## Getting Started with NanoPi NEO3 LTS

- Soc: RockChip RK3328, Quad-core 64-bit high-performance Cortex A53
- RAM: 1GB/2GB DDR4
- LAN: 10/100/1000M Ethernet with unique MAC
- USB Host: 1x USB3.0 Type A and 2x USB2.0 on 2.54mm pin header
- MicroSD Slot: MicroSD x 1 for system boot and storage
- LED: Power LED x 1, System LED x 1
- Key: User Button x 1
- Fan: 2Pin JST ZH 1.5mm Connector for 5V Fan
- GPIO: 2.54mm pitch 26 pin-header, include I2C, UART, SPI, I2S, GPIO
- Serial Debug Port: 2.54mm pitch 3 pin-header, 1500000bps
- Power: 5V/1A, via Type-C or GPIO
- PCB Dimension: 48 x 48mm
- Working Temperature: -20°C to 70°C
- Weight: 22g

# 3 Diagram, Layout and Dimension

## 3.1 Layout



#### NanoPi NEO3 Layout

• GPIO (I2C/UART/SPI/I2S/GPIO)

Pin#	Name	Linux GPIO	Pin#	Name	Linux GPIO
1	3.3V(OUT)		2	5V(OUT/IN)	
3	I2C0_SDA		4	5V(OUT/IN)	
5	I2C0_SCL		6	GND	
7	GPIO2_A2/IR-RX	66	8	GPIO3_A4/UART1_TX	100
9	GND		10	GPIO3_A6/UART1_RX	102
11	GPIO2_B7/I2S1_MCLK	79	12	GPIO2_C3/I2S1_SDI	83
13	GPIO2_C1/I2S1_LRCK_TX	81	14	GND	
15	GPIO2_C2/I2S1_SCLK	82	16	GPIO3_A5/UART1_RTSN	101
17	3.3V(OUT)		18	GPIO3_A7/UART1_CTSN	103
19	GPIO3_A1/SPI_TXD	97	20	GND	
21	GPIO3_A2/SPI_RXD	98	22	GPIO2_C7/I2S1_SDO	87
23	GPIO3_A0/SPI_CLK	96	24	GPIO3_B0/SPI_CSN0	104
25	GND		26	GPIO0_D3/SPDIF_TX	27

#### • USB2.0

Pin#	Name	Pin#	Name
1	GND	2	GND

3	DP1	4	OTG_DP
5	DM1	6	OTG_DM
7	5V	8	5V

Note:

1. For more details refer to the document: <u>NanoPi-NEO3-2005-Schematic.pdf</u>

## 3.2 Dimensional Diagram

Refer to the document: pcb file in dxf format

# 4 Get Started

## 4.1 Essentials You Need

Before starting to use your NanoPi NEO3 get the following items ready

- NanoPi NEO3
- MicroSD Card/TF Card: Class 10 or Above, minimum 8GB SDHC
- TYPC-C 5V/2A power adapter
- A host computer running Ubuntu 16.04 64-bit system

## 4.2 TF Cards We Tested

To make your NanoPi NEO3 boot and run fast we highly recommend you use a Class10 8GB SDHC TF card or a better one. The following cards are what we used in all our test cases presented here:

• SanDisk TF 8G Class10 Micro/SD High Speed TF card:





• SanDisk TF128G MicroSDXC TF 128G Class10 48MB/S:



• 川宇 8G C10 High Speed class10 micro SD card:



## 4.3 Install OS

#### 4.3.1 Download Image Files

Go to <u>download link</u> to download the image files under the officail-ROMs directory and the flashing utility under the tools directory:

Image Files:				
rk3328-sd-friendlycore-bionic-5.4-arm64- YYYYMMDD.img.zip	Based on UbuntuCore 18.04 and Linux-5.4.12 Kernel			
rk3328-sd-friendlywrt-5.10-YYYYMMDD.img.zip	Based on OpenWrt and Linux-5.10 Kernel			
Flashing Utility:				
win32diskimager.rar	Windows utility. Under Linux users can use "dd"			

#### 4.3.2 Linux 4.3.2.1 Flash to TF

- FriendlyCore / Debian / Ubuntu / OpenWrt / DietPi are all based on a same Linux distribution and their installation methods are the same.
- Extract the Linux image and win32diskimager.rar files. Insert a TF card(at least 8G) into a Windows PC and run the win32diskimager utility as administrator. On the utility's main window select your TF card's drive, the wanted image file and click on "write" to start flashing the TF card.

After it is installed you will see the following window:

🎨 Complete 📃 💌				
1	Write Successful.			
	ОК			

;

 Insert this card into your board's BOOT slot and power on (with a 5V/2A power source). If the PWR LED is on and the STAT LED is blinking this indicates your board has successfully booted.

# 5 Work with FriendlyWrt

## 5.1 Introduction to FriendlyWrt

FriendlyWrt is a customized system made by FriendlyElec based on an OpenWrt distribution. It is open source and well suitable for developing IoT applications, NAS applications, smart home gateways etc.

## 5.2 First boot

For the first boot, the system needs to do the following initialization work :

- 1) Extended root file system
- 2) Initial setup (will execute /root/setup.sh)

So you need to wait for a while (about 2~3 minutes) to boot up for the first time, and then set FriendlyWrt, you can enter the ttyd terminal on the openwrt webpage, when the prompt is displayed as root@FriendlyWrt, it means the system has been initialized.

root@FriendlyWrt

## 5.3 Account & Password

The default password is password (empty password in some versions). Please set or change a safer password for web login and ssh login. It is recommended to complete this setting before connecting NanoPi-NEO3 to the Internet.

## **5.4 Network Connection**

Use a network cable to connect NanoPi-NEO3's WAN to a master router and the board will get an IP address via DHCP. Login into the router and check NanoPi-NEO3's IP address.

## 5.5 Login FriendlyWrt

Connect the PC to the LAN port of NanoPi-NEO3. If your PC without a built-in ethernet port, connect the LAN port of the wireless AP to the LAN port of NanoPi-NEO3, and then connect your PC to the wireless AP via WiFi, Enter the following URL on your PC's browser to access the admin page:

- <u>http://friendlywrt/</u>
- http://192.168.2.1/
- http://[fd00:ab:cd::1]

The above is the LAN port address of NanoPi-NEO3. The IP address of the WAN port will be dynamically obtained from your main router through DHCP.

## 5.6 Recommended security settings

The following settings are highly recommended to complete before connecting NanoPi-NEO3 to the Internet\_  $\ensuremath{\circ}$ 

- Set a secure password
- Only allow access to ssh from lan, change the port
- Only allow local devices to access luci

Edit /etc/config/uhttpd, Change the original 0.0.0.0 and [::] addresses to the local lan address, for example :

```
# HTTP listen addresses, multiple allowed
list listen_http 192.168.2.1:80
list listen_http [fd00:ab:cd::1]:80
# HTTPS listen addresses, multiple allowed
list listen https 192.168.2.1:443
```

```
list listen https [fd00:ab:cd::1]:443
```

Restart the service:

/etc/init.d/uhttpd restart

## 5.7 Safe shutdown operation

Enter the ttyd terminal, enter the poweroff command and hit enter, wait until the led light is off, and then unplug the power supply.

## 5.8 Install Software Packages

#### 5.8.1 Update Package List

Before install software packages update the package list:

\$ opkg update

#### 5.8.2 List Available Packages

\$ opkg list

#### 5.8.3 List Installed Packages

\$ opkg list-installed

#### 5.8.4 Install Packages

\$ opkg install <package names>

#### 5.8.5 Remove Packages

\$ opkg remove <package names>

## 5.9 Disable IPv6

```
sed -i -e "s/DISABLE_IPV6=0/DISABLE_IPV6=1/g" /root/setup.sh
rm -rf /etc/board.json /etc/config/system /etc/config/network
/etc/config/wireless /etc/firstboot_* /root/.friendlyelec
reboot
```

## 5.10 Some common issues of FriendlyWrt

- Unable to dial up
  - Go to "Network" -> "Firewall" and set "Inbound Data", "Outbound Data" and "Forwarding" in "WAN Zone" to "Accept";
  - If you still cannot access the Internet, you can try to turn off IPV6;
- Unable to power on
  - Try to replace the power adapter and cable. It is recommended to use a power supply with specifications above 5V/2A;
  - Note that some fast chargers with Type-C interface will have a delay, it may take a few seconds to start providing power;
- When doing secondary routing, the computer cannot connect to the Internet
  - If your main network is IPv4, and NanoPi-NEO3 works in IPv6, the computer may not be able to connect to the Internet. It is recommended to turn off IPv6 (the method is described later in this WiKi), or switch the main route to IPv6;
- If you have questions or have better suggestions, please send an email to techsupport@friendlyarm.com;

## 5.11 Let FriendlyWrt regenerate network settings

This method will trigger FriendlyWrt to re-identify the hardware model and generate the network configuration under /etc/config, which is similar but not completely equivalent to restoring factory settings:

```
rm -rf /etc/board.json /etc/config/system /etc/config/network
/etc/config/wireless /etc/firstboot * /root/.friendlyelec
```

The /root/setup.sh initialization script will be executed again at the next boot, so you can debug the /root/setup.sh script through this method.

## 5.12 Use USB2LCD to view IP and temperature

Plug the USB2LCD module to the USB interface of NanoPi-NEO3 and power on, the IP address and CPU temperature will be displayed on the LCD:

## 5.13 Work with USB WiFi Device

#### 5.13.1 Check USB WiFi Device with Command Line Utility

(1) Click on "services>ttyd" to start the command line utility

(2) Make sure no USB devices are connected to your board and run the following command to check if any USB devices are connected or not

lsusb

(3) Connect a USB WiFi device to the board and run the command again

lsusb

You will see a new device is detected. In our test the device's ID was 0BDA:C811

(4) Type your device's ID (in our case it was "0BDA:C811" or "VID\_0BDA&PID\_C811") in a search engine and you may find a device that matches the ID. In our case the device we got was Realtek 8811CU.

#### 5.13.2 Configure a USB WiFi Device as AP

(1) Connect a USB WiFi device to the NanoPi-NEO3. We recommend you to use the following devices:

	Distro Supp		
OS WiFi Chipset	FriendlyWrt OpenWrt 19.07.5	Ubuntu Core Ubuntu 20.04 64-bit	AP Mode
RTL8188CUS/8188EU 802.11n WLAN Adapter	Preinstalled driver	Yes	×
RT2070 Wireless Adapter	Preinstalled driver	Yes	×
RT2870/RT3070 Wireless Adapter	Preinstalled driver	Yes	×
RTL8192CU Wireless Adapter	Preinstalled driver	Yes	×
Ralink MT7601/MT7601U	Preinstalled driver	Yes	×
5G USB WIFI RTL8821CU/RTL8811CU (VID_0BDA & PID_C811)	Plug and play, Access Point mode by default	Yes	v
5G USB WIFI RTL8812BU (VID_0BDA & PID_B812)	Plug and play, Access Point mode by default	Yes	v
5G USB WiFi RTL8812AU (VID_0BDA & PID_8812)	Plug and play, Access Point mode by default	Yes	v
5G USB WIFI MediaTek MT7662 (VID_0E8D & PID_7612)	Plug and play, Access Point mode by default	No	V

Note: devices that match these VID&PIDs would most likely work. (2) Click on "System>Reboot" and reboot your NanoPi-NEO3

(3) Click on "Network>Wireless" to enter the WiFi configuration page

(4) Click on "Edit" to edit the configuration

(5) On the "Interface Configuration" page you can set the WiFi mode and SSID, and then go to "Wireless Security" to change the password. By default the password is "password". After you make your changes click on "Save" to save

(6) After you change the settings you can use a smartphone or PC to search for WiFi

#### 5.13.3 Common USB WiFi issues

1) It is recommended to plug in the usb wifi in the off state, then power it on, FriendlyWrt will automatically generate the configuration file /etc/config/wireless, if not, see if there is wlan0 by ifconfig -a, if there is no wlan0, usually there is no driver.

2) If ifconfig -a sees wlan0, but the hotspot is not working properly, try changing the channel and country code, an inappropriate country code can also cause the WiFi to not work.
3) Some USB WiFis (e.g. MTK MT7662) work in CD-ROM mode by default and need to be switched by usb\_modeswitch, you can try to add usb\_modeswitch configuration to the following directory: /etc/usb\_modeswitch.d.

## 5.14 Work with Docker Applications

5.14.1 Work with Docker: Install JellyBin

mkdir -p /jellyfin/config
mkdir -p /jellyfin/videos

# docker run --restart=always -d -p 8096:8096 -v /jellyfin/config:/config -v /jellyfin/videos:/videos jellyfin/jellyfin:10.1.0-arm64 -name myjellyfin

<complex-block><complex-block><complex-block><complex-block><complex-block>

5.14.2 Work with Docker: Install Personal Nextcloud mkdir /nextcloud -p docker run -d -p 8888:80 --name nextcloud -v /nextcloud/:/var/www/html/ --restart=always --privileged=true arm64v8/nextcloud

After installtion, visit port 8888.

## 5.15 Mount smbfs

mount -t cifs //192.168.1.10/shared /movie -o
username=xxx,password=yyy,file mode=0644

#### 5.16 Use sdk to compile the package

#### 5.16.1 Install the compilation environment

Download and run the following script on 64-bit Ubuntu (version 18.04+): <u>How to setup the</u> <u>Compiling Environment on Ubuntu bionic</u>

#### 5.16.2 Download and decompress sdk from the network disk

The sdk is located in the toolchain directory of the network disk:

```
tar xvf ~/dvd/FriendlyELEC-NanoPiR4S/toolchain/friendlywrt-kernel-
5.x.y/openwrt-sdk-19.07.5-rockchip-rk3399_gcc-7.5.0_musl.Linux-
x86_64.tar.xz
# If the path is too long, it will cause some package compilation
errors, so change the directory name here
mv openwrt-sdk-19.07.5-rockchip-rk3399_gcc-7.5.0_musl.Linux-x86_64 sdk
cd sdk
./scripts/feeds update -a
./scripts/feeds install -a
```

#### 5.16.3 Compile the package

download the source code of the example (a total of 3 examples are example1, example2, example3), and copy to the package directory:

```
git clone https://github.com/mwarning/openwrt-examples.git
cp -rf openwrt-examples/example* package/
rm -rf openwrt-examples/
```

Then enter the configuration menu through the following command:

make menuconfig

In the menu, select the following packages we want to compile (actually selected by default):

```
"Utilities" => "example1"
"Utilities" => "example3"
"Network" => "VPN" => "example2"
```

execute the following commands to compile the three software packages:

```
make package/example1/compile V=99
make package/example2/compile V=99
make package/example3/compile V=99
```

After the compilation is successful, you can find the ipk file in the bin directory, as shown below:

```
$ find ./bin -name example*.ipk
./bin/packages/aarch64_cortex-a53/base/example2_0.1-1_aarch64_cortex-a53.ipk
./bin/packages/aarch64_cortex-a53/base/example3_0.1-1_aarch64_cortex-a53.ipk
./bin/packages/aarch64_cortex-a53/base/example1_0.1-1_aarch64_cortex-
```

a53.ipk

#### 5.16.4 Install the ipk to NanoPi

You can use the scp command to upload the ipk file to NanoPi:

cd ./bin/packages/aarch64\_cortex-a53/base/
scp example\*.ipk root@192.168.2.1:/root/

Then use the opkg command to install them:

```
cd /root/
```

```
opkg install example2_0.1-1_aarch64_cortex-a53.ipk
opkg install example3_0.1-1_aarch64_cortex-a53.ipk
opkg install example1_0.1-1_aarch64_cortex-a53.ipk
```

# 6 Compile FriendlyWrt

#### 6.1 Download Code

```
mkdir friendlywrt-rk3328
cd friendlywrt-rk3328
repo init -u https://github.com/friendlyarm/friendlywrt_manifests -b
master-v19.07.1 -m rk3328.xml --repo-
url=https://github.com/friendlyarm/repo --no-clone-bundle
repo sync -c --no-clone-bundle
```

#### 6.2 1-key Compile

./build.sh nanopi\_r2.mk

All the components (including u-boot, kernel, and friendlywrt) are compiled and the sd card image will be generated.

# 7 Work with FriendlyCore 7.1 FriendlyCore User Account

Non-root User:

User Name: pi Password: pi

Root:

User Name: root Password: fa

## 7.2 Update Software Packages

\$ sudo apt-get update

#### 7.3 Setup Network Configurations

By default "eth0" is assigned an IP address obtained via dhcp. If you want to change the setting you need to change the following file:

```
vi /etc/network/interfaces.d/eth0
```

For example if you want to assign a static IP to it you can run the following commands:

```
auto eth0
iface eth0 inet static
address 192.168.1.231
netmask 255.255.255.0
gateway 192.168.1.1
```

You also need to modify the following file to add the DNS configuration:

vi /etc/systemd/resolved.conf

例如设置为192.168.1.1:

[Resolve] DNS=192.168.1.1

Restart the systemd-resolved service with the following command:

sudo systemctl restart systemd-resolved.service
sudo systemctl enable systemd-resolved.service

To change the setting of "eth1" you can add a new file similar to eth0's configuration file under the /etc/network/interfaces.d/ directory.

#### 7.4 Build kernel-header deb package

```
git clone https://github.com/friendlyarm/kernel-rockchip -b nanopi-r2-
v5.10.y
tar xvzf /path/to/rk3328/images-for-eflasher/friendlycore-lite-focal-
arm64-images.tgz
```

KERNEL\_SRC=\$PWD/kernel-rockchip MK\_HEADERS\_DEB=1 ./build-kernel.sh
friendlycore-lite-focal-arm64

# 8 Make Your Own OS Image

- Please refre this link :
  - sd-fuse\_rk3328

# 9 More OS Support

## 9.1 DietPi



DietPi is a highly optimised & minimal Debian-based Linux distribution. DietPi is extremely lightweight at its core, and also extremely easy to install and use. Setting up a single board computer (SBC) or even a computer, for both regular or server use, takes time and skill. DietPi provides an easy way to install and run favourite software you choose.

For more information, please visit this link https://dietpi.com/docs/.

DietPi supports many of the NanoPi board series, you may download the image file from here:

<u>https://dietpi.com/docs/dietpi\_sbc/#nanopi-series-friendlyarm</u>

## **10** Resources

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## **10.1 Schematics and Datasheets**

- Schematics
  - <u>NanoPi-NEO3-2005-Schematic.pdf</u>
  - Dimensional Diagram
    - pcb file in dxf format
- RK3328 Datasheet <u>Rockchip\_RK3328\_Datasheet.pdf</u>