

## G3128 Single Board Computer Development Manual



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High-end Embedded Solution Provider



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## **Release Notes**

Version	Release Date	Author	Description
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### **Chapter 1 Setting up Android Platform Development Environment**

Please install Linux operating system in PC which could fully play PC performance as compiling Android source could ask for high requirements in PC hardware. We use Ubuntu14.04 64bit system in this chapter. Please keep the same as our version.

#### **1.1 Install Ubuntu OS by U-disk**

Tool:

One U-disk bigger than 2GB

Software: Linuxlive usb creater, Download link : http://www.linuxliveusb.com/

**Operating System:** 

Ubuntu14.04, Download link : <u>http://www.ubuntu.com/download/desktop/</u>

Installation Method :

Step1: Download Ubuntu ISO file and linuxlive usb creater, and done installation. Step2: Insert U-disk, and open usb creater file, and done setting as hints, at first, please take installation and tell U-disk, second, find downloaded file ubuntu image file, third default, and check hide files and FAT32 format U-disk, last click lightning icon and done installation.-





Step3: Re-start computer, and enter into BIOS setting menu, and take U-disk launch. Generally, the desktop computer press DEL key, and notebook computer F2, or F10 enter into BIOS. Done setting, save and quit.

Step4: Re-start it one more time, and Ubuntu installation interface will be, please check your language and go on;

Step5: Check install, and go on;

Step6: Check your language, and go on;

Step7: Netconfig, installation or not both ok, or installation it after system done;

Step8: Check something else, and Go on; separate two zones for Ubuntu, " $-\uparrow$  /" and" -

 $\uparrow$  /home" . Zones can be re-buit or format. It depends on requirements.

Step9: Setup area, take yours;

Step10: Select Keyboard;

Step11: Login user name and password, and done setup. Go on and install it directly. Restart when done installation, and enter into Ubuntu operating system.

### **1.2** Install Dependent Package of Android Source Code

Dependent software package and 64bit System patches:



GIT

JDK 8

JDK 7

git-core , gnupg , flex , bison , gperf , libsdl-dev , libesd0-dev , libwxgtk2.6-dev ,

libwxgtk2.8-dev , build-essential , zip , curl , libncurses5-dev , zlib1g-dev , libxml2-utils ,

genromfs , lsb-core , libc6-dev-i386 , g++-multilib , lib32z1-dev , lib32ncurses5-dev ,

u-boot-tools,

android-tools-fastboot,Texinfo,lib32readline-gplv2-dev,gcc-multilib,libswitch-perl,

gcc-arm-linux-gnueabihf

All software package needed:

sudo apt-get update

sudo apt-get upgrade

sudo apt-get install git-core gnupg flex bison gperf libsdl-dev libesd0-dev libwxgtk2.6-dev libwxgtk2.8-dev build-essential zip curl libncurses5-dev zlib1g-dev libxml2-utils genromfs lsb-core libc6-dev-i386 g++-multilib lib32z1-dev lib32ncurses5-dev u-boot-tools android-tools-fastboot Texinfo lib32readline-gplv2-dev gcc-multilib,libswitch-perl gcc-arm-linux-gnueabihf

#### Install aboving software packages one by one, and then failing ones will be found.

#### **Install manually JDK8:**

Step details in Ubuntu os:

Step1: Execute following order: sudo add-apt-repository ppa:openjdk-r/ppa sudo apt-get update sudo apt-get install openjdk-8-jdk

Step2: Re-start the system Check Java version:



root@david:/usr/lib/jvm# java -version

#### Till now, done JDK8 installation.

#### **Install manually DK7:**

Install manually jdk1.7 in Ubuntu: Step1: Execute following order: sudo add-apt-repository ppa:webupd8team/java sudo apt-get update sudo apt-get install oracle-java7-set-default

Step2: Re-start the system Step3: Check Java version: root@david:/usr/lib/jvm# java -version

Till now, done jdk7 installation.

#### **1.3** Install Cross-complier Tool

The cross-complier tool has been integrated into source code package yet, no need manual installation. Its path:(Android source code) prebuilts/gcc/linux-x86/arm

#### 1.4 Specify GCC Cross-complier

When install latest GCC cross-complier in Ubuntu system, the version is exceed 4.4. Check GG version with the following command:

gcc -version

Maybe shows following information:

david@ubuntu-server:~\$ gcc --version

gcc (Ubuntu/Linaro 4.6.3-1ubuntu5) 4.8.3

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Above information shows version is 4.8, it will be error hint. That caused by new GCC version error, you could find solution in internet. If you do not want to modify those error, just downgrading your version into 4.4 will be ok.



#### Solution :

Install 4.4 version sudo apt-get install gcc-4.4 g++-4.4 g++-4.4-multilib

Done installation, and downgrading version gcc

cd /usr/bin sudo mv gcc gcc.bk sudo ln -s gcc-4.4 gcc sudo mv g++ g++.bk sudo ln -s g++-4.4 g++

Check version and done downgrading: david@david-work:~\$ gcc -version gcc: unrecognized option '-version' gcc: no input files david@david-work:~\$ gcc --version gcc (Ubuntu/Linaro 4.4.7-8ubuntu1) 4.4.7 Copyright (C) 2010 Free Software Foundation, Inc.



### **Chapter2 Compiling Android Source Code Package**

G3128 single board computer is of eMMC memory as fault. State: Take ordinary permissions when compiling image. Done compiling, following images happen: uboot.img , kernel.img , resource.img , boot.img , recovery.img , misc.img , system.img , update.img.

uboot.img: bootloader, which used to guide kernel

kernel.img: kernal image

resource.img: source files image

system.img: android file system image

update.img: all android system upgrading, which includes all images compiled

#### 2.1 Install Android Source Code Package

Copy Android 5.1 source code package from cloud storage into user catalogue.

Notice: do not save this file into root catalogue of system file, if you do, there will be administration authority problem.

For example: Do following command in user' s authority :

cp yourcdromdir/source/g3128-android-v51-xxx.tar.bz2 ~/

cd

tar -xjvf g3128-android-v51-xxx.tar.bz2

Now all Android file saved in the extracted directory. Till here all Android source code package installation done well.

State: Source code names could be different as its data issued, subject to cloud storage.

#### 2.2 Analysis Compiled Script

State: Kinds of source code version is different but principle same. And its script details subject to its relevant source code package, here it used to be analysis realizing mechanism.



#### 2.3 Compiling Source Code

#### 2.3.1 Checking Compiling Assistance

Do following command to checking usage of mk script

./mk.sh –h

#### 2.3.2 Compiling Uboot

Do following command and compiling uboot. Save uboot.img file into out/release catalogue when compiling done.

./mk.sh -u -j=4

#### 2.3.3 Compiling Kernel

Do following command to compiling Android kernel in Android source code catalogue:

./mk.sh -k -j=4

Done compiling, new image happens: kernel.img and resource.img, save them into out/release

#### 2.3.4 Compiling Android File System

First, check "out catalogue" in Android root catalogue. Cancel full out cataluge at the first compiling, and take following command as following to compiling Android image files : ./mk.sh -s -j=4

Done compiling and save images into out/release, which includes: system.img , boot.img , misc.img , recovery.img., parameter.txt, and all system firmware package update.img.

#### 2.4 Configurating Kernel

Kernel configuration file:kernel/arch/arm/configs/g3128\_defconfig, and its steps are:

1) cp kernel/arch/arm/configs/g3128\_defconfig kernel/.config (copy it)



2) make menuconfig ARCH=arm (Manual configuration, and save it.)

3) cp kernel/.config kernel/arch/arm/configs/g3128\_defconfig (Updating

configuration files. )

4) ./mk.sh -k (Compiling kernel one more time.)



## **Chapter 3 Compiling Linux QT Source Code**

G3128 single board computer is of standard eMMC.

State: Take ordinary permissions when compiling image. Done compiling, following images will be happend: uboot.img , **kernel.img** , **resource.img** , **linux\_system.img** , **update\_linux.img**.

uboot.img: bootloader, which used to be guide kernel.

kernel.img: which is kernel image.

resource.img: which is source files image.

linux\_system.img: which is file system image.

update\_linux.img: which includes all Linux qt system updating images.

#### 3.1 Install Linux Source Code Package

Copy Linux QT source code package into user catalogue. Notice not save into root catalogue, or administrative authority issue happens:

For example: Do following command in user' authority:

cp yourcdromdir/source/g3128-linux-xxx.tar.bz2

cd

```
tar -xjvf g3128-linux-xxx.tar.bz2
```

Save all Linux files system into current zip catalogue. And till now, Linux source code package installation done.

State: The name of source code package maybe different name as date, please reference its real name in disk.

#### **3.2 Compiling Script Analysis**

State: Different version source code script are different, but principle same.

#### 3.3 Compiling Source Code

#### 3.3.1 Check compiling assistant out.



Do following command to check mk script details out:

./mk.sh -h

#### 3.3.2 Compiling Uboot

Do following command to compiling uboot in Linux source code catalogue and then save the image uboog.img into out/release:

./mk.sh -u -j=4

#### 3.3.3 Compiling Kernel

Do following command to compiling kernel in Linux source code catalogue:

./mk.sh -k -j=4

Done compiling and save all images kernel.img and resource.img into out/release.

#### 3.3.4 Compiling Linux File System

Do following command to compiling Linux file system in Linux source code catalogue:

./mk.sh -r -j=4

Done compiling and save image linux\_system.img into out/release.

#### 3.3.5 Generate System Update Package

Do following command to generate system update package in Linux source code catalogue :

./mk.sh -l -j=4

Done compiling and save image update\_linux.img into out/release.

#### 3.4 Configurating Kernel

All configuration files saved in kernel/arch/arm/configs/g3128\_defconfig, and configuration steps as following;

1) cp kernel/arch/arm/configs/g3128\_defconfig kernel/.config (copy files)



2) make menuconfig ARCH=arm (Manual configuration and save it when done configuration)

3) cp kernel/.config kernel/arch/arm/configs/g3128\_defconfig ( Update

configuration files )

4) ./mk.sh -k (Compiling kernel again)

#### 3.5 Configuration File System

The name of configuration file is rootfs/buildroot/configs/rk3128\_rootfs\_defconfig,and configuration process is:

1) cp configs/rk3128\_rootfs\_defconfig .config (Copy it)

2) make menuconfig (Manual configuration in rootfs/buildroot, and save it after done.)

3) cp .config configs/rk3128\_rootfs\_defconfig (Update configuration files)

4) ./mk.sh -r (Compiling it again in Linux source code catalogue)



## **Chapter 4 Programming Android Image Files**

#### 4.1 Upgrade Firmware in Ubuntu Environment

In Ubuntu Environment to upgrade firmware.

#### **Preparation :**

Insert power charger with G3128 single board computer, and connect OTG cable with PC, and connect serial cable with PC, and open serial terminal and command terminal;

Power on, and press Update key, meanwhile press Reset key, and upgrade automatically.

Then, take following operation in PC command line:

sudo ./upgrade\_tool uf update.img (Upgrade full Android upgrade image)

Or upgrade them separately: uboot, kernel and resource firmware files:

sudo	./upgrade_tool	di	uboot uboot.img
sudo	./upgrade_tool	di	-k kernel.img
sudo	./upgrade_tool	di	resource resource.img
sudo	./upgrade_tool	di	-b boot.img
sudo	./upgrade_tool	di	-r recovery.img
sudo	./upgrade_tool	di	-m misc.img
sudo	./upgrade_tool	di	-p paramater.txt
sudo	./upgrade_tool	di	-s system.img

Comment:

All images and download tool are in out/release.

#### 4.2 Upgrade Firmware in Windows

#### 4.2.1 Install RK USB Drive

#### Steps :

Step1, Run DriverAssitant\_v4.4 in DriverInstall.exe, and done installation;



驱动安装	表 驱动卸载	]	
		52	
喘芯微驱动助手	DriverInstall		
端芯微驱动助手 	DriverInstall 安装驱动成功.		

Notice:

- 1 ) Support xp,win7\_32,win7\_64,win8\_32,win8\_64 OS.
- 2) Done installation of XP OS, still hint find new device, please take automount "自动安装"
- 3 ) Click quit drive and install drive then if old drive version found before installation.

#### 4.2.2 Connect Device

Run AnroidTool.exe tool in AndroidTool, and find following interface:

F	0x00000000	London		
-		Loader	\rockdev\RK3288Loader_uboot_Apr21.	
1	0x00000000	Parameter	\rockdev\rk3288=3.10=uboot=data1G	
Г	0x00002000	uboot	\rockdev\uboot.img	
Г	0x00004000	Misc	\rockdev\Image=rk3288\misc.img	
Г	0x00006000	Resource	\rockdev\kernel\resource.img	
Π	0x0000E000	Kernel	\rockdev\kernel\kernel. img	
	0x00016000	Boot	\rockdev\Image~rk3288\boot.img	
Γ	0x00026000	Recovery	\rockdev\Image=rk3288\recovery.img	
Г	0x00092000	System	\rockdev\Image=rk3288\system.img	
Г	0x00194000	Userdata	\rockdev\Image\data.img	
Г	0x00036000	Backup		
		0x00002000           0x00004000           0x00006000           0x00006000           0x00006000           0x00016000           0x00026000           0x00026000           0x00016000           0x00026000           0x000194000           0x00194000           0x00194000           0x00036000	0x00002000         uboot           0x00004000         Misc           0x00006000         Resource           0x00006000         Resource           0x00006000         Recovery           0x00026000         Recovery           0x000026000         System           0x00036000         Userdata           0x00036000         Backup	0x00002000       uboot      Vrockdev/uboot.img         0x00004000       Mise      Vrockdev/Lmagerrk3288 hise.img         0x00000000       Resource      Vrockdev/Lernel/vernel.img         0x00002000       Kernel      Vrockdev/Lernel/vernel.img         0x00002000       Boot      Vrockdev/Lmagerrk3288\boot.img         0x00026000       Recovery      Vrockdev/Lmagerrk3288\boot.img         0x000036000       System      Vrockdev/Lmagerrk3288\system.img         0x00036000       Userdata      \rockdev/Image\data.img         0x00036000       Backup      Vrockdev/Image\data.img

1) When eMMC have not programmed any firmware before.



Press Update key, and connect G3128 single board computer with PC through OTG cable. Done connection, take off Update key will be ok. And the board will enter into MASKROM, and waiting for programming to upgrade.

镜像 升级	固件 高级功能	能				下载Boot成功 等待Maskrom开始	
固件	升级	切换	擦除Flash			等待Maskrom成功 测试设备开始	
因供版本	5 0 00	Loodort	ī★· 230	1 龙氏信白。	PK20	测试设备成功 校验芯片开始	
	3. 8. 60	LoaderAp	(.4. 2.30		INOZ	校验芯片成功 获取FlashInfo开始	
固件:	E:\3288\uj	odate.img				获取FlashInfo成功	
	1					准备IDB开始 准备IDB成功	
Demo	1					下载IDB开始 下载IDB成功	
						重启设备开始	
						重启设备成功 等待Loader开始	
						等待Loader成功	
						测试设备开始测试设备成功	
						下载固件开始	
						正在下戰回升(100%)	
						下载固件成功	
	4	安理 ーイ	MASKRON	设备		里后设备开始 雷白设备成功	

2) When the G3128 single board computer have been programmed firmware before:

Power the board, and connect the board with PC through OTC, press Update key, and meanwhile press Reset key, re-start the board, take off Update key will be ok. And then the board will enter into LOADER, and waiting for upgrading. And its interfaces like following picture:

載鏡像 升级國	固件 高级功能	a de la companya de l		下载Boot开始	
固件	升级	切换 擦除Flash		下戦/Boot以/J 等待Maskerom开始 等待Maskerom成功	
固件版本:	5.0.00	Loader版本: 2.30	芯片信息:	测试设备开始 测试设备成功 	
固件:	E:\3288\up	date. img			
Demo				在台108开始 准备IDB开始 下载IDB开始	
				下载_1188,49 重启设备开始 重启设备成功	
				等待Loader开始 等待Loader成功 测试设备开始	
				一切以及全成功下载固件开始	
	5	发现一个LOADER	设备		



#### 4.2.3 Take AndroidTool to Upgrade Firmware

In last sections described how to install RK USB drive and how to connect with PC. No matter blank board or upgraded board, once done upgraded and connect well, just upgrade its firmware will be ok: Or upgrade uboot, kernel and resource firmwares one by one, or upgrade its firmware update.img.

Run AndroidTool.exe in AndroidTool

MASKROM mode:

Upgrade every firmware: click the firmware which need to be upgraded, and clink do "执行"

#         Image: Constraint of the second secon	Hbth:           0x00000000           0x00016000           0x00016000           0x00002000           0x00002000	名字 Loader Parameter uboot Misc Resource Kernel Boot Recovery	路径 \rockdev\RK3288Loader_uboot_Apr21 .\rockdev\R43288-3.10-uboot-data16 .\rockdev\uboot.ing .\rockdev\uboot.ing .\rockdev\kernel\resource.ing .\rockdev\kernel\kernel.ing .\rockdev\uboot.ing	
	0x00000000           0x00000000           0x00000000           0x00000000           0x00000000           0x00000000           0x00000000           0x00000000           0x00016000           0x00016000           0x00016000           0x00016000           0x0002000	Loader Parameter uboot Misc Resource Kernel Boot Recovery	<pre>\rockdev\RK3288Loader_uboot_Apr21\rockdev\rK3288-3.10-uboot_data16\rockdev\uboot.img\rockdev\LmagerrK3288\misc.img\rockdev\kernel\resource.img\rockdev\kernel\kernel.img\rockdev\LmagerrK3288\boot.img\rockdevLmagerrK3288\boot.img</pre>	
Image: Constraint of the second sec	<ul> <li>0x00000000</li> <li>0x00002000</li> <li>0x00004000</li> <li>0x00006000</li> <li>0x00006000</li> <li>0x00006000</li> <li>0x00016000</li> <li>0x00026000</li> <li>0x00026000</li> <li>0x00026000</li> </ul>	Parameter uboot Misc Resource Kernel Boot Recovery	\rockdev\rk3288-3.10-uboot-data1G \rockdev\uboot.img \rockdev\uboot.img \rockdev\kernel\resource.img \rockdev\kernel\kernel.img \rockdev\lmage-rk3288\boot.img	
I         I           5         I           5         I           5         I           5         I           5         I           5         I           5         I           5         I           6         I           7         I           1         I	<ul> <li>0x0002000</li> <li>0x0004000</li> <li>0x0006000</li> <li>0x00006000</li> <li>0x00016000</li> <li>0x00026000</li> <li>0x00026000</li> <li>0x00026000</li> </ul>	uboot Misc Resource Kernel Boot Recovery	\rockdev\uboot.img \rockdev\uboot.img \rockdev\kernel\resource.img \rockdev\kernel\kernel.img \rockdev\Image~rk3288\boot.img	
	Ox00004000     Ox00006000     Ox0000E000     Ox00016000     Ox00026000     Ox00026000     Ox00026000     Ox00026000	Misc Resource Kernel Boot Recovery	\rockdev\Image=rk3288\misc.img\rockdev\kernel\resource.img\rockdev\kernel\kernel.img\rockdev\Image=rk3288\boot.img	
5	<ul> <li>0x00006000</li> <li>0x00008000</li> <li>0x00016000</li> <li>0x00026000</li> <li>0x00026000</li> </ul>	Resource Kernel Boot Recovery	\rockdev\kernel\resource.img \rockdev\kernel\kernel.img \rockdev\Image-rk3288\boot.img	
	<ul> <li>0x0000E000</li> <li>0x00016000</li> <li>0x00026000</li> <li>0x00026000</li> </ul>	Kernel Boot Recovery	\rockdev\kernel\kernel.img \rockdev\Image=rk3288\boot.img	
л	Ox00016000     Ox00026000     Ox00026000	Boot Recovery	\rockdev\Image-rk3288\boot.img	
)                 0       1	0x00026000	Recovery	and the second se	
) Г .0 Г .1 Г	Z 000002000		\rockdev\Image=rk3288\recovery.img	
.0 Γ .1 Γ	0x00092000	System	\rockdev\Image=rk3288\system.img	
<u>1</u>	0x00194000	Userdata	\rockdev\Image\data.img	
	0x00036000	Backup		
	¥ .0 00 C			-
oader	ver:0.02	执行	切換 低格 清空	
	L			
		坐和—	<b>▲WACKDON</b> 出友	

Or upgrade unit firmware update.img, and take update.img, click '升级'

固件	升级 切换 搜除Flash	寺行和askrom开始 等待和askrom成功 測试设备开始 2001年2月2日
固件版本:	5.0.00 Loader版本: 2.30 芯片信息: R	初国で登載がり     校验芯片开始     校验芯片开始     校验芯片の功     女師の    レック    TA
固件:	E:\3288\update.img	秋秋/lashinfoft/h 获取FlashInfoft/b 律をIDB开始 准条TDB行わ
]Demo	7	下载IDB开始 下载IDB成功 五日以名工作
		重启设备成功 等待Loader开始
		等待Loader成场 测试设备开始 测试设备成功
		下载固件开始



#### LOADER mode:

Update every firmware, and check the firmware which need to be upgraded, and click '执行'

#		地址	名字	路径	
	Γ	0x00000000	Loader	\rockdev\RK3288Loader_uboot_Apr21	
2	Г	0x00000000	Parameter	\rockdev\rk3288=3. 10=uboot=data1G	
3	Г	0x00002000	uboot	\rockdev\uboot.img	
4		0x00004000	Misc	\rockdev\Image-rk3288\misc.img	
5	Г	0x00006000	Resource	\rockdev\kernel\resource.img	
6	Г	0x0000E000	Kernel	\rockdev\kernel\kernel. img	
	Г	0x00016000	Boot	\rockdev\Image-rk3288\boot.img	
3	Г	0x00026000	Recovery	\rockdev\Image-rk3288\recovery.img	
9	Г	0x00092000	System	\rockdev\Image-rk3288\system.img	
10	Г	0x00194000	Userdata	\rockdev\Image\data.img	
11	Г	0x00036000	Backup		

Or upgrade unit firmware update.img, check update.img, and click '升级'

影镜像 升级 B	<u>固件</u> 高級功能	下載Boot开始 下載Boot成功
固件	升级 切换 擦除Flash	等待Maskeron开始 等待Maskeron成功 训试设备开始
固件版本:	5.0.00 Loader版本: 2.30 芯片信息: RK32	测试设备成功
固件:	E:\3288\update.img	秋取FlashInfo开始 获取FlashInfo成功
Demo		作量115分均 准备115成功 下载IDB开始
		下载IDB成功 重启设备开始 重启设备成功
		等待Loader开始 等待Loader成功 1991年20名 正和4
		(1)11.22番开始 测试设备成功 下载固件开始
	发现一个LOADER设备	

#### 4.3 Update Firmware by TF Card When Off-line.

When board power on, the CPU will boot from SD card boot preferentially, and then guide. There are two functions of SD Card Boot: Upgrade and Run. Here is SD card upgrade



#### function:

Tool	:	SD_	Firmware_	Tool.exe
------	---	-----	-----------	----------

#### Steps :

Step1, Run SD\_Firmware\_Tool.exe in PC, and like following picture:

	<mark>鼎</mark> 瑞芯微仓	建升级藏盘工具 ▼	1.410			
	第一步:)	选择可移动磁盘设备		SDBoot:2.1	2	
		Generic STORAGE DEVICE	USB Device	~		
	第二步日	选择功能模式				
	E	☑ 固件升级	🗌 PCBA测试	SD启动		
	第三步:	选择升级固件				
	[	E:\3288\V60\update.img		选择固件		
	第四步:	选择Demo数据(可选)				
	Γ			选择Demo		
	[			开始创建		
				恢复磁盘		
ten2 Inse	rt TF into	) PC, and softwa	re tool will find	d TF card like		
tep2, Inse	ert TF into 副 瑞花微和	)PC, and softwa 刘建升级藏盘工具 ▼	re tool will find	d TF card, like:	X	
tep2, Inse	ert TF into 書 端芯微仓	)PC, and softwa 刘建升级藏盘工具 ▼	re tool will find 1.46	d TF card, like:	×	
tep2, Inse	ert TF into 晶 若芯微创 第一步::	)PC, and softwa N建升级磁盘工具 ↓ 选择可移动磁盘设备	re tool will find 1.46	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF intc <mark>亂 瑞芯微创</mark> 第一步:; [	) PC, and softwa 则建升级磁盘工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE	re tool will find 1.46 USB Device 7.4G	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF intc <del>111                                  </del>	D PC, and softwa	Tre tool will find 1.46	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF into 第一步: 第二步: 第二步:	D PC, and softwa 小建升级截盘工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 可固件升级	LISB Device 7.4G	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF into	D PC, and softwa	re tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF into	D PC, and softwa 小建升级磁盘工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 了 固件升级 选择升级固件	rre tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2.	12	
tep2, Inse	ert TF into	D PC, and softwa 小建升级截盘工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 可固件升级 选择升级固件 E:\3288\V60\update.img	re tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2. 「SD启动 」选择固件	12	
tep2, Inse	ert TF into	D PC, and softwa 小建升级 藻盘 工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 可固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	rre tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2. SD启动 选择固件	12	
step2, Inse	ert TF into <u>3</u>	D PC, and softwa 小建升级磁盘工具 ↓ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 ☑ 固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	re tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2. SD启动 选择固件 选择固件	× 12	
step2, Inse	ert TF into 第一步:: 第二步:: 第三步:: 第三步:: 第三步:: [	D PC, and softwa 小建升级截盘工具 マ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 可固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	Ire tool will find 1.46 E USB Device 7.4G	d TF card, like: SDBoot:2. SD启动 选择固件 选择固件	× 12	
step2, Inse	ert TF into	D PC, and softwa 小建升级磁盘工具 ↓ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 ☑ 固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	Ire tool will find	d TF card, like: SDBoot:2. SD启动 选择固件 选择固件	× 12	
step2, Inse	ert TF into <u>第</u>	D PC, and softwa 小建升级磁盘工具 ↓ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 ☑ 固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	Ince tool will find	d TF card, like: SDBoot:2. SD启动 选择固件 选择Demo 开始创建	× 12	
cep2, Inse	ert TF into	D PC, and softwa 加建升级藻盘工具 ▼ 选择可移动磁盘设备 Generic STORAGE DEVICE 选择功能模式 ⑦ 固件升级 选择升级固件 E:\3288\V60\update.img 选择Demo数据(可选)	Ine tool will find	d TF card, like: SDBoot:2. SD启动 选择固件 选择固件	× 12 ) )	

Step3, In function mode, check "固件升级", "选择升级固件" (which means zipped firmware update-android.img in Android)

Step4, Click "开始创建", and upgrade, and click "开始创建", following picture will shows,



che	ck	format	TF	or	not,	yes,	and	upgrade	then.
志微创建升	级磁盘	工具 〒1.46				×			
** (= )= 457+		n \0.47							
弗一步:选择可 Generic	移动地設备	記録音 E DEVICE USB Devi	ice 7.4G	~	SDBoot:2.12				
第二步:选择功	能模式								
☑周件	升级	PC:	BAillit	s	四启动				
第三步:选 <mark>SD</mark>	Firmw	are_Tool			X				
E	<b>i)</b> 6	刘建升级磁盘,磁盘	<b>】</b> 上数据将会	会长,是否	继续? 固件				
第四步:选	4	<b>是</b> (1)	(否op)						
					Demo				
					开始创建				
					恢复磁盘				
grading	:								
			中级藏盘工	具 v1.4	6			X	
		第一步:选择i	可移动磁盘	<b>役备</b> DEVICE USE	Device 7.4C		DBoot:2.12		
		第二步·选择:	功能模式	DEVICE USD	Device 7,44				
		jj [] ⊡ []	件升级		PCBAWIE	SI	启动		
		第三步:选择:	升级固件						
		E:\32	88\V60\upda	te.img			选择固件		
		第四步:选择)	Demo数据 (可	"选)					
							进场Dees		
							12E3# Delito		
							703# Demo		
							开始创建		
				山口口	<b>ПОЛО</b>		开始创建		
			开如	台格式化	用户盘		开始创建		
	che ☆微创建升 第一步:选择可 第二章 》 第二章 》 第二章 》 第二章 》 第二章 》 第二章 》 》 第二章 》 》 》 》 》 》 》 》 》 》 》 》 》	check 式微创建升级磁盘 第一步:选择可移动磁盘 Generic STORAG 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 Grading :	check format ☆ 菜 教 創 建 升 级 菜 菜 工 具 v1.46 第一步:选择可移动磁盘设备 Generic STORAGE DEVICE USB Dev 第二步:选择功能模式 第二步:法 SD_Firmvare_Tool 通 建 芯 袋 创 建 升 级 磁盘,磁盘 第四步:法 夏rading : 第二步:选择: []	check format TF 法公役创建升级磁盘工具 v1.46 第一步:选择可移动磁盘设备 Generic STORAGE DEVICE USB Device 7.46 第二步:选择功能模式 第二步:法 SD_Firware_Tool 第二步:法 第二句: 第二句	check format TF or 式微创建升级磁盘工具 v1.45 第一步:选择可移动磁盘设备 Generic STORAGE DEVICE USB Device 7.46 第二步:选择功能模式 第二步:选择功能模式 第二步:法 第四步:法 第四步:法 第四步:法 第一步:选择可移动磁盘设备 Generic STORAGE DEVICE USB 第二步:选择功能模式 定 第二步:选择功能模式 定 第二步:选择功能模式 定 第二步:选择功能模式 定 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式 第二步:选择功能模式	theck format TF or not, 古花读创建升级磁盘工具 v1.45 第一步: 选择可移动磁盘设备 SDBoot:2.12 Generic STORAGE DEVICE USB Device 7.46 第二步: 选择功能模式 第二步: 法 SD Fireware_1001 第二步: 法 GO Fireware_1001 第二步: 法 GO Fireware_1001 正 01年升级磁盘, 磁盘上数据将会丢失, 是否继续? 固件 中面。 所复磁盘 Grading :	check format TF or not, yes,          法法律创建升级菜盘工具 v1.46         第一步:法择可移动磁盘设备         SDBoot:2.12         Generic STORAGE DEVICE USB Device 7.4G         第二步:法择功能模式         第二步:法择功能模式         B)         Firxvare_Tool         第二步:法程可移动磁盘设备         B)         Firxvare_Tool         第二步:法程可移动磁盘设备         度(Y)         否(R)         emo         研究         Firxvare_Tool         第二步:法程可移动磁盘计数据将会丢失,是否继续?         B)         Firxvare_Tool         第二步:法程可移动磁盘设备         「當 写 芯袋 创建升级 賞 盘 工具 v1.46         第二步:法程可移动磁盘设备         第二步:法程可移动磁盘设备         第二步:法程可移动磁盘设备         第二步:法择可移动磁盘设备         第二步:法择可称动磁盘设备         第二步:法择可称动磁盘设备         第二步:法择可能模式         PCBA测试         第四步:法择Demo数据 (可选)	check format TF or not, yes, and Stability and a get L + v1.46 Stability and a get L + v1.46 Subsort: 2.12 Generic STORAGE DEVICE USB Device 7.46 Subsort: 2.12 Generic STORAGE DEVICE USB Device 7.46 Subsort: 2.12 Generic STORAGE DEVICE USB Device 7.46 Subsort: Bit Harding H	check format TF or not, yes, and upgrade          # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format TF or not, yes, and upgrade         # check format The not, so format The fo

Step 5, Done upgrade.

# Graperain

件
mo
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Step6, Pull out TF card, and insert it into the board, and power, and it upgrade automate. Done upgrade, following printing information shows:

- [ 85.661371] ret = 0
- [ 86.507524] ret = 0

librkupdate\_INFO:Start to download uboot,offset=0x2000,size=4194304

librkupdate\_INFO:Start to download misc,offset=0x6000,size=49152

librkupdate\_INFO:Start to download resource,offset=0x8000,size=3768320

librkupdate\_INFO:Start to download kernel,offset=0x10000,size=20463636

librkupdate\_INFO:Start to download boot,offset=0x1c000,size=1991896

librkupdate\_INFO:Start to download recovery,offset=0x2c000,size=28082176

librkupdate\_INFO:Start to download system,offset=0xb4000,size=1610612736

librkupdate\_Finish to upgrade firmware. SD upgrade ok. Doing Actions succeeded.please remove the sdcard......

Step7, Power off, and pull out TF card, and power on the board, and check out upgrade done.



## Chapter 5 Programme Linux-qt Image File

#### 5.1 Update Firmware in Ubuntu Environment

Update firmware in Ubuntu environment means, PC in Ubuntu OS, and done update G3128 sbc in corresponding commands.

#### **Preparation :**

Power on G3128 sbc, connect the board with PC through OTG cable, and serial ports too. Visit serial terminal and command terminal in PC.

Then, press Update key, and meanwhile press Reset key, and enter into upgrade mode.

Next, do following operation in PC command terminal: sudo ./upgrade\_tool uf update\_linux.img (Update full Linux image)

Or Update uboot, kernel and resource firmwares separately: sudo ./upgrade\_tool di uboot uboot.img sudo ./upgrade\_tool di -k kernel.img sudo ./upgrade\_tool di resource resource.img

Comment: All images and upgrade tools saved in out/release.

#### 5.2 Update Firmware in Windows Environment

#### 5.2.1 Install RK USB Drive

Steps :

Step1, Run DriverInstall.exe in DriverAssitant\_4.4 file. And one drive installation first.



驱动安	[	SEE之力卸载		
				]
芯微驱动助手	Driveriestall	X	8	
驱动安	安装驱动成功	5.		

Notes:

- Support XP, Win7\_32, Win\_64, Win8\_32, Win8\_64 OS.
- Please take automate installation when XP done installation, but the system still hint find new device.
- Click quit drive and then install drive if old version drive found before installation.

#### **5.2.2 Connect Device**

Run AndroidTool.exe in AndroidTool file, and its interface likes:

		地址	名字	路径	
		0x0000000x0	Loader	\rockdev\RK3288Loader_uboot_Apr21	
2	Г	0x00000000	Parameter	\rockdev\rk3288=3.10=uboot=data1G	
3	Г	0x00002000	uboot	\rockdev\uboot.img	
4	Г	0x00004000	Misc	\rockdev\Image=rk3288\misc.img	
5	Г	0x00006000	Resource	\rockdev\kernel\resource.img	
6	Π	0x0000E000	Kernel	\rockdev\kernel\kernel.img	
7		0x00016000	Boot	\rockdev\Image=rk3288\boot.img	
8	Γ	0x00026000	Recovery	\rockdev\Image=rk3288\recovery.img	
9	Г	0x00092000	System	\rockdev\Image=rk3288\system.img	
10	Г	0x00194000	Userdata	\rockdev\Image\data.img	
11	Г	0x00036000	Backup		

3 ) For blank board, which means eMMC no firmware or image.

Press Update key, and connect the board with PC (Windows os) throgh OTG cable. Done the connection, take off Update key will be ok. And the board will enter into MASKROM mode,

#### and waiting for programme.

idroid并及.	上共 ▼2.3				
裁鏡像 升级国	固件 高级功能			下载Boot成功 等待Maskrom开始	
周供	14/18 17			等待Maskrom成功	
	J150	13Ki2/1 asu		测试设备开始	
固件版本:	5.0.00 L	.oader版本: 2.30	芯片信息: 1	K32 校验芯片成功	
				获取FlashInfo开始	
固件	E:\3288\update	e.img		获取FlashInfo成功	
	d.			准备IDB开始	
	(A.S. 1997)			住备IDB成功 ズサrpp 工社	
Demo				下载IDD开始	
				重启设备开始	
				重启设备成功	
				等待Loader开始	
				等待Loader成功	
				侧阔汉备并归 测试设备成历	
				下载固件开始	
				正在下载固件(100%)	
				正在校验固件(100%)	
	发现	-AWASKROW	设备	重启设备升贴 专户设备成功	
	12-11	a fundation	м <b>н</b>	里口以普风切	

4 ) For the board which have been programmed firmware before.

Power on, connect the board with PC through OTG cable, press Update key, and meanwhile press Reset key, and re-start the board. Pull off Update key will be ok. And then the board will enter into LOADER mode, and waiting for programme, and interface likes:

镜像 升级[	固件 高级功	能				下載Boot开始 下載Boot成功	
固件	升级	切换	擦除Flash			等待Maskrom开始 等待Maskrom成功 30052-0-5-2749	
固件版本:	5.0.00	Loader版	体: 2.30	芯片信息:	RK32	侧凤设备开始 测试设备成功 校验芯片开始	
固件:	E:\3288\u	pdate.img				び短心力 成め 获取FlashInfo开始 获取FlashInfo成功	
Demo						在备LDB开始 准备IDB成功 下载IDB开始	
						下载110版切 重启设备开始 重启设备成功	
						等待Loader开始 等待Loader成功 测试设备开始	
						测试设备成功下载固件开始	
		4D - 200		н г.			

#### 5.2.3 Take AndroidTool Update Firmware

In last sections described how to install RK USB drive and how to connect board with PC. Both blank board or programmed board, could be update firmware as needed when connection done. Update uboot, kernel and resource firmware files separately or update unit



High-end Embedded Solution Provider

firmware in one time.

Run AndroidTool.exe tool in AndroidTool file.

MASKROMM mode updating:

Update every firmwares separetly: click wanted firmware, and click "执行';

					等待Maskrom成功
¥		地址	名字	路径	测试设备开始
1		0x00000000	Loader	\rockdev\RK3288Loader_uboot_Apr21	测试设备成功
	~	0x00000000	Parameter	\rockdev\rk3288=3.10=uboot=data1G	校验芯片开始 
)	~	0x00002000	uboot	\rockdev\uboot.img	校验心方成功 
4	~	0x00004000	Misc	\rockdev\Image=rk3288\misc.img	状取Plashinto开始
5	~	0x00006000	Resource	\rockdev\kernel\resource.img	秋秋Fiashinio所-切 W牛欠 Thp II市ム
3	~	0x0000E000	Kernel	\rockdev\kernel\kernel.img	1世田10071%月 )准名TIDB成Th
7	~	0x00016000	Boot	\rockdev\Image=rk3288\boot.img	下載TDB开始
3	~	0x00026000	Recovery	\rockdev\Image=rk3288\recovery.img	下載TDB成功
	~	0x00092000	System	\rockdev\Image=rk3288\system.img	<b>重启设备开始</b>
10	Г	0x00194000	Userdata	\rockdev\Image\data.img	重启设备成功
1	Г	0x00036000	Backup		等待Loader开始
					等待Loader成功
					测试设备开始
					测试设备成功
					下载固件开始
oad	er V	(er:0.02	执行	切換 低格 清空	正在下载固件(100%)
		L			正在校验固件(100%)
					- 下载固件成功
			42-311-	<b>Ан</b> исирон沿女	重启设备开始
			及况	T MADANCE 仅 伯	重启设备成功

Or update unit firmware update\_linux.img: Check update\_linux.img, and click '升级'

镜像 并级	固件 高级功能	3			下载, Doot, M, JJ 等待Masker om 开始	
固件	升级	切换	擦除Flash		等待Maskrom成功 训动设备开始	
					测试设备成功	
固件版本:	5.0.00	Loader)	版本: 2.30	芯片信息: RK32	校验芯片开始 校验芯片成功	
	L				获取FlashInfo开始	
固件:	E:\3288\up	date.img			获取FlashInfo成功	
					推奋IDB 推奋IDB 推奋IDB 推奋IDB 推奋IDB	
1.	0				下载IDB开始	
lnewo					下载IDB成功	
					重启设备开始 重启设备成功	
					等待Loader开始	
					等待Loader成功	
					测试设备开始	
					例 风 夜 备 风 切	
					正在下载固件(100%)	
					正在校验固件(100%)	
					下載同伴成功	

#### LOADER mode updating:

Update every firmwares separately: Check firmware and click "执行"

	地址	名字	路径			
	0x00000000	Loader	\rockdev\RK3288Loader_uboot_Apr21			
	0x00000000	Parameter	\rockdev\rk3288-3.10-uboot-data1G			
1	0x00002000	uboot	\rockdev\uboot.img			
	0x00004000	Misc	\rockdev\Image-rk3288\misc.img			
	0x00006000	Resource	\rockdev\kernel\resource.img			
	0x0000E000	Kernel	\rockdev\kernel\kernel.img			
	0x00016000	Boot	\rockdev\Image=rk3288\boot.img			
1	0x00026000	Recovery	\rockdev\Image=rk3288\recovery.img			
1	0x00092000	System	\rockdev\Image=rk3288\system.img			
	0x00194000	Userdata	\rockdev\Image\data.img			
1	0x00036000	Backup				
• 1	'er:0.02	执行	切換 低格 清空			

Or update unit firmware update\_linux.img: Check firmware update\_linux.img, and click "升

#### 级

像 升级[	目件 高级功能		下載Boot开始 下載Boot成功	
固件	升级 切换 擦除Flash		等待Masker om开始 等待Masker om成功	
固件版本:	5.0.00 Loader版本: 2.30	芯片信息: RK32	测试设备开始 测试设备成功 检验芯片开始	
固件:	E:\3288\update.img		Ct描心片成功 获取FlashInfo开始 获取FlashInfo成功	
Demo			在留IDB开始 准备IDB开始 下载IDB开始	
			下戰1105%-50 重启设备开始 重启设备开始	
			等待Loader开始 等待Loader成功 测试设备开始 测试设备成功	
			下载固件开始	
	发现一个I OADER			

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### 5.3 Update Firmware When Off-line

When board power on, the CPU will boot from SD card boot preferentially, and then guide. There are two functions of SD Card Boot: Upgrade and Run. Here is SD card upgrade function:

Tool : SD\_Firmware\_Tool.exe

Details :

Step1, Run SD\_Firmware\_Tool.exe in PC (Here is SD\_Firmware\_Tool.\_v1.46), likes:

弗一亚	:选择可移动姬盘设备	SDBoot:2.12
	Generic STORAGE DEVICE USB Device	
第二步	:选择功能模式	
	✓固件升级 PCBA测试 □	SD启动
第三步	:选择升级固件	
	E:\3288\V60\update.img	选择固件
第四步	:选择Demo数据(可选)	
		选择Demo
		开始创建

Step2, Insert TF card into PC, and software will find TF, likes:

<mark>鼎</mark> 瑞芯微:	创建升级藏盘工具 <b>▽</b> 1.46	×
第一步	:选择可移动磁盘设备 SDBoot:2.12	
	Generic STORAGE DEVICE USB Device 7.4G	
第二步	:选择功能模式	
	☑ 固件升级 □ PCBA测试 □ SD启动	
第三步	选择升级固件	
	E:\3288\V60\update.img 选择固件	
第四步	:选择Demo数据(可选)	
	选择Demo	
	<b>开始创建</b>	
	恢复磁盘	



Check "固件升级", and check the firmwares (here means update-android.img in Android) which need to be updated.

Click "开始创建", and updating. One dialog box pops up when click "开始创建", hints format or not, yes "是", and start updating.

	副 瑞芯微创建升级藏盘工具 ∨1.46	
	第一步:选择可移动磁盘设备 SDBoot:2.12	
	Generic STORAGE DEVICE USB Device 7.4G	
	第二步:选择功能模式	
	✓ 固件升级 PCBA测试 SD 启动	
	第三步:选	
	E: (1) 创建升级磁盘,磁盘上数据将会丢失,是否继续? 固件	
	第四步:选	
	开始创建	
	恢复磁盘	
Updating :		
	圖 瑞士賞创建升拓黨身工員1 46	
	ME 1998 AF DR GIBE / L-R PRAINE → 27 × 1 × 3.0	
	第一步:选择可移动磁盘设备 SDBoot:2.12	2
	Generic STORAGE DEVICE USB Device 7,4G	
	第二步:选择功能模式	
	✓ 固件升级 PCBA测试 SD启动	
	第三步:选择升级固件	
	E:\3288\V60\update.img 选择固件	
	第四步:选择Demo数据(可选)	
	选择Demo	
	开始创建	
	开始格式化用户盘       恢复磁盘	

Done update.

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第一步	选择可移动磁盘设备		SDBoot:2.12
	Generic STORAGE DEV	~	
第二步	:选择功能模式		
	🗹 固件升级	🗌 РСВАѾі式	SD启动
第三步	:选择升级固件		
	E:\3288\V60\upd	_Firmware_Tool	送 选择固件
第四步	:选择Demo数据(F	创建升级磁盘成功	1.
		确定	选择Demo
			开始创建

Pull out TF card, and insert it into G3128 board, power on, and it will upgrade automatically. Done upgrade, and its printing information goes as:

- [ 85.661371] ret = 0
- [ 86.507524] ret = 0

librkupdate\_INFO:Start to download uboot,offset=0x2000,size=4194304

librkupdate\_INFO:Start to download misc,offset=0x6000,size=49152

librkupdate\_INFO:Start to download resource,offset=0x8000,size=3768320

librkupdate\_INFO:Start to download kernel,offset=0x10000,size=20463636

librkupdate\_INFO:Start to download boot,offset=0x1c000,size=1991896

librkupdate\_INFO:Start to download recovery,offset=0x2c000,size=28082176

librkupdate\_INFO:Start to download system,offset=0xb4000,size=1610612736

librkupdate\_Finish to upgrade firmware. SD upgrade ok. Doing Actions succeeded.please remove the sdcard......

Power off, pull out TF card, and power on one more time, and check upgrade done.

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## **Chapter 6 Product Portfolio**

#### 6.1 System on Module Series

G4418 SOM (Samsung S5P4418) G6818 SOM (Samsung S5P 6818) G3288 SOM (Rockchip RK3288 stamp hole) GR3288 SOM (Rockchip RK3288 Immersion Gold MXM) G3128 SOM (Rockchip RK3128 Immersion Gold MXM) G3399 SOM (Rockchip RK3399 stamp hole) GR3399 SOM (Rockchip RK3399 Immersion Gold MXM) M9 SOM (Qualcomm 8916)

#### 6.2 Development Board Series

G4418 development board (Samsung S5P4418) G6818 development board (Samsung S5P 6818) G3288 development board (Rockchip RK3288 stamp hole) GR3288 development board (Rockchip RK3288 Immersion Gold MXM) G3399 development board (Rockchip RK3399 stamp hole) GR3399 development board (Rockchip RK3399 Immersion Gold MXM)

#### 6.3 Single Board Computer (SBC) Series

G4418 single board computer (Samsung S5P4418) G6818 single board computer (Samsung S5P 6818) G3128 single board computer (Rockchip RK3128) G3288 single board computer (Rockchip RK3288) GR3399 single board computer (Rockchip RK3399)

Instructions: More information of specifications and other products, please pay attention to website and contact us directly.

www.graperain.com