Elite LC

Clave2 Basic v2.2.2.2

Developer Guide

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Contents

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1

Overview

About the Guide

Mode	Model	Version	Releasing Date
Elite LC	Clave2 Basic	V2.2.2.2	June 2014

▪ CONVENTIONS USED

The following conventions are used throughout this document:

Italic	File Names and Directory Names.
Bold	Keystrokes, Menu Items, and Window Names and Fields
`Consolas`	API parameter
Arial	API Macro, Error Code
CAP	API Struct
	Critical Information

▪ DOCUMENT IMPROVEMENT

Document Writing Team dedicates to insure the accuracy and completeness of context. Your feedback will assist them to make continuous improvement on Clave2 document. Please do not hesitate to email us info@senselock.com.

What is Clave2?

Great Price Quality, Great Performance Stability

Clave2 is the most cost-effective software protection series for developers, designed to be an affordable and easy solution to protect software developers' interests. Within the kit, APIs, tools, strategy and sample programs are provided to help you integrate your software with Clave2.

Clave2 Basic is a combination of former edition Clave LC and authentication product iToken L100 that enables developers to apply on different field in a short time.

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Features

Clave2 Basic has an outstanding feature of built-in AES algorithm that is effective in fighting against “Soft-decryption” and direct physical attacks on the chip. Moreover, Clave2 Basic is also featured by a large space, rapid execution and convenient deployment.

1920-byte, Larger Space

Users can store more data, make the protection scheme more flexible and fulfill the requirement of protecting more software products (module) at the same time.

Driverless

Clave2 Basic supports HID standard, and in most circumstances, does not require installing the driver on purpose. It is highly compatible and convenient to use.

Rapid Execution

Users enable to set up more and higher-complex encryption points in order to increase the difficulty of decryption.

Multithread Access (Windows only)

It supports multi-thread access in hardware and teamwork between developers.

AES Algorithm Protection

128-bit AES (Advanced Encryption Standard) is commonly adopted over the world and binds the software and device more coherently.

Secure Channel

Using the AES algorithm to establish secure communication channels with application of random scrambling technology, Clave2 Basic have the communication data between equipment and software concealed so that crackers are unable to intercept any valid information.

Envelope Encryption

Without source code, users can implement the software protection rapidly by using envelope encryption.

Handy Remote Update

You can update the encrypted data remotely without callback of dongles. Furthermore, the updating process is reliable and secure that greatly improves work efficiency and saves the management and logistics costs.

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Simplified API

3 types of interfaces are supported:

Generic API supports VC, Delphi, VB, VBScript, JavaScript, C# and etc.

Middleware ActiveX Controls has demos in VB and Delphi.

Script ActiveX Controls has demos in ASP, ASP.net, PHP and JSP.

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2

Start to Know

Clave2 Basic is an easy-to-understand product for software protection. Before using LC, let us figure out few primitive concepts:

Developer ID

When you purchase Clave2 Basic at first time, the seller will assign you a Developer ID, a serial number that will write into all dongles in your following orders.

Under x86 system, Developer ID of Trial edition is “3F3F3F3F” in hexadecimal.

Under x64 system, Developer ID of Trial edition is “FFFFFFFF” in hexadecimal.

All trial products share the same Developer ID.

Password

Clave2 Basic uses password mechanism to manage different permissions. Privileges can be obtained after being verified genuinely and predefined into three levels:

ADMIN PASSWORD
Admin password owner has top privileges to set the memory blocks, other passwords.

USER PASSWORD
User is to invoke AES algorithm and read-writable data area (read-writable memory Block 0, read-only memory Block 1~3).

AUTHENTICATION PASSWORD
After the successful verification of password, it not only has privileges of User Password, but also can invoke HMAC algorithm to identify authorization.

All passwords are initiated with a string “12345678”. The Administration Password must be kept confidential and software developers must not place in the released software.

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Key

REMOTE UPDATE KEY

This is to verify the remote updating package, 20-byte binary. It is strongly recommended to set this key in pending remote update.

AUTHENTICATION KEY

If you plan to use authentication feature, before releasing devices, it is required to set different Authentication Key to distinguish the identity of device user.

Data Storage

Clave2 Basic has 1920 bytes of non-volatile memory in total which can be used long-term preservation of data without power supply. The storage area is divided into four blocks, including Block 0~2 (512 bytes respectively), Block 3 (384 bytes). During the read-and-write, all the blocks are required to be read or written as a whole, not cross-block.

With user privileges, Block 0 is read-writable; Block 1~3 is read-only. With admin privileges, all blocks are read-writable.

Memory Blocks	Size	User Privileges	Authentication Privileges	Admin Privileges
Block 0	512 bytes	Read-writable	Read-writable	Read-writable
Block 1	512 bytes	Read-only	Read-only	Read-writable
Block 2	512 bytes	Read-only	Read-only	Read-writable
Block 3	384 bytes	Read-only	Read-only	Read-writable

Memory blocks can be written at least 10,000 times. Reading operations are unlimited. Before using Clave2 Basic, please scheme appropriate writing operations.

Device SN

Device SN is short for Device Serial Number, which is used to uniquely distinguish the device form others. It is able to bind with software and trace back its using history.

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Project

Project is a file that is used in tool Developer. It is an emulated copy of device without storing passwords. You can create the protection scheme by creating and editing the project file instead of reading and writing into real device.

Batch Package

Batch Package is a clone of device with storing passwords and keys. It is used to produce the devices in batch by tool Batch Producer. The file itself is password secured which is predefined by software developer that guarantees the user of tool Batch Producer has no privileges to access the content of Batch Package, and effectively split up development process and deployment process securing the confidential data.

Remote Update Package

Remote Update Package is a file used to update the content of target device, in order to update validity of license or replace the expired device data. It can be generated by the tool Developer.

Remote Update Key of the Package must be according with the target device.

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Demo Using API

3

It is greatly recommended that using API function in your code can bring about more security and flexibility.

A common way is to write critical data in the storage and use them while running software that bounds software and device tightly for software cannot run without device at all. Moreover, you can use the read-writable area for storing temporary data in order to increase the cohesion between software and device.

Read Data

The demo codes in C of reading data from Clave2 Basic are as follows:

```
lc_handle_t handle;
int res;
unsigned char buffer[512]; /*Opening up LC*/
res = LC_open(1234 /*Filling your Developer ID*/, 0, &handle);
if(res) {
printf("open failed\n");
return -1;
}
/* Verifying Read-and-Write Password*/
res = LC_passwd(handle, 1, (unsigned char *)"12345678" /*Filling Read-and-Write
Password*/);
if(res) {
LC_close(handle);
printf("verify password failed\n");
return -1;
}
/* Reading data block, as a whole*/
res = LC_read(handle, 0 /* Filling the block number for reading*/, buffer);
if (res) {
LC_close(handle);
printf("read failed\n");
return -1;
}
```


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```
res = LC_close(handle);
```

AES Encryption

Besides that, AES encryption is another option for a tighter bound between software and device. We advise you to hit higher encryption strength by using AES.

AES is an advanced encryption algorithm and characterized by security that does not depend on the algorithm itself but the key (cipher code) used.

Without the key required, there is no way to simulate the calculation completely. Clave2 Basic has 128-bit AES built in, the corresponding input and output length is 16 bytes, which is long enough to avoid from monitoring and exhausting attacks.

There is a variety of ways to actualize AES validation process. The most common is to calculate the input/output data and to store in the software, then to select partial data from running software and to make a comparison between both results. Only if the results are identical, the device is taken valid.

In addition, AES encryption algorithm can be applied to encrypt partial data of pre-protected software and to decrypt by using device afterwards while running the software.

For more API encryption information, please see samples in SDK.

The demo codes in C of using AES algorithm to verify devices are as follows:

```
lc_handle_t handle;
int res, rnd;
/* Pre-invoke data from code table of LC*/
unsigned char aesTable[] = {
/* Code Table 001 */
0x00,0x01,0x02,0x03,0x04,0x05,0x06,0x07,0x08,0x09,0x0a,0x0b,0x0c,0x0d,0x0e,0x0f,
/* Plain Text*/
0x00,0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88,0x99,0xaa,0xbb,0xcc,0xdd,0xee,0xff,
/* Cipher Text*/
/* Code Table 002 */
/* Pre-calculate data from code table*/
/* ... */
/* ... */
};
unsigned char buffer[16];
/* Initiating the random number generator */
```


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```
srand(time(NULL));
/* Opening up LC*/
res = LC_open(1234 /*Filling your Developer ID*/, 0, &handle);
if(res) {
printf("open failed\n");
return -1;
}
/* Verifying Read-and-Write Password*/
res = LC_passwd(handle, 1, (unsigned char *)"12345678" /*Filling Read-and-Write
Password*/);
if(res) {
LC_close(handle);
printf("verify password failed\n");

return -1;
}
/* Randomly pick up a Code Table*/
rnd = rand() % (sizeof(aesTable) / (16 * 2));
/* Invoke LC to conduct AES calculation*/
res = LC_encrypt(handle, &aesTable[rnd * (16 * 2)], buffer);
if (res) {
LC_close(handle);
printf("read failed\n");
return -1;
}
/* verifying the algorithm results*/
if (memcmp(buffer, &aesTable[rnd * (16 * 2) + 16], 16)){
LC_close(handle);
printf("invalid device!\n");
return -1; /* Device does not match */
}
res = LC_close(handle);
```


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Envelope Protection

4

The envelope protection can help you make a rapid encryption that effectively reduces the efforts you put on. It does not require any amendments on source code, but the enveloper only. Therefore, it is available to add extra protection codes in the compiled binary program for avoiding authorization from being abused. This is the most time-effective solution but with a drawback of less strength, in contrast to the way of calling API which we strongly recommend.

The enveloper works with whole Clave2 series and differentiates from other conventional tools. Its basic principle is to bind the shell with the inner stored data, and only execute with the corresponding device, that dramatically increase the difficulties to decrypt.

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Remote Updating

5

Mechanism

You can write data area remotely without admin password. This solution greatly reduces your expenditure on maintenance. The remote update is a signature process based on the standard HMAC algorithm that ensures data integrity.

You have to set remote-update key in the device in advance and use it to write a digital signature while making a corresponding update package. The device will only be updated after the success of verification. In this case, any changes to update package will be detected in the transmission that definitely solidifies the update process.

The remote update can only be applied to a single data area ranging from memory Block 1~ 3. The data stored before will be overwritten as a whole. If you would like to update multiple data area, you have to generate corresponding update package respectively.

The Remote Update Key (cipher code) must be set from the device in advance, and required for making update package.

The Device SN is required before generating the update package in order to select the target device.

Use the remote upgrade feature, the memory block 1~3 to retain the first 4 bytes, use the first of their pre-cleared, and ensure that future updates are the first 4 bytes of 0x00. While using the remote update feature, the first 4 bytes of data area ranging from Block 1~ 3 have to be retained.

Furthermore, it is flexible to use the kit and API functions to generate the update package.

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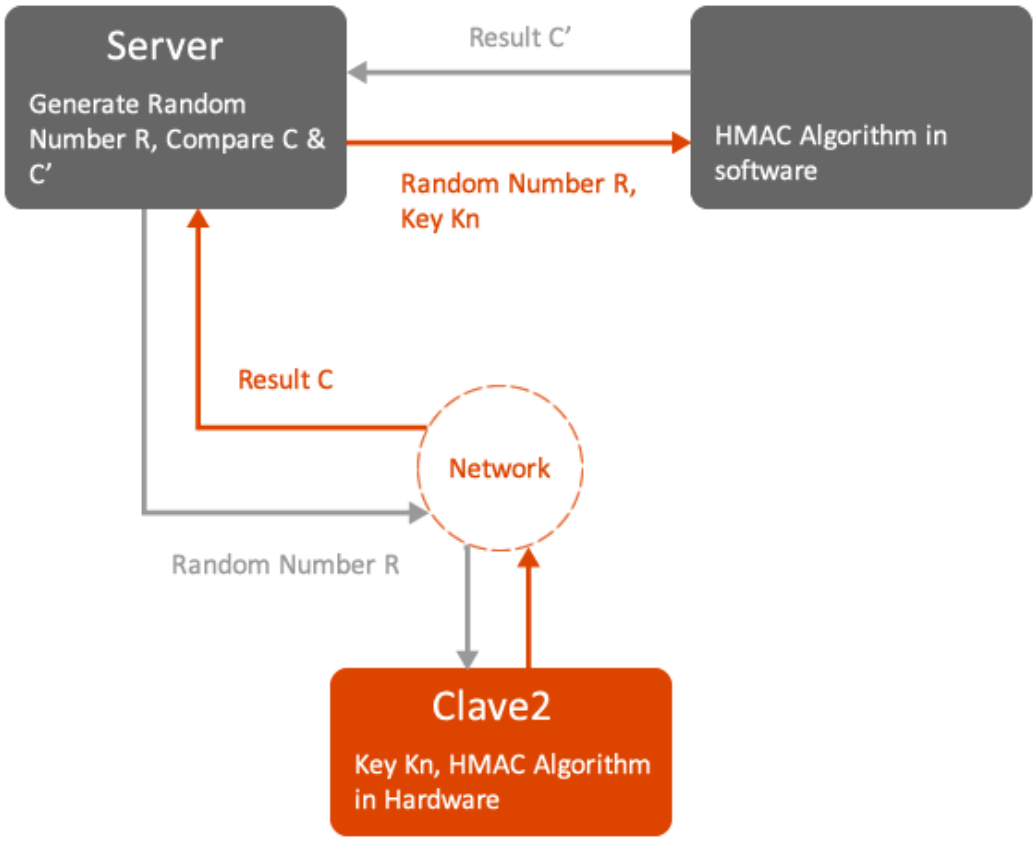
Authentication

6

Mechanism

Clave2 is armed with HMAC-SHA1 algorithm, and able to implement challenge-response authentication instead of conventional username-password method. Its general mechanism is as follows:

Put the key Kn in the device in advance. While authenticating, the server side sends a random number (challenge) to the device on client side, and verifies if the result is calculated based on the key Kn. If the verification is successful, it is confirmed that the client side has such key Kn.



If you plan to use authentication feature, before releasing devices, it is required to set different Authentication Key to distinguish the identity of device user.

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Tool – Enveloper

7

Please refer to the document *Clave2 Basic Enveloper Guide_en*.

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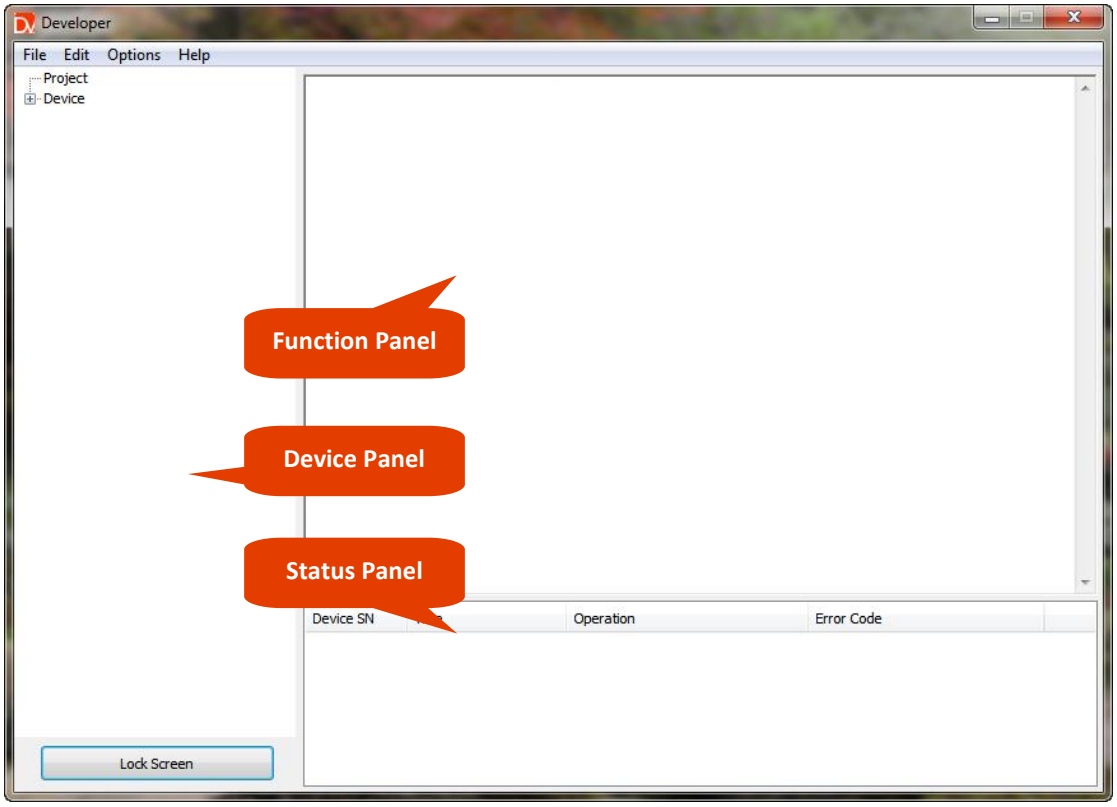
Tool – Developer

8

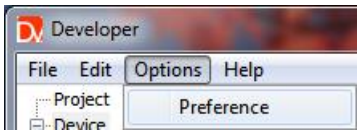
Developer is used to create and edit the data inside the device, set passwords and keys on different levels, check the device information, export Project and Batch Package.

Main Window



Set Up Work Space

1. Click **Preference** of drop down menu **Options** from top menu bar.



2. In the tab General, you could define your own **Start Page** when launching the program.

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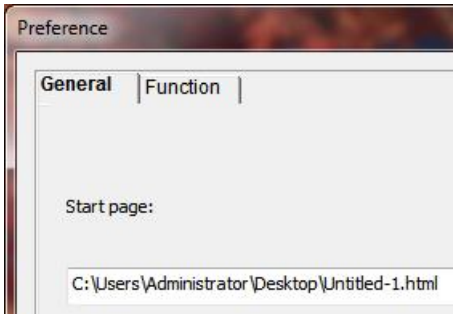
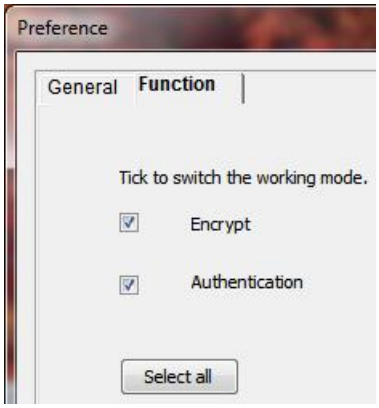


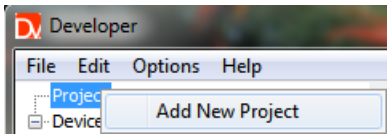
3. In the tab **Layout**, tick the checkbox **Encrypt** or **Authentication** to select the working mode:



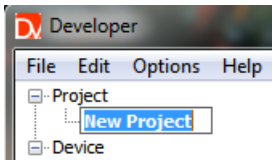
Edit Project

Create a Project File

1. Right click the node Project in the tree view.



2. A new project file will be created under the node **Project** after click the item **Add New Project**. You could rename later by triple click the project name.



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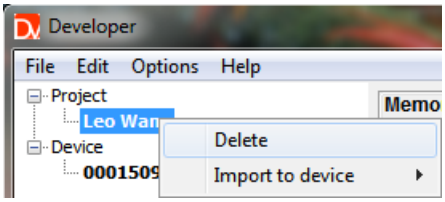
Delete the Project File

1. Right click the project file **Leo Wang** in the tree view.



2. Click the item **Delete**, and a dialogue box **Delete project file** will pop out to ask you to confirm deletion.

Export to Device

It is to export the current data from a project into the device directly. The passwords and keys of the device will be remained.

1. Right click the project file **Leo Wang** in the tree view.

2. Click the device in the extended menu of item **Export to Device**. The content of project file will be made a clone in the chosen device. Designing the scheme with project file and writing into device afterwards will decrease writing operations.

Edit Device

Open Device

1. Plug in a device after launch the Developer. A dialogbox **Input Password** will pop out.

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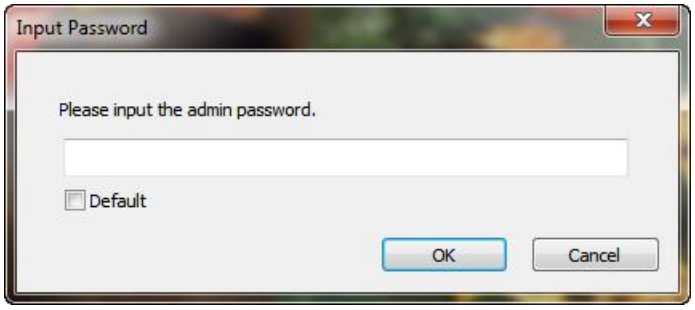
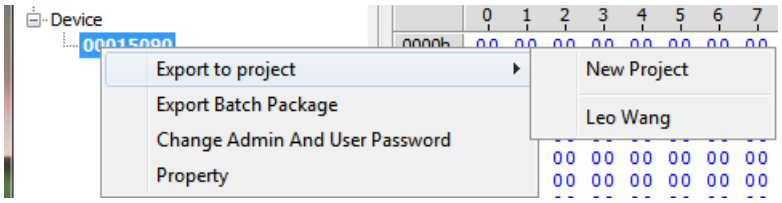


2. You are required to input the valid Admin Password before accessing the device. The checkbox **Default** is designed to auto-type original password “12345678” for convenience of development.

Export to Project

It is to export the data in memory block to a Project file in order to review or save as a template in further development.

1. Right click the device **00015090** in the tree view. A dropdown menu will slide out.



2. Hover on the item **Export to Project** to activate an extended menu. Copy the data in the memory blocks of device to a new project file by clicking **New Project**, or to an existing project **Leo Wang**.

Get Project File

The project files are stored in a folder **Project** under the same path with Developer. It will be generated automatically by launching the tool.

It is available to transfer project files from other places; the Developer will refresh them out automatically from the default folder **Project**.

Export to Batch Package

It is to export the current data into Batch Package file with passwords and keys setting required.

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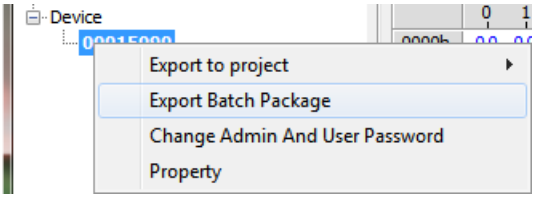
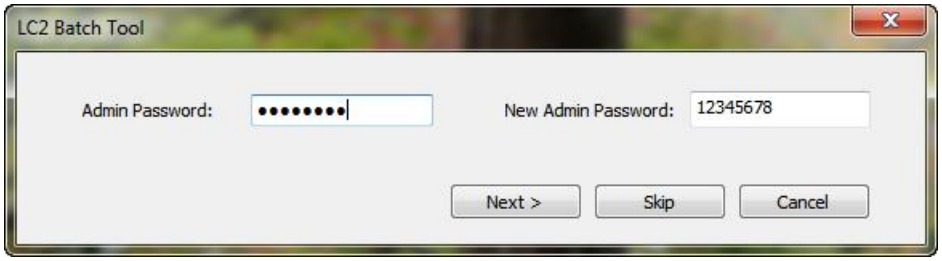
1. Right click the device **00015090** in the tree view. A dropdown menu will slide out.



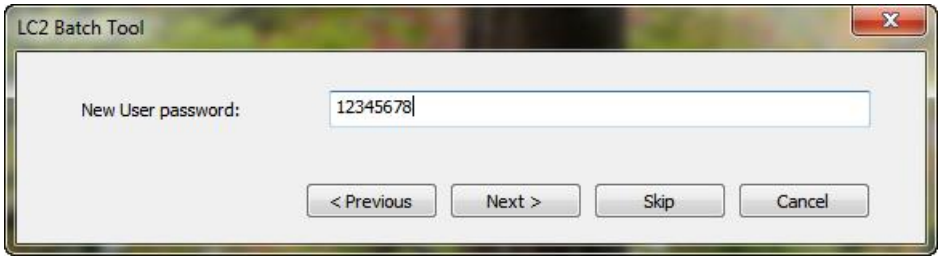
2. Click the item **Export Batch Package** to have dialogbox **Set up Batch Package** as following.



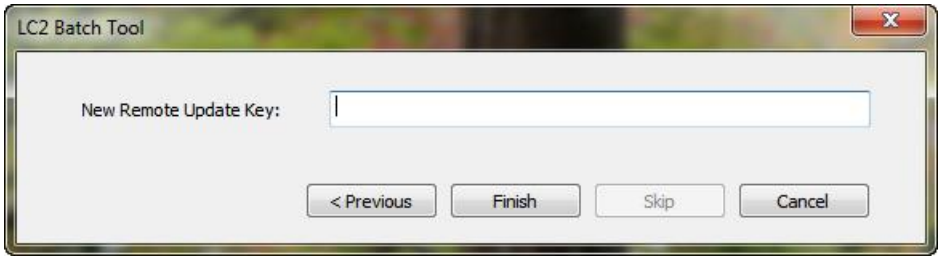
Admin Password of Batch Devices should be identical to those which are about to be produced in batch mode. For producing brand new dongles, you should not fill out and the program will take it as default.

New Admin Password of Batch Devices is required to set, for releasing dongles must not have default Admin Password.

3. Click **Next** with valid input or Click **Skip** to leave values by default. Then the dialogbox will ask to set **User Password of Batch Devices**.



4. Click **Next** with valid input or Click **Skip** to leave values by default. Then the dialogbox will ask to set **New Remote Update Key of Batch Devices**.



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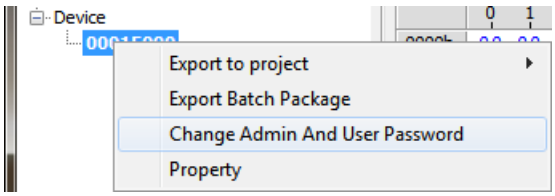
5. Click **Finish** to complete setting up the content of Batch Package file. Leaving **New Remote Update Key of Batch Devices** blank will be taken as default.
6. A new dialogbox **Set up File Password** pops out to require 8-byte password setup for Batch Package file.

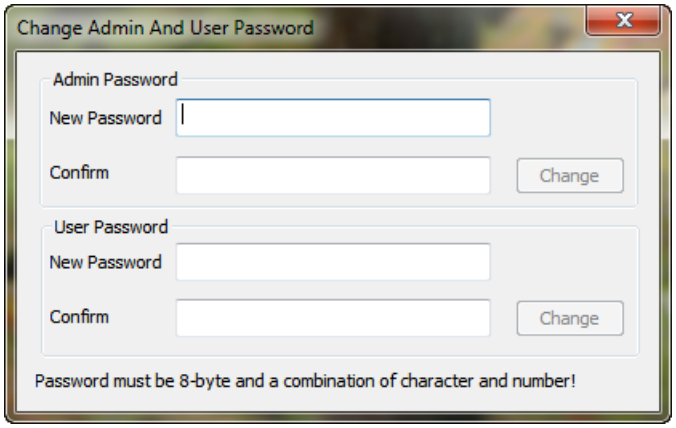
   This design is to guarantee the security of Batch Package file without being abused, for it contains critical information. Unlike Project file, it is a full copy of device and must be preserved in confidence.

Change Admin and User Passwords

1. Right click the device **00015090** in the tree view. A dropdown menu will slide out.

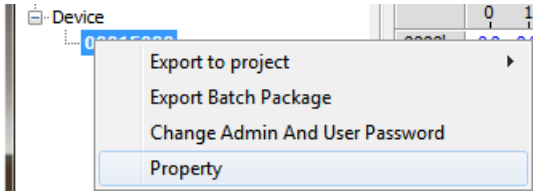


2. Click the item **Change Admin and User Password** to have dialogbox **Change Password**.



Check Device Property

1. Right click the device **00015090** in the tree view. A dropdown menu will slide out.



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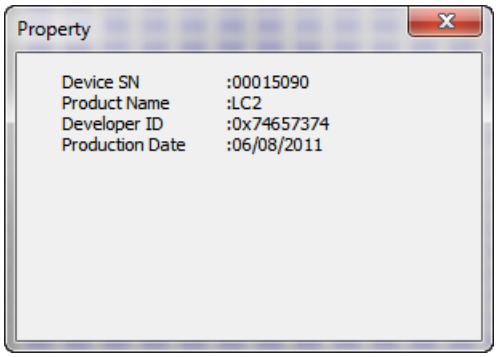
2. Click the item **Property** to have dialogbox **Property**.

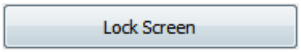


Get Batch Package File

The batch package files are stored in a folder **Batch Package** under the same path with Developer. It will be generated automatically by launching the tool.

While finishing generating a batch package, the program will remind you to select a path to store. The default path is the folder **Batch Package**.

Lock Screen



This button is a shortcut to lock the screen while the developer is away from the desk. As the previous experience keeps reminding us, human being is always the weak part of the security chain.

Edit Memory Blocks

Memory Blocks has two columns: Hexadecimal and Text. Select either a Project or device; the function panel will switch into tabs that have Memory Blocks.

Switch among Memory Blocks

Memory is sliced into four data blocks, and the scroll bar enables to browse row by row. We also setup four buttons to jump into the specific block instantly as follows.

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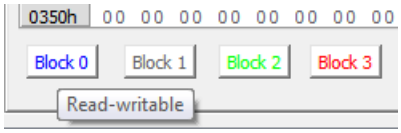
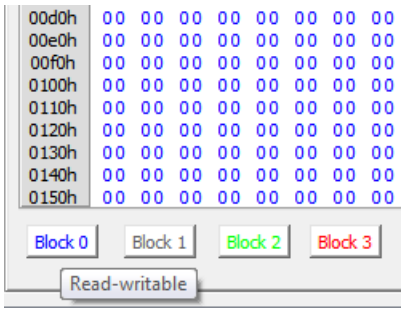
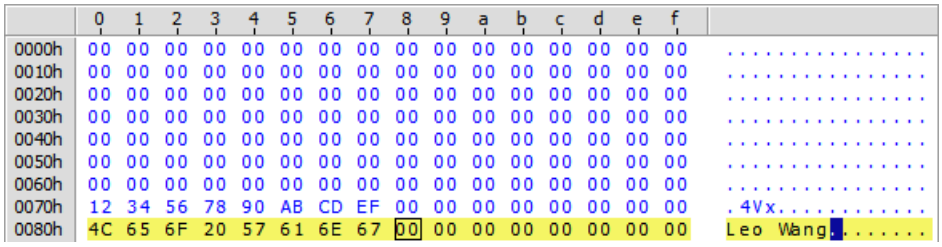
1. Hover on the button **Block 0**, a tip will show up with read & write attribute under User privileges. With Admin privileges, all four blocks are read-writable.



2. Click **Block 0** to switch to memory block 0.



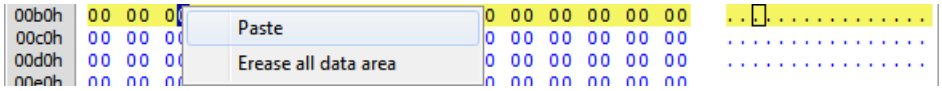
Type Directly



1. It is available to type in hexadecimal number 0~9 and A~F directly in the hexadecimal column or plain text in the text column, for instance, “Leo Wang”, which will be converted into hex format automatically and display in hexadecimal column, and vice versa.

Paste from Clipboard

1. Right click in the memory block that you would like to start pasting, a shortcut menu will pop out.



2. Click the item **Paste**. If the data length from clipboard exceeds the capacity of memory block, a dialogbox will remind you instantly.

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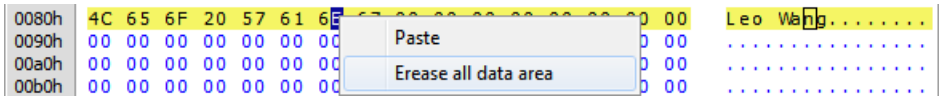
Erase Memory Blocks

1. Right click anywhere within the memory block, a shortcut menu will pop out.



2. Click the item **Erase All Data Area** will delete all data stored in the memory blocks, but only effect after hitting **Save**.

Save Changes

It works as same as write data into the Project or Device. When no changes come upon the memory blocks, the button **Save** will maintain unavailable in grey.

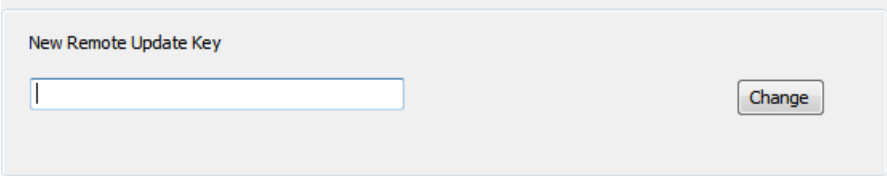
Disregard Changes

As any changes that come upon the project or device are emulated, this button **Disregard** is same to read data from the Project or Device.

Set Remote Update

Change Remote Update Key

1. Select a device and go to the tab **Remote Update**.



2. Enter the text field with 20-byte hex number under **New Remote Update Key** and click **Change**.

Generate Remote Update Package

1. Edit the data in memory blocks of a device as the content of the remote update package.

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It is required to clear first 4 bytes of target block (1~3) before generating remote update package, and to value 0x00 for the first 4 bytes of target block of forthcoming remote update packages.

2. After editing the data in memory blocks of a device, go to the tab **Remote Update**.

3. Fill out with Remote Update Key, Device SN and Block Number (1~3) and click **Generate Remote Update Package** to choose a path to save. The default name is in the format of, for instance, SN_00015090_block_1.data.

Set Authentication

Change Authentication Password

1. Select a device and go to the tab **Authentication**.

2. Enter the text field with a 8-byte hex number under **New Authentication Password** and define **Retries** (The value could be 1~15, or -1 that will disable the function of retries), then click **Change**.

Change Authentication Key

1. Select a device and go to the tab **Authentication**.

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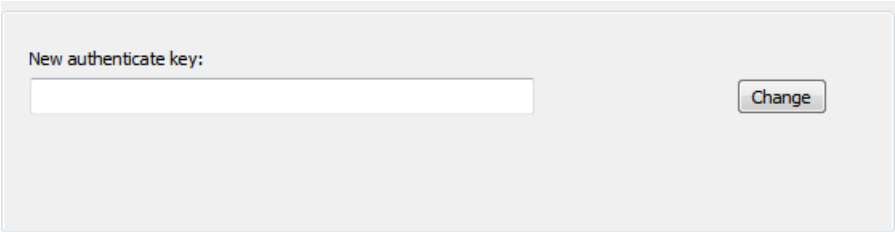

2. Enter the text field with a 20-byte **New Authentication Key**, then click **Change**.

Review Operation Status

Check Operation Results

Device SN	Time	Operation	Error Code
00015090	2011-11-24 09:45:59	Application start	Successful
00015090	2011-11-24 09:47:57	Read Device	Successful

The status panel logs all operations related to device by **Device SN**. The error code tells you about the operation status to avoid possible maloperation.

Rows are listed by time in ascending order. Click the header cell **Time** to view in descending order.

Get Device Log File

The log files are stored in a folder **Log** under the same path with Developer or Batch Producer. It will be generated automatically by launching the tools.

The log could be sent to tech support as an attachment while suffering the malfunction of devices.

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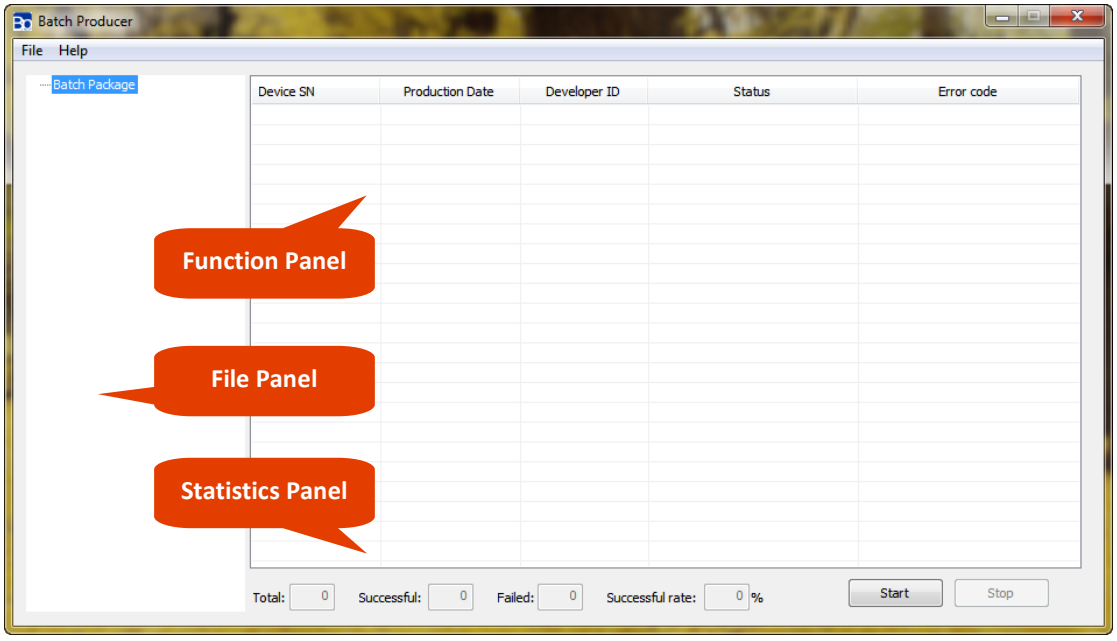
Tool – Batch Producer

9

Batch Producer is used to produce devices in large quantity. Its design is to import the Batch Package file and apply on device one by one.

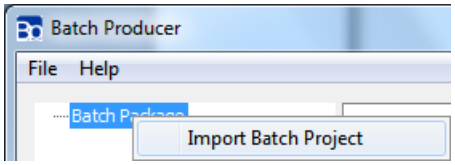
Main Window



Edit the Batch Package

Import from Batch Package

1. Right click the tree node **Batch Package** in the File Panel. A dropdown menu will slide out.



2. Click the item **Import Batch Project** to activate a dialogbox to select specific Batch Package file **Test.LC2f**.

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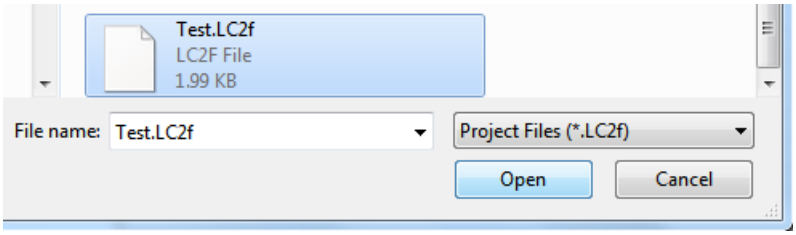
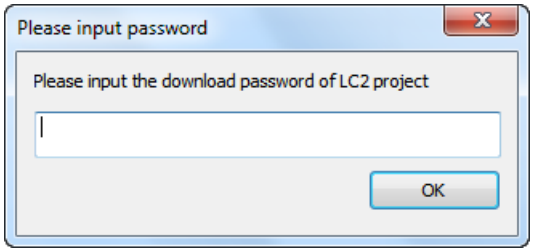
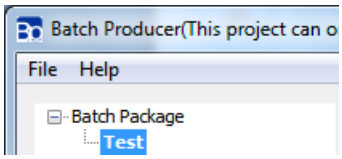


3. Then a dialogbox **Input Password** will require the 8-byte password to Batch Package file that you pre-set via the Developer.

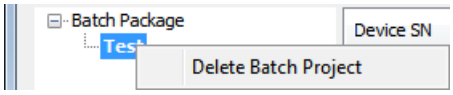


4. After inputting a valid password, the imported Batch Package file **Test** will be listed in the tree under **Batch Package**.



Delete Batch Package

1. Right click the imported Batch Package file **Test** in the file panel. A dropdown menu will slide out.



2. The deletion will only remove the Batch Package from the Batch Producer, not the file itself. That means that you can import anytime afterwards.

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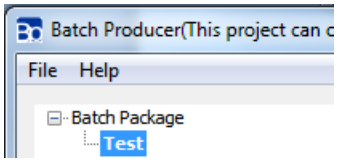
Use Batch Package

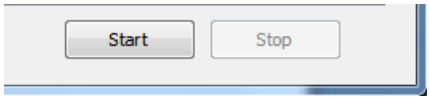
Produce the Device

> The Developer ID of the device to be produced must be identical to the device that used to export the Batch Package file.

1. Select the Batch Package **Test** from the tree of file panel.



2. Click **Start** from the statistic panel to get into batch producing mode.



3. Plug the device to be produced, the Batch Producer will work automatically. After few seconds, the grid in function panel will display the result for the device.

Device SN	Production Date	Developer ID	Status	Error code
✔ 00015090	2011-06-08	74657374	Setting device is completed	Successful

4. It is available to either click **Stop** to quit the batch producing mode or pull out the finished device and plug other device to be produced.

> It is required to re-plug after clicking **Start**, if the device to be produced was already plugged.

Check Producing Results

Each time the device is being produced, no matter succeeded or failed, the relevant results will be displayed in the statistic panel on the lower left.

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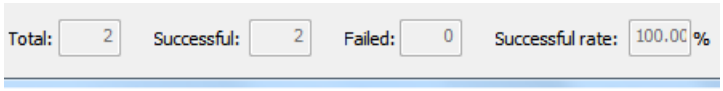

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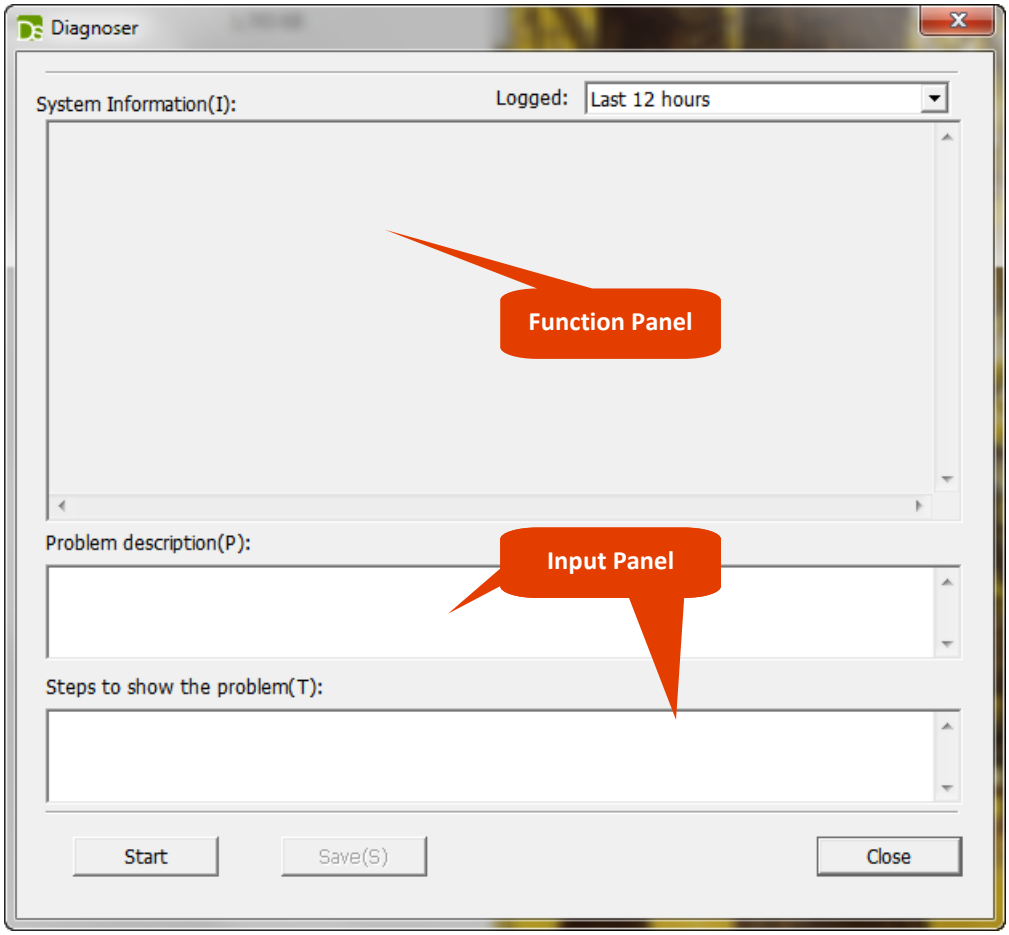
Tool – Diagnoser

10

Diagnoser is the new tool for users to provide the information of using environment in detail for software developer or us. After the collection completed, you could input the problem description and how to review the problem as well. For all information collected will be saved in a text file and ready to be emailed out as attachment.

Main Window



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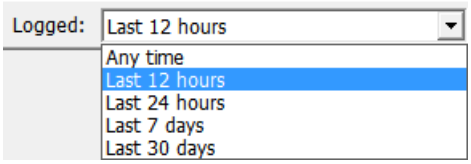
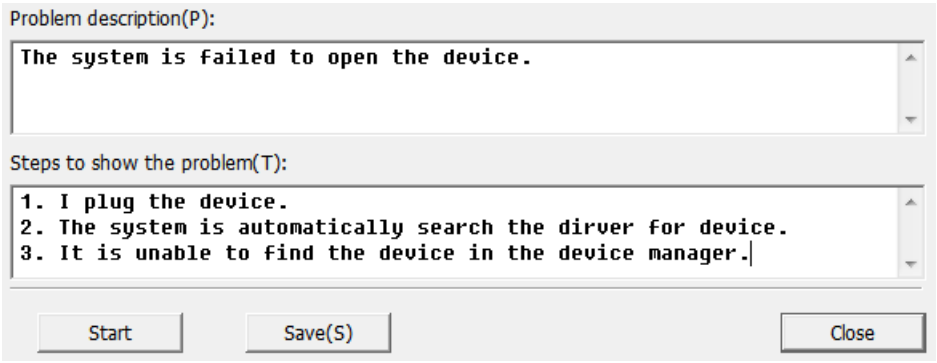
Diagnose Use Environment and Device

Collect System Information

1. Click the dropdown list **Logged**, to select a time slot since the issue came out.



2. Click **Start** to collect the sytem informaton on use environment and device, a dialogbox containing progress bar will pop out afterwards. Click **OK**, after the process is done.
3. Fill out two text fields **Problem Description** and **Steps to Demo the Problem** in the input panel.



4. click **Save**, it will require to select a path to store save the collected information and the text you wrote in the format of text.
5. Then you could attach the file and email back to tech support, for end-user, it is more suitable to send to the software vendor.

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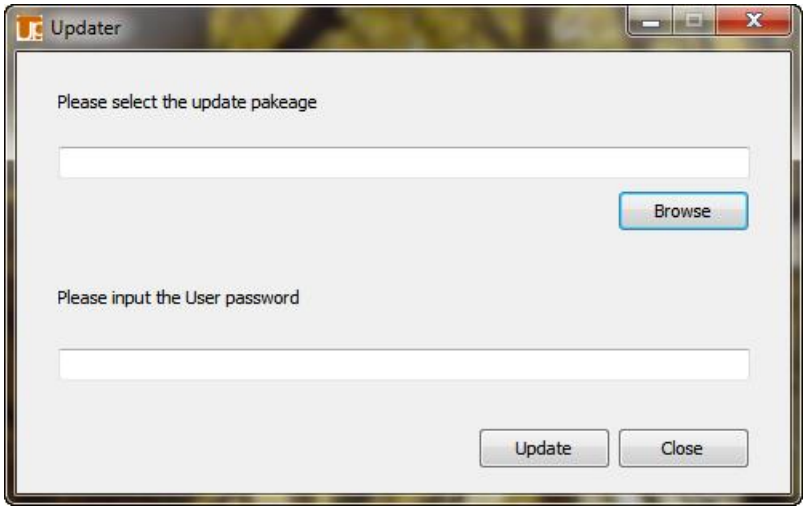
Tool – Updater

11

Updater is the tool that updates the device content with remote update package issued by the software developer.

Main Window



Update the Device

Load Remote Update Package

1. After using the Developer to generate a remote update package, click **Browse** to select and load into the Updater.
2. Input a valid User Password, and click **Update** to finish.

> The Remote Update Key that you initiated the device must be as same as the Remote Update Package that you set with the Developer. Otherwise, it will not be successful.

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Trouble Shooting

12

Q1: How to change password at all levels? What are privileges under each level respectively?
A1: After verification of administration password, you can call **LC_set_passwd** function to modify all passwords. After verification of authentication password, you can call **LC_change_passwd** function to make device self-modified.

About password privileges at all levels, please refer to the corresponding chapters of the development guide.

Q2: What password do you need to write data?
A2: Block 0 is writable after the verification of any password. Block 1~ 3 is only writable to administration password.

Q3: How to write data more after than 512-byte?
A3: The memory of device is divided into blocks. Except for Block 3 (384 bytes), each block can store 512 bytes that needs to be read and written as a whole. Therefore, reading or writing the data beyond block boundaries requires operations on different blocks.

Q4: What operations do I need to open the device? After opening the device, do I have to shut it down?
A4: Except retrieving the version number of software, the other operations require device must be turned on. When you no longer use device, please shut it down to avoid an error next start-up.

Q5: Why do I get the encrypted data that look like corrupted characters (Unrecognizable)?
A5: Due to the use of AES encryption technology, input/output data within LC are binary code. If you need input/output data in the format of string, you can make an encapsulation based on AES function of encryption and decryption, for instance, using BASE64 encode.

Q6: On a computer with more than one type of software using the device, is it possible to cause conflictions among those devices?
A6: LC devices with same Developer ID can be used simultaneously. You only need to use different index values to traverse all LC devices when calling **LC_open** function.

Q7: In batch Production of dongles, the tool kit provided does not meet my requirements.
A7: I suggest you use API functions to develop your own production tools. Please contact us directly if you have any questions.

Q8: What is the Device SN?
A8: The device serial number is globally unique, unchangeable and designed to manage different devices or customers.

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Specification

13

Item	Value	Note
Working Voltage	DC 5V +/- 5%	
Max Consumption	100mW	
Working Temperature	0°C~70°C	
Data Retention	10 Years	Typical
Write Circles	10,000	Lowest
Connection Type	USB 2.0	Low speed with HID

Item	Value	Note
AES Encryption Time	20ms	avg.16 bytes
AES Decryption Time	26ms	avg.16 bytes
Reading Time	179ms	avg.512 bytes
Writing Time	246ms	avg.512 bytes
HMAC Calculation Time	185ms	avg.100 bytes

Operating System Supported:

Windows 2000, Windows XP, Windows Vista, Windows 7, Windows Server 2003, Windows Server 2008, Mac OS, Linux

Programming Language Supported:

VC++, C#, Java, Delphi, VB, AutoCAD

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