

# LACERTA M-GEN Stand-Alone AutoGuider PC application

User's guide for the PC application:  
LMG\_SAAG\_app.2.01.exe

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For usage with Firmware 02.01

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# 1 Required environment

To run the application You need a 32-bit Windows operating system. An USB to serial converter IC is placed into the Handcontroller to communicate with the PC. The driver of this IC must be installed (only once) before running the application.

## 1.1 Installing the FTDI D2XX driver

The latest driver program can be downloaded from the homepage of the manufacturer (FTDI) of the IC. (From here: <http://www.ftdichip.com>, Drivers / D2XX menu.)

Choose the latest, proper driver for Your Windows operating system and for the proper IC, which is the FT232R. The driver version **equal to or above 2.04.06** can be surely used.

After downloading the driver start it and it will install the driver if there was not before. If You are asked to restart the computer do so. This installation must be done only once for a computer, not required later. (Follow the FTDI's application note on installing the driver if having troubles!)

# 2 Usage of the application

The PC application does several functions for Your LACERTA M-Gen autoguider. Basically it is not for controlling the device (since it is stand-alone) but to download or upload data.

The PC application's version show that highest verison number of the Firmware in the device that it can handle. There is always a new PC aplication for each new Firmware release. This is because at uploading a new Firmware the structure of the stored variables may differ and the PC application must know the new Firmware's structures too.

The application is of console type or command line. It will start in a terminal (text) window (similar to an old DOS app.). When You open a new terminal (Start menu / Run / "cmd") and navigate to the proper directory, You can start the application by entering "LMG\_SAAG\_app.2.01" followed by the command line options that define the desired function of it. You must not use the application this way, there are always executable batch (.bat) files released with the new Firmware to start different functions of the application.

## 2.1 Command line options

Here is a list of the available command line options or switched. These are not detailed here but in a later section.

The format of the command line is the following:

```
LMG_SAAG_app.2.01 [options]
```

The options (in any order) can be:

- |                    |   |
|--------------------|---|
| -u <i>filename</i> | Upload the <i>filename</i> Firmware file into the device.   |
| -x <i>flags</i>    | Some parts of the Firmware should be excluded from upload procedure that are defined by <i>flags</i> . (Not advised to use without experience.) |
| -f                 | Starts the file-handling function of the application.   |
| -r                 | The same as before but shows also the deleted file entries.<br>(for a possible download – if its data has not been overwritten)                 |
| -d                 | Sets all the stored variables/parameters to their default value at Firmware update.   |
| -v                 | Queries and displays all the version numbers in the device.   |
| -e                 | Starts the Firmware in the device (ie. after an upload).  |
| -?                 | Listing these options onto the screen.  |

## 2.2 Firmware updating (-u filename)

**WARNING:** never plug out the USB cable or power-off the device during Firmware uploading. It may damage the boot program that makes the upload possible and the device must be reprogrammed at factory that is not a part of the warranty.

To upload a new Firmware it is enough to supply the device only from USB bus. (The DC power input may be charged too, has no effect.)

Altogether all the programs in the device is called a Firmware. There are separate programs for the Handcontroller and for the Camera that can be updated. The released firmware file contain all three programs (two for the Camera). Updating of these is done at the same time generally so the functionalities are guaranteed.

You can upload not only a newer Firmware but You can “restore” an older on as well. In this case keep in mind that those variables’ values are lost (set to default) which were new in the later Firmware.

To do the update procedure there is always a `lmg_update_version.bat` file in the release pack, where the *version* stands for the 4-digit version code (ie. for 1.22 is 0122). By starting this batch file the Firmware update can be done by one click.

The process of the updating:

1. Connect the Handcontroller with the USB port to the PC (using the supplied cable);
2. Connect the Camera to the Handcontroller with the proper (8-wire) cable;
3. Turn on the Handcontoller (by pressing ESC on it). If it is hold down for more than 1 second the device will start in UPDATE MODE regardless if it contains a valid Firmware or not;
4. Wait for some seconds while the PC (and the driver) detects the device. (At the first time Windows will display the identification and says when it is ready to use);
5. Start uploading with starting the supplied batch file or typing the following row (in the console):

```
LMG_SAAG_app.2.01 -u 201
```

If the Firmware file’s name is not the default `LMG_versioncode.fw` (so the leading zeroes can be skipped), then the full filename must be given.

Before uploading the Firmware parts the application displays the content of the Firmware file (the version numbers of the contained programs, 3 pieces). Then it downloads the stored variables’ content from the EEPROM memory according to the current Firmware in the device. After this the application uploads the new Firmware into the Handcontroller then to the Camera, which takes about a minute altogether and on the LCD display the updating state can also be be monitored.

After the updates are done succesfully the variable values are restored into the device’s EEPROM according to the new Firmware.

When the update process is finished the current verison numbers are queried and displayed for checking the success. (The “boot version” numbers can be neglected, it is only informational for some purposes.)

If only a part of the Firmware should be uploaded for some purpose (ie. the HC was updated ok but the Camera failed), the parts of the Firmware files and upload process can be excluded, using the `-x` switch followed by some of these characters:

- `'h'` : skip updating the Handcontroller's Firmware;
- `'c'` : skip updating the Cameras's Firmwares;
- `'e'` : don't change the EEPROM content (no read and write takes place). Using this is **not recommended**, only in very rare cases for experts. If the version of the stored data does not match the Firmware in the device, no variables are initialized from here and are not stored at power-off. Most of the variables will have weird (low) value.

Updating only the Handcontroller's Firmware is done with excluding the Camera:

```
LMG_SAAG_app.2.01 -u 201 -x c
```

Updating only the Camera's Firmwares is done with excluding the Handcontroller (that includes skipping the refresh of the EEPROM variables):

```
LMG_SAAG_app.2.01 -u 201 -x h
```

If You want to start the uploaded Firmware before the application exits, use `-e` switch:

```
LMG_SAAG_app.2.01 -u 201 -e
```

## 2.3 Handling files (-f or -r)

This is a separate operating mode of the PC application. The device must be running in application mode to access the filesystem. The PC application will ask the device if it can switch to filesystem transfer mode and if it is allowed, the Handcontroller will enter a 'file exclusive mode' (displaying it on the LCD), every function is stopped in it. This mode is refused if a file is currently open in the device and PC application will not be able to connect to it.

After a successful connection in this mode the PC application lists the file entries stored in the device. The shown columns are the following.

- #n  
The index of the file (the file entry's number).
- del  
The 'deleted' state of the file entry if a '\*' is shown here. (Only in recovery mode, -r switch). The data of the deleted entry is shown. This does not mean that the file content is fully available but can be attempted to download it, more on this later.
- created at  
The creation date and time of the file. The value is always what it was set in the device at the creation of the new file. Setting proper date and time was the User's responsibility.
- last opened  
The date and time of the last opening of the file. The device does not check if this time was set earlier than the creation date.
- file ID  
The unique ID of the file, a 6-digit hexadecimal value. Each file created gets its own unique ID and so are the files distinguishable. There is a counter in the EEPROM memory of the HC that increases for each new file.

Note: setting the EEPROM variables to default (see 2.7) does not affect this ID counter.

This 6-digit ID will appear in the filename of the downloaded files. This avoids overwriting an old file with a new one, except when the new one is a re-opened variant of the old file (if data was appended to it).

- downloaded  
If the value is 'yes' then this file has been downloaded yet at least once and was not opened since. If You are using only one PC to download Your files, this file must exist on the PC (if not deleted).  
If the vaule is 'no' then the file was never downloaded yet or contains new data (= the file was re-opened). Downloading this file is advised.

If there are no files in the device, the PC application displays the case and exits.

After displaying the list (the order of the files is not the same as seen in the device's filesystem screen), the following options are possible:

- 1-16)  
The index of the file that You want to see the details of. Only an existing file entry index is accepted. (Accepts deleted file entries' index as well regardless if it is shown in the list (-r switch) or not).  
By choosing this option the data content of the file is downloaded into the PC's memory (not saved to a real file yet). This can take several seconds. If the file takes up almost all the memory available (2Mbytes) downloading it may take up to 2 minutes and 45 seconds (approximately).  
The PC application then continues with displaying the file's details.
- f)  
Deletion of all the files. ("Format"). The file contents are not changed and may be downloaded later until some new file overwrites the file entry or the file's data pages.  
This operation must be confirmed by the User once again.
- q)  
Exits the PC application. (The HC continues working from where it was interrupted.)

If You entered an index of the file, the details menu will be shown for that file:

- ID  
The file's unique ID, see above.
- creation  
Creation date and time.
- last open  
Date and time of the last opening.
- size  
The data content's exact size in bytes.
- ERROR in file (optionally displayed)  
If the content has an error for some purpose, it is displayed in this row. Depending of the cause the file may some contain valid data but invalid data at the ending part of the file too. Detecting wrong data could be done posteriorly by the user and considering those data invalid. In some cases the PC application could detect data stream failure too. Error does not arise by proper use of the device (turning off from menu before power-down for example).

Then the file details menu's options are shown:

- d)

Save the downloaded file content into a file on PC. The filename starts with "MG" characters followed by the 6-digit hexadecimal ID of the file. The extension is ".dat". The content of this file on the PC is the raw saved version of the file in the device, could be re-opened and interpreted later again, which will be available in the later versions of the PC application. Newer version will generate more and more handy outputs by the file content. (It is planned to generate a main HTML file where all diagrams, statistics and raw data can be reached from. See 3.3)

Note: currently the file is fully downloaded before entering the file details menu, later for faster navigation the data will be downloaded only by selecting this option here.

After saving the file to PC, the file entries' "downloaded" state will be "yes" valued, see at the previous menu.

From App.ver.02.01 downloading a raw file includes creating a formatted CSV output file. More on this see 3.2.

➤ e) (optional)

If the file exists and so is not a deleted one this option is also shown. This is to delete / erase this file entry. Similar to the "formatting" this also preserves the data content for a "recovery", if not overwritten by a new file.

➤ q)

Returns to the files' list menu.



## **2.4 Processing raw file to formatted ones (-p)**

This is done the following way:

```
LMG_SAAG_app.2.01 -p MG000000.dat.content\MG000000.dat
```

The raw filename (and/or path) must be given as a parameter.

This function creates the formatted output files, written about in 3. The destination is always `MG000000.dat.content\` relative directory entry. The six 0's are for the actual data file's ID, this is only an example.

## **2.5 Querying version numbers (-v)**

This is done the following way:

```
LMG_SAAG_app.2.01 -v
```

It may happen that the first try fails, try to query it again then. The query is done in UPDATE MODE so if the device was in application mode it will be restarted in update mode. Don't query the versions if the device is actively working because it will be interrupted suddenly (and can make the open file (if any) to have an error).

First the BOOT then the Firmware version number is displayed of the Handcontroller and then the same for the Camera. If this is not connected to the HC, an error message is shown ("can't get camera boot version").

## **2.6 Starting the Firmware application (-e)**

(Re)starting the Firmware in application mode is done with the `-e` switch or by simply starting the supplied `lmg_start.bat` file in the Firmware pack.

If the device was in UPDATE MODE, the Firmware will start. If there is no valid Firmware in it, a "NO FIRMWARE" text is shown at the middle of the display.

If the device was already running in application mode it will be restarted anyway, independent of what is was doing. Don't restart the application if the device is actively working (has an open file etc.)!

## **2.7 Setting stored parameters back to factory default (-d)**

At the phase of writing back the EEPROM content of the Firmware update process, this switch is used to set them to the factory default value. If something is working very badly in the device due to some parameter that can't be altered (this must not occur), this can be used to reset all the parameters to a valid, default value.

The switch works only along with the Firmware uploading (`-u`) but not in itself. If the refresh of the EEPROM variables are disabled (`-x e`), resetting of the parameters will not be done.

### 3 File data content and outputs

When You download a file from the device, a new directory is created with the name of the file's ID („MG” followed with the file's unique ID, a 6-character hexadecimal number) plus „.content”. The directory will be created into the application's working directory.

File types that are created at download time:

- The RAW data stored in the device.
- A RAW (but „human readable”) text format output that contains all the data items in a formatted mode. This is a CSV file that can be parsed as a single text file or opened by Microsoft Excell.

File types that are created with the '-p' (process) switch (see 2.4):

- A well formatted HTML output file. This is a visual representation of the data stored with diagrams, separated into different parts.
- (The CSV file is updated also.)

#### 3.1 *The RAW data file*

The filename is the same as the directory's with a „.dat” extension appended. This file would be used for re-interpreting the old data files with the later PC application versions that will generate more sophisticated data and more diagrams etc. as the application is developed.

## 3.2 CSV format raw text data

The filename is always „events.csv”. This is a text file, may be interpreted by a user program if some wants to. Microsoft Excell also opens it. Each line is splitted into columns by the semicolon (;) character. Excell splits the line data into its columns by this.

This file holds „events” that have ocured in the device. Most of them have timestamp to be able to fully recover the operation of the device. Each line in this file holds one event’s data. The first 3 columns is always the same as the very first row says:

Date	Time	event
------	------	-------

Date      yy.mm.dd. format (year, month, day). Year is the last 2 digits of 20xx.  
Time      Seconds elapsed since the last midnight in 0.1 sec. resolution.  
event     The type of the stored event or data. This indicates how to interpret the following columns’ data as described below.

Note: the date and time value is always that You have set up in the device. It’s Your responsibility to enter the proper date and time before You open or create a file by the device.

The Firmware ver. 02.01 generates the following events (formatted lines):

- **<OPEN>**  
The file has been (re)opened. The version number is written in the next column as „file has been opened by FW version 02.01”.
- **<EOF>**  
Indicates End Of File. Must be only at the last row of the file. The next column of this event gives information about the file-end:  
„End Of File (msg = ‘...’)”, where ‘...’ stands for the cause of it. If empty, the file was closed normally and could be re-opened later. If there is an error message, the file is broken (wasn’t closed normally, the data stream is broken) and can’t be re-opened.
- **AE change**  
AutoExposure has changed its state and the output signals.

The 1st following column shows the new state, which can be:

- IDLE      - the AE is idle
- WAIT      - wait state („w” shown in its screen)
- ML        - mirror lockup state („m” shown in its screen)
- EXP        - exposure state („e” shown in its screen)

The 2nd following column shows the new AE output signals (the physical output on the stereo jack connector). Can be:

- empty     - neither signal is active
- FOC       - focus signal is active only (middle pin pulled down)

- EXP - exposure signal is active only (inside pin pulled down)
- FOC+EXP - both signals are active

- **drift**

A new guiding star position is read from the Camera. The „drift” is the offset to the guiding center where the star should be held at.

The next two following column contains the RA and DEC drift values measured in pixel units as fractional numbers. (The drift is scaled to the CCD’s horizontal pixel size which is 4.85µm because the pixel aspect ratio is not exactly 1:1).

The next two columns may be empty or store a fractional number (for RA and for DEC). An empty column means that no new autoguiding signal were calculated (and put out), in this case the device only accumulated the new position. This happens only if the „Num” of an axis’ guiding parameters is set more than one.

If there is a value, it means the calculated correction signal length (in seconds) put out to the ST-4 compatible output. (Note that this is the calculated value, a new signal that happens before the previous signal elapsed will „overwrite” it.) A zero value means that the autoguider signals are set to be inactive on that axis. The sign of the value shows the direction of the new correction signal.

This event is only stored when the autoguiding is working (has been started), there is a new guiding star position and the AutoExposure process is in the exposure state.

- **position**

The next two following column contains the X and Y raw star’s position of center. It is generated when You were saving positions with inactive autoguiding. Note that these X-Y coordinates are the raw CCD coordinates, what means the following:

- The Y coordinate must be multiplied with  $4.65/4.85 = 0.9588$  (= CCD pixel aspect ratio) to have coordinates for a virtual square-pixel CCD.
- For binned modes, the position is given in binned pixel units. The CCD pixel aspect ratio (above) must be applied as well.

- **Variable**

Stores the current value of some variable. The next column contains the variable’s identifier (name) and the 2nd next column it’s value, which’s format depends on the variable. The followings are stored in this version:

Name	Description	Value
gain	Camera gain	2...9
expo	Camera expo.time	50...4000 (ms)
thr.	threshold	1...99 (%)
RA	RA settings	*
DEC	DEC settings	*

\* = new variable+value column pairs come as they can be seen at the RA/DEC settings page (guiding screen, page 3 and 4).

- **ERROR: ...**

If the **event** starts with this string („ERROR:”) an unknown-type event is found in the data stream or is some error in it. Always use the same (or a later) version of PC Application as the firmware that stored data into the file in the device to avoid such cases!

### **3.3 HTML formatted output**

There is an embedded parser in the PC Application that interprets the stored events and generates a human readable output file of them.

The HTML is splitted into several sections, separated with horizontal lines. Currently only one type of section is available, the „Guided exposure”.

#### **Guided exposure #n:**

This is data and diagrams of one exposure that were done during an active autoguiding. The number of it (#n) is counted by the parser.

The date of starting the exposure can be seen next to the section name.

The „AutoExposure info” table shows the starting, ending time of the guided exposure along with the time spent in non-idle state(s) between them. All the values are meant in seconds with 0.1 step.

The „Point spread” diagram shows all the guiding star positions got from the Camera. The center of the diagram is the guiding center (where the star should be held). The background grid has one pixel width resolution to show the effective spreading of the position.

Next to this there is some information about the guiding positions and actions: how many positions were read from the Camera during the exposure, how many frames per second was the actual frame rate (in average), and how many times were a new non-zero length correction signal sent to the axes.

The „Guide star drifts” diagram is the same as the „Point spread” but the two axes (RA (top), DEC (bottom)) separately as a function of the time (horizontal axis). Some statistical data is shown for the data sets like mean and standard deviation. The full std. deviation interval is drawn right to the diagrams.

The „Approx. tracking error of the mount” is what its name suggests. The effective autoguider correction signals are used to reproduce the tracking error of the mount and/or the effect of the polar misalignment. The diagrams’ scaling is given. The unit is seconds, because it is independent of any of the used parameter settings, depends only on Your mount’s actual correction speed.