostid
```

The hostid is typically the Ethernet address (also called a MAC address) of the network card. An Ethernet address has six bytes, each with two hexadecimal digits, giving a hostid with twelve hexadecimal digits. Alternatively, the hostid can be the volume serial number of your C hard drive. The volume serial number has 4 bytes, each with two hexadecimal digits, giving a hostid with eight hexadecimal digits.

Using COMSOL on an IPv6 Network

COMSOL has been tested on both IPv6-only networks and hybrid IPv4/IPv6 networks. To make sure that the license manager uses IPv6, set the environment variable `FNP_IP_PRIORITY` to 6. See the *FlexNet Publisher License Administration Guide* for details.

Troubleshooting License Errors

If you have questions or problems with your installation, see Troubleshooting License Errors.

After the installation is finished, a COMSOL Multiphysics 6.4 folder is created on the Windows Start menu. Additionally, a COMSOL Multiphysics 6.4 shortcut icon is placed on the Windows desktop:

To start COMSOL Multiphysics, double-click the desktop icon or select COMSOL Multiphysics 6.4 from the Windows Start menu.

Cross-Platform User Interface

The default user interface for COMSOL is a Windows application. There is also a cross-platform user interface that you can start by going to the `bin\win64` folder in the COMSOL installation directory and double-clicking `comsolxpl.exe`. The cross-platform user interface is identical to the interface on Linux and macOS.

The COMSOL Multiphysics Folder on The Start Menu

Depending on which COMSOL products and software components you have licensed and installed, the COMSOL Multiphysics 6.4 folder on the Windows Start menu contains a selection of the items in the following list:

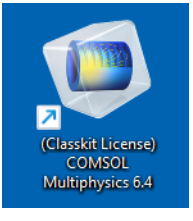
- COMSOL Multiphysics 6.4: Starts the COMSOL Desktop.
- COMSOL Documentation: Starts the COMSOL Documentation window, from which you can access and search all the installed documentation. By default, the PDF documents open inside the COMSOL Documentation application; to instead open them in Adobe Acrobat, you need to modify browser settings for the Adobe PDF Reader add-on.

- COMSOL Launchers: Opens a folder with launchers for the following additional COMSOL programs and utilities:
  - Setup: Starts the COMSOL Setup program, which you can use to add, remove, and repair COMSOL products and to change the license.
  - Uninstall: Starts the COMSOL Uninstaller. For more information, see Removing (Uninstalling) the COMSOL Installation.
  - Update: Starts the COMSOL Installer in update mode.
  - COMSOL Multiphysics Client 6.4: Starts a COMSOL Multiphysics client that can be connected to a COMSOL Multiphysics server.
  - COMSOL Multiphysics Server 6.4: Starts a COMSOL Multiphysics server that a COMSOL Multiphysics client can connect to.

    For more information on running COMSOL in client–server mode, see Running COMSOL Multiphysics in Client–Server Mode.
  - LMTOOLS: Starts the FlexNet license manager control panel (LMTOOLS). For more information, see License Manager Installation on Windows.
  - For launching COMSOL Multiphysics with any of the available graphics rendering options — OpenGL® and software rendering — the following shortcuts are available: COMSOL Multiphysics 6.4 (OpenGL), and COMSOL Multiphysics 6.4 (Software).
  - This folder also contains launchers for COMSOL Multiphysics, COMSOL Documentation, COMSOL with MATLAB (if available), and COMSOL with Simulink (if available) which appear on the main COMSOL Multiphysics 6.4 Start menu.

Starting COMSOL Multiphysics for a Classkit License

If you have a Classkit License, start COMSOL Multiphysics by double-clicking the dedicated Windows desktop icon:



Creating Desktop Shortcuts Manually

Sometimes it is necessary to create the COMSOL shortcuts manually, for example, when COMSOL Multiphysics is installed on a shared network drive.

1 Locate the COMSOL executable. Its default location is

```
C:\Program Files\COMSOL\COMSOL64\Multiphysics\bin\win64\comsol.exe
```

2 Right-click `comsol.exe` and select **Create shortcut**, which creates a shortcut with a default name **comsol.exe - Shortcut**. If this shortcut is not created on the Desktop, then move it there by drag-and-drop.

Creating a Desktop Shortcut Manually for the Cross-Platform User Interface

The cross-platform user interface for COMSOL that is available on macOS and Linux has a slightly different look-and-feel than the user interface for Windows. You can get access to the cross-platform user interface from

```
C:\Program Files\COMSOL\COMSOL64\Multiphysics\bin\win64\comsolxpl.exe
```

assuming that the default installation location has not changed by you during installation.

To create a shortcut to the cross-platform user interface, right-click `comsolxpl.exe` and select **Create shortcut**, which creates a shortcut with a default name **comsolxpl.exe - Shortcut**. If this shortcut is not created on the Desktop, then move it there by drag-and-drop.

Creating Desktop Shortcuts Manually for a Classkit License

If you manually create a desktop shortcut for a Classkit License, then, in addition to the steps above, the shortcut's Target needs to be modified with additional options. Right-click the **COMSOL** shortcut icon and select **Properties**. Change the text string in the **Target** field to

```
"C:\Program Files\COMSOL\COMSOL64\Multiphysics\bin\win64\comsol.exe"
-Dcs.ckl
"C:\Program Files\COMSOL\COMSOL64\Multiphysics\bin\win64\
comsolclasskit.ini"
```

(The complete text string must be written on a single row with spaces between the command and each argument.)

Here, `C:\Program Files\COMSOL\COMSOL64\Multiphysics` represents the default COMSOL installation directory. This can be changed in the Target field text string if your installation is placed in a different folder.

Creating Desktop Shortcuts Manually for COMSOL with MATLAB

If you manually create a desktop shortcut for a COMSOL with MATLAB, then, in addition to the steps above, the shortcut's Target needs to be modified with additional options. Right-click the **COMSOL** shortcut icon and select **Properties**. Change the text string in the **Target** field to

```
"C:\Program
Files\COMSOL\COMSOL64\Multiphysics\bin\win64\comsolmphserver.exe" matlab
```

(The complete text string must be written on a single row with spaces between the command and each argument.)

Here, `C:\Program Files\COMSOL\COMSOL64\Multiphysics` represents the default COMSOL installation directory and this can be changed in the Target field text string if your installation is placed in a different folder.

Creating Desktop Shortcuts Manually for COMSOL with Simulink

If you manually create a desktop shortcut for a COMSOL with Simulink, then, in addition to the steps above, the shortcut's Target needs to be modified with additional options. Right-click the **COMSOL** shortcut icon and select **Properties**. Change the text string in the **Target** field to

```
"C:\Program
Files\COMSOL\COMSOL64\Multiphysics\bin\win64\comsolmphserver.exe" simulink
```

(The complete text string must be written on a single row with spaces between the command and each argument.)

Here, `C:\Program Files\COMSOL\COMSOL64\Multiphysics` represents the default COMSOL installation directory and this can be changed in the Target field text string if your installation is placed in a different folder.

Running COMSOL Multiphysics in Client–Server Mode

When you start COMSOL Multiphysics by, for example, double-clicking the Windows desktop icon, COMSOL Multiphysics is run as a single application that includes both the COMSOL Multiphysics client and COMSOL Multiphysics server, as explained later in this section. However, the COMSOL client–server architecture lets you access the COMSOL Multiphysics server — the COMSOL computational engine — as a separate process. For example, the COMSOL

Desktop can act as a COMSOL Multiphysics client when connected to a COMSOL Multiphysics server.

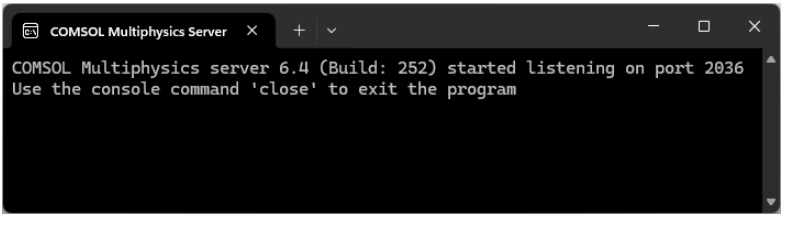
The license server is not the same as a COMSOL Multiphysics server. The license manager can run on a computer different from both the ones used by COMSOL Desktop and COMSOL Multiphysics server.

You need a Floating Network License to run the COMSOL Multiphysics server and the COMSOL Multiphysics client on separate computers. However, any COMSOL license is sufficient for running client and server on the same computer.

The client and server need not run on the same platform. For example, you can run the COMSOL Desktop on Windows connecting to a COMSOL Multiphysics server on a Linux or macOS computer. This enables offloading heavy-duty computations from your personal laptop or desktop to run just the COMSOL Desktop graphical user interface. A typical use would be to run the COMSOL Multiphysics server on a computer with large amounts of memory (RAM) and processing power and to use your personal computer for pre- and postprocessing with the COMSOL Desktop.

STARTING A COMSOL MULTIPHYSICS SERVER

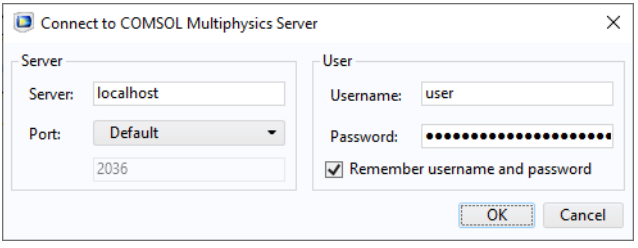
The COMSOL Multiphysics server is a single user server allowing multiple sessions by the same user, one session at a time. To start a COMSOL Multiphysics server, click **COMSOL Multiphysics Server** in the **COMSOL Launchers** folder underneath your COMSOL Multiphysics folder on the Windows Start menu. When you start a COMSOL Multiphysics server from the Windows Start menu, a command window appears asking you for a username and password. You can use any username and password of your choice, it is only used for connecting a COMSOL Multiphysics client with a COMSOL Multiphysics server.



When the COMSOL Multiphysics server starts, it listens for a COMSOL Multiphysics client connection on the port listed in the command window. In the example above it is port 2036.

CONNECTING A COMSOL CLIENT TO A COMSOL MULTIPHYSICS SERVER

You can start a COMSOL Multiphysics client session by clicking **COMSOL Multiphysics Client** in the **COMSOL Launcher** folder underneath your COMSOL Multiphysics folder on the Windows Start menu. You can also connect to a COMSOL Multiphysics server from the COMSOL Desktop by selecting **File** > **Connect to Server**. When you start the Client, a Connect to Server window appears prompting you for a computer name (Server) where the COMSOL Multiphysics server is running, Port number, Username, and Password.



Once you have filled out this information and clicked OK, the COMSOL Multiphysics server command window indicates that a COMSOL Multiphysics client has connected. For more information on running COMSOL in client–server mode, see the *COMSOL Multiphysics Reference Manual*.

Running COMSOL Multiphysics in Batch Mode

You can submit COMSOL Multiphysics batch jobs from the COMSOL Desktop and the command line.

To run a COMSOL Multiphysics batch job from the COMSOL Desktop, you need to make the Batch feature visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. In the Model Builder, right-click a Study node and select Batch to create batch jobs.

From the Windows command window, you can start batch jobs by using the `comsolbatch` command. For example:

```
comsolbatch -inputfile in.mph -outputfile out.mph
```

To run a specific study add the command line option `-study` *<tag>*, where *<tag>* is the tag of the study to run, for instance, `std1`. To see the tag, click the toolbar button **Model Tree Node Text** in the **Model Builder** and select **Tag**.

The *COMSOL Multiphysics Reference Manual* has a dedicated section on running COMSOL Multiphysics from the Windows command window, including a list of COMSOL commands and associated syntax.

Multicore Settings

COMSOL Multiphysics supports two modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations, including cluster support. This section covers shared-memory processing, or multithreading, which is important for the performance of COMSOL Multiphysics computations. Some terms that are frequently used when describing multithreading are:

- *Core*: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.
- *Speedup* is how many times faster a job runs on *N* cores compared to 1 core, on a specific compute node. The speedup depends on the simulation type, the hardware used, and hardware drivers used.

In Windows, the default number of processor cores used by COMSOL Multiphysics is the total number of available physical cores. For example, if you have a 2 x dual core machine, 4 cores are used in parallel by a COMSOL Multiphysics process.

To find out how many processor cores your Windows machine has:

1 Start the Windows Task Manager (press Ctrl+Shift+Esc, or right-click the taskbar and select Task Manager in the context menu).

2 On the **Performance** page, click **CPU**. The number of cores can be seen as the number next to **Cores**.

If you want COMSOL Multiphysics to leave out one or more processor cores, you can set the number of cores used for a computational job in the **Preferences** window on the **Computing** > **Multicore** page (by first selecting the **Number of cores** checkbox and then entering the number of processor cores to use).

You can also change the default behavior of COMSOL Multiphysics by setting the environment variable `COMSOL_NUM_THREADS` to the desired number of cores. See the *COMSOL Multiphysics Reference Manual* for more information.

Running COMSOL Multiphysics on Clusters

You can launch COMSOL cluster jobs from the COMSOL Desktop and the command line. To run COMSOL Multiphysics on a cluster, you need to make the cluster features visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. Then, in the Model Builder, right-click a Study node and select Cluster Computing or Cluster Sweep to create cluster jobs. Cluster computing requires a Floating Network License.

The following terms occur frequently when describing the hardware for cluster computing and shared-memory parallel computing:

- Compute node: The compute nodes are where the distributed computing occurs. Each distributed COMSOL process resides in a compute node and communicates with other compute nodes using MPI (message-passing interface).
- Host: The host is a physical machine (hardware) with a network adapter and unique network address. The host is part of the cluster. It is sometimes referred to as a physical node.
- Core: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.

The number of hosts and the number of compute nodes are usually the same. For some special problem types, like very small problems with many parameters, it might be beneficial to use more than one computational node on one host.

A tutorial for cluster testing is included in the Application Libraries window under **COMSOL Multiphysics/Cluster_and_Batch_Tutorials/micromixer_cluster**.

Running From a Desktop PC

To access the COMSOL Multiphysics running on a cluster, it is recommended to work on a desktop PC. To do so, use one of the following options:

- Install COMSOL Multiphysics on your local PC. Also install the client portion of Microsoft HPC Pack on the desktop PC. Use a version that is compatible with the version of Windows Server that is installed on the cluster. Microsoft HPC Pack enables you to access the cluster from your workstation.
- Alternatively, connect to the head node via a remote desktop connection and start COMSOL Multiphysics on the head node.

QUICK TROUBLESHOOTING

- Your first step is to make sure you have the latest release installed. Check that you have COMSOL Multiphysics 6.4 or later. Also make sure to install the latest product updates.
- For Windows HPC Server, log in to each node with remote desktop and start the COMSOL Desktop GUI. No error messages should be displayed.
- If you get the error message "Process status indicates that process is running," then cancel any running jobs in the Windows HPCS Job manager or other scheduler that you use. In the COMSOL Desktop, locate the External Process page at the lower-right. Click the Clear Status button.

For more information about how to run COMSOL Multiphysics in parallel on Windows clusters, see the *COMSOL Multiphysics Reference Manual*. For installation on Clusters, see Cluster Installation.

Running COMSOL Multiphysics on the Cloud

COMSOL Multiphysics and COMSOL Server support cloud computing. See

- www.comsol.com/partners-consultants/hpc
- www.comsol.com/model/running-the-comsol-software-with-amazon-ec2-14075
- www.comsol.com/model/running-the-comsol-software-with-microsoft-azure-89751

Running COMSOL Multiphysics with MATLAB

Running COMSOL Multiphysics with MATLAB requires a LiveLink™ *for* MATLAB® license. To run COMSOL Multiphysics with MATLAB, double-click the COMSOL Multiphysics 6.4 with MATLAB icon on the desktop.

Alternatively, start COMSOL Multiphysics with MATLAB from the Start menu by pointing to Programs, then to COMSOL Multiphysics 6.4, and then select COMSOL Multiphysics 6.4 with MATLAB.

Running COMSOL Multiphysics with MATLAB starts a COMSOL Multiphysics server and a MATLAB Desktop. The COMSOL Desktop is not started. You can change the path to the MATLAB installation in the Preferences window accessed from the Options menu of the COMSOL Desktop. For more information, see the LiveLink™ *for* MATLAB® documentation.

STARTING COMSOL MULTIPHYSICS WITH MATLAB USING THE GRAPHICS SERVER

To display the plot in a COMSOL graphics window you need to run COMSOL Multiphysics with MATLAB using the graphics server. To do so, append the flag `-graphics` to the COMSOL Multiphysics with MATLAB target path.

Running COMSOL Multiphysics with Simulink

Running COMSOL Multiphysics with Simulink requires a LiveLink™ *for* Simulink® license. To run COMSOL Multiphysics with Simulink, double-click the COMSOL Multiphysics 6.4 with Simulink icon on the desktop.

Alternatively, start COMSOL Multiphysics with Simulink from the Start menu by pointing to Programs, then to COMSOL Multiphysics 6.4, and then select COMSOL Multiphysics 6.4 with Simulink.

Running COMSOL Multiphysics with Simulink starts a COMSOL Multiphysics server and a MATLAB Desktop. The COMSOL Desktop is not started.

You can change the path to the MATLAB installation in the Preferences window accessed from the Options menu of the COMSOL Desktop. For more information, see the LiveLink™ *for* Simulink® documentation.

Installation Over the Internet

INSTALLATION OF A TRIAL LICENSE OVER THE INTERNET

A trial license can be given to you with the intention to test the software without any payment obligation for noncommercial and nonproduction use. This option is not available in all regions.

Installation of a Single User Trial License requires a license passcode. A passcode has a form similar to:

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

This is usually sent to you by your COMSOL representative by email. Once you locate your passcode, follow these steps to prepare for download and installation:

1. Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.
2. If you have not already created a COMSOL Access account, you are prompted to create it. When you have created the account, you can enter your license passcode to associate it with your account information.

   If you already created a COMSOL Access account, you can associate the license file with your account on the COMSOL Access page under Manage Licenses at www.comsol.com/access/licenses.
3. Follow the web-based instructions to download the software.
4. Continue with the instructions in the section Downloading and Installing the COMSOL Software.

A license passcode can also be used for class kit licenses (CKL).

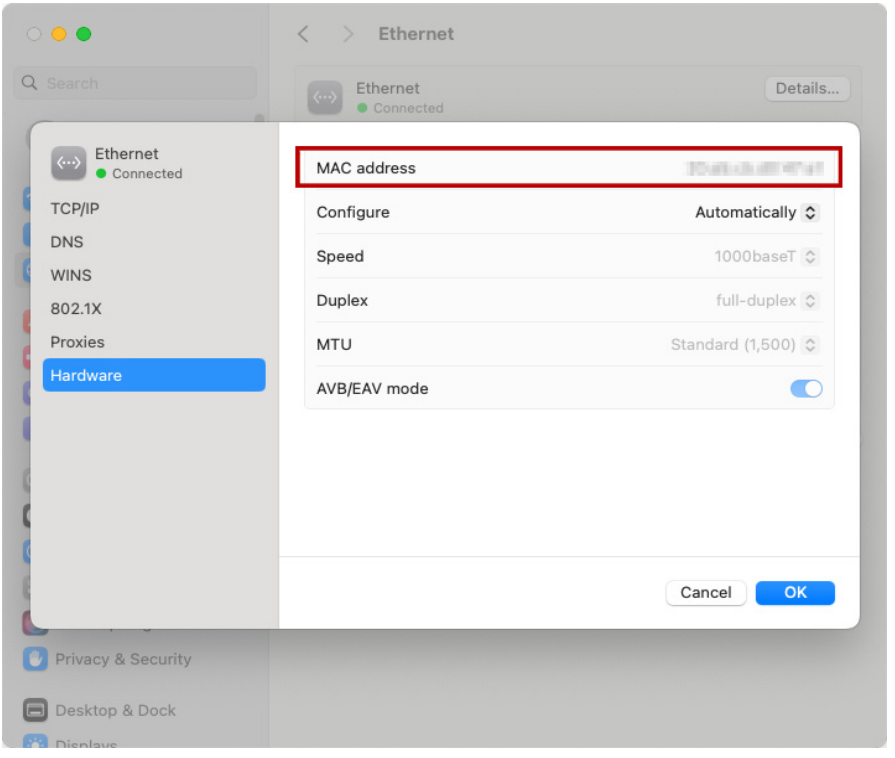
INSTALLATION OF A PAID-FOR LICENSE OVER THE INTERNET

Installation of any paid-for license on macOS requires a license file that is sent to you by your COMSOL representative by email. To be able to generate the license file, information about your hardware is needed in the form of a hostid (host ID). The hostid is used to lock the license to your hardware and needs to be sent by you to a COMSOL representative prior to the license file being generated.

Obtaining the Hostid

Follow these steps to obtain a hostid:

1. From the **Apple menu**, open **System Settings** and select **Network**.
2. Select the correct network adapter and then click **Details...**.
3. Select the **Hardware** tab where you will find the MAC address listed.
4. If there are multiple network adapters, report the MAC address for all of them. These numbers should each consist of 12 characters.



Obtaining the Hostname

If you have been informed by your COMSOL representative that you need to run a license manager for your installation, then you also need the hostname. To get the hostname, launch the **Terminal** application and run the `hostname` command.

If your network administrator has set a fixed IP address for your computer, this IP Address can be used in place of the hostname. For more information on license manager installation, see License Manager Installation on macOS.

Obtaining the License File from a COMSOL Representative

Send the hostid information, as well as hostname, if applicable, in an email to your COMSOL representative, who will respond with an email including an attached license file (`license.dat`). Save this file to your local Home folder to ensure that the COMSOL installer will be able to read it during the installation process. Avoid protected folders such as Desktop, Documents, and Downloads.

Below is an example of the contents of a `license.dat` file for a Single User License on macOS. The license file is a text file, and this example shows that the licensed products are COMSOL Multiphysics, Particle Tracing Module, Subsurface Flow Module, and LiveLink™ *for* Excel®.

```
#--------------------------------------------------------------------
# COMSOL 6.4 NSL License No: 1234567 Windows/Mac
# Visit www.comsol.com/install for latest installation instructions
#--------------------------------------------------------------------
FEATURE SERIAL LMCOMSOL 6.4 permanent uncounted \
          VENDOR_STRING=C,18000100200 HOSTID=ANY sort=100 SN=1234567 \
          TS_OK SIGN=8045890A6FE4
FEATURE COMSOL LMCOMSOL 6.4 permanent uncounted HOSTID="70f2b13f4dfd \
          0116b8cc761a" PLATFORMS="i86_n x64_n i86_mac x64_mac" \
          SN=2076312 SIGN=E607EB680852
FEATURE PARTICLETRACING LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc 0026b9cc760a" PLATFORMS="i86_n x64_n \
          i86_mac x64_mac" SN=2076312 SIGN=3835733C6290
FEATURE SUBSURFACEFLOW LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc 0026b9cc760a" PLATFORMS="i86_n x64_n \
          i86_mac x64_mac" SN=2076312 SIGN=3A9BA162C9E4
FEATURE LLEXCEL LMCOMSOL 6.4 permanent uncounted HOSTID="70f1a12f4dfc \
          0026b9cc760a" PLATFORMS="i86_n x64_n i86_mac x64_mac" \
          SN=2076312 SIGN=EE9C11E44356
FEATURE COMSOLGUI LMCOMSOL 6.4 permanent uncounted \
          HOSTID="70f1a12f4dfc 0026b9cc760a" PLATFORMS="i86_n x64_n \
          i86_mac x64_mac" SN=2076312 SIGN=0D0A83382550
```

A Single User License file can normally not be edited or changed in any way by the user but has to be identical to the one sent to you by a COMSOL representative. However, if you were sent a license file that requires a license manager, then minor edits are required. For information on the type of license file required for installations using a license manager, see The License File.

Registering with COMSOL Access

Once you have saved your license file, follow these steps to register or login to COMSOL Access and to start the installation:

1. Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.

2 If you have not already created a COMSOL Access account, you are prompted to create it. While creating the account, point to your license file (`license.dat`) to associate it with your account information.

   If you already created a COMSOL Access account, then you can associate the license file on the COMSOL Access page with your account under Manage Licenses at www.comsol.com/access/licenses.

3 Continue with the instructions in the next section.

Downloading and Installing the COMSOL Software

1 Go to the web page www.comsol.com/product-download. To download the COMSOL installer, you must first create a COMSOL Access account as described in the section Installation over the Internet.

2 You are now given the option of downloading the COMSOL online installer or the COMSOL offline installer. For both options, make sure to download the version that matches your computer's CPU architecture:

   - `COMSOL64_macarm64.dmg` or `COMSOL64_maci64.dmg` (online).
   - `COMSOL64_full_macarm64.dmg` or `COMSOL64_full_maci64.dmg` (offline).

If you have problems downloading (such as **Error downloading file. Connection refused: connect**), please review this knowledge base entry: www.comsol.com/support/knowledgebase/1149. If you still have problems, contact your local COMSOL representative or technical support from the Support Center page www.comsol.com/support.

Starting the Installer

The COMSOL Installer is a user interface tool that guides you through the installation process. To run the installer:

1 Mount the DMG-file by double-clicking it and open it in Finder.

2 Launch the COMSOL Installer by double-clicking `COMSOL Setup`.

3 The COMSOL 6.4 Installer window should now appear. Continue with the instructions in the section Running The COMSOL Installer below.

Installation from USB Flash Drive

If you have received a USB Flash Drive from a COMSOL representative:

1. Connect the USB Flash Drive to your computer and open it in Finder.
2. Launch the COMSOL Installer by double-clicking `COMSOL Setup`.
3. The COMSOL 6.4 Installer window should now appear. Continue with the instructions in the section Running The COMSOL Installer below.

Running The COMSOL Installer

The steps for running the COMSOL Installer are independent of the installation media. If you have followed the above instructions, the COMSOL Installer should now appear. Continue with the instructions for Windows in the section Running the COMSOL Installer.

Automated Installation

You can install the COMSOL software using an automated installation process with minimal user interaction. This method requires installation from the offline installer and an answer file.

The answer file is a text file with a specific format that contains predefined settings for the COMSOL installer. If non-ASCII characters are used, the answer file is expected to be UTF-8 encoded by default, but UTF-16 is also supported if the file starts with a byte order mark (BOM).

A template answer file, `setupconfig.ini`, with detailed usage information is available in the DMG image.

To perform an automated installation:

1. Open the DMG file in Finder.
2. Copy `setupconfig.ini` to a local directory and customize it as needed.
3. Right-click **COMSOL 6.4 Installer** and select **Show Package Contents**.
4. Navigate to **Contents** > **Resources** and locate the `setup` executable.
5. Open a Terminal window.

6 Click and drag the `setup` executable to the terminal window. The full path should be copied to the command prompt.

7 In the terminal, add `-s` and the full path of your `setupconfig.ini` file to the command, with spaces in between. If needed, it should be possible to click and drag the setupconfig.ini file to the terminal to input the path.

8 Run the command, which should now resemble something like this:

```
/Volumes/COMSOL64_full_macarm64/COMSOL\ 6.4\ Installer.app/Contents/
Resources/setup -s /Users/username/Desktop/setupconfig.ini
```

or this:

```
/Volumes/COMSOL64_full_maci64/COMSOL\ 6.4\ Installer.app/Contents/
Resources/setup -s /Users/username/Desktop/setupconfig.ini
```

depending on the CPU architecture.

Removing (Uninstalling) the COMSOL Installation

To remove a COMSOL installation from your system, you can use the COMSOL Installer's uninstallation option. This removes all the files and directories that were initially created by the COMSOL Installer. Files and directories that were created or modified after the installation are not removed.

You can start the COMSOL Uninstaller in a few different ways:

- Launch the **COMSOL Setup** application from the installation directory, and select **Uninstall COMSOL 6.4**.
- Launch the COMSOL Installer using the same method as for the original installation, and select **Uninstall COMSOL 6.4**.
- In a terminal window, run the following command:

  ```
  /Applications/COMSOL64/Multiphysics/setup uninstall
  ```

Alternatively, to remove the COMSOL installation, you can also delete the `COMSOL64` folder including all subfolders. The following file may also be added by the installer: `/Library/LaunchDaemons/com.comsol.lmcomsol.plist`.

Product Updates and Application Library Update

COMSOL periodically releases product updates with improvements and corrections to reported problems. By default, COMSOL does not check for updates at startup. You can turn this feature on and off from the **Preferences** window accessible from the COMSOL Desktop. Here you can also configure settings for the Application Library Update.

The COMSOL Application Library is updated on a regular basis by COMSOL. To open the **Application Library Update** window from the **File** > **Help** menu (Windows users) or from the **Help** menu (macOS and Linux users), select **Update COMSOL Application Libraries**.

This connects you to the COMSOL Application Update website where you can access the latest updates. This includes files that have been added or improved since the latest product release.

Using the **Updates** section in the **Preferences** window, which you open from the COMSOL Desktop, you can configure proxy server settings as well as application and documentation directories for the Application Library Update. See the *COMSOL Multiphysics Reference Manual* for more information including command-line options for the Application Libraries.

As an alternative, you can update COMSOL without starting the update from inside COMSOL Multiphysics. To do this, run `COMSOL Update.app`.

Automated Updates

You can update the COMSOL software using an automated update process with minimal user interaction using the abovementioned DAT-file. Consult www.comsol.com/product-update for detailed instructions.

Changing the Path to the MATLAB® Installation

You can change the path to the MATLAB installation in the **Preferences** > **LiveLink Connections** window accessed from the **Options** menu of the COMSOL Desktop. For more information, see the LiveLink™ *for* MATLAB® documentation.

Cluster Installation

COMSOL Multiphysics supports two modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations, including cluster support. This section is dedicated to distributed-memory parallel installation.

COMSOL Multiphysics can distribute computations on compute clusters using the MPI model. One large simulation can be distributed across many compute nodes. Also, parametric sweeps can be done with individual parameter cases distributed to each cluster node.

SYSTEM REQUIREMENTS

The installation instructions above can also be followed for clusters. COMSOL supports shared-memory parallelism and distributed-memory parallelism on macOS with Apple silicon. For details on system requirements, including additional software packages required for certain configurations, see www.comsol.com/system-requirements.

LICENSE MANAGER

COMSOL Multiphysics requires a Floating Network License for running on clusters. Please check the license file for the `CLUSTERNODE` feature, which needs to be present to enable the cluster computing functionality. The license manager needs to be accessible from all nodes in the cluster. Therefore it is often a good idea to have it run on the head node.

INSTALLATION FOLDER

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

FEATURES

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

ACCESS TO CLUSTER

If you work on a computer that is not on the cluster, install COMSOL Multiphysics on that computer. Typically, you use a scheduler to launch jobs on the cluster. Make sure the scheduler client software is installed on that computer. You can configure the installation to use the scheduler by changing the `comsol.ini` file according to the section on MPI Options in the *COMSOL Multiphysics Reference Manual*.

For more information on installing and running COMSOL on clusters, see Running COMSOL on Clusters and the *COMSOL Multiphysics Reference Manual*.

License Manager Installation on macOS

Many of the instructions for installing the license manager are similar to those for Windows. This section covers only the differences when installing on macOS. For general information on the license manager software, see License Manager Installation on Windows.

FlexNet® License Manager Software Components

The license manager consists of the following software components:

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

The license server manager (`lmgrd`) and the vendor daemon (`LMCOMSOL`) run on the license server. When a user starts COMSOL Multiphysics on a client computer, communication is established through the network from the client to the license server and the license server manager (`lmgrd`). The license server manager then makes a request to the vendor daemon (`LMCOMSOL`), which releases licenses according to information in the `license.dat` file. The FlexNet utility programs are used for handling license server management tasks.

FlexNet® License Manager Documentation

For detailed information on the FlexNet® license manager software, select **Help** > **Documentation** in the COMSOL Desktop and scroll to the bottom of the page to locate a PDF copy of the *FlexNet Publisher License Administration Guide*.

Note: This PDF file is only available if you have locally installed documentation.

The License File

The license file for use on macOS is identical to that for Windows. See The License File and The License Features for more information.

Installing the License Manager

The license manager components are automatically installed when installing the COMSOL software unless otherwise specified on the Products page of the COMSOL Installer; see Products Page. The checkbox for the license manager components can be found last in the list of software components.

If you want to install COMSOL on the same computer as the license manager, perform a complete COMSOL installation and make sure to include the license manager components.

If you want to install the license manager on a computer where running the COMSOL Installer is inconvenient, please contact COMSOL Support for access to the files needed for installing only the license manager.

LICENSE MANAGER PAGE

See License Manager Page for information about the license manager settings in the installer. For macOS, this page also contains some additional settings:

- In the **User to run license manager** field, enter the username for the user that will run the license manager. If left empty, the root user will run the license manager, which is not recommended from a security point of view.
- Optionally, specify a group the user belongs to in the **Group of the user** field.

Note: The License Manager page only appears if the installer is started by a superuser (such as root or by using `sudo`).

To run the installer with `sudo`:

1. Open the DMG-file in Finder.
2. Right-click **COMSOL 6.4 Installer** and select **Show Package Contents**.
3. Navigate to **Contents** > **Resources** and locate the setup executable.
4. Open a Terminal window.
5. Click and drag the `setup` executable to the terminal window. The full path should be copied to the command prompt.

6 In the terminal, add `sudo` to the start of the command.

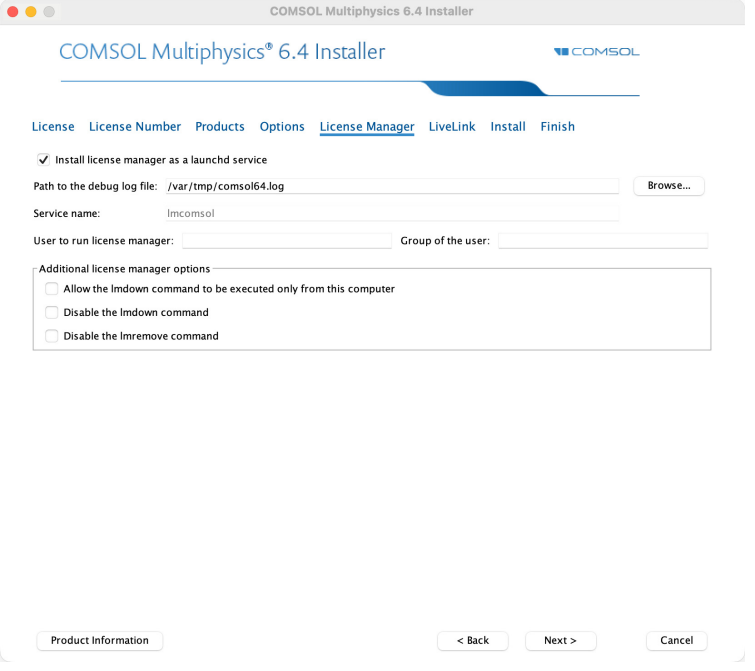
7 Run the command, which should resemble something like this:

```
sudo /Volumes/COMSOL64_macarm64/COMSOL\ 6.4\ Installer.app/Contents/
Resources/setup
```

or

```
sudo /Volumes/COMSOL64_maci64/COMSOL\ 6.4\ Installer.app/Contents/
Resources/setup
```

depending on the CPU architecture.



When finished, skip the remainder of this section and continue with Starting the License Manager.

To install only the license manager, follow the installation instructions for COMSOL earlier in this document, and, on the Products page, clear all checkboxes except the one for the license manager.

AUTOMATED LICENSE MANAGER INSTALLATION

Alternatively, the license manager can be installed using an automated installation process with minimal user interaction; for this option, see Automated Installation. Set `licmanager = 1` in the answer file to install the license manager. It is also possible to automatically configure the license manager to run as a service. Use

`licmanager.service = 1` in the `setupconfig.ini` file and provide values for the other `licmanager.service.*` lines.

Starting the License Manager

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

STARTING THE LICENSE MANAGER MANUALLY

To start the license manager manually:

1. Change directory to the `license/macarm64` or `license/maci64` directory:

   ```
   cd /Applications/COMSOL64/Multiphysics/license/macarm64
   ```

   or

   ```
   cd /Applications/COMSOL64/Multiphysics/license/maci64
   ```

   depending on your CPU architecture.

2. Start the license manager:

   ```
   ./lmgrd -c ../license.dat -l /var/tmp/comsol64.log
   ```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol64.log`.

STARTING THE LICENSE MANAGER AUTOMATICALLY AT STARTUP

To configure the license manager to run automatically at startup:

1. Copy the template file `com.comsol.lmcomsol.plist` to `/Library/LaunchDaemons`:

   ```
   sudo cp /Applications/COMSOL64/Multiphysics/license/macarm64/
   com.comsol.lmcomsol.plist /Library/LaunchDaemons/
   ```

   or

   ```
   sudo cp /Applications/COMSOL64/Multiphysics/license/maci64/
   com.comsol.lmcomsol.plist /Library/LaunchDaemons/
   ```

   depending on your CPU architecture.

   Typically, the template file must be edited: the `lmgrd` and `license.dat` paths should be updated, and a user that is not `root` should be specified for running the service.

2. Open the file `/Library/LaunchDaemons/com.comsol.lmcomsol.plist` in a text editor, for example, TextEdit, and make the necessary edits.

3 Set the correct permissions for the file:

```
sudo chmod 600 /Library/LaunchDaemons/com.comsol.lmcomsol.plist
```

4 Enable and start the daemon:

```
sudo launchctl load -w /Library/LaunchDaemons/com.comsol.lmcomsol.plist
```

To disable automatic startup for the license manager and remove the license manager daemon:

1 Stop and disable the daemon:

```
sudo launchctl unload -w /Library/LaunchDaemons/com.comsol.lmcomsol.plist
```

2 Remove the service file:

```
sudo rm -rf /Library/LaunchDaemons/com.comsol.lmcomsol.plist
```

3 Remove the log file:

```
rm /var/tmp/comsol64.log
```

Verifying That the License Manager Is Running

Once you start the license manager, it is good practice to verify that the license manager processes are running. Open the Activity Monitor and look for the vendor daemon (`LMCOMSOL`) and license server manager (`lmgrd`) processes.

Starting COMSOL Multiphysics

After the installation is complete and the license manager is running on the license server, you can start using COMSOL Multiphysics. For more information on how to run COMSOL Multiphysics, see Running COMSOL Multiphysics on macOS.

Changing the License

If you have received a new license file — for example, when adding COMSOL products to an existing license — replace the current license file with the new one

and then restart the license manager or reread the license file. Double-check the contents of the new file to make sure it lists all the products included in the license.

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

RESTARTING THE LICENSE MANAGER

To restart the license manager:

1. Change the directory to `license/macarm64` or `license/maci64`:

   ```
   cd /Applications/COMSOL64/Multiphysics/license/macarm64
   ```

   or

   ```
   cd /Applications/COMSOL64/Multiphysics/license/maci64
   ```

   depending on your CPU architecture.

2. Stop the license manager:

   ```
   ./lmdown -c ../license.dat
   ```

3. Restart the license manager:

   ```
   ./lmgrd -c ../license.dat -l /var/tmp/comsol64.log
   ```

OBTAINING A HOSTID

If you need to verify the hostid of the license server, you can follow the steps in Obtaining the Hostid. Alternatively, if COMSOL is already installed on the license server, you can determine the hostid by running the `lmhostid` command:

```
COMSOL64/Multiphysics/license/macarm64/lmhostid
```

or

```
COMSOL64/Multiphysics/license/maci64/lmhostid
```

depending on your CPU architecture.

The hostid is typically the Ethernet address (also called a MAC address) of the network card of your computer. An Ethernet address has six bytes, each with two hexadecimal digits. Thus, the full hostid has twelve hexadecimal digits.

Using COMSOL on an IPv6 Network

COMSOL has been tested on both IPv6-only networks and hybrid IPv4/IPv6 networks. To make sure that the license manager uses IPv6 for communication, set the environment variable `FNP_IP_PRIORITY` to 6. See the *FlexNet Publisher License Administration Guide* for details.

Troubleshooting License Errors

If you have questions or problems with your installation, see Troubleshooting License Errors.

The COMSOL Applications

After the installation is finished there are several COMSOL applications available. How many are available depends on which products and licenses you have:

COMSOL Multiphysics This is the primary application for running COMSOL Multiphysics. It launches COMSOL Multiphysics as a standalone application.

COMSOL Multiphysics (Classkit License) This application launches COMSOL Multiphysics for a Classkit License. This application is only available if you have a Classkit License.

COMSOL Documentation This application starts the COMSOL Documentation window, from which you can access and search all the installed documentation.

COMSOL with MATLAB Use this application for running COMSOL with LiveLink™ *for* MATLAB®. This application is only available if you have a LiveLink™ *for* MATLAB® license.

COMSOL with Simulink Use this application for running COMSOL with LiveLink™ *for* Simulink®. This application is only available if you have a LiveLink™ *for* Simulink® license.

COMSOL Multiphysics Server This application launches the Terminal application and starts a COMSOL Multiphysics server in a terminal window.

COMSOL Update This application checks for available product updates on www.comsol.com

COMSOL Setup This application makes it possible to add, remove, and repair COMSOL products and to change the license.

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

Running COMSOL Multiphysics from a Terminal Window

COMSOL Multiphysics can also be launched from a terminal window using the shell script `COMSOL64/Multiphysics/bin/comsol`.

To run the `comsol` command more easily, include the `COMSOL64/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/COMSOL64/Multiphysics/bin/comsol /usr/bin/comsol
```

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

The `comsol` command must not be moved from the `COMSOL64/Multiphysics/bin` folder. The COMSOL applications also use this script.

Running a Classkit License

To start COMSOL Multiphysics with a Classkit License, use the `-ckl` command-line option. For example:

```
/Applications/COMSOL64/Multiphysics/bin/comsol -ckl
```

Running COMSOL on Clusters

You can launch COMSOL Multiphysics cluster jobs from the COMSOL Desktop and the command line.

To run COMSOL Multiphysics on a cluster from the COMSOL Desktop, you need to make the cluster feature visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. Then in the Model Builder, right-click a **Study** node and select **Cluster Computing** or **Cluster Sweep** to create cluster jobs. Cluster computing requires a Floating Network License.

The following terms occur frequently when describing the hardware for cluster computing and shared memory parallel computing:

- Compute node: The compute nodes are where the distributed computing occurs. Each distributed COMSOL process resides in a compute node and communicates with other compute nodes using MPI (message-passing interface).
- Host: The host is a physical machine (hardware) with a network adapter and unique network address. The host is part of the cluster. It is sometimes referred to as a physical node.
- Core: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.

The number of used hosts and the number of computational nodes are usually the same. For some special simulation types, like very small simulations with many parameters, it might be beneficial to use more than one computational node on one host.

A tutorial model for cluster testing is included in the Application Libraries window under **COMSOL Multiphysics/Cluster_and_Batch_Tutorials/micromixer_cluster**.

QUICK TROUBLESHOOTING

- First, ensure that you have the latest release installed. Check that you have COMSOL 6.4 or later and make sure to install the latest product updates.
- If you get the error message **Process status indicates that process is running**, then cancel any running jobs in the scheduler that you use. In the COMSOL Desktop, locate the **External Process** page at the lower-right. Click the **Clear Status** button.

For more information about how to run COMSOL Multiphysics in parallel on Mac clusters, see the *COMSOL Multiphysics Reference Manual*. For installation on Clusters, see Cluster Installation.

Running COMSOL Multiphysics in Client–Server Mode

When you start COMSOL Multiphysics by, for example, launching the COMSOL Multiphysics application, COMSOL Multiphysics is run as a single application that includes the functionality of both the COMSOL Multiphysics Client and COMSOL Multiphysics server, as explained later in this section. However, the COMSOL client–server architecture lets you access the COMSOL Multiphysics

server — the COMSOL computational engine — as a separate process. For example, the COMSOL Desktop can act as a COMSOL Multiphysics Client when connected to a COMSOL Multiphysics server.

The license server is not the same as a COMSOL Multiphysics server. The license manager can run on a computer different from both the ones used by COMSOL Desktop and COMSOL Multiphysics server.

You need a Floating Network License to run the COMSOL Multiphysics server and the COMSOL Multiphysics Client on separate computers. However, any COMSOL license is sufficient for running the Client and the server on the same computer.

The Client and server need not run on the same platform. For example, you can run the COMSOL Desktop on macOS and connect to a COMSOL Multiphysics server on a Windows or Linux computer. This enables offloading heavy-duty computations from your personal laptop or desktop to run just the COMSOL Desktop graphical user interface. A typical use would be to run the COMSOL Multiphysics server on a computer with large amounts of memory (RAM) and processing power and to use your personal computer for pre- and postprocessing with the COMSOL Desktop.

STARTING A COMSOL MULTIPHYSICS SERVER

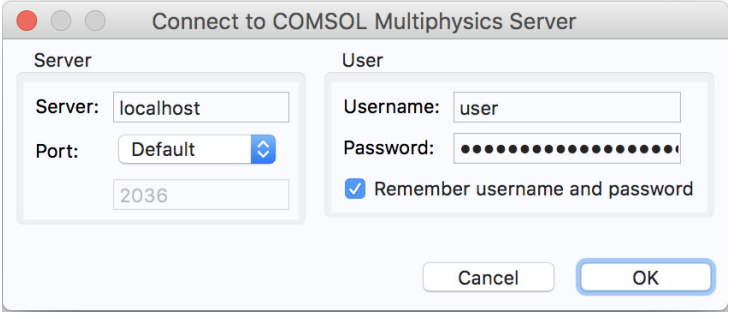
To start the COMSOL Multiphysics server, run the COMSOL Multiphysics Server application. A terminal window appears asking you for a username and password. You can choose any username and password, it is only used for connecting a COMSOL Multiphysics client with a COMSOL Multiphysics server.

When the COMSOL Multiphysics server starts, it listens for a COMSOL Multiphysics client connection on the port listed in the command window.

Connecting a COMSOL Multiphysics Client to a COMSOL Multiphysics Server

You can start a COMSOL Multiphysics client session from the COMSOL Desktop by selecting **Connect to Server** from the **File** menu in the COMSOL Desktop. When you start the client, a Connect to COMSOL Multiphysics Server window appears prompting you for a computer name (Server) where the

COMSOL Multiphysics server is running, Port number, Username, and Password.



Once you have filled out this information and clicked **OK**, the COMSOL Multiphysics server terminal window displays information that a COMSOL Multiphysics client has connected. For more information on running COMSOL in client–server mode, see the *COMSOL Multiphysics Reference Manual*.

Running COMSOL Multiphysics in Batch Mode

You can submit COMSOL Multiphysics batch jobs from the COMSOL Desktop and the command line.

To run a COMSOL Multiphysics batch job from the COMSOL Desktop, you need to make the Batch feature visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. In the Model Builder, right-click a **Study** node and select **Batch** to create batch jobs.

From the terminal window, you can start batch jobs using the `comsol batch` command. This is an example of how such a command could look:

```
comsol batch -inputfile in.mph -outputfile out.mph
```

To run a specific study add the command line option `-study` *<tag>*, where *<tag>* is the tag of the study to run, for instance, `std1`. To see the tag, click the toolbar button **Model Tree Node Text** in the **Model Builder** and select **Tag**.

The *COMSOL Multiphysics Reference Manual* includes a dedicated section on running COMSOL Multiphysics from the terminal window, including a list of COMSOL commands and associated syntax.

Multicore Settings

COMSOL Multiphysics supports two modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations, including cluster support for Windows and Linux. This section covers shared-memory processing, or multithreading, which is important for the performance of COMSOL Multiphysics computations. Some terms that are frequently used in when describing multithreading are:

- *Core*: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.
- *Speedup* is how many times faster a job runs on *N* cores compared to 1 core, on a specific compute node. The speedup depends on the simulation type, the hardware used, and hardware drivers used.

On macOS, the default number of processor cores used by COMSOL Multiphysics is the total number of available physical cores. For example, if you have a 2 x dual core machine, 4 cores are used in parallel by a COMSOL process.

SHARED-MEMORY OPTIONS

From the terminal window, use the `comsol` command option `-np` to control the number of cores and processors used. The default is to use all available cores and processors. For example:

```
comsol -np 2
```

launches COMSOL using 2 cores (if available).

You can experiment to find the options that work best for your configuration. For more information see the *COMSOL Multiphysics Reference Manual*.

Running COMSOL Multiphysics on Clusters

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

or **Cluster Sweep** to create cluster jobs. Cluster computing requires a Floating Network License.

COMSOL Multiphysics cannot be run on a cluster running macOS Intel; however, you can use the Cluster Computing or Cluster Sweep feature to connect to a Windows, Linux, or macOS ARM64 cluster.

A tutorial model for cluster testing is included in the Application Libraries window under **COMSOL Multiphysics/Cluster_and_Batch_Tutorials/micromixer_cluster**.

For more information about how to run COMSOL Multiphysics in parallel on clusters, see the *COMSOL Multiphysics Reference Manual*. For installation on Clusters, see Cluster Installation for Windows and Cluster Installation for Linux.

Running COMSOL Multiphysics on the Cloud

COMSOL Multiphysics and COMSOL Server support cloud computing. See

- www.comsol.com/partners-consultants/hpc
- www.comsol.com/model/running-the-comsol-software-with-amazon-ec2-14075
- www.comsol.com/model/running-the-comsol-software-with-microsoft-azure-89751

Installation Over the Internet

INSTALLATION OF A TRIAL LICENSE OVER THE INTERNET

A trial license can be given to you with the intention to test the software without any payment obligation for noncommercial and nonproduction use. This option is not available in all regions.

Installation of a Single User Trial License requires a license passcode. A passcode has a form similar to `FFFFFFFF-TYUS-123456-1234567-123456789`.

This is usually sent to you by your COMSOL representative by email. Once you locate your passcode, follow these steps to prepare for download and installation:

1. Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.
2. If you have not already created a COMSOL Access account, you are prompted to create it. When you have created the account, you can enter your license passcode to associate it with your account information.

   If you already created a COMSOL Access account, you can associate the license file with your account on the COMSOL Access page under Manage Licenses at www.comsol.com/access/licenses.
3. Follow the web-based instructions to download the software.

A license passcode can also be used for class kit licenses (CKL).

Continue with the instructions in the section Downloading and Installing the COMSOL Software.

INSTALLATION OF A PAID-FOR OR TRIAL LICENSE OVER THE INTERNET

Installation of any paid-for license on Linux requires a license file, which is sent to you by your COMSOL representative by email. To be able to generate the license file, information about your hardware is needed in the form of a hostid (host ID).

The hostid is used to lock the license to your hardware and needs to be sent by you to a COMSOL representative prior to the license file being generated.

A trial license can be given to you with the intention to test the software without any payment obligation for noncommercial or nonproduction use. This option is not available in all regions. For installation of a Single User Trial License on Linux, you can follow the same instructions as for a paid-for license.

Obtaining the Hostid

Follow these steps to obtain a hostid:

1. Start a Terminal window.
2. Enter `cat /sys/class/net/*/address`

   This displays all physical Ethernet addresses (also called MAC addresses) which consists of six bytes displayed as six pairs of hexadecimal digits such as `00:40:05:16:E5:25`. Choose one that does not consist of zeros only.

Obtaining the Hostname

If you have been informed by a COMSOL representative that you need to run a license manager for your installation, then you also need the hostname:

1. To get the hostname, start a Terminal window.
2. Enter `hostname` at the terminal prompt.

If your network administrator prefers to use a fixed IP address for this particular computer, this IP Address can be optionally used in place of the hostname. For more information on license manager installation see License Manager Installation on Linux.

Obtaining the License File from a COMSOL Representative

Send the hostid information, as well as hostname, if applicable, in an email to your COMSOL representative, who responds by email including an attached license file (`license.dat`). Save this file to any location on your computer. You need to refer to it during installation. A trial license file for Linux cannot normally be edited or changed in any way by the user but has to be identical to the one sent to you by a COMSOL representative. However, if you were sent a license file that requires a license manager, then minor edits are required. For information on the type of license file required for installations using a license manager, see The License File.

Registering with COMSOL Access

Once you have saved your license file, follow these steps to register or login to COMSOL Access and to start the installation:

1 Click the link for downloading the software as given in the software download email from your COMSOL representative. This link is identical or similar to: www.comsol.com/product-download.

2 If you have not already created a COMSOL Access account, you are prompted to create it. While creating the account, point to your license file (`license.dat`) to associate it with your account information.

   If you already created a COMSOL Access account, then you can associate the license file on the COMSOL Access page with your account under Manage Licenses at www.comsol.com/access/licenses.

3 Continue with the instructions in the section below.

Downloading and Installing the COMSOL Software

1 Go to the web page www.comsol.com/product-download. To download the COMSOL installer, you must first create a COMSOL Access account as described in the section Installation over the Internet.

2 You are now given the options of downloading the COMSOL online installer or the COMSOL offline installer (a DVD image).

If you have problems downloading (such as **Error downloading file. Connection refused: connect**), please review this knowledge base entry: www.comsol.com/support/knowledgebase/1149. If you still have problems, contact your local COMSOL representative or technical support from the Support Center page www.comsol.com/support.

Starting the Online Installer for Installation over the Internet

The COMSOL Installer is a user interface tool that guides you through the installation process. The file to download is called `comsol64_lnx.zip`. Start the COMSOL Installer by extracting the downloaded file and then running the `setup` script. The COMSOL 6.4 Installer window should now appear. Next, continue with the instructions in the section Running The COMSOL Installer. below.

Installation from Downloaded DVD Image

1. Download the DVD image(s). The default image, `COMSOL64_dvd.iso`, is too large to burn to disc and must be mounted directly. For installations that require physical discs, download the files `COMSOL64_dvd_1.iso`, `COMSOL64_dvd_2.iso`, and `COMSOL64_dvd_3.iso` instead.
2. When you have downloaded the DVD image(s), mount the single image directly or burn the numbered images to discs. To directly mount the image, you can use a loopback device:

```
mount -o loop,exec COMSOL64_dvd.iso /mnt
```

Starting the Installer from a DVD or Mounted DVD Image

The COMSOL Installer is a user interface tool that guides you through the installation process. To start the installer:

1. Make sure the COMSOL DVD is in the DVD drive (or mount the image).
2. Type `/mnt/setup`

The COMSOL 6.4 Installer window appears. Now continue with the instructions in the section Running The COMSOL Installer below.

Installing from a DVD

This section applies if you have received a DVD from a COMSOL representative.

The COMSOL Installer is a user interface tool that guides you through the installation process. To start the installer:

1. Insert the COMSOL 6.4 DVD into the DVD drive.
2. If the DVD is not mounted automatically by your operating system, use the `mount` command to mount it.
3. To start the installation, enter the command:

   <drivepath>`/setup`

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

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

The COMSOL 6.4 Installer window appears. Now continue with the instructions in the section Running The COMSOL Installer below.

Installation from USB Flash Drive

If you have received a USB Flash Drive from a COMSOL representative:

1. Connect the USB Flash Drive to your computer.
2. If the USB Flash Drive is not mounted automatically by your operating system, use the `mount` command to mount it.
3. To start the installation, enter the command:

   `<drivepath>/setup`

   where `<drivepath>` is the mount point of the USB Flash Drive, for example `/media/usb`

   You might have to mount the USB Flash Drive with the option `-o exec` if your Linux distribution mounts the drive without execute options by default.
4. The COMSOL 6.4 Installer window appears. Now continue with the instructions in the section Running The COMSOL Installer below.

Running The COMSOL Installer

The steps for running the COMSOL Installer are independent of the installation media option you use. If you have followed the above instructions, the COMSOL Installer should now appear. For a detailed description and screenshots of the different COMSOL Installer steps, see the instructions for Windows in the section Running the COMSOL Installer. The procedure for running the COMSOL Installer on Linux is similar and summarized below with the differences from installation on Windows highlighted:

1. When the installer window appears, click **New Installation**.
2. Read the license agreement, select **I accept the terms of the license agreement**, specify **License information**, and then click **Next**.
3. If you have a Named Single User License and you are installing the software on the license server, a dialog opens up and you are asked to enter the username to bind the license to.
4. Select the products to install and specify the path to the COMSOL installation directory. Installing in the default path requires administrative rights.
5. Click **Next**.
6. If you have licensed LiveLink™ *for* MATLAB® or LiveLink™ *for* Simulink®, then specify the MATLAB root folder.

7 Click **Next**.

8 Click **Install** to start the installation.

9 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 **Close** to quit the installer. If you installed from DVD, use the unmount and eject commands to unmount and eject the DVD. Some Linux configurations automatically unmount and eject the DVD when you press the DVD drive button.

10 To make sure all users can easily start COMSOL Multiphysics, include the `comsol64/bin` directory in all users' paths or make a symbolic link from `/usr/local/bin/comsol` to the `comsol` command (see the Linux `ln` command). The installer can do this step automatically if you run the installer as an administrator.

You may also need to install the fonts (using the normal Linux distribution methods) for the languages that you want to use when running COMSOL Multiphysics.

Web Browser for Viewing Documentation and Help

By default, documentation is shown in the **Documentation** window and context help in the **Help** window integrated in the COMSOL Desktop. If you prefer to use an external browser, you can specify this on the **Help** page of the **Preferences** window.

You can choose your preferred web browser in two ways:

- In the **Executable** field on the **User Interface** page of the **Preferences** window.
- If no browser executable has been specified, the browser to use is determined by the script `browser` in the bin directory. The variable `BROWSERS` in this file contains a list of web browsers that are available with the supported Linux versions in order of preference. Edit the file in any text editor to adjust it for your preferred web browser. To make a specific browser the preferred web browser, put it first in the list.

Automated Installation

You can install the COMSOL software using an automated installation process with minimal user interaction. This method requires installation from a DVD or DVD image and an answer file.

The answer file is a text file with a specific format that contains predefined settings for the COMSOL installer. If non-ASCII characters are used, the answer file is expected to be UTF-8 encoded by default, but UTF-16 is also supported if the file starts with a byte order mark (BOM).

A template answer file, `setupconfig.ini`, with detailed usage information is available on the DVD. Create a copy of this file and customize it with a text editor.

When the answer file is ready, start the installation by running

```
<drivepath>/setup -s <answerfile>
```

where *<drivepath>* is the media mount point, and where *<answerfile>* is the complete path to your answer file.

Removing (Uninstalling) the COMSOL Installation

To remove a COMSOL installation from your system, you can use the COMSOL Installer's uninstallation option. This removes all the files and directories that were initially created by the COMSOL Installer. Files and directories that were created or modified after the installation are not removed.

You can start the COMSOL Uninstaller in a few different ways:

- Launch the COMSOL Installer using the same method as for the original installation, and select **Uninstall COMSOL 6.4**.
- In a terminal window, run the following command:

  ```
  /usr/local/comsol64/multiphysics/setup uninstall
  ```

Alternatively, to remove the COMSOL installation, delete the `comsol64` folder including all subfolders and the following files if they exist:

```
/usr/local/bin/comsol
/usr/local/bin/comsol-6.4
/usr/share/applications/comsol-multiphysics-6.4.desktop
~/.local/share/applications/comsol-multiphysics-6.4.desktop
/usr/lib/systemd/system/lmcomsol.service
```

Product Updates and Application Library Update

COMSOL periodically releases product updates with improvements and corrections to reported problems. By default, COMSOL does not check for updates at startup. You can turn this feature on and off from the **Preferences** window accessible from the COMSOL Desktop. Here you can also configure settings for the Application Library Update.

The COMSOL Application Library is updated on a regular basis by COMSOL. To open the **Application Library Update** window, from the **Help** menu, select **Update COMSOL Application Libraries**.

This connects you to the COMSOL Application Update website where you can access the latest updates. This includes applications that have been added or improved since the latest product release.

Using the **Updates** section in the **Preferences** window, which you open from the COMSOL Desktop, you can configure proxy server settings as well as application and documentation directories for the Application Library Update. See the *COMSOL Multiphysics Reference Manual* for more information including command-line options for the Application Libraries.

Automated Updates

You can update the COMSOL software using an automated update process with minimal user interaction using the abovementioned DAT-file. Consult www.comsol.com/product-update for detailed instructions.

Changing the Path to the MATLAB® Installation

You can change the path to the MATLAB installation in the **Preferences** > **LiveLink Connections** window accessed from the **Options** menu of the COMSOL Desktop. For more information, see the LiveLink™ *for* MATLAB® documentation.

Cluster Installation

COMSOL Multiphysics supports two modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations,

including cluster support. This section is dedicated to distributed-memory parallel installation.

COMSOL Multiphysics can distribute computations on compute clusters using the MPI model. One large simulation can be distributed across many compute nodes. Also, parametric sweeps can be done with individual parameter cases distributed to each cluster node.

SYSTEM REQUIREMENTS

The installation instructions above can also be followed for clusters. COMSOL supports shared-memory parallelism and distributed-memory parallelism on Linux. For details on system requirements, including additional software packages required for certain configurations, see www.comsol.com/system-requirements.

LICENSE MANAGER

COMSOL Multiphysics requires a Floating Network License for running on clusters. Please check the license file for the `CLUSTERNODE` feature, which needs to be present to enable the cluster computing functionality. The license manager needs to be accessible from all nodes in the cluster. Therefore it is often a good idea to have it run on the head node.

INSTALLATION FOLDER

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

FEATURES

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

ACCESS TO CLUSTER

If you work on a computer that is not on the cluster, install COMSOL Multiphysics on that computer. Typically, you use a scheduler to launch jobs on the cluster. Make sure the scheduler client software is installed on that computer. You can configure the installation to use the scheduler by changing the `comsol.ini` file according to the section on MPI Options in the *COMSOL Multiphysics Reference Manual*.

For more information on installing and running COMSOL on clusters, see Running COMSOL on Clusters and the *COMSOL Multiphysics Reference Manual*.

License Manager Installation on Linux

Many of the instructions for installing the license manager are similar to those for Windows. This section only covers the differences for Linux installations. For more information, see License Manager Installation on Windows.

FlexNet® License Manager Software Components

The license manager consists of the following software components:

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

The license server manager (`lmgrd`) and the vendor daemon (`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 license server manager (`lmgrd`). The license server manager then makes a request to the vendor daemon (`LMCOMSOL`), which releases licenses according to information in the `license.dat` file. The FlexNet utility programs are used for handling license server management tasks.

FlexNet® License Manager Documentation

For detailed information on the FlexNet® license manager software, select **Help** > **Documentation** in the COMSOL Desktop and scroll to the bottom of the page to locate a PDF copy of the *FlexNet Publisher License Administration Guide*.

Note: This PDF file is only available if you have locally installed documentation.

The License File

The license file for use on Linux is identical to that for Windows, except in the case of a Named Single User License, which is described below. See The License File and The License Features for general license file information.

LICENSE FILES FOR NAMED SINGLE USER LICENSE

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

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

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

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

For more information on which `FEATURE` items are available, see The License File and The License Features.

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/comsol64/multiphysics/license/LMCOMSOL.opt
```

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

```
VENDOR LMCOMSOL port=1719 options=/usr/local/comsol64/multiphysics/
license/LMCOMSOL.opt
```

Installing the License Manager

The license manager components are automatically installed when installing the COMSOL software unless otherwise specified on the Products page of the

COMSOL installer; see Products Page. The checkbox for the license manager components can be found last in the list of software components.

If you want to install COMSOL on the same computer as the license manager and you did not choose to install the license manager as a service, first perform a complete COMSOL installation including the license manager software components.

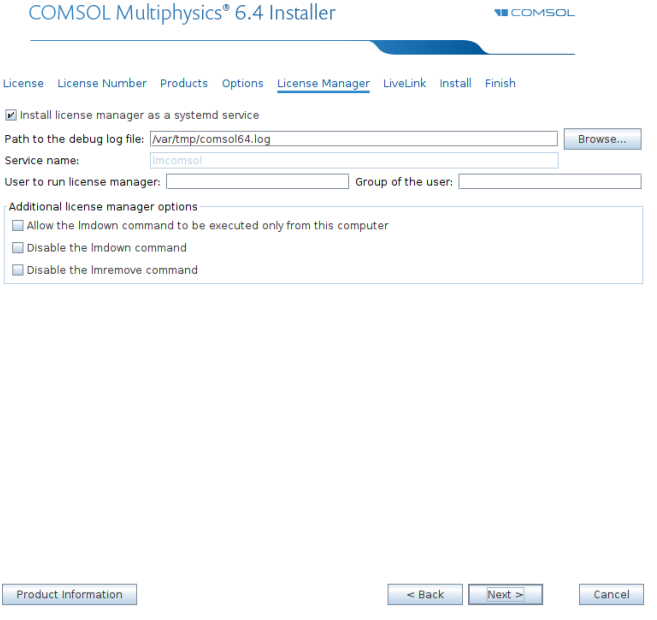
If you want to install the license manager on a computer where running the COMSOL Installer is inconvenient, please contact COMSOL Support for access to the files needed for installing only the license manager.

License Manager Page

See License Manager Page for information about the license manager settings in the installer. For Linux, this page also contains some additional settings:

- In the **User to run license manager** field, enter the username for the user on the computer that will run the license manager. If this field is empty, the root user runs the license manager, which is not recommended from a security point of view.
- Optionally, specify a group the user belongs to in the **Group of the user** field.

Note: The License Manager page only appears if the installer is started by a superuser (such as root or by using `sudo`) on a system that uses `systemd`.



To install only the license manager, follow the installation instructions for COMSOL earlier in this document, and on the Products page, clear all checkboxes except the one for the license manager.

When finished, skip the remainder of this section and continue with Starting the License Manager below.

AUTOMATED LICENSE MANAGER INSTALLATION

Alternatively, the license manager can be installed using an automated installation process with minimal user interaction, see Automated Installation. Set `licmanager = 1` in the answer file to install the license manager. It is also possible to automatically configure the license manager to run on systemd-based Linux distributions. Use `licmanager.service = 1` in the `setupconfig.ini` file and provide values for the other `licmanager.service.*` lines.

Starting the License Manager

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

The installer can set up the license manager to start automatically; in case it did, you can skip the following section.

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/comsol64.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol64.log`.

STARTING THE LICENSE MANAGER AUTOMATICALLY AT BOOT

In order for the license manager to start automatically at boot, you need to add shell commands to the appropriate boot script. You must be a superuser (root) to

edit boot scripts. In some cases, however, the COMSOL Installer automatically installs and configures the license manager.

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

systemd-Based Systems

For Linux distributions that use `systemd`, use the `lmcomsol.service` file, located in the `comsol64/license/glnxa64` or `comsol64/license/glnxarm64` directory, to start the license manager. To use `lmcomsol.service`, do the following steps:

1. Update the paths to `lmgrd`, `license.dat`, and `comsol64.log` in case you have different locations for these files.
2. Optionally, replace `username` with an actual username. Preferably do not use `root`; instead, use the account used to install COMSOL or another account with access to both the `lmgrd` executable and the log file location above.
3. Create a `/usr/tmp` directory if it does not exist and set its permissions to 1777 with the `chmod 1777 /usr/tmp` command.
4. If you already have the license manager installed using `systemd`, stop the previous version of it by typing `systemctl stop lmcomsol`.
5. Copy the `lmcomsol.service` file to `/usr/lib/systemd/system/` and run the `systemctl enable lmcomsol` and `systemctl start lmcomsol` commands to activate the license manager.

If you obtained the license server binaries through COMSOL support and run SELinux on your system, make sure to unzip the binaries under `/usr/local`.

Verifying That the License Manager Is Running

Once you start the license manager, it is good practice to verify that the license manager processes are running. Use administrative commands such as `top` or `ps` to check that both the vendor daemon (`LMCOMSOL`) and the license server manager (`lmgrd`) are running. On Linux distributions that use `systemd`, if the license

manager is installed as a service according to the instructions, you can run `service lmcomsol status` instead.

Starting COMSOL Multiphysics

After the installation is complete and the license manager is running on the license server, you can start using COMSOL Multiphysics. For more information on how to run COMSOL Multiphysics, see Running COMSOL Multiphysics on Linux.

Changing the License

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

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

RESTARTING THE LICENSE MANAGER

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

```
./lmdown -c ../license.dat
./lmgrd -c ../license.dat -l /var/tmp/comsol64.log
```

When installed as a service on Linux distributions with `systemd` according to the instructions, you stop it with the `service lmcomsol stop` command and start it with the `service lmcomsol start` command.

OBTAINING A HOSTID

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

```
comsol64/multiphysics/license/glnxa64/lmhostid
```

or

```
comsol64/multiphysics/license/glnxarm64/lmhostid
```

depending on your CPU architecture.

Using COMSOL on an IPv6 Network

COMSOL has been tested on both IPv6-only networks and hybrid IPv4/IPv6 networks. To make sure that the license manager uses IPv6 for communication, set the environment variable `FNP_IP_PRIORITY` to 6. See the *FlexNet License Administration Guide* for details.

Troubleshooting License Errors

If you have questions or problems with your installation, see Troubleshooting License Errors.

In order for the help system to work on Linux, some packages need to be installed; for details, see www.comsol.com/system-requirements.

Running COMSOL Multiphysics

If you are running a Linux version with a graphical desktop environment, you might find a COMSOL Multiphysics icon that you can simply click to start COMSOL Multiphysics in the menus. Alternatively, using a terminal window, you can run the `comsol` command. If it is not available, ask your system manager to make it available to you, or, if you have administrative privileges on your Linux system, add the `comsol` command to the search path. The setup can do this automatically for you during installation if you run it with root privileges. The `comsol` command is located in the bin folder in the COMSOL installation directory. This is a typical example of a command that adds `comsol` to the search path (assuming you are logged in as root):

```
ln -s /usr/local/comsol64/multiphysics/bin/comsol /usr/bin/comsol
```

Multicore Settings

COMSOL Multiphysics supports two modes of parallel operation: shared-memory parallel operations and distributed-memory parallel operations, including cluster support for Windows and Linux. This section covers shared-memory processing, or multithreading, which is important for the performance of COMSOL Multiphysics computations. Some terms that are frequently used in when describing multithreading are:

- *Core*: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.

- *Speedup* is how many times faster a job runs on *N* cores compared to 1 core, on a specific compute node. The speedup depends on the simulation type, the hardware used, and the hardware drivers used.

On Linux, the default number of processor cores used by COMSOL Multiphysics is the total number of available physical cores. For example, if you have a 2 x dual core machine, 4 cores are used in parallel by a COMSOL process.

SHARED-MEMORY OPTIONS

From the Terminal window, use the `comsol` command option `-np` to control the number of cores and processors used. The default is to use all available cores and processors. For example:

```
comsol -np 2
```

launches COMSOL Multiphysics using 2 cores (if available).

You might need to experiment to find the options that work best for your configuration. For more information see the *COMSOL Multiphysics Reference Manual*.

Running COMSOL Multiphysics in Batch Mode

You can submit COMSOL Multiphysics batch jobs from the COMSOL Desktop and the command line.

To run a COMSOL Multiphysics batch job from the COMSOL Desktop, you need to make the Batch feature visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. In the Model Builder, right-click a **Study** node and select **Batch** to create batch jobs.

From a terminal window, you can start batch jobs using the `comsol batch` command. This is an example of such a command:

```
comsol batch -inputfile in.mph -outputfile out.mph
```

To run a specific study add the command line option `-study` *<tag>*, where *<tag>* is the tag of the study to run, for instance, `std1`. To see the tag, click the toolbar button **Model Tree Node Text** in the **Model Builder** and select **Tag**.

The *COMSOL Multiphysics Reference Manual* has a dedicated section on running COMSOL Multiphysics from a terminal window, including a list of COMSOL commands and associated syntax.

Running COMSOL Multiphysics in Client–Server Mode

When you start COMSOL Multiphysics by, for example, entering the `comsol` command with no additional arguments, COMSOL Multiphysics is run as a single application that includes the functionality of both the COMSOL Multiphysics client and COMSOL Multiphysics server, as explained later in this section. However, the COMSOL client–server architecture lets you access the COMSOL Multiphysics server — the COMSOL computational engine — as a separate process. For example, the COMSOL Desktop can act as a COMSOL Multiphysics client when connected to a COMSOL Multiphysics server.

The license server is not the same as a COMSOL Multiphysics server. The license manager can run on a computer different from both the ones used by COMSOL Desktop and COMSOL Multiphysics server.

You need a Floating Network License to run the COMSOL Multiphysics server and the COMSOL Multiphysics client on separate computers. However, any COMSOL license is sufficient for running the client and the server on the same computer.

The client and server need not run on the same platform. For example, you can run the COMSOL Desktop on Windows connecting to a COMSOL Multiphysics server on a Linux computer. This enables offloading heavy-duty computations from your personal laptop or desktop to run just the COMSOL Desktop graphical user interface. A typical use would be to run the COMSOL Multiphysics server on a computer with large amounts of memory (RAM) and processing power and to use your personal computer for pre- and postprocessing with the COMSOL Desktop.

Starting a COMSOL Multiphysics Server

To start the COMSOL Multiphysics server from a terminal window, run the `comsol` command with the `mphserver` argument:

```
comsol mphserver
```

You are then prompted for a username and password. You can use any username and password of your choice, it is only used for connecting a COMSOL Multiphysics client with a COMSOL Multiphysics server.

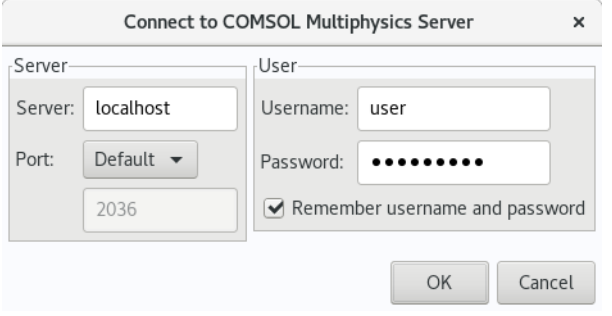
When the COMSOL Multiphysics server starts, it listens for a COMSOL Multiphysics client connection on the port listed in the command window.

Connecting a COMSOL Multiphysics Client to a COMSOL Multiphysics Server

You can start a COMSOL Multiphysics client session from the COMSOL Desktop by selecting **Connect to Server** from the **File** menu in the COMSOL Desktop. You can also start a COMSOL Multiphysics client session from a terminal window by running the `comsol` command with the `client` argument:

```
comsol client
```

When you start the client, a Connect to COMSOL Multiphysics Server window appears prompting you for a computer name (Server) where the COMSOL Multiphysics Server is running, Port number, Username, and Password:



Once you have filled out this information and clicked **OK**, the COMSOL Multiphysics server terminal window displays information that a COMSOL Multiphysics client has connected. For more information on running COMSOL in client–server mode, see the *COMSOL Multiphysics Reference Manual*.

Running a Classkit License

To start COMSOL Multiphysics using a Classkit License, start COMSOL Multiphysics using the `-ckl` option:

```
comsol -ckl
```

Running COMSOL on Clusters

You can launch COMSOL Multiphysics cluster jobs from the COMSOL Desktop and the command line.

To run COMSOL Multiphysics on a cluster from the COMSOL Desktop, you need to make the cluster feature visible: in the Model Builder tree, click the **Show More Options** button ( ) and select **Batch and Cluster** in the **Show More Options** dialog. Then in the Model Builder, right-click a **Study** node and select **Cluster Computing** or **Cluster Sweep** to create cluster jobs. Cluster computing requires a Floating Network License.

The following terms occur frequently when describing the hardware for cluster computing and shared memory parallel computing:

- Compute node: The compute nodes are where the distributed computing occurs. Each distributed COMSOL process resides in a compute node and communicates with other compute nodes using MPI (message-passing interface).
- Host: The host is a physical machine (hardware) with a network adapter and unique network address. The host is part of the cluster. It is sometimes referred to as a physical node.
- Core: The core is a processor core used in shared-memory parallelism by a computational node with multiple processors.

The number of used hosts and the number of computational nodes are usually the same. For some special simulation types, like very small simulations with many parameters, it might be beneficial to use more than one computational node on one host.

A tutorial model for cluster testing is included in the Application Libraries window under **COMSOL Multiphysics/Cluster_and_Batch_Tutorials/micromixer_cluster**.

QUICK TROUBLESHOOTING

- First, ensure that you have the latest release installed. Check that you have COMSOL 6.4 or later and make sure to install the latest product updates.
- If you get the error message **Process status indicates that process is running**, then cancel any running jobs in the scheduler that you use. In the COMSOL Desktop, locate the **External Process** page at the lower-right. Click the **Clear Status** button.

For more information about how to run COMSOL Multiphysics in parallel on Linux clusters, see the *COMSOL Multiphysics Reference Manual*. For installation on Clusters, see Cluster Installation.

Running COMSOL Multiphysics on the Cloud

COMSOL Multiphysics and COMSOL Server support cloud computing. See

- www.comsol.com/partners-consultants/hpc
- www.comsol.com/model/running-the-comsol-software-with-amazon-ec2-14075
- www.comsol.com/model/running-the-comsol-software-with-microsoft-azure-89751

Running COMSOL Multiphysics with MATLAB

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

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

```
comsol mphserver matlab
```

Starting COMSOL Multiphysics with Matlab using the graphics server

To display the plot in a COMSOL graphics window you need to run COMSOL with MATLAB using the graphics server. To do so, start COMSOL with MATLAB from a terminal window with the `-graphics` flag:

```
comsol mphserver matlab -graphics
```

Required Programs for Running COMSOL with MATLAB

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

- To install the missing packages on Debian and Ubuntu, type
  ```
  sudo apt-get install xterm csh
  ```
- To install the missing packages on RedHat Enterprise and Fedora, type
  ```
  sudo yum install xterm tcsh
  ```
- To install the missing packages on OpenSUSE, type
  ```
  sudo zypper install xterm tcsh
  ```

Running COMSOL Multiphysics with Simulink

Running COMSOL Multiphysics with Simulink starts a COMSOL Multiphysics server and a MATLAB Desktop. The COMSOL graphical user interface is not started. For a tutorial, see the *Introduction to LiveLink for Simulink* manual.

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

```
comsol mphserver simulink
```

Note that the Simulink window is not opened by this command.

Required Programs for Running COMSOL with Simulink

The `xterm` program is necessary for the command `comsol mphserver simulink`.

- To install the missing packages on Debian and Ubuntu, type
  ```
  sudo apt-get install xterm
  ```
- To install the missing packages on RedHat Enterprise and Fedora, type
  ```
  sudo yum install xterm
  ```
- To install the missing packages on OpenSUSE, type
  ```
  sudo zypper install xterm
  ```

COMSOL Multiphysics Client–Server Security

The COMSOL Multiphysics client–server architecture lets you access the COMSOL Multiphysics server — the computational engine in COMSOL Multiphysics — as a separate process. COMSOL Multiphysics client–server uses a TCP/IP connection to send data between client and server. The COMSOL Multiphysics server is a single-user server. The design of COMSOL Multiphysics client–server assumes that you, the user, start both the client and the server manually. You are responsible for setting a password for mutual authentication of the client and server. The COMSOL Multiphysics client–server architecture is designed to operate in a secure environment and has only basic security incorporated in its design.

You can also access a COMSOL Multiphysics server with the COMSOL API client in a Java method running in a separate process or a process on a separate computer. This happens, for example, in the LiveLink™ *for* MATLAB®, where MATLAB® loads the COMSOL API client and launches a separate process with the COMSOL Multiphysics server.

Password Security

You can control if the client–server password is stored on file between sessions. In the COMSOL Multiphysics client, select the **Remember username and password** checkbox in the **Connect to COMSOL Multiphysics Server** dialog to store the password between sessions. In the COMSOL Multiphysics server, by using the option `-passwd nostore`, you can avoid storing the password on file. If you do not provide the option, the password will be stored on file, and you will not be asked to provide it when you start a new server session.

Before storing your password on file, it is hashed by the SHA256 algorithm. This means that an adversary that gets access to your password file will not easily be able to obtain the password you originally entered. However, if an adversary gets access to your password file, the adversary could login on a COMSOL Multiphysics server started by you, or, potentially, have you log in on a hostile COMSOL Multiphysics server.

By default, both the COMSOL Multiphysics client and the COMSOL Multiphysics server write the hashed password to the file `.comsol/v64/`

`login.properties` in your home directory. Both COMSOL Multiphysics client and server will attempt to make the password file inaccessible for other users by introducing access restrictions. When you use the client *and* server on the same computer there will only be a single password file by default. This could also happen if you run the client and server on separate computers, if your home directory is located on a shared network drive.

You should avoid storing your client–server password on file if your home directory is located on a network drive that does not encrypt network traffic. If your password is stored on a local drive, your client–server password security will be improved if the drive is encrypted. Generally, a user with administrative access to your computer could get access to your password file.

The COMSOL Multiphysics client–server is designed to protect your password file during network traffic between client and server (see the next section).

TCP/IP Connection

The TCP/IP communication between client and server is not encrypted. However, the server and client are mutually authenticated using a challenge handshake authentication protocol (CHAP), which means that the client–server password cannot be easily obtained by an adversary that can eavesdrop the network traffic between client and server.

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 and tunnel the client–server traffic. When doing this you may need access to the port number used for client–server communication. The port number is 2036 by default but can be controlled and modified both from the client and the server.

COMSOL Multiphysics Server Security

When running COMSOL Multiphysics client–server operations from the client, file system access is typically performed on the client. However, COMSOL Multiphysics client can potentially access files on the file system and other operating system resources on the server computer with the same privileges as the user that launched the Multiphysics server. The COMSOL Multiphysics client–server security design assumes that the same physical user is operating both the client and the server and that this user is not an adversary.

In particular, when using the COMSOL API on the client computer, you should avoid running Java methods, or MATLAB functions with the LiveLink for MATLAB, that have not been reviewed from a security point of view. Some operations on the COMSOL Multiphysics server will read and write files on the client and server computer, and other operations may run operating system

commands or initiate network traffic on the client or server computer. These operations are performed with the same privileges as the user that started the COMSOL Multiphysics client or server.

When running model methods or add-ins in for COMSOL Multiphysics client–server, these are run using the security settings for applications (see the next section).

Application and Physics Builder Security

Models and applications can be protected with the AES256 encryption algorithm using passwords for running and editing. For applications without a running password, the model or application is decrypted using a secret but hard-coded password. To achieve the highest security, use both an editing and a running password.

Protecting a model or application only encrypts the XML data structure that represents the Model Builder and the Application Builder data structures. Auxiliary data structures describing the geometry, mesh, and solution are *not* encrypted.

Compiled physics builder files are obfuscated with the AES256 encryption algorithm using a hard-coded password.

Method Security

You can use the Application Builder to write Java methods that are run from applications, model methods, and add-ins. When you run those methods, the privileges of the methods are controlled by the security settings that you find in the **Preferences** window under **Security** in the COMSOL Multiphysics desktop.

The security settings will apply to all applications, model methods, and add-ins that you load in COMSOL Multiphysics.

Note that any MPH file may contain applications, model methods, and add-ins. If you intend to load an MPH file from an unreliable source, you should enable all security features. You can do that by reverting to **Factory Settings** and clearing all checkboxes under **General** in the security settings, and finally clicking **OK**.

Security Settings

If your MPH files come from reliable sources or you make them yourself, you can keep the factory settings for security. If you write methods that require additional system access, you can give methods more privileges, but you should revert to the original settings if the situation changes. Find a general description of the security settings in the section Security Settings in the *COMSOL Multiphysics Reference Manual*.

Add-In Security

For add-ins that require extended privileges permanently, you can disable all security settings for certain methods in the add-in by using the `comsoltrust` command. This command makes it possible to maintain restricted security settings for applications generally but allow certain adds-in to operate.

Email Password

When your password to the SMTP email server is stored as preference, the behavior is operating system dependent.

Windows

The password is encrypted using the built-in Windows data protection mechanism for the current user. The encrypted password is stored in the preference files `%USERPROFILE%\.comsol\v64\comsol.prefs` and `%USERPROFILE%\.comsol\v64\comsolserver.prefs`.

Mac and Linux

The password is encrypted using an autogenerated password. The encrypted password is stored in the preference files `$HOME/.comsol/v64/comsol.prefs` and `$HOME/.comsol/v64/comsolserver.prefs`. The autogenerated password is stored in the read-protected file `$HOME/.comsol/v64/prefskeyserver.properties`.

COMSOL Server Security

For information about COMSOL Server security, see the section *Security* in the *COMSOL Server Manual*.

Troubleshooting License Errors

If you have questions or problems with your installation, start by checking the COMSOL Support Knowledge Base at www.comsol.com/support/knowledgebase for up-to-date information about installation and license issues. If this does not help, then please contact COMSOL technical support at support@comsol.com.

THE COMSOL SUPPORT KNOWLEDGE BASE

The most important Knowledge Base entries for installation questions and license errors are the following:

SUBJECT	KNOWLEDGE BASE ENTRY
Could not obtain license for COMSOL Multiphysics GUI	www.comsol.com/support/knowledgebase/903
Running COMSOL in parallel on clusters	www.comsol.com/support/knowledgebase/1001
Updating the COMSOL License Manager	www.comsol.com/support/knowledgebase/1022
COMSOL Installation Companion	www.comsol.com/support/learning-center/article/comsol-Installation-Companion-58101
Error: An error has occurred. See the log file C:\Users...	www.comsol.com/support/knowledgebase/1083
Selecting hardware for clusters	www.comsol.com/support/knowledgebase/1116
Error: Error downloading file. Connection refused: connect	www.comsol.com/support/knowledgebase/1149

You can also view videos about installation at: www.comsol.com/videos?workflow%5B%5D=workflowstep-install.

LICENSE ERRORS

This section summarizes the most common postinstallation error messages generated by the COMSOL software, and it gives some advice how to troubleshoot them. For a complete list of error messages, see the FlexNet license manager documentation. This documentation is shipped with your COMSOL installation; see FlexNet® License Manager Documentation on where to find it.

If you need to review the license manager log file, or send it to COMSOL technical support, this is where you usually find it (depending on choices you made during the installation):

- Windows: `C:\ProgramData\COMSOL\comsol64.log`.
- macOS: `/var/tmp/comsol64.log`
- Linux: `/var/tmp/comsol64.log`

If you need to access the license file, this is where you usually find it:

- Windows:
  `C:\Program Files\COMSOL\COMSOL64\Multiphysics\license\license.dat`
- macOS: `/Applications/COMSOL64/Multiphysics/license/license.dat`
- Linux: `/usr/local/comsol64/multiphysics/license/license.dat`

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, see the FlexNet license manager documentation or send the complete error message to support@comsol.com.
License error: -1. Cannot find license file.	The license file is missing or your system settings do not allow you to read the file. Review the license manager installation steps above and check that you have administrative rights on your computer.
License error: -2. Invalid license file syntax.	There is a formatting problem with your license file. This can happen if you edit it with a word processing software such as Microsoft Word which inserts extra (invisible) characters. Use a plain text editor instead (on Windows: Notepad, WordPad, or similar). Formatting problems can also happen if the file is damaged while being copied or emailed from one computer to another.
License error: -4. Licensed number of users already reached.	The license manager has detected that all available licenses of a certain COMSOL product have been used by other users. Contact your license administrator and report this problem. You might need more licenses of one of the add-on products.
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. Please send the log file to support@comsol.com if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to one of the License Manager Installation sections of this manual for instructions how to install and start the COMSOL license manager.

ERROR MESSAGE	EXPLANATION
License error: -10. Feature has expired.	This error message indicates that you have a time-limited (trial) license and that your license has expired. Contact your license administrator to see if a more recent license file is available. You can also contact a COMSOL representative to renew your time-limited license.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the lmgrd daemon and the LMCOMSOL daemon. If the problems remain, send the license manager log file to support@comsol.com.

ERROR MESSAGE	EXPLANATION

License error: -15. Cannot connect to license server system.	The license manager has not been installed or started yet. If the first line of your license.dat file looks like this:
	`SERVER mylicserver 000123456789 1718`
	a license manager is required. Please refer to the License Manager Installation sections of this manual for instructions on how to install and start the COMSOL license manager.
	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.
	Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.
	Check that the `license.dat` file on the COMSOL client computer points to the correct license server hostname. First, find the `license.dat` according to the instructions above.
	Check that the first line has the correct license server hostname. For example, if your license server hostname is `apollo`, the first row in the license.dat file should look like this:
	`SERVER apollo 000123456789 1718`
	If the COMSOL client computer does not recognize `apollo` as a proper hostname, it might help to instead use the fully qualified domain name (`apollo.thecompany.com`) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.
	Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages.
	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.
	For information about a loss of connection to the license server while running the COMSOL Multiphysics software, see License Server Interruptions below.

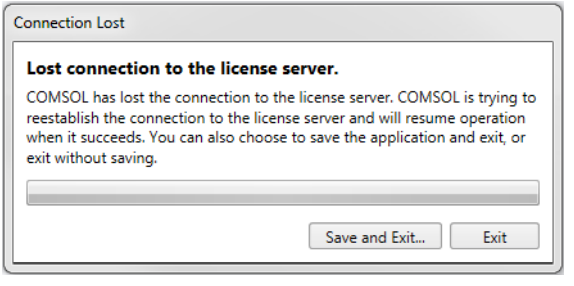
License error: -39. User/host not on INCLUDE list for feature.	The error means that your username does not match the one listed in the license manager options file, `LMCOMSOL.opt`. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.

ERROR MESSAGE	EXPLANATION
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 have a future date.
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. This error could also indicate that your firewall is not configured properly in order to let the license manager and vendor daemon network traffic through (typically ports 1718 and 1719). It could also indicate problems with other network security settings. Contact your systems administrator for help.
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. 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.

License Server Interruptions

If the license server does not respond during a COMSOL Multiphysics session so that the COMSOL Multiphysics software cannot connect to the license server, you will see the following effects:

- The following error message appears after a few minutes:



Click **Save and Exit** to save the current COMSOL Multiphysics model and then exit, or click **Exit** to exit from the COMSOL Desktop without saving. You could also wait to see if the connection can be reestablished. If you choose to save the mode, you get a choice of location for the file. In addition, if there are models on the server that are not used by the COMSOL Desktop, they are saved immediately in their original locations with `autosaved` appended to their

filenames in order not to overwrite the original files. Models that have never been saved are saved in the recovery folder also when recovery is not enabled. However, if there is no recovery file and the program has stopped when executing a runnable, it is not possible to save the model. If you are running a COMSOL batch job, the output file is used if it is not identical to the input file.

- As soon as the connection to the license servers has been lost, you will not be able to add feature nodes with license requirements to the **Model Builder**. Trying to add such nodes result in an error message such as "Could not obtain license for Floating Potential 1 {fb1}, Required product: AC/DC Module" and a license error -15 (see list of license errors above).

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