SOYAL

Mifare® Open System Rules Programmer Manual

Licensee Training Instruction

V080215

Index

1. Introduction：

1-1. Mifare Card

Sector 00		Sector 08	
Block 00（00）	Manufacturer Block	Block 32（20）	
Block 01（01）		Block 33（21）	
Block 02（02）		Block 34（22）	
Block 03（03）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 35（23）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 01		Sector 09	
Block 04（04）	SOR	Block 36（24）	
Block 05（05）		Block 37（25）	
Block 06（06）		Block 38（26）	
Block 07（07）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 39（27）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 02		Sector 10	
Block 08（08）		Block 40（28）	
Block 09（09）		Block 41（29）	
Block 10（0A）		Block 42（2A）	
Block 11（0B）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 43（2B）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 03		Sector 11	
Block 12（0C）		Block 44（2C）	
Block 13（0D）		Block 45（2D）	
Block 14（0E）		Block 46（2E）	
Block 15（0F）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 47（2F）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 04		Sector 12	
Block 16（10）		Block 48（30）	
Block 17（11）		Block 49（31）	
Block 18（12）		Block 50（32）	
Block 19（13）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 51（33）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 05		Sector 13	
Block 20（14）		Block 52（34）	
Block 21（15）		Block 53（35）	
Block 22（16）		Block 54（36）	
Block 23（17）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 55（37）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 06		Sector 14	
Block 24（18）		Block 56（38）	
Block 25（19）		Block 57（39）	
Block 26（1A）		Block 58（3A）	SOR
Block 27（1B）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 59（3B）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF
Sector 07		Sector 15	Event Log
Block 28（1C）		Block 60（3C）	
Block 29（1D）		Block 61（3D）	
Block 30（1E）		Block 62（3E）	
Block 31（1F）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF	Block 63（3F）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF

1-1-1. Manufacturer Block:

This is the first data block (block 0) of the first sector (sector 00). It contains the IC manufacturer data. Due to security and system requirements this block is protected and un-writable by the IC manufacture at producing process.

1-1-2. Data Blocks:

All sectors contain 3 blocks of 16 bytes for storing data (Sector 0 contains only two data blocks and read-only manufacturer block). The data blocks can be configured by the trailer configure as

- Read/Write blocks, for example: literal sentence or contact-less access control.
- Value blocks, for example: electronic wallet applications, where additional commands like increasing and decreasing for direct control of the stored value are provided.

1-1-3. Trailer Blocks:

Each sector has a trailer block containing the access conditions for the four blocks of sector, which are stored in bytes 6~9. The trailer configure also specify the type of the data blocks. However, SOYAL has arranged two most common-used configure for programming mifare system.

Default (FF078069):

Key A Read/Decrease, **Key A** Write/Increase

A: Decrement B: Increment:

Key A Read/Decrease, **Key B** Write/Increase

Sector **00**	
Block 00（00）	*Manufacturer Block*
Block 01（01）	**(Data Block)**
Block 02（02）	**(Data Block)**
Block 03（03）	FFFFFFFFFFFF**FF078069**FFFFFFFFFFFF

Trailer Block

Trailer Block	Key A	Trailer Config	Key B
	0~5 bytes	6~9 bytes	10~15 btes
	FFFFFFFFFFFF	**FF078069**	FFFFFFFFFFFF

Sector 02	
Block 08（08）	*(Data Block)*
Block 09（09）	*(Data Block)*
Block 10（0A）	*(Data Block)*
Block 11（0B）	FFFFFFFFFFFFFF078069FFFFFFFFFFFF

Trailer Block

1-2. AR-737P:

The AR-737P is the smartest programmer in contact-less Mifare® Smart Card System. It is designed to improve read/write performance of contact-less Mifare® applications. Choosing AR-737P is the royal road to hasten and simplify the integrated software development.

1-2-1. Features:

- Supports single instruction auto CRC8 check and auto backup/restore function.
- Supports RS-232 or USB 2.0 interface (USB Driver should be installed at first)
- Controllable via software (Mifare Key and SOR Tools softwares)
- Built-in temperate Key A/B and default Key A/B buffers.
- Supports SORmifare protocol with high-security and user-friendly interface.

1-2-2. Applications:

- Hotel, Motel, Sea House and Retailing Industries.
- Parking, Pre-payment, Ticketing.
- Access Control System.
- Electronic Wallet
- Customer License Control.

1-2-3. SOR – SOYAL Open system Rules

a. Introduction of SOR

SOYAL Open system Rules (SOR) is the protocol that SOYAL developed based on MIFARE® MF1 IC S50, complying ISO14443A standard, in order to offer an exclusive interface which guarantees absolute security of various applications for our partners. Before using SOYAL open system rules, users are required to get an individual distribution license from SOYAL.

Although MIFARE® MF1 IC S50 offered two alternate keys to increase the security classification, there are still some risks of personal careless and man-made betrayal. However, SOYAL Open System Rule only not provide one way, Authorization Media, to protect the Key A and Key B from divulging, but also give a multi-comparison and Organization Layers to keep your system from above mentioned affairs happening.

b. Advantages of SOR

- Unbreakable security protected by Key A/B
- Off-line value-stored function
- Friendly user interface
- 6-layer management structures

c. Authorization Media – SIM, CIM, UIM

There three types of cards – SIM, CIM, and UIM, which are seperatly used for issuing new cards (either authorization cards or end-user cards) or launching new programmers. Based on different authorized permissions, each of them plays different roles in SOR system. The detailed functions are tabled as below：

Type	Name	Appearance	Function Description
Authorization Card	**SIM**		◎ Master Card with **the highest authority** ◎ Contains both CIM&UIM's functions ◎ Allow issuing SIM/CIM/UIM & readers of sub-layer (Sub-layer of LAM excluded)
	CI M		◎ Allow issuing **LAMs** of the same layer ◎ Allow modifying LAMs of the same layer including ID, value and expiry date
	UIM		◎ Allow launching & modifying **readers** of the same layer
End-user Card	**LAM**	 A blank card in general.	◎ End-user card contains multiple applications such as stored-value, consuming and access control… ,etc..

d. Organization Layers

The 6-layer managing structure is exclusively designed for SOYAL's partners (or main distributors) to extend their business up to six layers in maximum. SOR, as the foundation of the system, is default positioned at top of all layers, and SOYAL's partners (or main distributors) are going to be positioned on Layer 1. Similarly, those who are distributors of SOYAL's partners are going to be positioned on Layer 2 by their suppliers.

SOR					
Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
1 ~ 60000	0 ~60000	0 ~ 250	0 ~ 250	0 ~ 250	0 ~ 250
SOYAL's Distributors	Sub-layer of distributors				

Figure 1, Organization Layers-1

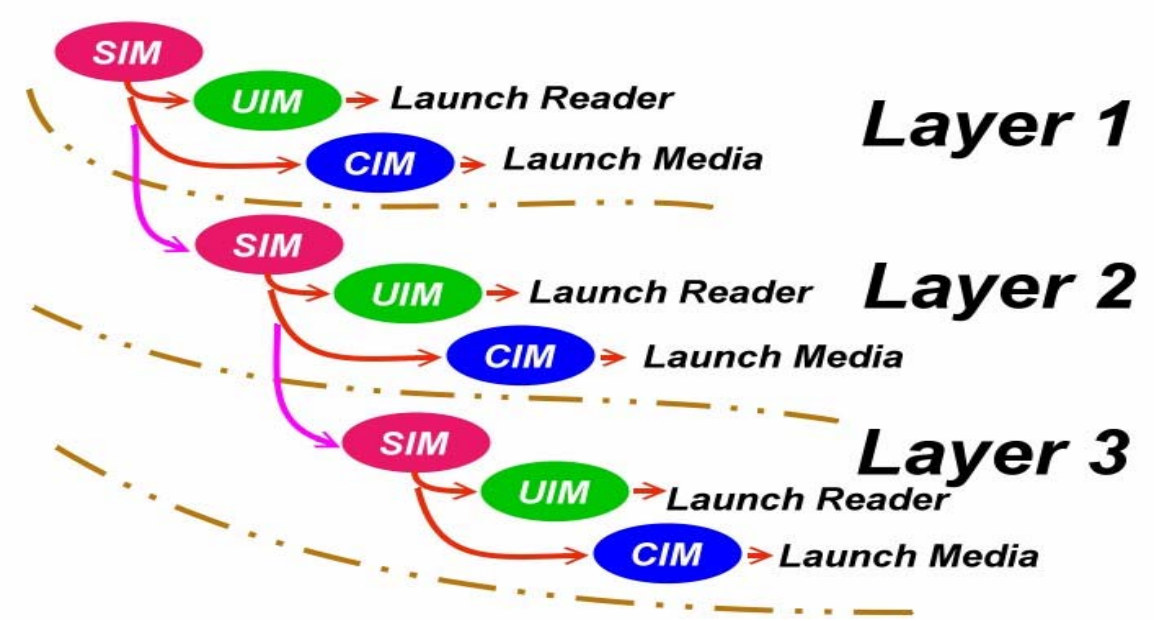


Figure 2, Organization Layers-2

e. SOR in Mifare Card

In the SOR System, we have already taken the sector 01 for our default functions, such as: authorization, layer-management, off-line operation commends… etc..

Otherwise, we also use the sector 14 and 15 for last five transaction logs tracking.

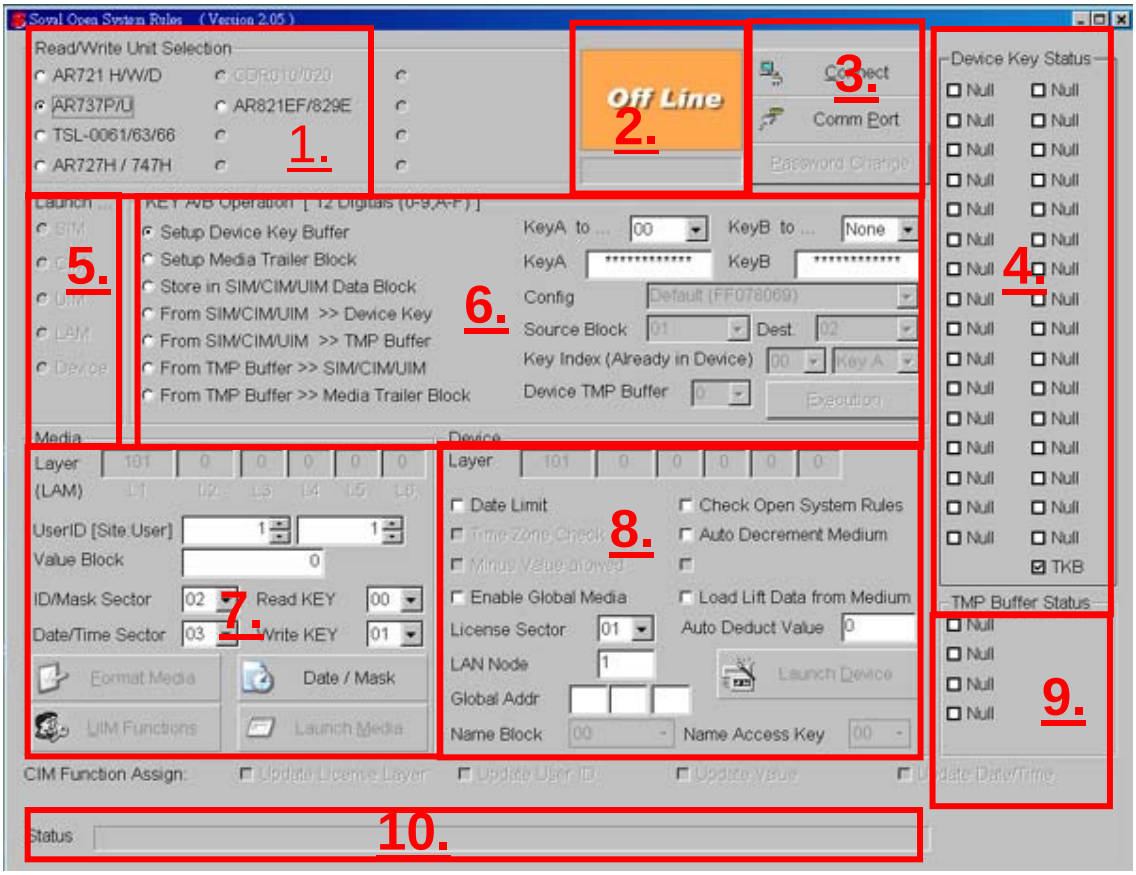
1-2-4. Specification:

AR-737P		
RF Frequency		13.56MHz (SORmifare)
Power Requirement		5VDC (USB powered)
Power Consumption		<1.5W
Communication Interface	RS-232	AR-737PDX**2**N21
	USB	AR-737PDX**8**N21
Baud Rate	RS-232	9600 bps (N, 8, 1)
	USB	USB 2.0 (Virtual COM Port)
Environment		-10°C ~ +75°C 0-95% non-condensing
Compliance (Optional)		☐ ISO14443A ☐ ISO15693 ☐ ISO14443A/B+15693
Proximity Reading Range		Up to 60mm for ISO Card
Supported Tags		Mifare 1 (IC50) Mifare Ultra Light (L10) Mifare Pro (IC70)
Indicator		A bi-color LED and a beeper
Color		Dark Pearl Gray
Dimensions (mm)		113(L)*71(W)*36(H)
Weight (g)		150±10
Housing Material		ABS
Others		SOR Supported

1-2-5. Product Details

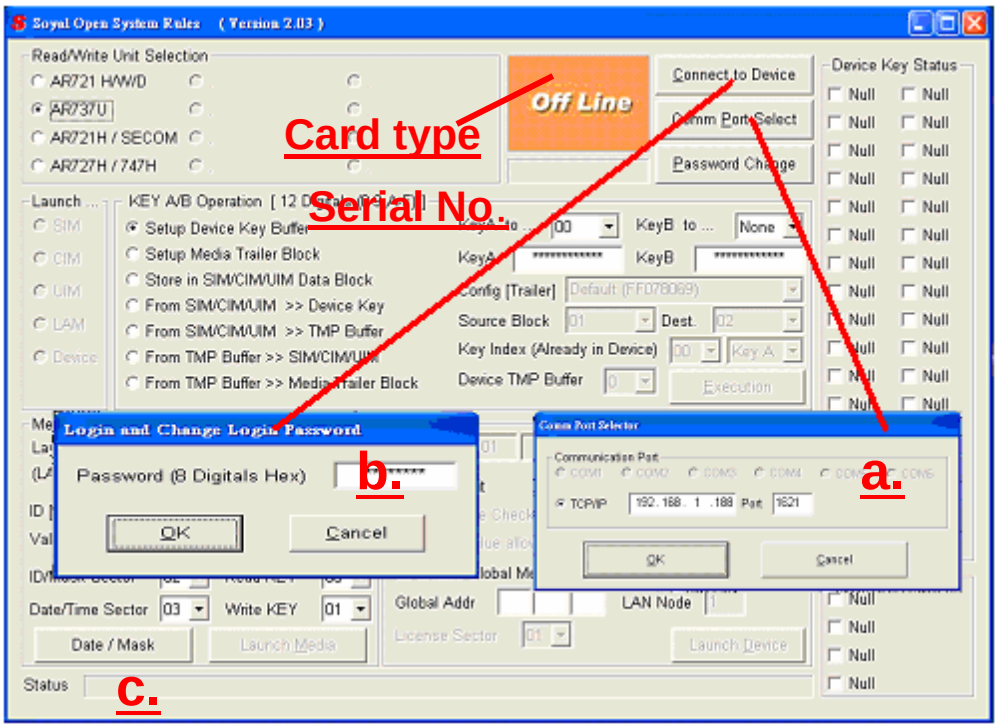
- User guide *1
- Soyal Mifare Open System Rules Programmer Manual *1
- AR-737P device *1
- Soyal SIM Card *3；Soyal CIM Card *3；Soyal UIM Card *3
- SOYAL Software CD which included Mifare Key of SOYAL Tools and USB interface driver
  P.S. If you were purchased the AR-737PDX8N21 (USB Interface), you should install its USB driver before you use it. (Regarding the note of install, please refer to the appendix)
- Hexagonal Wrench *1；Hexagonal Screw *2

2. “Mifare Key” Operation



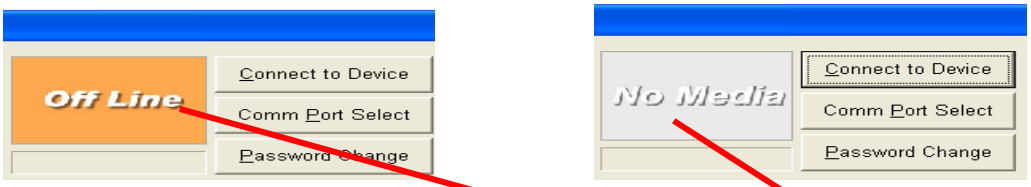
1. Select the device you’re going to read or write
2. Show device on/off-line and card type (SIM / UIM / CIM/ LAM) and its serial number
3. Select communication port / Login device / Change login password (Default value: 112344)
4. Perpetual area that is write-only for device’s key (total 33 sets, 0-31 for saving Key A and Key B; 32 fixed to default value: FFFFFFFFFFFF)
5. Select the card or device will be written in. However, SIM/UIM/CIM option only will be selected while launch the sub-layer’s SIM/UIM/CIM.
6. Key A / Key B setting area which is HEX (0~9 and A~F) and allow each Key to contain 12 characters.
7. Cards’ functions setting area (layer setting, card number, storage value, expiry date, Global access management)
8. Reader setting area (layer setting, support *SOR* or not, layer setting, check card’s date, increase / decrease value, Global access management
9. AR-737P’s temporary area can save the blocks’ data from SIM/UIM/CIM for e.g. writing a new Key A/B into a new medium, which all data in this area will be lost while device power-off. (Total 4 sets)
10. Status: Response message

Login Mifare Key



1. Click “Comm Port Select” to select communication type (RS-232, USP or TCP/IP) as shown on **a.**

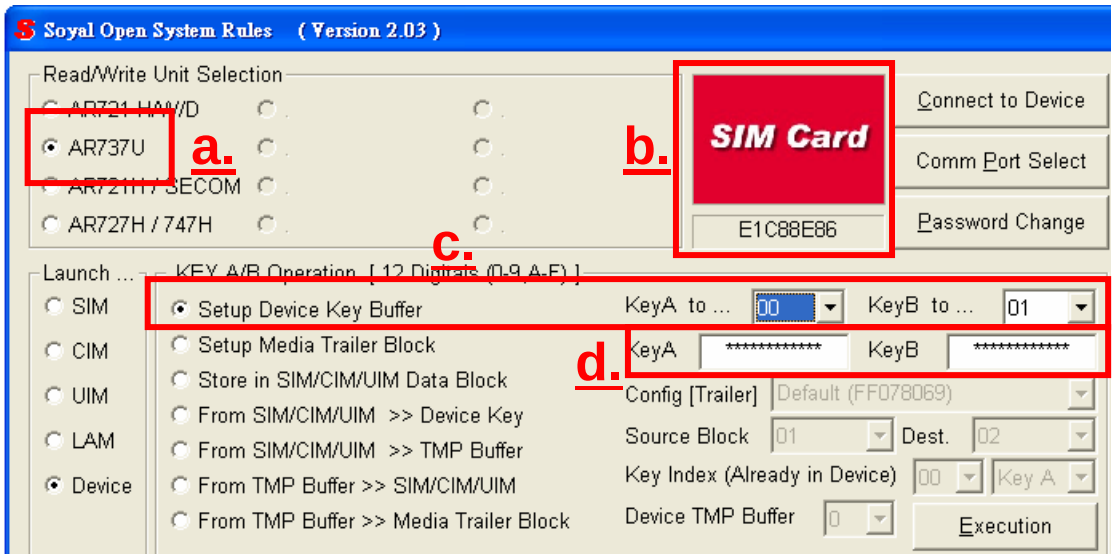
2. Click “Password Change” in order to change the password if necessary as shown on **b.**



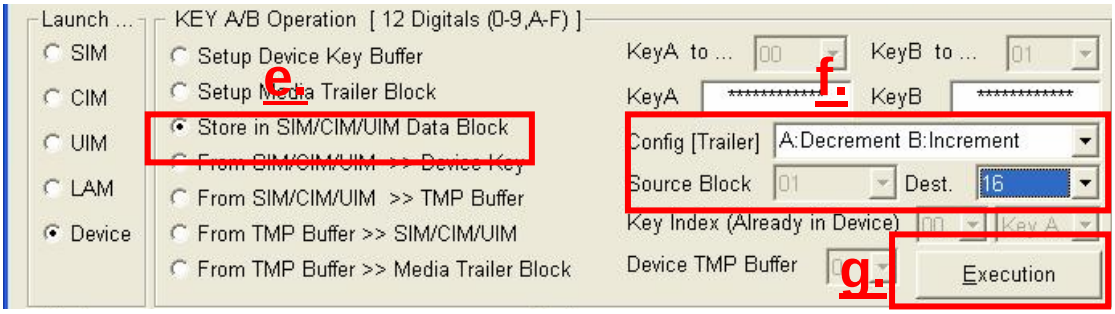
4. When the value of “Card Type” shows from Off Line to No Media and gives a beep sound, and the message “ Device Login OK” is given by “Status” column means the programmer is connecting to the PC as shown on **c.**

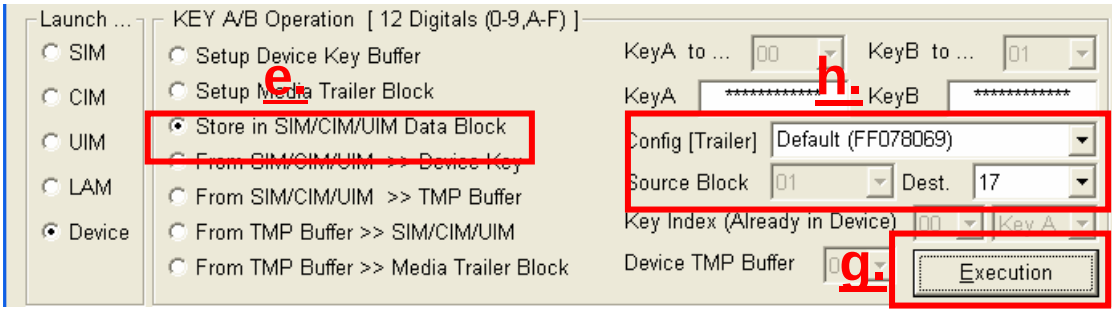
Setup Master Code into Key A/B

Before writing the master code into the Key A and Key B positions of the Media's (SIM, CIM, UIM) Trailer Block, we need to set up device key buffer first as follows:



1. Select your Read / Write device – AR737U as shown on **a.**
2. Place SIM on the device as shown on **b.**
3. Select "Setup Device Key Buffer" and fill out the value "00" at Key A and "01" at Key B as shown on **c.**
4. Set up the master code as Key A and Key B in 12 digits (0-9, A-F) respectively as shown on **d.**





5. Select "Store in SIM/CIM/UIM Data Block" as shown on **e.**
6. Set up "Config (Trailer)" in "A:Decrement B:Increment" and "Dest." in the value "16" as shown on **f.**

7. Press “Execution” as shown on **g.**

8. Again, “Config (Trailer)” in “Defualt (FF078069)” and “Dest.” In the value “17” as shown on **h.**, and press “Execution” as shown on **g.**

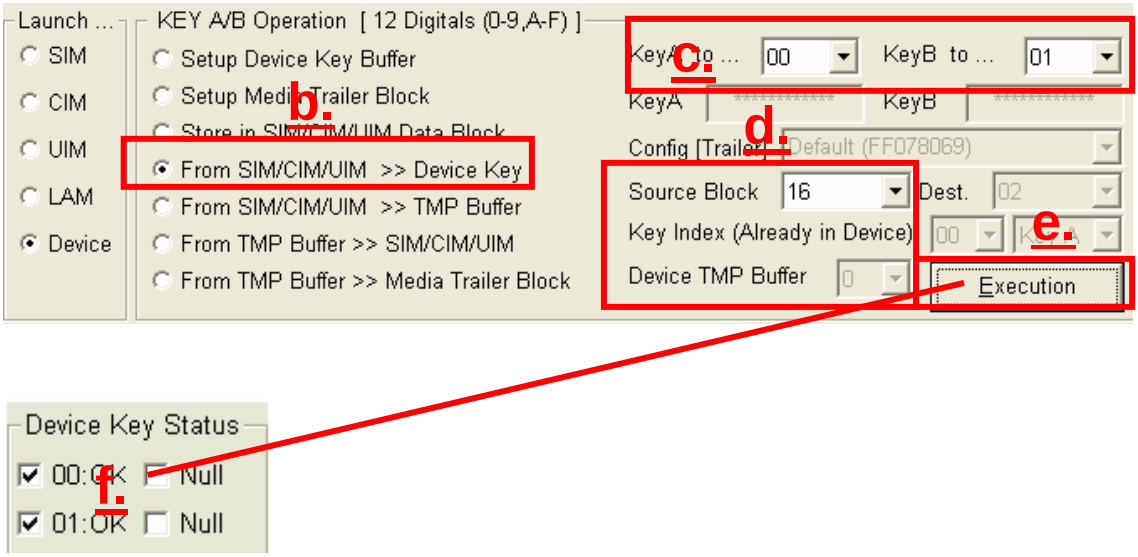
9. Repeat Step 6-8 as mentioned above for setting up other SIM, CIM & UIM cards

3) Launch LAM:

3.1. Save Key A and Key B into the Device Key

Place SIM or CIM on the programmer to read out its master code and save the code into the **Device Key** of the device. Therefore we can issue the LAM. And the steps are as follow:

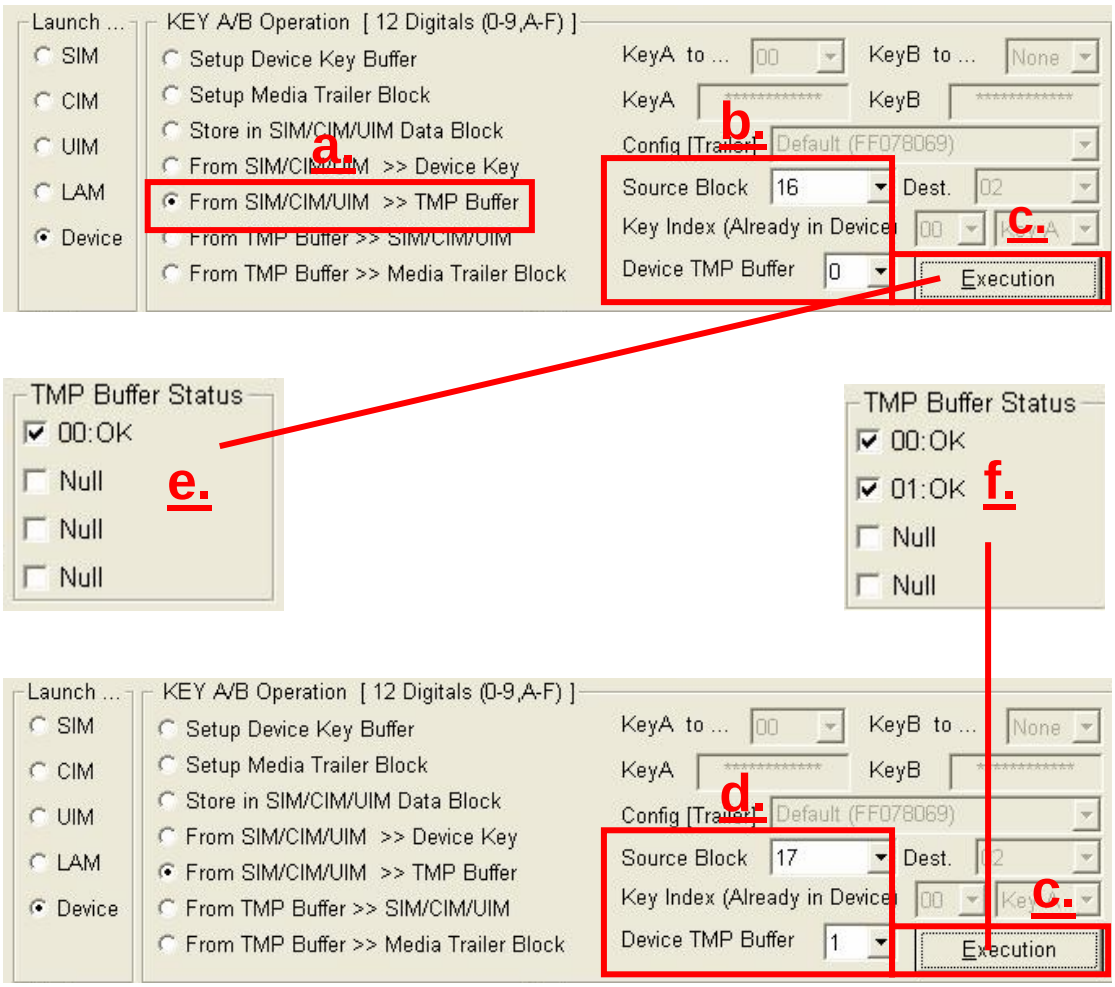
1. Place SIM on the programmer as shown on **a.**



2. Select “From SIM/CIM/UIM >> Device Key” as shown on **b.**
3. Give value “00” and “01” in KeyA and KeyB respectively as shown on **c.**
4. Give value “16” in “Source Block” as shown on **d.** and press “Execution” **e.**
5. Then, “Device Key Status” should be changed as shown on **f.**

3.2. Save 16th and 17th Data Blocks into the TEM Buffer

Place SIM or CIM on the programmer to read its master code then save the code into the **TMP Buffer** of the device, so that LAM can be formatted by the mentioned data as follows:

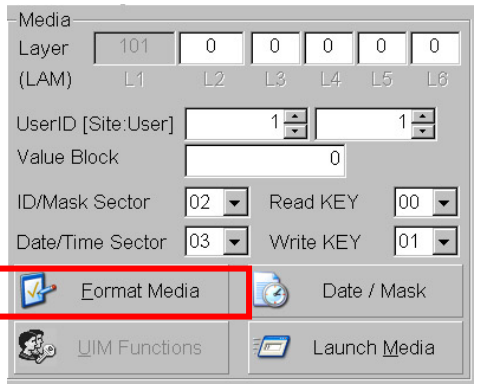


1. Select “From SIM/CIM/UIM >> TMP Buffer” as shown on **a.**
2. Give the value “16” in “Source Block” and “0” in “Device TMP Buffer” as shown on **b.**
3. Press “Execution” as shown on **c.**, then “TMP Buffer Status” should be changed as shown on **e.**
4. Again, give the value “17” in “Source Block” and “1” in “Device TMP Buffer” as shown on **f.**
5. Remove the SIM/CIM from the programmer, and place a new card on the programmer.

3.3. Start to format Media as below:

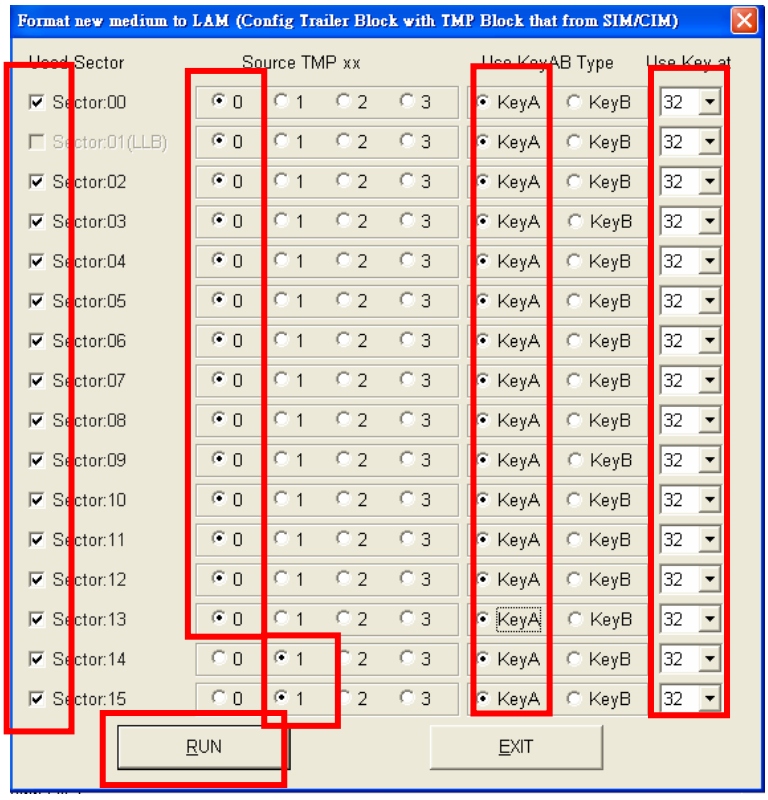
Place either SIM or CIM on AR-737P, and then start to program the new card.

Put a new card on the AR-737P.



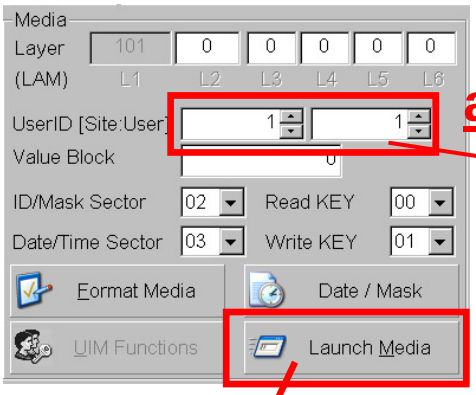
3.3.1 Format a new media:

A new media's (for example: a new mifare card) default value is to use the Key A as master code to read or write data into the media. In order to make it easier to program the new media, SOYAL sets this default value at the 32nd key (initial key) of device for user. **Please sequentially press the RUN button to format all other new cards.**



New Media			
Sector	**Write-in source**	**Authorized by**	**The Authorized Key is from**
00 – 13	TEM 00 (KeyA-Read; KeyB-Write)	Key A	32nd Key of device (Default Value)
14 – 15	TEM 01 (KeyA-Rread: KeyA-Write)	Key A	32nd Key of device (Default Value)

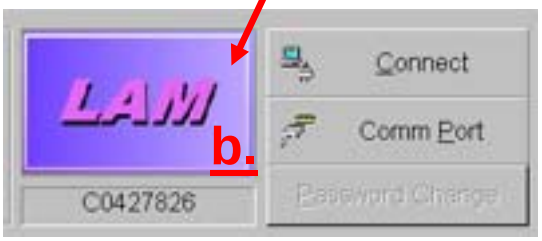
After you format all new cards, please set the USER ID as shown on **a.** , then press “LAUNCH MEDIA” and the status should be changed to be “LAM” as shown on **b.**



i.e.: 200 pieces of cards:

User ID:

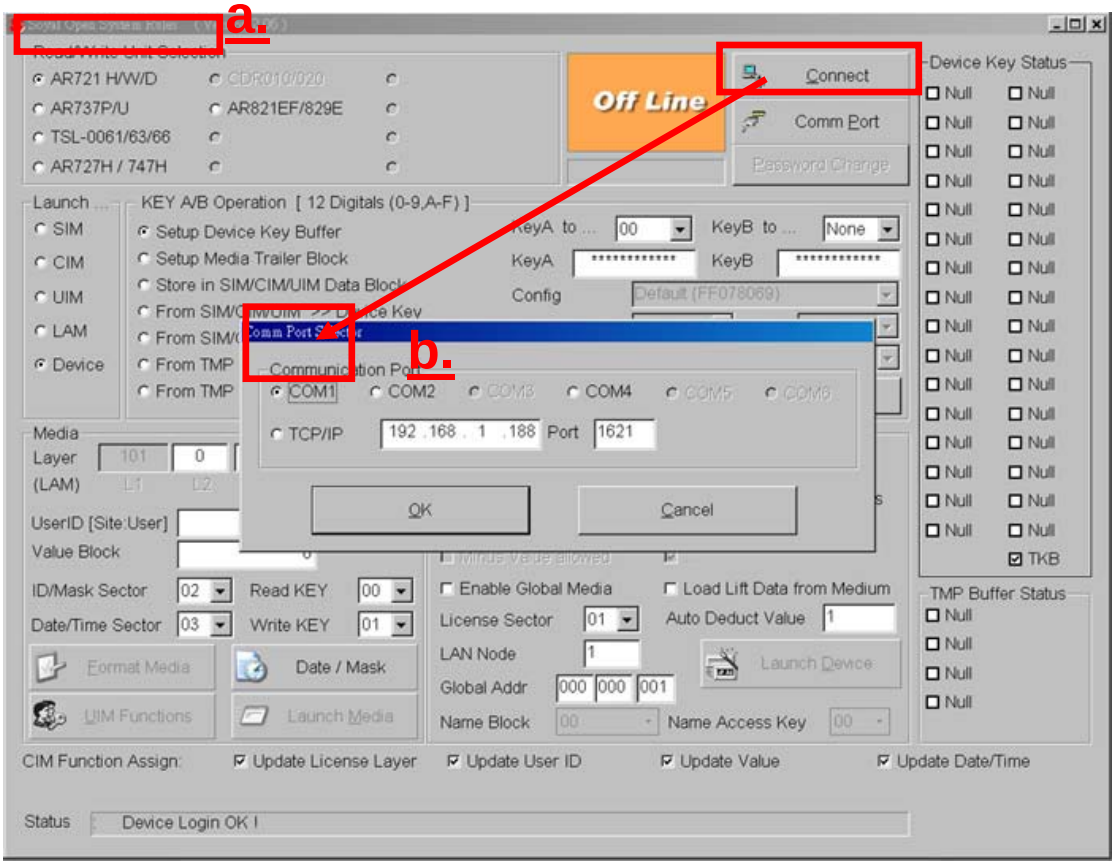
From:	1	1
To:	1	200



1) Launch Device:

4.1. Select which device you want to program. For example, **AR-721H** as shown on **a.**

4.2. Re-select the COM PORT as shown on **b.**



4.3. If the connection between device and computer is OK, you would see two places showing the successful connecting as follow:

4.3.1 Device ON/OFF Line status:

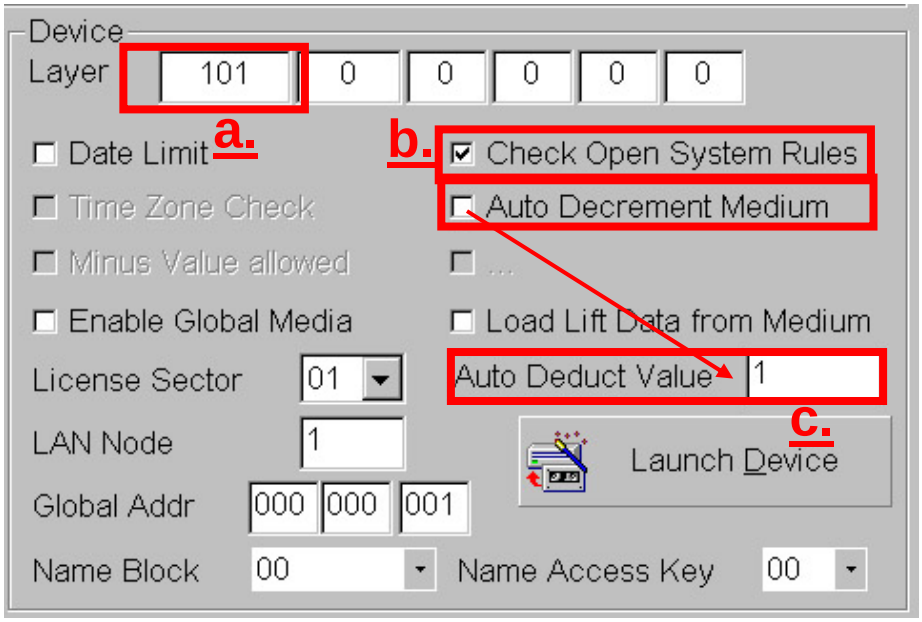
4.3.2 Status row:

4.4. Place either SIM or UIM

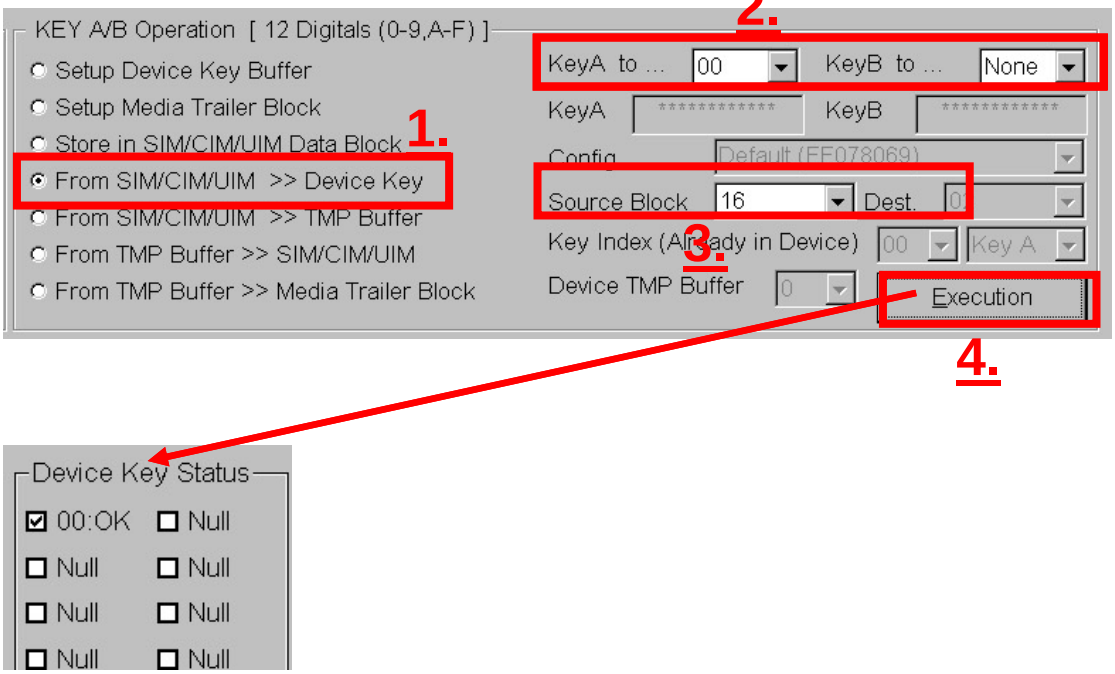
4.4.1. To Change Device layer, and press launch Device as shown on **a.**

4.4.2. Please select “Check Open System Rules” as shown on **b.**

4.4.3. If you want to use the store-value function, you could also select the Auto Decrement Medium and designate to decrease how much value would be deducted at each time as shown on **c.**

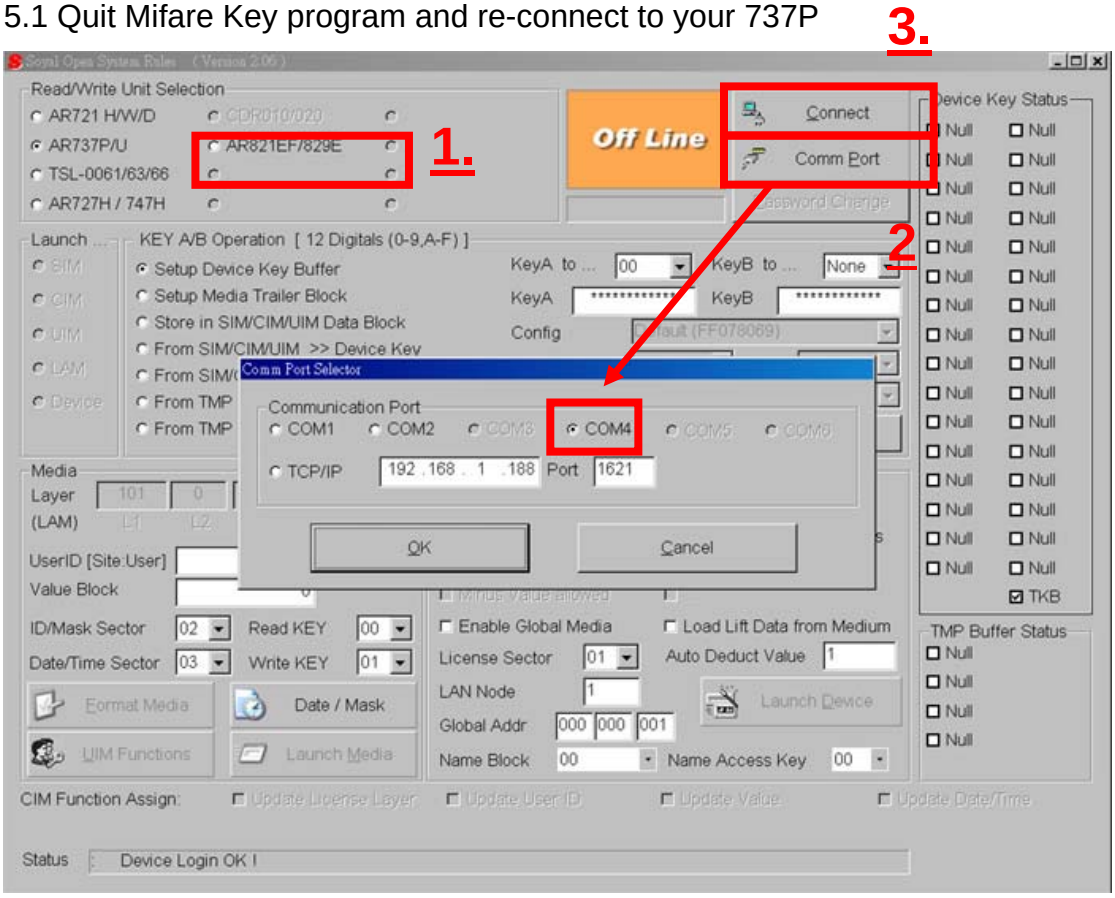


4.5. Save the “Key A” into AR-721H:



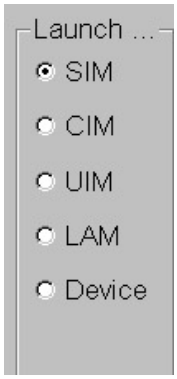
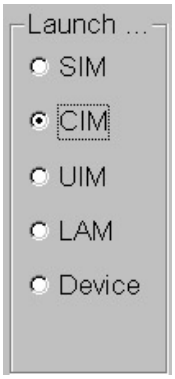
2) Launch Sub-layer's authorized cards

5.1 Quit Mifare Key program and re-connect to your 737P

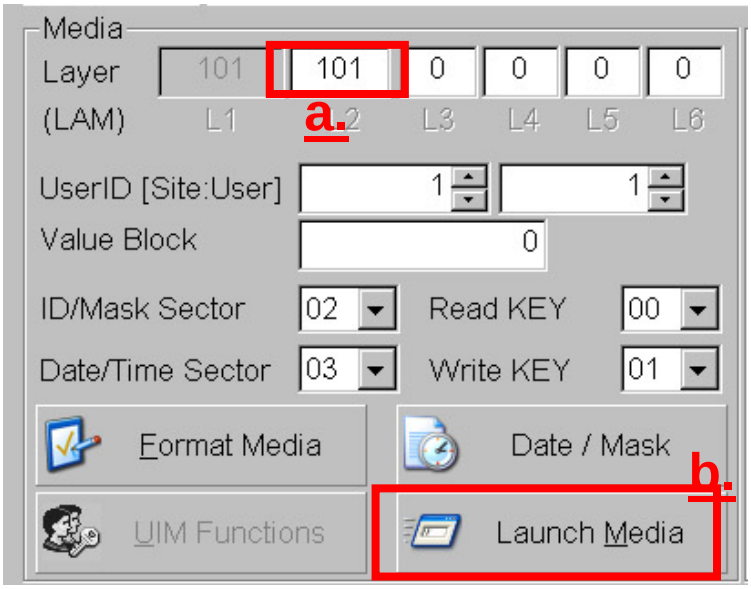


5.2. Put your SIM or CIM upon your 737P

5.3. Put your Sub-layer's authorized cards on your AR-737P, and select which kind of card you're going to launch.

SIM	CIM	UIM
		

5.4 Key-in your Sub-layer's layer's code **a.** at L2. and launch it. **b.**

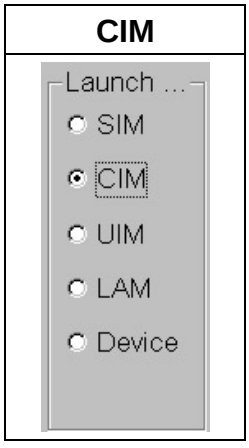


5.5 **Launch CIM for a security guard**

5.5.1 Quit the Mifare Keya software and re-launch it.

5.5.2 Re-connect to your 737P and put your SIM or CIM on it.

5.5.3 Put a new CIM card on your 737P.



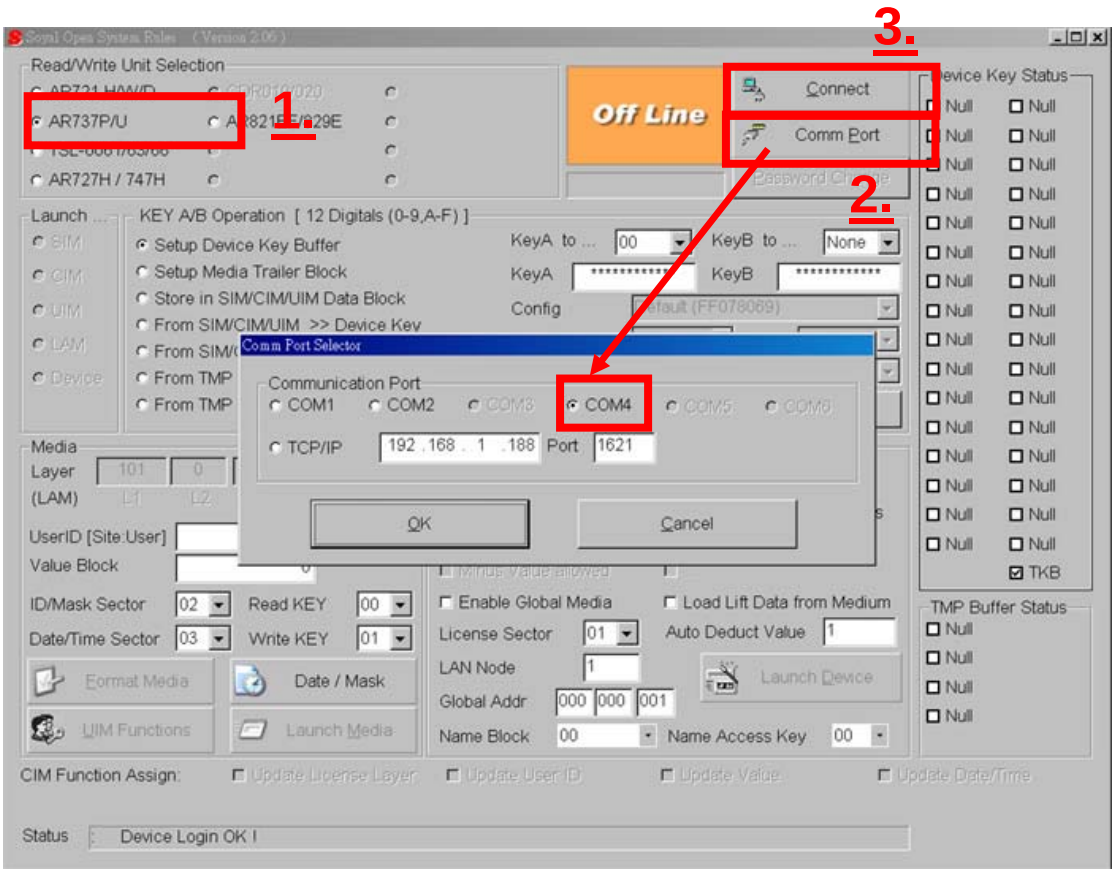
5.5.4 Security Card:

You may want to create some special card with limited functions for security guards' using. You could make it by choosing following options.

5.5.5 Key-in your Sub-layer's layer code at L2. Then launch it as same as 5.4.

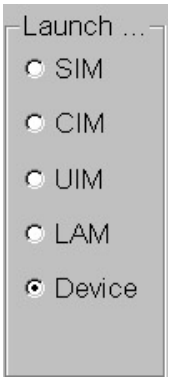
3) Launch Sub-layer's AR-737P (Programmer)

6.1. **Quit** Mifare Key program and re-connect to the Sub-layer's 737P.

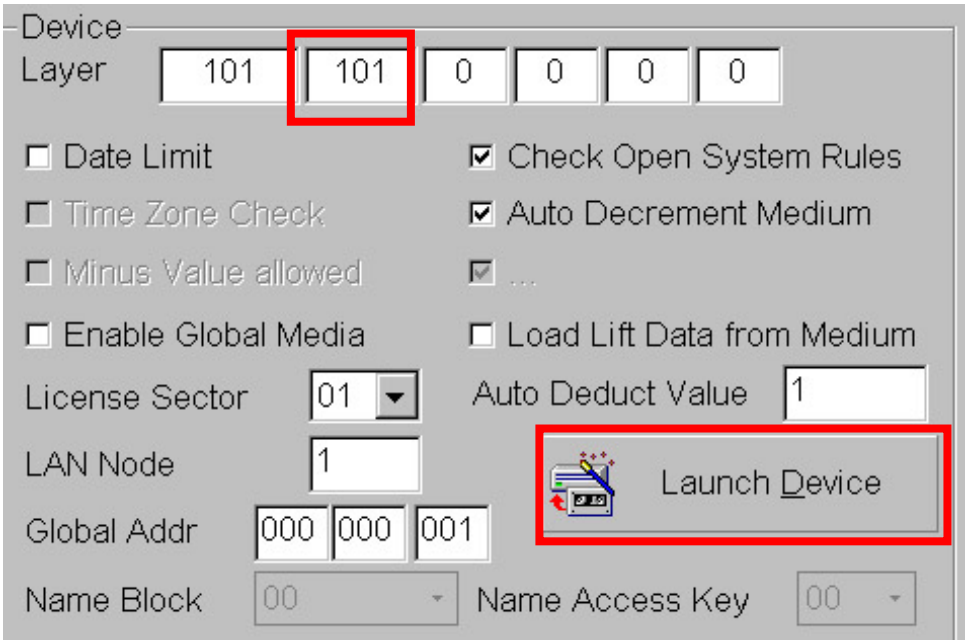


6.2. Put your SIM or UIM on the Sub-layer's 737P

6.3.



6.4. Designate Sub-layer's AR-737 to support SOR functions

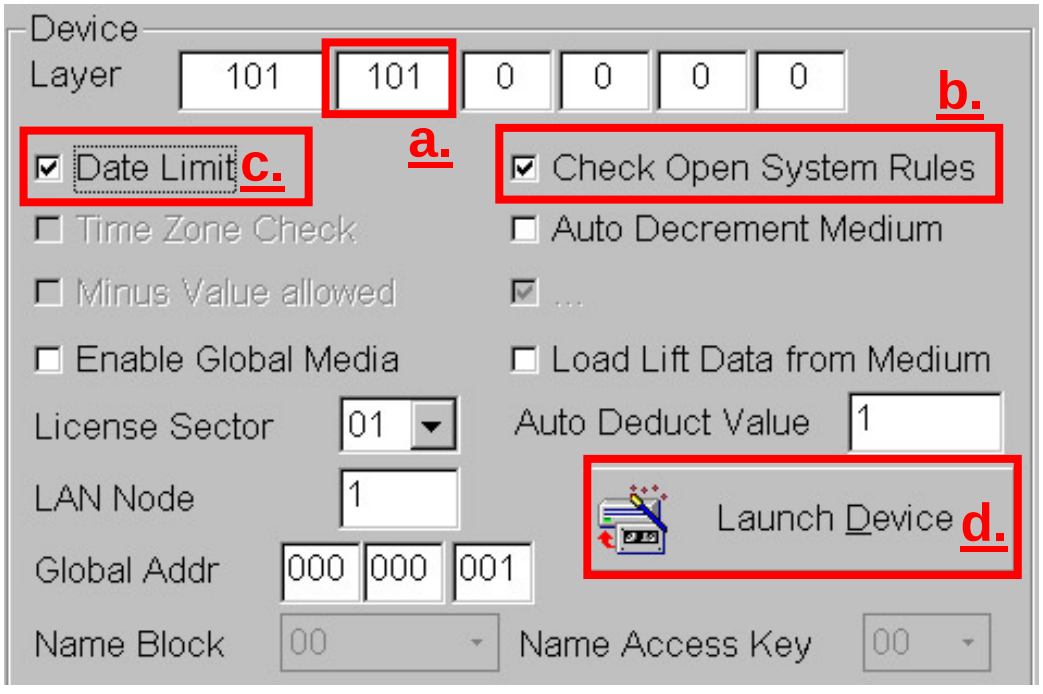


6.5. **Launch AR-737P for a security guard**

6.5.1. Quit Mifare Key program and re-connect to the **security guard's 737P**

6.5.2. Put Sub-layer's SIM or UIM on the **security guard's 737P**

6.5.3. Notice about the layer code and check SOR as shown on **a.** and **b**, then only designate **a security guard's 737P** to program the date of limit. **C.** Finally, Launch Device **d.**.



How to change the Key A/Key B and re-format the LAM card into new Key A/Key B?

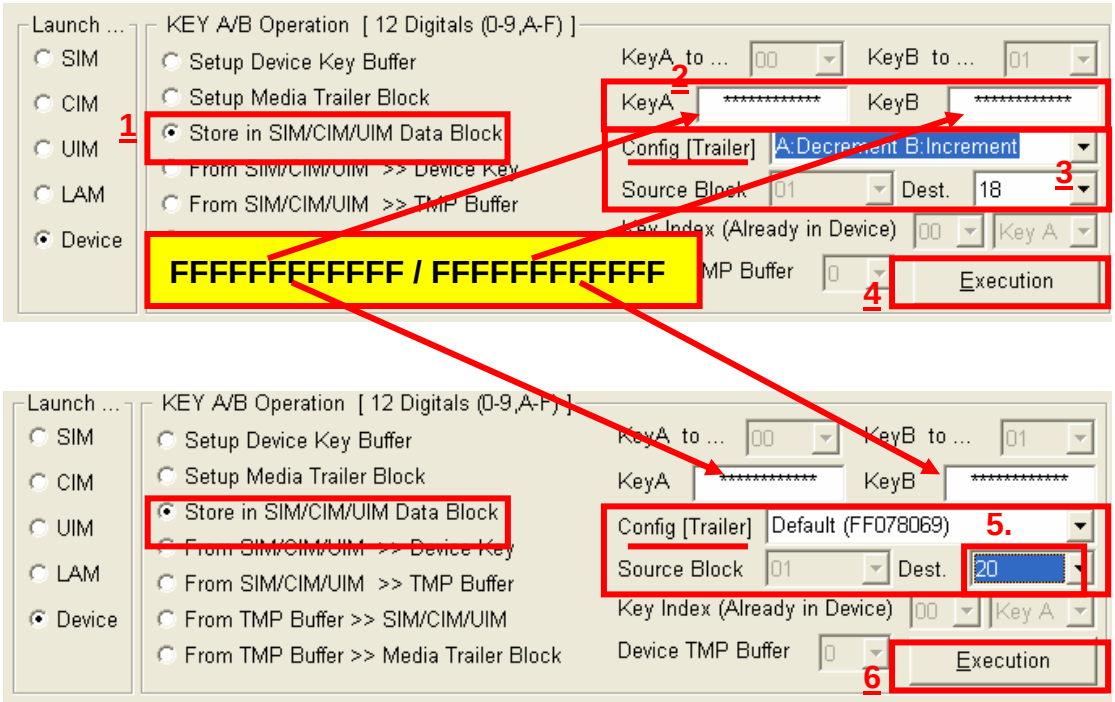
Setp1: Reset the Key A/B and save at another Data Block

a、 Select Key A/B Operation as shown on 1.

b、 Key-in new 12-digit password at both Key A and Key B as shown on 2.
i.e. FFFFFFFFFFFF/ FFFFFFFFFFFF (Default: 12 F letters)

c、 Please save the A:Decrement B:Increment of Config 【Trailer】 at Data Block18 as shown as shown on 3. And then put authorized cards and press the Execution 4. and

d、 Please save the Config【Trailer】in Default (FF078069) value at Data Block20 as shown on 5. Then press the Execution 6.



Setp2: Save old Key A/B to Device Key Status:

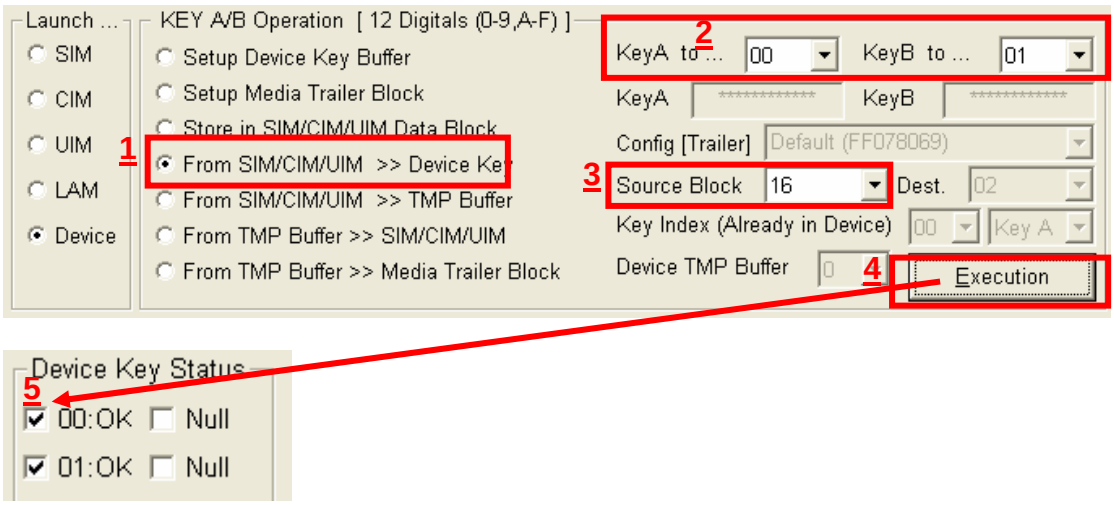
a、 Select Key A/B Operation: From SIM/CIM/UIM to Device Key as shown as **1.**

b、 Put one authorized card , like SIM, on the programmer AR-737P.

c、 Select Key A save to Device Key 00 and select Key B save to Device Key 01 as shown on **2.**

d、 Save the source Key A/B from Data Block 16 as shown on **3.**

e、 Press the Execution **4.**, and then the Device Key Status will save the Key A/B of Data Block 16 as shown as **5.**



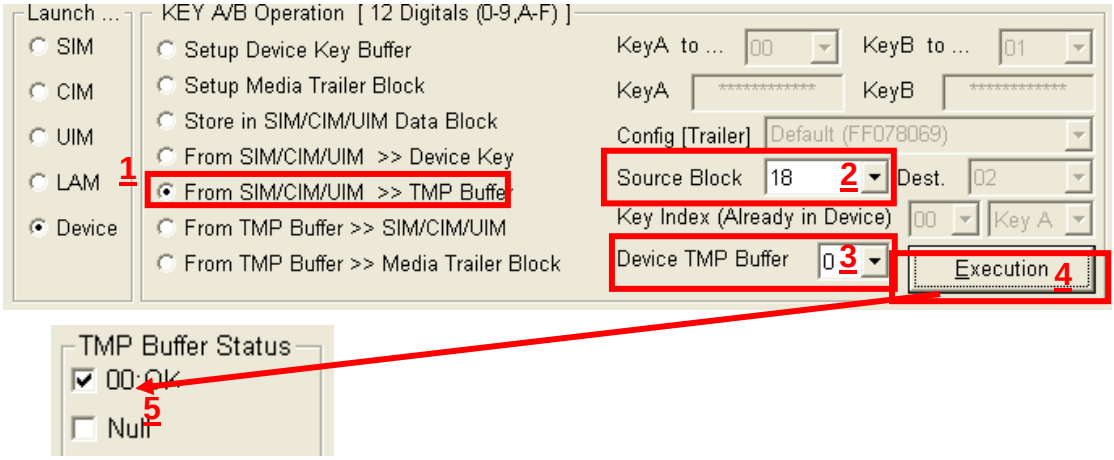
Setp3: Save new Configure 【Trailer】(included the new Key A/B) to TMP Buffer Status:

a、 Select Key A/B Operation: From SIM/CIM/UIM to TMP Buffer as shown as 1.

b、 Select the Source Block 18 as shown on 2.

c、 Select the content of Data Block 18 and save as Device TMP Buffer 0 as shown on 3.

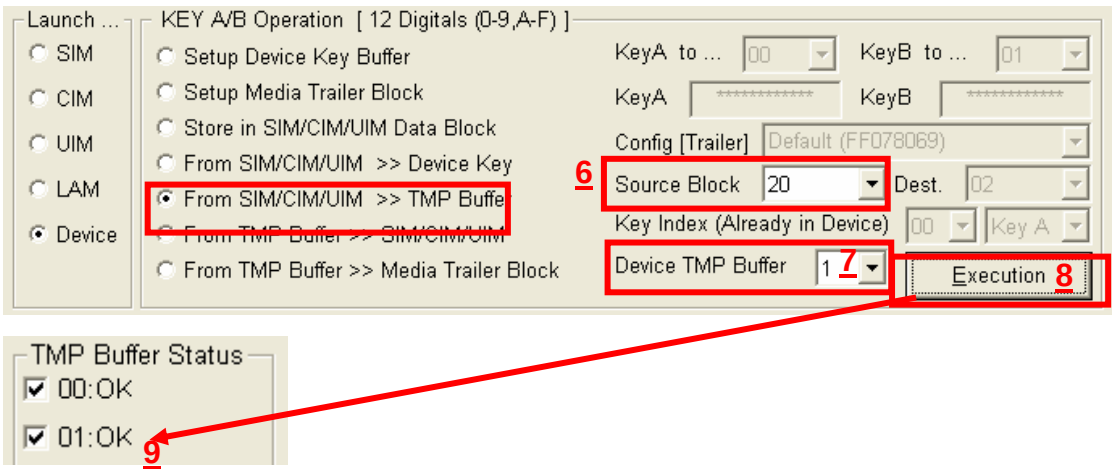
d、 Press the Execution 4., and then the TMP Buffer Status will save the content of Data Block 18 as shown as 5.



e、 Select the Source Block 18 as shown on 6.

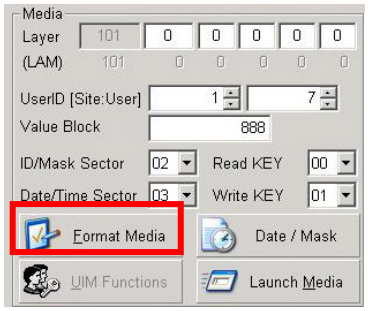
f、 Select the content of Data Block 20 save to Device TMP Buffer 1 as shown on 7.

g、 Press the Execution 8., and then the TMP Buffer Status will show the content of Data Block 18 as shown as 9.



Setp4: Reformat the LAM card

a、 Press Format button at Media area as follows:



b、 Content of LAM card

The content of whole New LAM Card before being formation:

Sector	Write-in source	Authorized to program by	The Authorized Key is from
00 – 13	TEM 00 (**Block 16**) (KA-R;KB-W)	Key A	**32nd** Key of device (Default Value)
14 – 15	TEM 01 (**Block 17**) (KA-R; KA-W)	Key A	**32nd** Key of device (Default Value)

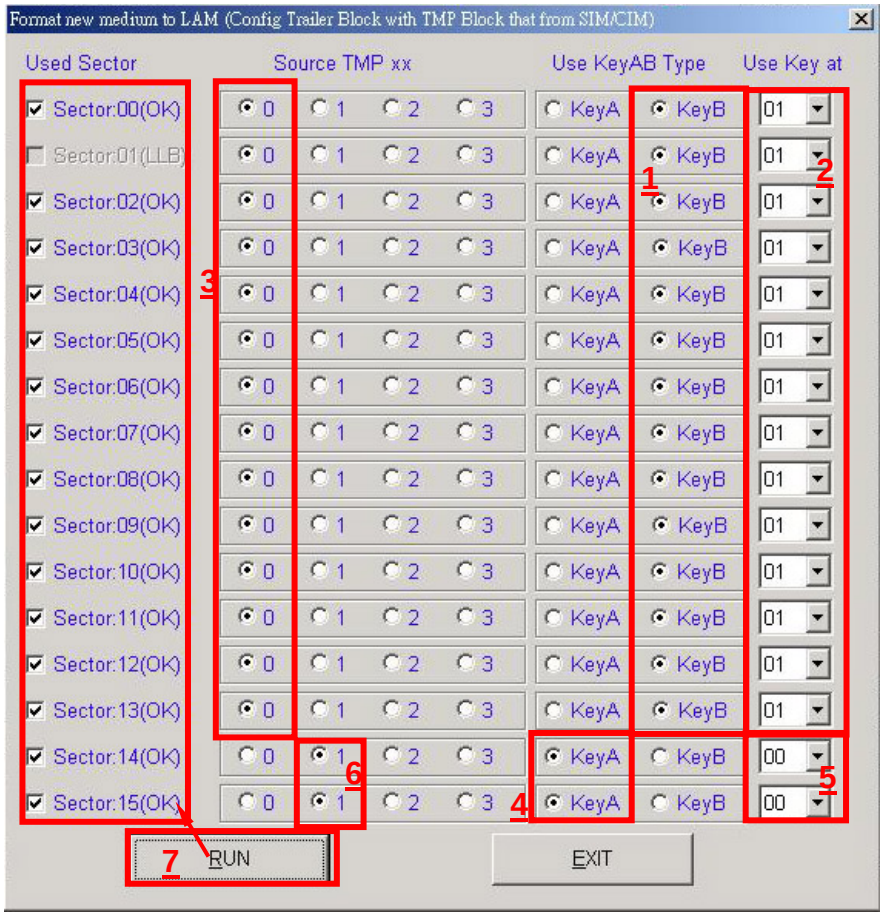
The content of New LAM Card after being formation:

Sector	Write-in source	Authorized to program by	The Authorized Key is from
00 – 13	TEM 00 (**Block 18**) (KA-R;KB-W) (New Key A/B)	**Key B**	**01** Key of device (Default Value)
14 – 15	TEM 01 (**Block 20**) (KA-R; KA-W) (New Key A)	Key A	**00** Key of device (Default Value)

c、 For having designated LAM's Config【Trailer】of Sector 00 to 13 as A:Decrement B:Increment at the first time. In other words, the LAM card can only be programmed or written by previous Key B (as shown on **1.**) that has been saved at Device Key 01 (as shown on **2.**). In the same time, LAM card will be programmed or written with the new Key A/B and new Config【Trailer】of TMP Buffer 0 (as shown on **3.**).

d、 For having designated Config【Trailer】of Sector 14 to 15 as Default (FF078069) at the begining. In the other worlds, the LAM card can only be programmed or written by previous Key A (as shown on **4.**) that has been saved at Device Key 00 (as shown on **5.**). In the same time, LAM card will be programmed or written with the new Key A/B and its new Config【Trailer】of TMP Buffer 1 (as shown on **6.**).

e、 Press the Run button to reformat the LAM card.



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