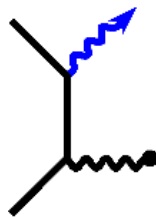


# Starter + Development kit for LCM2 and LCM3 display modules

Version 2.0.4



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# 1 Introduction

The starterkit intends to get you started quickly on using graphical LCM display modules. It can be used for LCM2 as well as for the new LCM3 modules.

This ensemble does not only work as a starter kit so you can see your display "alive", but it also is a development for developing your application software.

The starterkit provides additional components and software for development and, together with the display module chosen, allows you to start designing your own application quite easily.

Please note:

The software coming with this starterkit is classified as "Test Software" according to our General Software License (see appendix A). This License restricts the use of Test Software. Especially there is an evaluation period of 30 days. Also the windows "LCM-Toolbox" software will be only functional for 30 days. To obtain the full license under our General Software License, where the software is no longer classified as "Test Software" and can be used without the restrictions of test software, please submit the registration and license form to Simplify Technologies GmbH either by fax or letter.

This registration is **free of charge**. The registration form can be found in appendix B

*If you decide not only to use the LCM as a display module but rather want the LCM to handle your application completely, please contact us to explore the possibilities of explicitly programming and extending the LCM platform. The flexibility of the LCM allows for economically realizing your specialized application making the LCM the platform of choice for your current and future developments.*

*We also will gladly provide you with custom solutions and development services for your application if you like to have additional features for the system or want to take advantage of our software development services. If this handbook leaves certain questions open, please feel free to ask us.*

*We strive for providing reliable and solid solutions. However, the modules are not intended for purposes where a malfunction of the module results in a safety risk. It is the customers responsibility to only use the module in a way that such safety hazard is avoided. The information provided with this documentation is subject to change without notice as further development of the LCM platform, software and documentation proceeds.*

## 2 Getting started

### 2.1 Starterkit Content

This starterkit contains the following components (see fig. 1):

- A folder which contains the following printed documentation: This Starterkit Handbook, the GUI Interpreter Handbook.
- A CD-ROM which the following content:
  - The "LCM-Toolbox" software for Windows
  - The "Character-Compiler" software for Windows for converting and optimising fonts
  - Source code in ANSI-C as a basis for your development
  - The documentation in PDF format
- An adapter board for the LCM module with a reset button, power switch and connections for power supply and communication.
- A RS-232 cable for the connection with the PC.
- A cable for connecting the LCM module with the hardware of your product.



Figure 1: Content of the Starterkit

## 2.2 Putting it all together

To prepare for running the first example, please proceed as follows (see below for more details of these steps):

1. Install the Software from the CD-ROM onto your Windows PC.
2. Run the example provided

After these steps you can modify the example and create your own application.

### 2.2.1 Installing the Software

The LCM Toolbox software can be installed on Windows-PCs (developed for Windows XP, however source code is also provided on the CD for accessing the modules under Linux). Please remember to register the software free of charge to move from the evaluation license to a full license. Without registration and acceptance of the license the windows master will stop working after the 30-day evaluation period.

### 2.2.2 Connecting the hardware

Please refer to figure 2 for the connections to be made before operating the module.

1. Connect the cable of the adapter board with the respective connector of the LCM module.
2. Connect the power supply heads on the adapter PCB with a suitable power source. The voltage needed is 5,5 - 7,0 Volt, the current to be supplied is 1 Ampere for an 8 inch module. Smaller modules need less current.

The adapter PCB features reverse voltage protection to avoid damage to the module. Please make sure that polarity matches the indications on back of the adapter PCB as otherwise the module will not operate. Also, please do not power up the supply before the module is connected (no "hot-plugging").

3. Connect the Sub-D connector with the RS232 serial communications cable (1:1 cable) to the serial port of the PC. If your PC does not feature a RS-232 serial connection you can use a converter cable (USB-RS232). Please note that if you use an USB/serial converter, performance usually is lower as compared to a direct serial connection. This is due to the USB protocol and the specific Windows driver implementation.

The button on the adapter board is for resetting the module. The switch allows powering up and down the module.

### 2.3 Running the example

For running the example please start the LCM-Toolbox software. In the "Settings" menu select the serial port used and the baud rate you want (see figure 3).



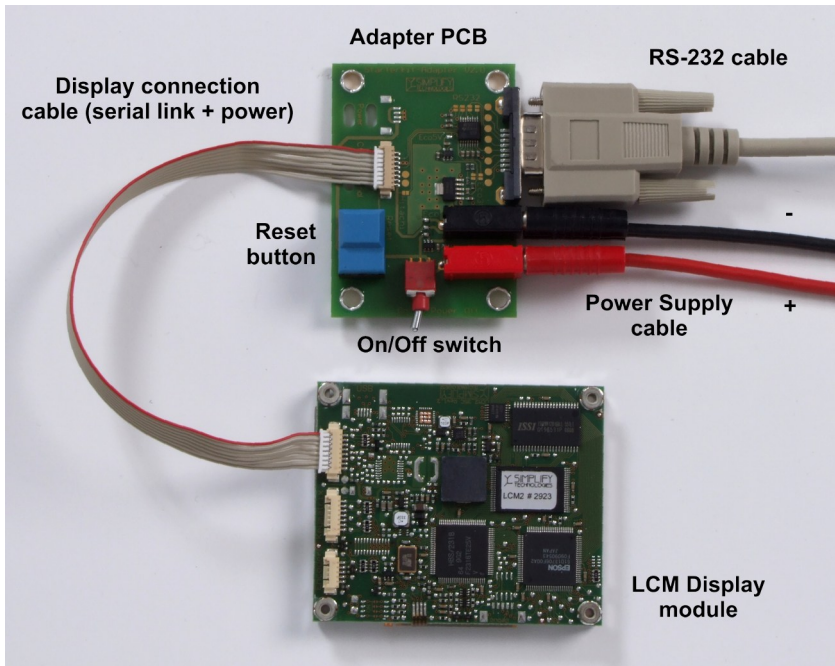


Figure 2: Connecting the Starterkit

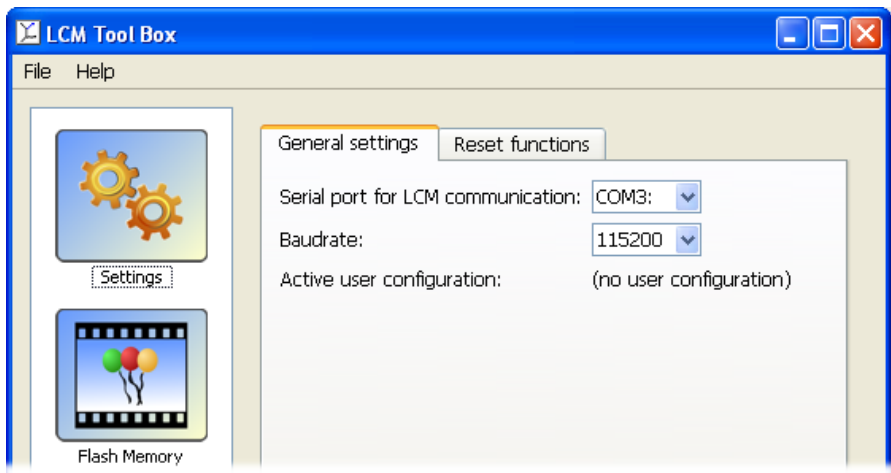


Figure 3: The LCM-Toolbox: Selecting communications parameter

### 3 Some more details

In the "GUI Master" menu select the program you want to run on the display as the "GUI-Master-Library". This program comes as a dynamic link library (DLL). An example DLL ("gui\_app\_lib.dll") is provided in the installation path of the software.

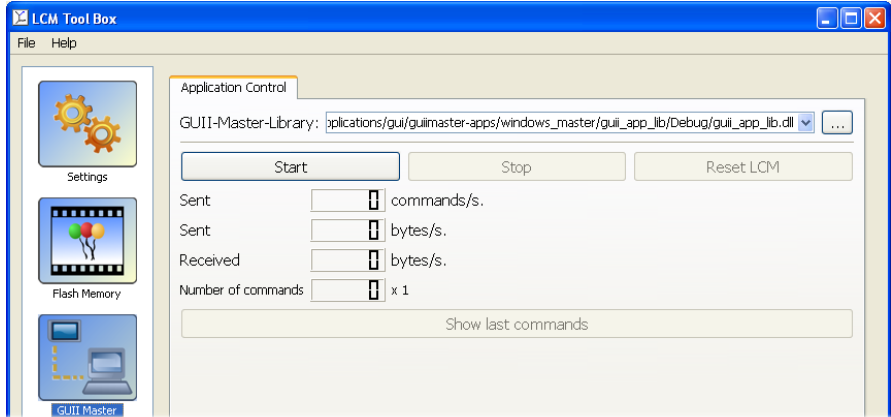


Figure 4: LCM-Toolbox: Executing an example

Now press "Start". The display should now react and show a simple example. As instructions are sent from the PC and responses are received, the master window will indicate how many data is sent and received. While the application is running, the start button is disabled and when the demo ends, it gets enabled again. The "Stop" button allows you to stop the demo at any time. It then becomes a "continue" button allowing to resume demo execution. With "Reset LCM" you can send a reset to the display module. The application is also reset upon exit of the GUI Master part of the LCM Toolbox.

### 3 Some more details

Let us look into more details on what the starterkit contains, technically.

Maybe you wondered why the software controlling the display has been called "master". This is due to the fact that the software on the modules follows a "master-slave" concept. As the display module does not know anything about the intended application, is designed to be the "slave". Some "master" must talk to it (on the serial line) to give instructions on what to show on the display.

Usually, engineers use modules like the present one within their devices which are working with a microcontroller. This one controls the logic of the application and

can also control a LCD module by sending commands (and therefore acting as a "master"). Figure 5 shows a scheme of this master-slave configuration. For getting you started quickly a master software for a PC is integrated into the "LCM-Toolbox" software provided with the starterkit.

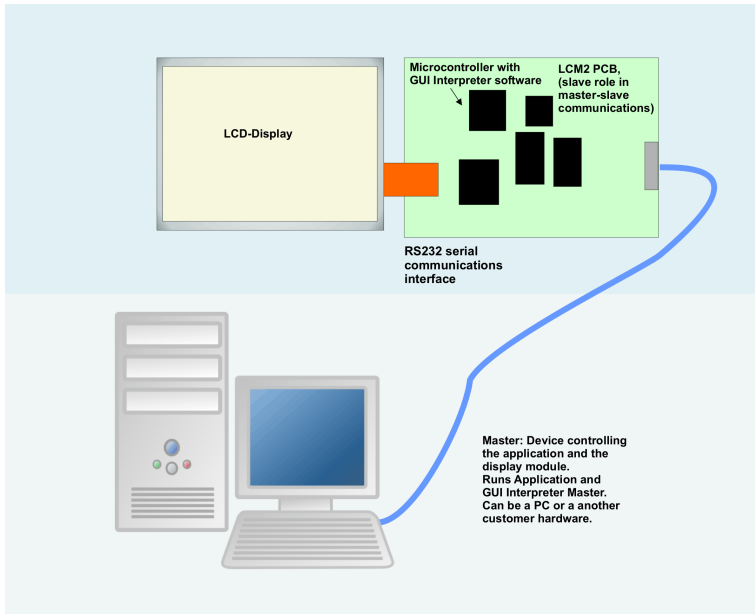


Figure 5: Overview of Master-Slave arrangement

The display module itself consists of the following major components:

1. The module itself contains a PCB (printed circuit board) with the interfacing for the display, communications and power supply. With the display mounted, it is a ready-to-go hardware solution for implementing a graphical user interface. Accessing the LCM from your hardware is realised by a serial interface.
2. The LCM is equipped with its own system software, the "GUI Interpreter", which receives instructions from your application on what to show on the display. The GUI Interpreter then interprets and executes these instructions and replies with a feedback to the request.

**Therefore, there is no need to explicitly program the LCM device itself. This significantly reduces the effort for developing your application software.**

## 4 Modifying the example

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Because the GUI Interpreter on the LCM modules acts as a slave in a master/slave environment, a master part is needed, too. It is assumed that your hardware which uses the LCM will act as the master, as it "knows everything" about your application. In order to get you started quickly, a "GUI Interpreter Master" is provided as a possible example for the realisation of such a software in the two following versions:

- A master software integrated in the "LCM Toolbox" software which runs on "Windows XP", right out of the box. This is what you see when you connect the LCM module to the PC and start the master software. Additionally, we provide an example project which allows you to change the application demo and to create your own application. **This allows you to start developing your application even before you have your application hardware ready.**
- An example master in ANSII-C source code. This piece of software can easily be compiled to generate a master software for various systems:

**for Linux:** Before compiling adjust the included Makefile to your system properties.

**for your hardware:** Before compiling provide a function for sending a byte and one for receiving a byte.

*The GUI-Interpreter Handbook covers the communication protocol details. In the comprehensive function reference the set of display commands is described. Thus, whatever programming language you decide to use for the master software, here is the information you need for implementing a master software different from the examples provided.*

## 4 Modifying the example

The example provided of course is an arbitrary one and its application most probably has nothing to do with the application you are thinking of. Thus, this example needs to be modified to finally end up as a piece of software useful for your purposes.

First, let's have a brief look on the structure of this application: The windows master consists of two components. First, there is the main window which you see after you started the program. Second, there is "gui\_app\_lib.dll", a DLL (dynamic link library) which contains the display application code. In order to modify the example application and to develop your own, you need to modify this "gui\_app\_lib.dll".

A sample project for "gui\_app\_lib.dll" is provided for Visual C++.NET 2003. This project can also be imported from the Visual C++.NET 2005 or 2008 Express Edition, which you can download free of charge from Microsoft. Please note that the Windows SDK which is also needed in order to build the project can also be downloaded from Microsoft.

To adjust the project provided to your environment, please proceed as follows: In the property dialog of the project go to "C/C++" / "General Properties" and add the following folders as additional include directories the "GUI\_Application\_Library..." folder and the subdirectories "GUI\_Master\_Library" and "Examples\_Includes". The project should now compile and the DLL to be chosen in the respective field of the windows master can be found in the "Debug" subdirectory. *Please press the "Reset LCM" button before generating a new demo version to allow the Windows master to release the DLL which will then be overwritten by the new one.*

If you do not want to use this development environment other programming tools could also be used to generate an equivalent DLL.

Now, let's do a simple modification on the application part of the Software. Figure 6 shows a screenshot of how the project and the application source code contained in the file "gui\_app\_lib.cpp" appear in Visual C++.NET 2005 Express Edition.

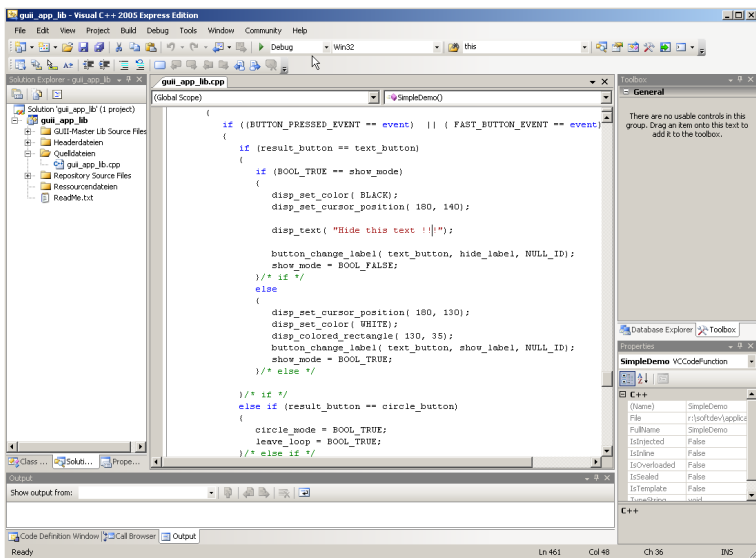


Figure 6: Screenshot while modifying the demo application

Modifications to change the display application code need only to be made to the file `gui_app_lib.cpp`. For example, as you can see in figure 6, if you want to change the text "Hide this text !!!" which is shown on the display under certain circumstances, it suffices to just modify the text in the development environment and to then build the project again.

## 5 What's next: Realizing your own application

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After starting the GUI Windows Master with this new library the demo behaviour has changed accordingly.

Feel free to modify this code and to use all the GUI Interpreter features and instructions. The GUI Interpreter provides quite some more instructions and possibilities as seen in the example. Please refer to the GUI Interpreter Handbook for a comprehensive explanation of how it works and for the full function reference which comes as an extra PDF document. In addition you will find on the CD of the starterkit example source code which shows how to use various graphical objects like menus, buttons, bar indicators etc.

Using the full scope of the GUI Interpreter functions should allow you to realise the complete graphical user interface of your application.

## 5 What's next: Realizing your own application

After you've had your first example up, running and modified, we have the following suggestions for developing your "real" application:

Depending on the size of your project, you may consider the following options:

- If you only need a relatively small number of units, you can use the LCM modules themselves and talk to them from your hardware directly.
- If your project will lead to thousands of units to be produced each year you may find it worthwhile to develop your own display interface, possibly closely integrated into your system. For these solutions we offer a software library (GUI library) which helps programming all those graphical and touch screen functions.

Let us shortly highlight some information on these two options:

### 5.1 Accessing LCM modules from custom hardware

If you want to control the LCM module from your custom hardware, this can be done similar to connecting the LCM to the PC for the demo. The first thing to do is to implement the master part of the communications software on your hardware. The source code provided should give you most of what is needed to do so.

The LCM supports several versions of a protocol and for a quick test, you can use it in ASCII mode. Using ASCII mode allows to even connect the LCM to a simple terminal program on a PC and type commands. So for the first trials with your hardware, you may try to just send some ASCII commands. For the more advanced features, binary communications is required. We recommend to use the full functionality of the binary protocol and to secure the data transmission with the CRC16 and other features provided.

If the programming language of your choice is not ANSI-C (which is used for the example master source code provided), you can of course use the language you like and implement the communications routines. Either way you find all the details and explanations of how to communicate with the LCM modul in the GUI Interpreter Handbook and in the Function Reference.

## 5.2 Developing a complete custom LCD interface

If your application requires a level of integration beyond what can be done when using the LCM modules and you want to develop your own display interface hardware, Simplify Technologies offers a software library for the display and touch functions. This software "GUI library" is widely compatible to the GUI Interpreter. It comes in ANSI-C source code and can be compiled for a large variety of processors. **Using the GUI library allows to easily port the applications developed using this starterkit to your custom hardware.** More information on the GUI library can be obtained from our website ([www.simplify-technologies.de](http://www.simplify-technologies.de)).

If you look for a solution still different from what has been proposed here, Simplify Technologies will also be glad to support you with development services for your display project.

## 6 Additional functions of the LCM Toolbox software

Additional to the execution of display applications the LCM Toolbox features the following functions:

1. Uploading of objects, pictures and slide shows into the flash memory of the module
2. Update of the GUI-Interpreter software of the LCM modules

### 6.1 Upload of objects, pictures and slide shows; defining the startup behavior

Using some binary objects (e. g. pictures) would take longer if they had to be uploaded into the LCM module via the serial link every time they get used. Therefore they can be uploaded at one time into the flash memory of the module. This can be done under the menu "Flash Memory" within the LCM-Toolbox. The respective "Config" tab allows to define more details. Here also the startup behavior of the module can be set to one of the following options:

1. The display is switched on and shows a small message (default behavior),
2. An empty screen is shown.
3. An arbitrary picture uploaded into the flash memory gets shown.
4. A slide show, consisting of various pictures, is presented. The properties of the slide show can be defined (e. g. the time period for which each image is shown). After a reset the module automatically starts the slide show. Pictures are changed after the defined interval. Alternatively on a module with touch screen pressing the touch allows to:

**Pressing on the left part of the display:** Go back one picture,

**Pressing on the central part of the display:** Pause / continue slide show,

**Pressing on the right part of the display:** Go forward one picture

The slide show can be stopped using the "Stop running slideshow" button in the "Settings" section and the "Reset functions" tab of the LCM toolbox software.

### 6.2 Software-Update of the GUI Interpreter

Under the "Update" menu a LCM module can be equipped with a new firmware version of the "GUI-Interpreter". For testing a dummy flash kernel can be used which just simulates the procedure without flashing anything. The memory image of the new software and a suitable flash kernel gets selected and by pressing of the buttons "Upload new software" the update is transferred into the LCM module.

For the details of using these functions please refer the the online help function of the LCM toolbox application.



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After registration a registration key will then be sent to you by email which can be entered into the GUI-Interpreter Windows Master software to lift the 30-day restriction. If you have questions about the license, we will be glad to help.

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a) Software is inherently complex and may not be completely free of errors. The software is for this reason not suitable for use in products or in a way that might result in damages in the event of software faults. This is especially the case if the software were to be used in safety-related applications such as in medical applications, aerospace and space applications, traffic technology, nuclear and military technology. This is expressly acknowledged by licensee when using the software. The results and possible damages resulting from the use of the software are the sole responsibility of the licensee. The licensee is obliged to verify and secure the fitness of the software for any particular purpose to which it is put.

b) The licensor and the suppliers and agents of the licensor shall not be held liable unless they act intentionally or with gross negligence. Liability claims for whatever legal basis, especially breach of an obligation other than by delay or impossibility, breach of duty during contract negotiations and tort are excluded. This does not hold if liability is mandatory, e. g. according to the german product liability law, in the case of intention or gross negligence, absence of warranted quality, violation of substantial contractual obligations, death or personal injury accountable to the licensor.

c) Liability is in particular excluded for the following damages: Licensor is not liable for loss of data. Licensee agrees to ensure that sufficient backups are made and appropriate data security measures are undertaken. Expressly excluded is the liability for loss of profit, interruption of business, goodwill, loss of business information or other property damages resulting from the use of the software or the fact that it cannot be used. Liability is also expressly excluded for incidental, untypical or consequential damages. This shall hold even if licensor has been advised of the possibility of obtaining such damages. A shift in the burden of proof for the disadvantage of the customer is not obtained with this regulation. Licensor hereby advises licensee to regularly check the results of licensee's work and to secure data on a regular basis.

d) In no case shall licensor's liability for damages exceed the amount paid by licensee for the software out of which such claim arose.

e) The limitation of liability shall also extend to all employees, representatives, agents, and suppliers of the licensor.

f) Licensee shall indemnify and release licensor from and against and defend from any claim, suit or proceedings relating to product liability.

g) Licensee shall be liable for all statements and claims made by licensee for distribution and marketing purposes.

### 8. Intellectual property rights of third parties

a) Licensor believes that for the Federal Republic of Germany the use of the software according to the license does not affect the intellectual property rights of third parties. If the use of the software nevertheless affects the intellectual property rights of third parties within the Federal Republic of Germany, licensor is liable against such third parties. Licensor does not warrant that the software is free of intellectual property rights of third parties outside the Federal Republic of Germany. Licensee is obliged to ensure that the software can be legally used outside the Federal Republic of Germany.

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b) Licensee shall inform licensor immediately if third parties claim that intellectual property rights have been infringed. Licensor shall pay the cost of any legal action arising from claims in relation to an infringement of intellectual property rights within the Federal Republic of Germany, and shall manage and control the defence or settlement of any such claims. Licensee shall pay the costs of any legal action for cases outside the Federal Republic of Germany

c) If the use of the software according to this license affects the intellectual property rights of third parties within the Federal Republic of Germany, the licensor, at his sole discretion but with consideration to the licensee's situation, shall decide whether to obtain a license, change the software or replace the software fully or partially, or ends the license.

d) If licensor does not settle the issue of intellectual property rights of third parties within the Federal Republic of Germany, licensee is entitled to withdraw from the license agreement. In the event that the holder of property rights prohibits licensee from exercising the license, payments of all kind made (e.g. compensation payments) shall entitle the licensee to claim or reclaim part of the licensing fee paid under clause 3 above of the license.

e) For software not purchased licensor can only be held liable due to infringement of intellectual property rights of third parties according to the provisions of this license in the case of gross negligence or intent.

#### 9. Miscellaneous

a) Transfer by the licensee of the rights granted under this license is only permissible if the prior written consent of the licensor to the transfer has been obtained.

b) Set-off against the obligation to pay the license fee can only be made by the licensee if he has accounts receivable from the licensor that have been accepted or have been legally validated.

c) If certain issues are not covered in this agreement the licensors general terms of sale shall apply as far as necessary for resolving the respective issue. Otherwise this license contains all contractual agreements made between the parties. No other oral or written agreements have been made. Modifications and additions to this contract shall only be valid if they have been made in writing.

d) In the event that any of the above provisions are held to be in violation of applicable law, void, or unenforceable in any jurisdiction, both parties agree to replace such provision(s) with a valid agreement that will - as far as is possible - achieve or lead to the same economic results as those intended, and that best complies with the overall intent of this contract.

e) Place of performance is the place of business of the licensor.

f) Place of jurisdiction for all issues arising from this license is, as far as is allowed by sec. 38 of the German Civil Code (ZPO), the seat of the licensor. This Agreement is solely governed by the laws of the Federal Republic of Germany. Application of the United Nations Convention on Contracts for the International Sale of Goods is hereby expressly excluded.

Version Date: 16.05.2007

## **B Registration form**

We have received the "General Software License" of Simplify Technologies GmbH, and would hereby like to register the Software contained in the LCM starterkit, and accept the "General Software License" of Simplify Technologies GmbH to solely govern the use of the Software for the starterkit and the LCM display modules.

Company: \_\_\_\_\_

Name: \_\_\_\_\_

Email: \_\_\_\_\_

Department: \_\_\_\_\_

Street: \_\_\_\_\_

Zip code, city: \_\_\_\_\_

Country: \_\_\_\_\_

Tel: \_\_\_\_\_

Fax: \_\_\_\_\_

The registration shall be sent to the email account given above.

Date and signature of the representative, duly authorized to this effect:

Date: \_\_\_\_\_ Company, Signature: \_\_\_\_\_