SOFTWARE USER GUIDE

PowerMir TKS

MIRSENSE

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## Revisions

<table>
<thead>
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<th>Version</th>
<th>Date</th>
<th>Author</th>
<th>Modification</th>
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<tr>
<td>1.0</td>
<td>2019-07-30</td>
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<td>Document Creation</td>
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<td>G. Aoust</td>
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## Software Version

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
<th>Release Date</th>
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<tr>
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<td>2.1.0</td>
<td>2020-03-09</td>
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I. Introduction

MirSense PowerMir TurnKey System (PTKS) is an agile pulsed and continuous wave QCL current driver. It is compact, powerful and controlled by a user-friendly graphical interface. It has been designed and manufactured in France to provide the highest quality and reliability.

This manual is an important part of your purchase as it will help familiarize with the system and explain its numerous features. Please read this manual thoroughly before starting the installation and using your instrument.

Don’t hesitate to contact MirSense or your authorized MirSense distributor if you have additional technical or application questions. We provide web-based as well as direct e-mail and telephone support. Thank you for purchasing a MirSense product.

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II. Hardware and system requirements

Please make sure that you are using a computer running Windows version 10 (64 bits) and that you have at least 700 MB of free space on your hard drive. The application comes as a portable distribution, meaning that you do not need to install anything prior to launching the executable file. All necessary files are contained within the application folder.

A minimal resolution of 900x900 pixels is required for proper display.
III. Software installation

A. Installing communication driver

When the PTKS is turned ON with the USB cable properly plugged into the computer, a FTDI USB to Serial UART interface IC within the PTKS should install automatically on your computer. This component is a driver managing communication with your PC. If such an installation does not start automatically (it can occur if you don’t have administrator rights for example), you can still install manually the driver of this component by launching the “CDM21228_Setup” program provided with the installation key.

B. Installing the portable distribution

Unzip the « PowerMirDriverX.Y.Z» zip folder to the desired location. This location must have enough hard drive space to ensure that log files created during the use of the PTKS will be saved. If you already have the unzipped version of the software, you only need to paste the folder to the desired location. It is not recommended to run the software directly or the USB key, otherwise you could experience GUI (Graphical User Interface) speed issues.

![Folder Structure](image)

Figure 1 – View of the top folders contained in the portable distribution. The database folder contains the “.ins” configuration file as well as the pattern definition text files that are loaded by default. The logs folder contains the application log files.

C. Configuration files

Each PTKS is built for a specific laser target. The corresponding parameters are stored into a proprietary MirSense “.ins” file, which is necessary to start your application. It is also possible to store several PTKS parameters into a single “.ins” file, for example if your PTKS manages several laser heads.

Make sure that the proper “.ins” configuration file is present in the database folder (see Figure 1). The application will load it at startup. Hence, it must match the laser to drive. If the wrong .ins file is loaded at startup, the application could send incorrect current instructions to the lasers and potentially damage them. Please contact MirSense if you don’t have the “.ins” configuration file associated with your system of lasers.
D. Executable launch

To launch the program, locate the executable file present in the “PowerMirDriverX.Y.Z” folder. This executable file should be launched with administrator privileges, otherwise you could experience GUI speed issues. Indeed, the PowerMir Driver needs to change FTDI’s FT232RQ registry parameters in order to enhance the communication speed with the PTKS. The PTKS at that time can be either ON or OFF.

![Figure 2 - Location of the start-up icon to launch the PTKS user interface.](image)

Two windows should be launched. The first window is called the “console” in the background, and can display additional messages. It has to be kept open. If the console is closed, the GUI application is also closed without executing the correct termination procedure. The second window is the application itself, and you should see the home screen (see Figure 3 for an example).

![Figure 3 – Home screen of the PTKS user interface. On this example, the GUI in the foreground is configured for a dual channel PTKS. On the background, we can see the](image)
E. Preference file

A preference text file is used to store the user preferences. It can be found in the “gui/ressources/” folder. Do not modify any value in that file unless you know its impact, otherwise it could lead to a software malfunction.

Since this file is used by several mirSense application, you might find items within the preference file that aren’t related to your application.
IV. Software main screen

A. Home screen detailed breakdown

The GUI home screen will provide you with a secured access to your PTKS. We show in Figure 4 an overview of all elements within the home screen. A more detailed description of each element is presented in the following sections.

![PTKS home screen]

**Figure 4 - PTKS home screen**

1. **Top ribbon**
   The home screen's top ribbon is used to control the GUI connection.

2. **Head serial number**
   The serial number label of the PTKS Laser Head controlled by the buttons below it.

3. **Head status and information**
   Displays the status of the head, information about the contained laser and controls of the red alignment laser.

4. **System conditioning settings**
   Contains the necessary settings to condition the head before any use of the laser.

5. **Laser controls**
   Contains the lasers' controls.

6. **Graph area**
B. Top ribbon

The top ribbon of the home screen is used to control the PTKS connection.

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<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Close button</td>
<td>This button is used to safely exit the application. When clicked on, a pop up appears to confirm the close command. If confirmed, the application is closed and any connection to the PTKS is terminated. If any laser is ON, it is turned OFF. If any temperature regulation is still in process, it is also stopped.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Resize button</td>
<td>This button is used to resize the application, it behaves as the standard resize Windows button.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Reduce button</td>
<td>This button is used to reduce the application. It behaves as the regular Windows reduce button.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Connection button</td>
<td>This button indicates if the User Interface is connected to the PTKS Master Driver.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When the connection button is OFF and pushed, it enters the “Switching” mode (blue icon). During the “Switching”, the application searches through the available COM ports of the PC and identifies the relevant one. Only one PTKS should be connected to the PC as only one connection is supported for this version. If a suitable PTKS is found, the GUI sends the parameters within the “.ins” file (loaded from the database folder at GUI startup) to the PTKS.

When the connection button indicates ON, the status of the PTKS showed in the status bar should be “IDLE”. It means that the PTKS has been found and that the values within the “.ins” have been sent successfully. If “Disconnected” is shown instead or if the connection button stays on the OFF status, the instrument may not be properly connected to the USB port of the PC, or the PTKS might not be powered. If the problem persists, please contact MirSense.
5 **Bin button**
This button clears all acquired data from the GUI. If the application has been run for a very long time, clearing memory can be necessary. An automatic memory clear is also programmed to prevent any memory overflow on the computer, and can be configured in the preference file (see section III.E).

6 **Lock button**
This button is used to unlock the additional menus of the software. Those additional menus are only available to advanced users, since it can damage the connected laser if not properly handled.

7 **Elapsed time**
This label shows the elapsed seconds since the GUI application has been launched.

8 **Connection bar**
This bar indicates the current status of the PTKS. If ‘Disconnected’ is displayed, the connection with the PTKS is not properly set. If ‘IDLE’ is displayed, the connection is properly set. “Switching” is displayed during ON/OFF transitions.

C. **Head status and information**

Figure 6 – PTKS Laser Head status of the PTKS user interface.

1 **Device status**
The device status shows the status of the electronic driving the head. The colored square is orange before any connection is established. It turns green if the driver is under normal mode of operation, and red if it is in error mode. A label in grey can also be displayed at the right of the colored box to give information on that status.

2 **Sink Temperature**
The “sink temperature” is defined as the temperature of the mount holding the packaged QCL, inside the PTKS Laser Head The colored square is linked to the maximum allowed sink temperature for the PTKS to operate properly. If green, the sink temperature is within the established bounds. If red, the temperature is beyond the factory set limit programmed by MirSense, and this means that the head is not properly cooled. Make sure that the surrounding temperature of the
PTKS Laser Head satisfies the specifications. The label at the right of the colored square shows the real time value of that heat sink temperature.

3 **TEC Regulation**
The colored square indicates if the TEC element inside the packaged QCL inside the PTKS Laser Head is running or not.

4 **Laser emission status**
This label is ON whenever the current is enabled through the laser, OFF otherwise. If the current is enabled, the laser can potentially emit light (depending on the external trigger status and waveform selected).

5 **Check Error**
The arrow button must be used to acknowledge an error that occurred. The acknowledgment is required to recover normal mode of operation and to be able to turn the laser ON again. The label at the right of the arrow button gives the error code number, whose meaning has to be extracted from Figure 7.

6 **Laser wavelength**
The laser center wavelength.

7 **Laser power**
The laser maximum average power.

8 **Red Laser**
The checkbox is used to turn ON or OFF the red alignment laser. This laser is an optional feature of the PTKS.

<table>
<thead>
<tr>
<th>ERROR NUMBER</th>
<th>DESCRIPTION</th>
<th>ERROR CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Error</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>TEC communication error.</td>
<td>The PTKS Master Driver was unable to reach its TEC complementary Board.</td>
</tr>
<tr>
<td>60</td>
<td>Anormal temperature detected.</td>
<td>Factory set temperature limits have been overflowed.</td>
</tr>
<tr>
<td>61</td>
<td>The laser has been turned OFF to prevent any damage.</td>
<td>Laser proximity electronics is too hot.</td>
</tr>
<tr>
<td>62</td>
<td>The laser cannot be operated without a temperature regulation.</td>
<td>The laser has been turned ON while the temperature regulation was not running.</td>
</tr>
<tr>
<td>64</td>
<td>The system surroundings do not allow a suitable laser temperature regulation.</td>
<td>The TEC power consumption has overflown the factory set limit.</td>
</tr>
</tbody>
</table>

Figure 7 – Error code number decoding table.
D. System conditioning settings

1. **State loader**
   This spinner holds the list of all the PTKS Laser Head states that are available. A state can correspond for example to predefined pulse width of the laser, or to specific operating temperature ranges. Most of the time, this list is reduced to a single default state.
   If a new state is selected in the spinner, the corresponding state is immediately applied to the PTKS Master Driver.

2. **External modulation checkbox**
   This checkbox controls the use of the External TTL input. If the checkbox is OFF, any signal on the External TTL input is discarded. If ON, the input signal on the External TTL input is used to modulate the current driving the QCL, and is used as an “enable” signal.

3. **TEC status controller**
   This button is used to activate the Thermoelectric Cooler (TEC) regulating the temperature of the laser inside the PTKS Laser Head. The TEC has to be ON before being able to switch the laser ON.

E. Laser controls

1. **Loader of defined patterns**
   After pushing that button, a properly formatted text file needs to be given to the popup file selector. That file holds the power levels pattern expected from the
laser output, a name for identification as well as the repetition rate of that pattern. The given name is then available in the spinner list of defined patterns. Please refer to section IV.G for the text file template.

2 **Spinner of defined patterns**
This spinner holds the list of all the patterns that have been loaded. If a new name is selected in the spinner, the corresponding power levels are immediately applied to the laser, and the visualization graph is updated. In order to synchronize the PTKS current pattern and the displayed name in the spinner, the spinner is disabled if the module is not connected.
Predefined patterns can be loaded automatically at software startup, please refer to IV.G for more details.

3 **Launch/Stop button**
This launch button will not be available before having properly conditioned the system (see section IV.D). After pushing it, the pattern defined in the spinner is executed periodically and the launch button is replaced with the stop button.
Any external modulation provided by the user will be superimposed on the pattern if the external modulation checkbox is enabled.

F. **Visualization graph**

![Visualization graph](image)

Figure 10 – Laser visualization section of the PTKS user interface.

1 **Plot mode selection**
This group of two checkboxes allows to change the nature of the plot. The plot can show either:
- a live representation of the sink temperature history as a function of time. This allows to check the stability of temperature over time.
- a representation of the output power of the laser as a function of time. Only one period is shown.
A multiplying factor can be used to represent big numbers on the axis, and it is
2 **Save button**
When pushed, the user is required to browse to a folder location and to give a filename. The data contained in the graph at the time of the push will be exported into the given filename (Both displayed data and out-of-zoom data will be saved).

3 **Play-pause button**
When live data is displayed such as the temperature over time, it can be difficult to zoom on a specific feature because new data are added and automatic rescaling occurs. To prevent this, it is possible to pause the graph so that no more data are added to the display. Zoom operations can therefore be performed. Note that new data are acquired from the PTKS even if the graph is paused.

4 **Span button.**
This is a toggle button used to move the graph when toggled ON. To move the graph, push and keep clicked on the graph area while moving the cursor.

5 **Zoom-in button**
This is a toggle button. When ON, click and drag on a portion of the graph area to zoom on that particular area.

6 **Out-zoom button**
This button is used to go back to the previous zoom obtained using the zoom-in button.

7 **Home zoom**
This button allows to go back to the original view of the graph.

8 **The axis offset**
When the graph ticks represent large numbers, they are displayed in the scientific form. The axis offset represents the multiplier to apply to the ticks. On the displayed graph in Figure 10, the axis offset value is 1e2=100. The tick “1.44” hence corresponds to 1.44 x 1e2=144 seconds.

9 **The time span slider**
The MirSense logo is a cursor when live data are displayed. Translate this cursor horizontally to change the time span of the graph. Note that the cursor is hidden when the data is not live (for example in Power mode). The effect of the slider is on hold as long as the graph is in pause mode.

G. **Power levels patterns template**
New custom power levels patterns can be uploaded by the user to the PTKS Software. The power levels patterns correspond to the control of the laser internal modulation, in a very similar way as an external trigger (See **PowerMir Application Note**).

The internal modulation pattern must be defined by its period and a series of 252 boolean values describing the target pattern, where 1 indicate when the laser is ON and 0 when it is OFF.

The template for the text file is shown in Figure 11.
Figure 11 – Template for the definition of waveform patterns, for the power of the laser as a function of time in periodic mode.

- Any line starting with the "#" symbol is considered as a comment and will therefore be discarded during the load.
- If a line starts with "Frequency=X", then the number X is considered as the power levels pattern repetition rate. Note that the given frequency will be converted into the modulation period. Please refer to the general characteristics in the user guide to see the period range and precision.
- If a line starts with "Name=Y", then Y is considered as the name of the pattern and will be used to feed the spinner of defined patterns.
- If a line starts with "Form=Z", then Z should be a list of 252 values indicating the power level, expressed as booleans (0 or 1).

Also, if the text files are placed under the /database folder, they will be loaded automatically at software startup and they will populate the spinner of defined patterns.
VI. Startup procedure

(1) Make sure that your PTKS is properly connected to your PC, by following the installation procedure provided in the general user guide.

(2) Click on the connection button (ON/OFF at the top right corner of the application). The connection button should change to “Switching” status while the program is searching for the instrument. (this step can last a few seconds). The connection button should change to ON status, and “IDLE” should be visible in the connection bar.

(3) If the connection bar does not show “IDLE”, turn the connection button to OFF (if it is not already the case). Check the following items and then return to the previous step:
   - Check that your PTKS is powered and connected to the PC.
   - Check that the CDM driver have been installed.
   - Check that you’re using the right “Ins” file.
   - Unplug/plug the USB connection as it can sometimes not initialize correctly.

(4) Now that “IDLE” is in the connection bar, you have to condition your system using the “system conditioning” section. In particular, choose the mode of operation and start the thermo-electric cooler by pressing the TEC status controller button.

(5) The system is now ready to emit a laser pulse. Select the waveform to send to the laser, then click on the laser start button. Your PTKS can now potentially emit light, depending on the label selected in the spinner of defined patterns.

(6) You can launch new loaded power levels pattern from the selection spinner and they will be executed immediately.
VII. Software background tasks

A. PTKS safety

Various security checks are present inside the PTKS to ensure the safety of the whole system. If any problem is detected, the laser can be immediately stopped and an error code will appear on the GUI. You can refer to section IV.C for more details on errors codes on the GUI.

In particular, some securities are based on the measurement of temperatures of the laser and its surroundings. MirSense team optimized the temperature thresholds to allow an extended use of all available parameters and modulation flexibility. It is however possible that, for specific modulations, such a security is triggered. It can also be triggered if the heat environment of the PTKS Laser Heads is not properly drained, which could cause the Peltier regulation to hit its maximum ratings.

If such security is triggered, you should first identify the cause of the trigger before restarting and/or using the “check error” button (see section IV.C). Please contact MirSense if you cannot identify the cause, and prepare to provide the latest recorded log file located in the log folder (see Figure 1).

B. Periodic erase operations

In order to avoid any memory overload within the PC, an automatic data erase is programmed.

An automatic erase is triggered every 4 hours by default. The period of the automatic erase can be changed in the preference file, it is stored under the name “user”->”default_history_duration” and is expressed in seconds.

C. Logging operations

A report from the operations is continuously written to a log file in the logs folder. The log files are very helpful to understand the behavior of the PTKS. If you have any issue with your PTKS, it is essential to send the log file with your explanations to a MirSense representative so that the issue can be better understood.

Figure 12 – Content of the log files, recording the console messages for debug.