

Running TPT in Docker

Version 19u1



TPT 



Due to continuous product development, information in this document is subject to change without notice.

No part of this user manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system without express written permission from Picketec GmbH.

TPT Time Partition Testing and TPT logo are registered trademarks of Picketec GmbH.



www.piketec.com

Table of Contents

1 Introduction	4
2 TPT Docker image	8
3 TPT Docker container	10
4 Configure and run tests via the TPT API	12
5 Run tests via command line	15

1 Introduction

TPT can be run in a Docker container to execute tests. You are free to split the tests using a TPT API script and run them in several containers of the same image.

You will need:

- Docker (<https://docs.docker.com/>)
- a headless TPT for Linux-based Docker images, that is a TPT that can only be executed via the command line, or a normal TPT if you like to run TPT from a Windows-based Docker image; you can find TPT headless on the TPT download page
- a TPT FlexLM license; this is the same license file as for the "normal" TPT. You need to adjust the `license_default.cfg` in the TPT installation according to your license server data. The license server version must be at least 11.18.0.
- a TPT project file

```
#Example of a license_default.cfg for the TPT License Server
IP-Adr=lic.piketec.com
proxyType=<None>
port=30551
user=maxmustermann
password=mu34ma00a
LicenseType=TPTLicenseServer
proxyPort=0

# Example of a license_default.cfg for Flex LM
IP-Adr=30551@mylicenseserver.com
LicenseType=FlexLm
```

Docker cannot be used with a TPT Dongle license.



At the moment, tests on Linux can only be run on the EXE platform and the MATLAB/Simulink platform in a Docker container. Windows based containers support at least the EXE platform and C/C++ platform.

To help you get started, the TPT installation folder includes several sample files for Linux-based and Windows-based Docker images that you can adapt to your needs or simply use as inspiration. Unpack the Docker package which includes the following folders:

0_Docker_Image

- `License` folder (Linux only): contains a dummy license; add your TPT license into this folder and name it `tptheadless.lic`

- **TPT folder (Linux only):** contains the headless TPT installation for Linux-based Docker images
- **Dockerfile:** contains all commands to build a Docker image
- **build.bat:** batch script to build the Docker image
- **build.sh:** shell script to build the Docker image

1_SUT

- **lights_control_no_scaling.c and lights_control_no_scaling.h:** example SUT
- **TPT_lights_control_no_scaling.c:** code to connect the SUT with TPT
- **TPT_TestDriver.c, TPT_TestDriver.h:** test driver for executing the tests
- **make.sh:** makes the SUT executable in the Docker image using dynamic links
- **make_static.sh:** makes the SUT executable in the Docker image using static links
- **build_sut_in_docker.bat:** batch script to create a Docker container based on the Docker image and runs the shell script to make the SUT executable; removes the container
- **build_sut_in_docker.sh:** shell script to create a Docker container based on the Docker image and runs the shell script to make the SUT executable; removes the container

1_TPT_Example

TPT project file with the test cases to be executed.

2_Run_Simple_SUT_w_CLI

- **run_simple_SUT_w_CLI.bat:** batch script to start a Docker container based on the Docker image, mounts external volumes to the TPT project file, to a test result directory, and to the executable SUT; runs the test cases of the TPT project file and stores the test results in the results directory, and removes the container
- **run_simple_SUT_w_CLI.sh:** shell script to start a Docker container, s. `run_simple_SUT_w_CLI.bat`

3_Run_1_Instance_with_API

- **docker-compose.yml:** creates a Docker container based on the Docker image, mounts the needed external volumes, sets the needed ports for the API commands, starts TPT.
- **run_1_instance_with_API_compose.bat:** executes the `docker-compose.yml`
- **run_1_instance_with_API.bat:** does the same as `docker-compose.yml` but must be executed in a command line
- **talk_to_docker.tptapi:** API script with the commands necessary to run tests in TPT via the TPT API.

4_Run_3_Instances_with_API

- **docker-compose.yml:** creates three Docker containers based on the Docker image, mounts the needed external volumes, sets the needed ports for the API commands, starts

TPT.

- `run_3_instances_with_API_compose.bat`: **executes the** `docker-compose.yml`
- `run_3_instances_with_API.bat`: **does the same as** `docker-compose.yml` **but must be executed in a command line**
- `talk_to_docker.tptapi`: API script with the commands necessary to run tests in TPT via the TPT API.

Docker_C_Platform

(only for Windows available)

- `C-Example` folder: contains the TPT example
- `Scripts` folder: contains the TPT API script for recompiling
- `build.bat`: creates an Docker image based on the `Dockerfile`
- `Dockerfile`: contains all commands to build a Windows-based Docker image
- `execute_testcases.bat`: executes the test cases from the example available in the folder `C-Example`
- `rebuild_testframe.bat`: starts TPT and uses the API script `recompile.tptapi` in the folder `Scripts` to build the test frame using the C platform

Docker_Matlab_Platform

(only for Linux available)

- `Config` folder: contains the file `matlab.xml` which specifies the MATLAB version for TPT; by default this version is set to 9.12; change the version when you install a "mathworks/matlab image" different than R2022a
- `Launcher` folder: contains the launcher settings for the TPT API Server
- `License` folder: contains a dummy license; add your TPT license into this folder and name it `tptheadless.lic`
- `Dockerfile`: contains all commands to build a Linux-based Docker image
- `build.bat`: executes the `Dockerfile` to build the Docker image
- `run.bat`: creates a Docker container based on the new Docker image and creates folders for exchanging test data between Windows and Ubuntu; sets the TPT API port. Once the container is running, your default webbrowser opens with "noVNC"; click "connect" to load the launchers for the TPT API Server and MATLAB R2022a.

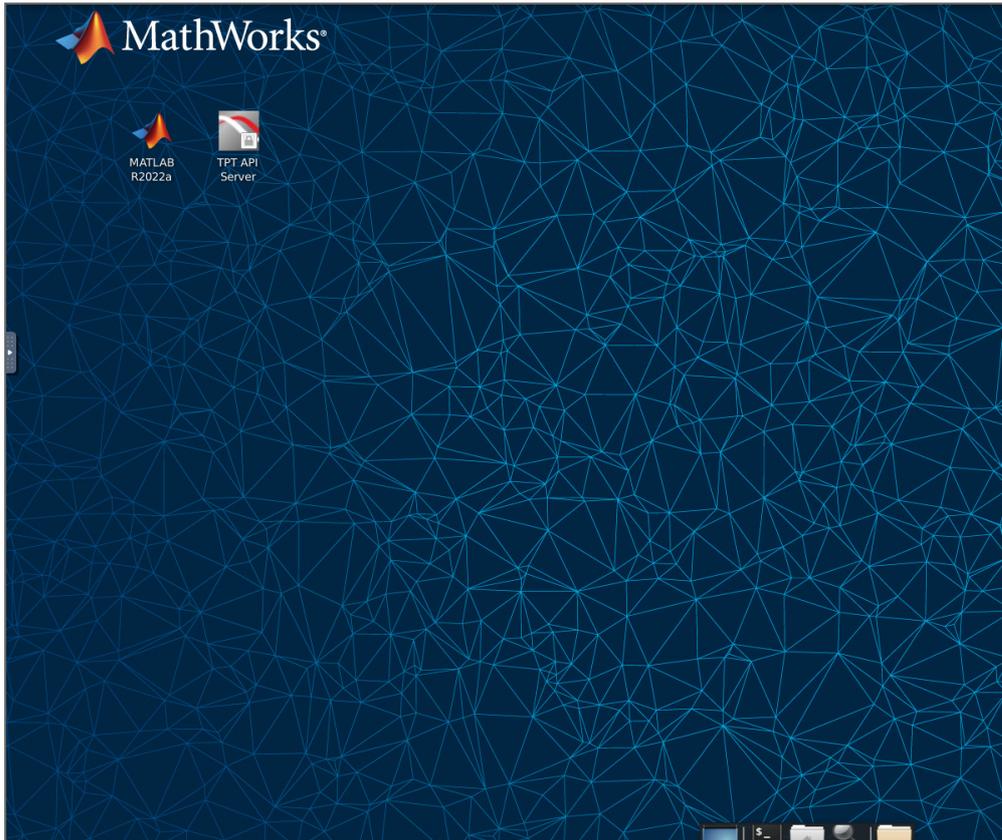


Figure 1-1: Screen with the launchers for TPT API Server and MATLAB R2022a Server

Double-click at TPT API Server to start the server for communicating with TPT in Docker. Double-click on MATLAB R2022a and log-in with your MATLAB log-in data. Then, install the Simulink add-on.

Limitations when running tests using the MATLAB/Simulink platform on Linux-based TPT Docker images:



- only 64-bit MATLAB versions are supported
- only the GCC compiler is supported
- multi-byte uft-8 characters in paths to test data are not supported
- generation of FUSION DLL and dashboard executable are not supported

2 TPT Docker image

A Docker image contains the code that is needed to execute software in a Docker container. The images can be based on Ubuntu or Windows operating systems.

Ubuntu-based Docker image

PikeTec offers a headless TPT version that is needed to build a Docker image based on Ubuntu (Linux). To create a Ubuntu-based Docker image, it is recommend to just modify the example in the headless package. A working TPT is contained within the headless package in the subfolder `Linux\0_Docker_Image\TPT`.

To create the example Docker image, copy a valid TPT Flexlm license file and paste into the `Linux\0_Docker_Image\License` folder; rename the license file to `tptheadless.lic`.



Instead of renaming the license file, you could also edit the value of the attribute `flexlmfile` in the `license_default.cfg` file.

Run `build.bat` in the subfolder `Linux\0_Docker_Image` to create a TPT image name "tpt_image".

Using external tools like C compilers

When you want to use tools like C compilers with TPT, add these external tools or install them; please read the Docker documentation on how to do this.

Windows-based Docker image

To create a Windows-based Docker image, create a Docker file including the commands to build a Docker image. Additionally, create a batch file that will start the building of the Docker image based on your commands in the Docker image, for example `docker build -t tpt_image`.

Preparations

Before starting the Docker image creation, place the following files next to the Docker file:

- TPT installation folder

The folder contains the TPT to be executed in Docker.

Do not use the headless package because this is for Linux-based systems only.



When you want to try out the "Docker_C_Platform example", you can just manually copy and the `Setup.exe` of your regular TPT and paste it next to the Docker file. The Docker file needs to be adjusted, see `README.txt` in the example folder.

- TPT license configuration file

Copy the file named `license_default.cfg` from `tpt-headless/Linux/0_Docker_Image/TPT` and enter the appropriate values, see [#Example of a license_default.cfg for the TPT License Server](#).

- TPT license file

The license file is necessary to run TPT; its name ends in `.lic`. After you placed the license file next to the Docker file, open the Docker file and enter the following line at the end: `COPY <license_file_name>.lic C:/TPT/<license_file_name>.lic`.

Create the Docker image

Open a command line in this folder and execute `build.bat` to create the Docker image named "tpt_image".

Using external tools like C compilers

When you want to use tools like C compilers with TPT, add these external tools to Docker; please read the Docker documentation on how to do this. Adjustments in the Docker file and copies of the external tool could be necessary.

If you create a Docker image based on the copy of a TPT installation, just run TPT before creating the Docker image and set the compilers in the TPT Tool Preference, see `Option|Preferences|General`. The specifications are saved in the file `tpt.config` and in plug-in specific XML files that can be found in the `config` folder. The file `tpt.config` and the folder `config` can be found in `C:/Users/<your name>/AppData/Local/TPT/<TPT installation name>` on your computer. Copy the file `tpt.config` and the folder `config` manually and paste both side by side into the copied TPT installation folder. Next, rename the `config` folder to `tpt.config.dir`. You can modify the XML files inside of the `tpt.config.dir`. For example, to adjust the path of a MinGW installation, open the file `ccompilers.xml` and replace the installation path with the absolute path to the MinGW installation in Docker.



If you create a Docker image based on a TPT setup like in the example "Docker_C_Platform_example", you can use the TPT API to set the C compilers after the Docker image has been created.

3 TPT Docker container

A Docker container is a temporarily running instance of a Docker image. When a Docker container is closed, it is reset to the state of the underlying image. Any change made during the execution is discarded. So, to keep test results even when the container is not active, you need to mount external volumes.

You must specify for each Docker container which TPT project has to be executed and which execution configuration should be used. The test cases to be executed are specified in the execution configuration.

You can execute tests in a Docker container by using an API script or a batch script.

Mount volumes

You should always mount at least the following volumes in your Docker container:

- volume to your SUT
- volume to your TPT project file
- volume to the test results storage

In a batch file, the syntax for mounting the volume to the SUT is as follows:

```
--mount type=bind,src=<path to the folder with the SUT in  
Windows>,dst=<path to a specific folder in Linux>
```

For example:

```
--mount type=bind,src=C:\Tools\Examples\Docker\1_SUT_  
Linux,dst=/temp/tptdata/sut
```

In a Docker compose file, this might look like this:

```
volumes:  
  - type: bind  
    source: ${C:\Tools\Examples\Docker\1_SUT_Linux}  
    target: /temp/tptdata/sut
```

More about the syntax of Docker files, see <https://docs.docker.com/engine/reference/builder/>

Executable of the SUT

To run the SUT in Docker, you have to modify the executable file. You need

- the C code to be tested
- a shell script to build the executable inside the Docker container
- and a batch file that creates the Docker container based on a TPT Docker image with the generated executable SUT and generates the test drivers

For the Linux-based Docker image, a C compiler is installed via Docker package manager, therefore the scripts can use `gcc` without changing anything. In the Windows-based image, the path to the `gcc` needs to be modified to make the `gcc` command available.

After the test driver generation is finished, the container can be terminated, thus removed.

Example

Example folder: `<headless TPT installation>\Linux\1_SUT`

Run the batch file `build_sut_in_docker.bat` to create a Docker container based on the Docker image `tpt_image` and to run the shell script to create an executable file that can be run in Linux. The container will be automatically removed after its task is finished.

4 Configure and run tests via the TPT API

You can communicate with a TPT running in a Docker container from outside by using TPT-specific API commands to create tests, configure platforms and so forth. To do this, you must run the API server in the TPT Docker container and specify a port on which to pass the API commands from outside. You need to map the network port of your physical network card to a port of Docker's internal network, for example. `-p 1100:1099`, meaning `[host_port]:[docker_internal_image_port]`.

In addition, you must define an answer port for the communication. With the environment variable `TPT_RMI_PORT`, you can specify the answer port to be used by TPT, for example, `--env TPT_RMI_PORT=40243`. The port must also be mapped to an open port via `-p`, for example, `-p 40243:40243 --env TPT_RMI_PORT=40243`.

To load the TPT API server, start TPT with the following arguments: `--apiPort [docker_image_port_for_TPT_API] --apiBindingName TptApi --run apiserver --headless`.

The `apiPort` and `apiBindingName` can also be specified in the `apiserver.xml` file (see `headless TPT folder: 0_Docker_Container/TPT/tpt.config.dir/apiserver.xml`). When you start the API server via the command line with an `apiPort` and an `apiBindingName` that differs from the specification in your `apiserver.xml` file, the command line specification wins.

Send API commands via an API script to a Docker container

To pass TPT API commands to a TPT in a Docker container, you can either use a custom Java program or an API script. You can create and maintain this script in a normal TPT using the API Script Editor, or use a text editor and save the file as `*.tptapi`.

It is essential to specify the following in the API script file:

- directory to the TPT API script
- a host variable, for example, `HOST = "localhost"`
- a binding, for example, `BINDING = "TptApi"`; the binding name is specified when you start the Docker container using the argument `--apiBindingName`

To send the API commands to TPT, open the API script in a normal TPT, adjust the path to the TPT project you like to run. Then, click  **Run**.

```

TPT - API Script Editor
API Script Editor x run script
C:\Tools\Examples\docker\3_Run_1_Instance_with_API\talk_to_docker.tptapi
1 from java.rmi.registry import LocateRegistry
2 from java.io import File as file
3
4 import time
5 import threading
6 import os
7 #Enter the root folder of the tpt headless examples here
8 example_dir = "C:\\Tools\\Examples\\Docker"
9
10 HOST = "localhost"
11 BINDING = "TptApi"
12
13 def runOnDocker(port, file, testset, name):
14     PORT = port
15     registry = LocateRegistry.getRegistry(HOST, PORT)
16     remoteTPTAPI = registry.lookup(BINDING)
17

```

Figure 4-1: API script in the 'API Script Editor' of TPT

You can also run API scripts directly in the TPT Docker container, for example: `/tpt/tpt_linux --run apiserver my_api_script.tptapi --headless`. The `apiPort` and `apiBindingName` can be omitted in this case, since the communication takes place within the TPT Docker container and the API script terminates automatically when it is finished.

Example: Run test in one Docker container with API

Example folder: `<headless TPT installation>\3_Run_1_Instance_with_API`

Check the volumes to be mounted and the port forwarding specified in the `docker-compose.yml` and the `run_1_instance_with_API.bat`.

Run the batch file `run_1_instance_with_API_compose.bat` to execute the services specified in the YAML file `docker-compose.yml`. A Docker image will be created based on the existing Docker image `tpt_headless_base`, the necessary external volumes are mounted, the ports are forwarded, and the TPT headless image is started in the Docker container.

Instead of `run_1_instance_with_API_compose.bat`, you can run `run_1_instance_with_API.bat`. The execution of this file leads to the same results as the execution of the `run_1_instance_with_API_compose.bat` but does not make use of the `docker-compose.yml`.

When the Docker container is running, open the TPTAPI script file `talk_to_docker.tptapi` in the API Script Editor in the TPT user interface, and run the API

Example: Run test in one Docker container with API (continued)

script.

If you want to distribute test cases to multiple Docker containers, you only need to create multiple Docker containers based on the TPT Docker image.

To communicate with the containers via the TPT API, set a different port share and port forwarding for each container. Adjust the value of the `TPT_RMI_PORT` environment variable accordingly, for example:

```
docker run -dit --network=bridge --name tpt1 -p 1100:1099 -p
40243:40243 --env TPT_RMI_PORT=40243
[...]
docker run -dit --network=bridge --name tpt2 -p 1101:1099 -p
40244:40244 --env TPT_RMI_PORT=40244
[...]
docker run -dit --network=bridge --name tpt3 -p 1102:1099 -p
40245:40245 --env TPT_RMI_PORT=40245
```

Make sure to use different test results directories for each Docker container. A test report will be generated for each Docker container.

You can specify in the API script that certain test sets are executed in specific Docker containers, but you can also split test cases of a test set numerically. For more information about the TPT API, see [TPT API](#).

Example: Run test in three Docker containers with API

Example folder: `<headless TPT installation>\4_Run_3_Instances_with_API`

Check the ports of all three Docker containers and add a different results path to each of them. The execution is as described in [Example: Run test in one Docker container with API](#)

5 Run tests via command line

To run tests via the command line, you must specify which project and which execution configuration needs to be run. Add the command to the same batch file that you use to create the Docker container.

Such a batch file might look like this:

```
:: create the Docker container and name it "tpt1"
docker run -it --name tpt1^

:: mount external volumes
--mount type=bind,src=C:\Tools\Examples\Docker\1_SUT_Linux,dst=
/temp/tptdata/tpt_prj^
--mount type=bind,src=C:\Tools\Examples\Docker,dst=/temp/tptdata/results^
--mount type=bind,src=C:\Tools\Examples\Docker\1_TPT_Example,dst=
/temp/tptdata/sut^
:
:: launch TPT Docker image in Docker container
tpt_headless_base^
:
:: run TPT headless, load the project file "LightControl.tpt", execute the
execution configuration "exeConfig", and store the results
/tpt/tpt_linux --run build --headless
/temp/tptdata/tpt_prj/LightsControl.tpt exeConfig --dataDir
/temp/tptdata/results

:: delete docker file "tpt1"
docker rm tpt1
```

Figure 5-1: Example of a batch file for creating Docker container

Example (Linux)

Example folder: <headless TPT installation>\2_Run_Simple_SUT_w_CLI

Run the batch file `run_simple_SUT_w_CLI.bat` to create a Docker container based on the Docker image. The external volumes are mounted, so the Docker container has access to the TPT project file, to the executable SUT, and to a test result directory. The test cases of the execution configuration named `exeConfig` are executed with TPT. After the test results have been stored in the specified directory, the container will be removed.