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# How to Enable the NPU on the Radxa Zero 3

Most operating systems for the Radxa Zero 3W or 3E do not have the NPU enabled by default.

This guide explains how to enable the NPU by adding an overlay to the device tree.

We cover the three most popular operating systems.

## Ubuntu 22.04 / 24.04

[Joshua Riek's](#) Ubuntu image for the Radxa Zero 3W and 3E does not include NPU acceleration by default.

To enable the NPU, you need to install the appropriate overlay and modify the boot configuration.

### Step 1: Locate the Kernel Device Tree Overlays

Navigate to the overlay directory:

```
cd /lib/firmware/$(uname -r)/device-tree/rockchip/overlay
```



Look for the NPU-related overlay files:

```
ls | grep npu
```



You should see files similar to these:

```
rk3568-npu-disable.dtbo
rk3568-npu-enable.dtbo
```



Note: The **RK3568 NPU overlay** is used because the RK3566 NPU in the Radxa Zero 3 is identical to the RK3568 NPU.

If you cannot find these files, search your system with:

```
sudo find / -name 'rk3568-npu*'
```



We need the `rk3568-npu-enable.dtbo` file.

## Step 2: Modify the Boot Configuration

Now that we know the location of the overlay, let's add it to the boot configuration.

Edit the **u-boot** configuration file:

```
cd /etc/default
sudo nano u-boot
```



Uncomment or add the following lines (make sure **U\_BOOT\_UPDATE** is set to "true" ):

```
U_BOOT_UPDATE="true"
U_BOOT_FDT_OVERLAYS="rk3568-npu-enable.dtbo"
U_BOOT_FDT_OVERLAYS_DIR="/lib/firmware/$(uname -r)/device-tree/rockchip/over
```



```
1 ## /etc/default/u-boot - configuration file for u-boot-update(8)
2
3 U_BOOT_UPDATE="true"
4
5 #U_BOOT_ALTERNATIVES="default recovery"
6 #U_BOOT_DEFAULT="l0"
7 #U_BOOT_PROMPT="1"
8 #U_BOOT_ENTRIES="all"
9 #U_BOOT_MENU_LABEL="Debian GNU/Linux"
10 #U_BOOT_PARAMETERS="ro earlycon"
11 #U_BOOT_ROOT=""
12 #U_BOOT_TIMEOUT="50"
13 #U_BOOT_FDT=""
14 #U_BOOT_FDT_DIR="/lib/firmware/"
15 U_BOOT_FDT_OVERLAYS="rk3568-npu-enable.dtbo"
16 U_BOOT_FDT_OVERLAYS_DIR="/lib/firmware/$(uname -r)/device-tree/rockchip/overlay"
17 #U_BOOT_SYNC_DTBS=false
```

## Step 3: Apply the Changes

Update U-Boot to apply the configuration:

```
sudo u-boot-update
```



Reboot your system to activate the NPU:

```
sudo reboot
```



```

radxa@zero3: ~
radxa@zero3:~$ sudo dmesg | grep RKNPU
[sudo] password for radxa:
[ 15.013044] RKNPU fde40000.npu: Adding to iommu group 0
[ 15.014027] RKNPU fde40000.npu: RKNPU: rknpu iommu is enabled, using iommu mo
de
[ 15.014121] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 15.014560] RKNPU fde40000.npu: Looking up mem-supply from device tree
[ 15.014586] RKNPU fde40000.npu: Looking up mem-supply property in node /npu@f
de40000 failed
[ 15.014664] RKNPU fde40000.npu: can't request region for resource [mem 0xfde4
0000-0xfde4ffff]
[ 15.016539] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 15.017141] RKNPU fde40000.npu: bin=0
[ 15.017200] RKNPU fde40000.npu: leakage=3
[ 15.017241] RKNPU fde40000.npu: pvtm = 88950, from nvmem
[ 15.017257] RKNPU fde40000.npu: pvtm-volt-sel=2
[ 15.017274] RKNPU fde40000.npu: soc version=0, speed=2
[ 15.018127] RKNPU fde40000.npu: avs=0
[ 15.018454] RKNPU fde40000.npu: l=0 h=2147483647 hyst=5000 l_limit=0 h_limit=
0 h_table=0
[ 15.019178] RKNPU fde40000.npu: failed to find power_model node
[ 15.019358] RKNPU fde40000.npu: RKNPU: failed to initialize power model
[ 15.019454] RKNPU fde40000.npu: RKNPU: failed to get dynamic-coefficient
radxa@zero3:~$

```

## Troubleshooting: NPU Not Working?

If your NPU isn't working, check the following:

1. Open the `extlinux.conf` file:

```
sudo nano /boot/extlinux/extlinux.conf
```

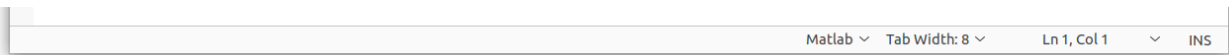


2. Look for the following line, which should have been added by the `u-boot` tool:

```

extlinux.conf [Read-Only]
/boot/extlinux
1 ## /boot/extlinux/extlinux.conf
2 ##
3 ## IMPORTANT WARNING
4 ##
5 ## The configuration of this file is generated automatically.
6 ## Do not edit this file manually, use: u-boot-update
7
8 default l0
9 menu title U-Boot menu
10 prompt 1
11 timeout 20
12
13
14 label l0
15     menu label Ubuntu 22.04.5 LTS 5.10.0-1012-rockchip
16         linux /boot/vmlinuz-5.10.0-1012-rockchip
17         initrd /boot/initrd.img-5.10.0-1012-rockchip
18         fdt /lib/firmware/5.10.0-1012-rockchip/device-tree/
19         fdt overlays /lib/firmware/5.10.0-1012-rockchip/device-tree/rockchip/overlay/rk3568-npu-enable.dtbo
20         append root=UUID=68085c0f-8b2e-416d-a502-3f9cdf3c15bf rootwait rw console=ttyS2,1500000 console=tty1 cgroup_enable=cpuset
cgroup_memory=1 cgroup_enable=memory quiet splash plymouth.ignore-serial-consoles
21
22 label l0r
23     menu label Ubuntu 22.04.5 LTS 5.10.0-1012-rockchip (rescue target)
24         linux /boot/vmlinuz-5.10.0-1012-rockchip
25         initrd /boot/initrd.img-5.10.0-1012-rockchip
26         fdt /lib/firmware/5.10.0-1012-rockchip/device-tree/
27         append root=UUID=68085c0f-8b2e-416d-a502-3f9cdf3c15bf rootwait rw console=ttyS2,1500000 console=tty1 cgroup_enable=cpuset
cgroup_memory=1 cgroup_enable=memory splash plymouth.ignore-serial-consoles single
28

```



In rare cases, the `u-boot` tool might fail to update this file automatically. If that happens, add it manually, ensuring the correct folder path and filename. It should resolve the issue.

## Armbian

Like Ubuntu, the Armbian image for the Radxa Zero 3W and 3E enables NPU acceleration neither.

To enable the NPU, you need to download the appropriate overlay and modify the boot configuration.

### Step 1: Download the NPU Overlay

Since the Armbian OS lacks additional overlays, you must first download the NPU overlay.

You can find the link to [download the rk3568-npu-enable.dtbo](#) here.

### Step 2: Add the NPU Overlay

Next, create a directory for user overlays:

```
sudo mkdir /boot/overlay-user
```



Move the NPU overlay file to the newly created directory:

```
sudo mv ~/Downloads/rk3568-npu-enable.dtbo /boot/overlay-user
```

### Step 3: Modify the Boot Configuration

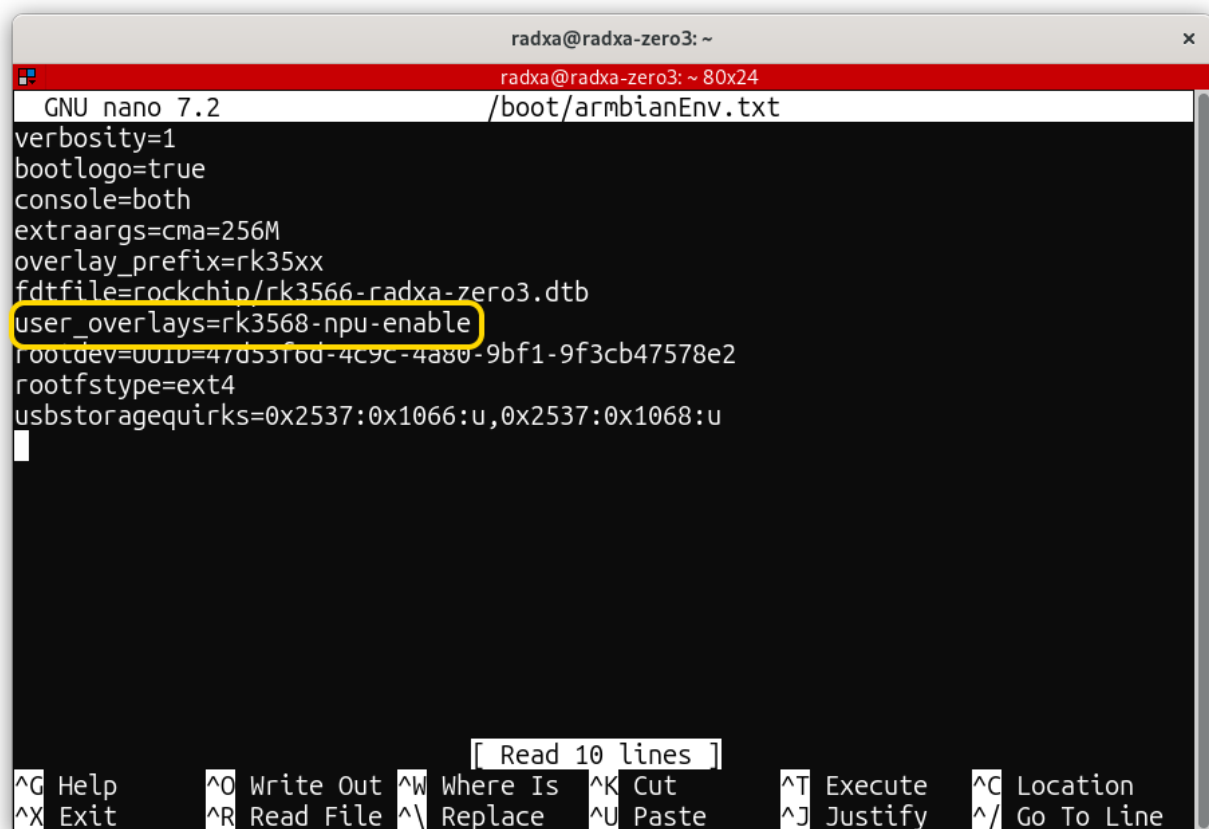
Edit the **armbianEnv.txt** file:

```
sudo nano /boot/armbianEnv.txt
```



Look for a line that starts with `user_overlays=`. If it doesn't exist, add it to the file. Add the name of your overlay (without the `.dtbo` extension) to the `user_overlays` line. If there are already other overlays listed, separate them with spaces. For example:

```
user_overlays=rk3568-npu-enable
```



```
radxa@radxa-zero3: ~
radxa@radxa-zero3: ~ 80x24
GNU nano 7.2 /boot/armbianEnv.txt
verbosity=1
bootlogo=true
console=both
extraargs=cma=256M
overlay_prefix=rk35xx
fdtfile=rockchip/rk3566-radxa-zero3.dtb
user_overlays=rk3568-npu-enable
rootdev=UUID=47d5316d-4c9c-4a80-9bf1-9f3cb47578e2
rootfstype=ext4
usbstoragequirks=0x2537:0x1066:u,0x2537:0x1068:u
[ Read 10 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute  ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify  ^_ Go To Line
```

Save and exit by pressing `<Ctrl>+<X>` , then `<Y>` , and `<Enter>` .

## Step 4: Apply the Changes

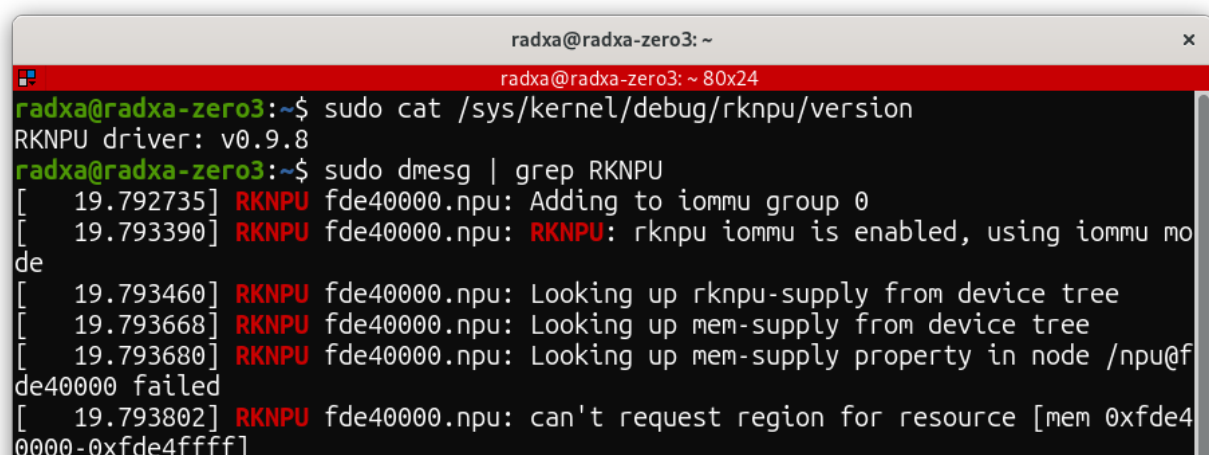
Reboot your system to activate the NPU:

```
sudo reboot
```



## Step 5: Verify NPU Activation

After rebooting, check if the NPU is recognized by running:



```
radxa@radxa-zero3: ~
radxa@radxa-zero3: ~ 80x24
radxa@radxa-zero3:~$ sudo cat /sys/kernel/debug/rknpu/version
RKNPu driver: v0.9.8
radxa@radxa-zero3:~$ sudo dmesg | grep RKNPu
[ 19.792735] RKNPu fde40000.npu: Adding to iommu group 0
[ 19.793390] RKNPu fde40000.npu: RKNPu: rknpu iommu is enabled, using iommu mode
[ 19.793460] RKNPu fde40000.npu: Looking up rknpu-supply from device tree
[ 19.793668] RKNPu fde40000.npu: Looking up mem-supply from device tree
[ 19.793680] RKNPu fde40000.npu: Looking up mem-supply property in node /npu@fde40000 failed
[ 19.793802] RKNPu fde40000.npu: can't request region for resource [mem 0xfde40000-0xfde4ffff]
```

```
[ 19.793860] RKNPU fde40000.npu: error -ENXIO: IRQ npu_irq not found
[ 19.798050] RKNPU fde40000.npu: Failed to get specification_serial_number
[ 19.798098] RKNPU fde40000.npu: Failed to get leakage
[ 19.798134] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 19.798270] RKNPU fde40000.npu: soc version=0, speed=0
[ 19.798403] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 19.799649] RKNPU fde40000.npu: avs=0
[ 19.799956] RKNPU fde40000.npu: l=0 h=2147483647 hyst=5000 l_limit=8000000000
h_limit=0 h_table=0
radxa@radxa-zero3:~$
```

Here's the improved version of your **Radxa Debian OS** section with clearer instructions and formatting:

## Enabling the NPU on Radxa Debian OS

The Radxa Debian OS does not enable NPU acceleration by default.  
To activate the NPU, you need to use the `rsetup` tool to modify the overlay tree.

### Step 1: Open `rsetup`

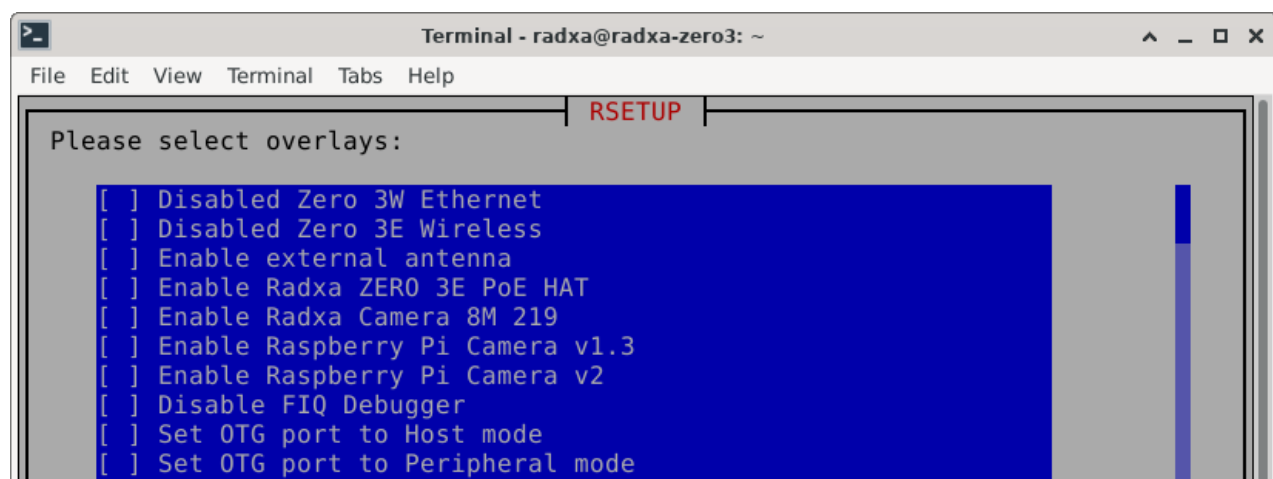
Launch the `rsetup` utility with:

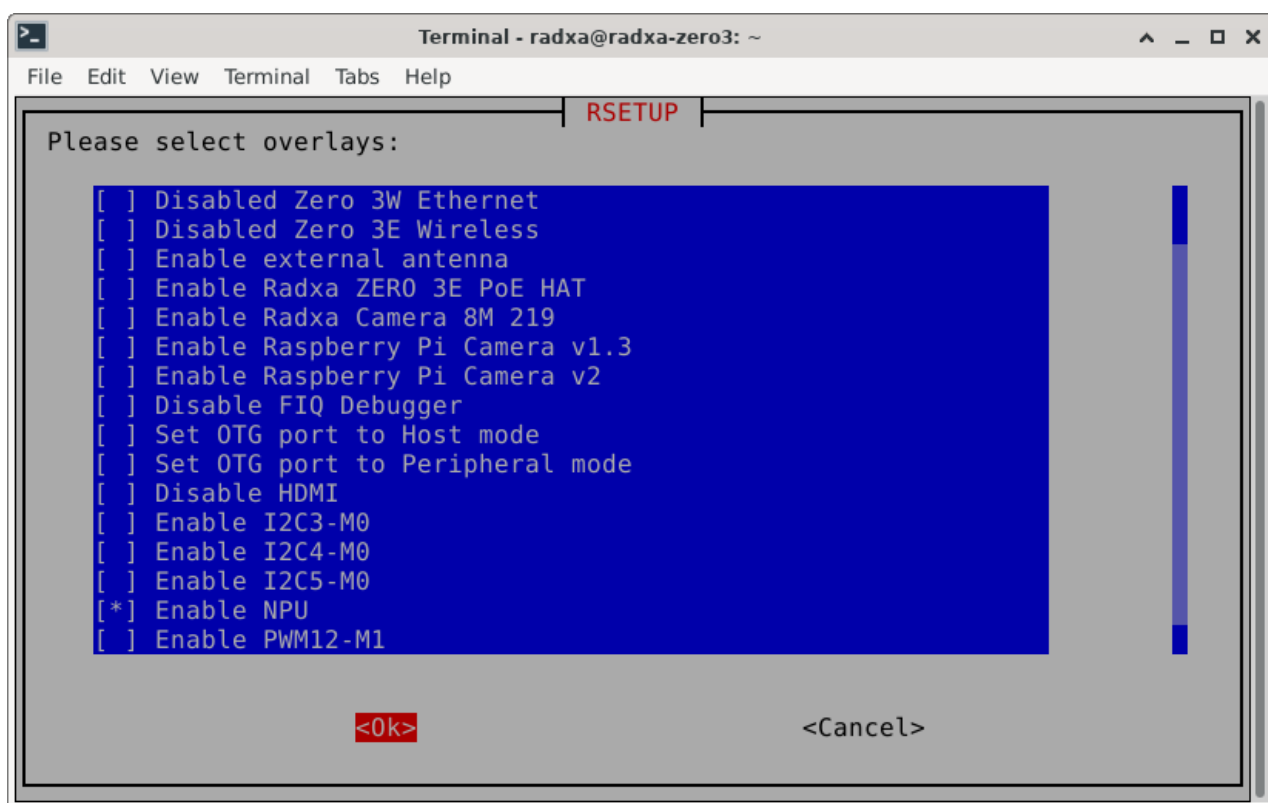
```
sudo rsetup
```



### Step 2: Enable the NPU

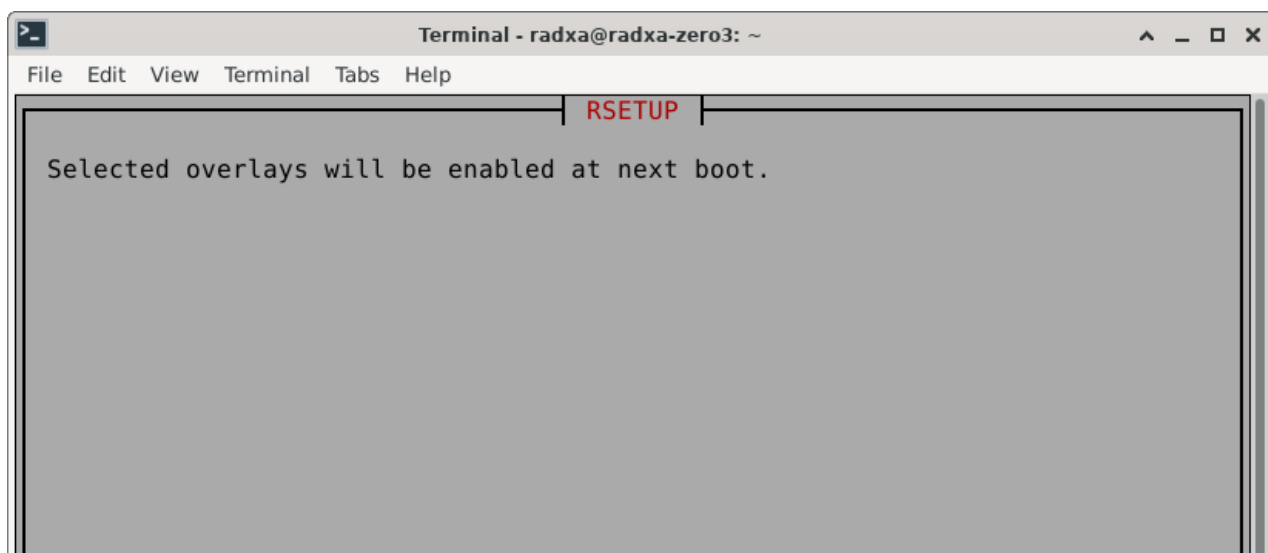
Navigate through the menu and select the **NPU** option:





### Step 3: Reboot the System

After enabling the NPU overlay, reboot the system for the changes to take effect:







sudo reboot



## Step 4: Verify NPU Activation

After rebooting, check if the NPU is recognized:

```
Terminal - radxa@radxa-zero3: ~
File Edit View Terminal Tabs Help
radxa@radxa-zero3:~$ sudo cat /sys/kernel/debug/rknpu/version
RKNPU driver: v0.8.8
radxa@radxa-zero3:~$ sudo dmesg | grep RKNPU
[ 19.282132] RKNPU fde40000.npu: Adding to iommu group 0
[ 19.283031] RKNPU fde40000.npu: RKNPU: rknpu iommu is enabled, using iommu mode
[ 19.283110] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 19.283416] RKNPU fde40000.npu: Looking up mem-supply from device tree
[ 19.283444] RKNPU fde40000.npu: Looking up mem-supply property in node /npu@fde40000 failed
[ 19.283524] RKNPU fde40000.npu: can't request region for resource [mem 0xfde40000-0xfde4ffff]
[ 19.284866] RKNPU fde40000.npu: Looking up rknpu-supply from device tree
[ 19.284947] RKNPU fde40000.npu: bin=0
[ 19.285164] RKNPU fde40000.npu: leakage=3
[ 19.285209] RKNPU fde40000.npu: pvtm = 88950, from nvmem
[ 19.285228] RKNPU fde40000.npu: pvtm-volt-sel=2
[ 19.286216] RKNPU fde40000.npu: avs=0
[ 19.286534] RKNPU fde40000.npu: l=0 h=2147483647 hyst=5000 l_limit=0 h_limit=0 h_table=0
[ 19.287181] RKNPU fde40000.npu: failed to find power_model node
[ 19.287355] RKNPU fde40000.npu: RKNPU: failed to initialize power model
[ 19.287466] RKNPU fde40000.npu: RKNPU: failed to get dynamic-coefficient
radxa@radxa-zero3:~$
```

You may also want to inspect the `/boot/extlinux/extlinux.conf` file to confirm that `rsetup` has correctly applied the overlay:

```
Terminal - radxa@radxa-zero3: ~
File Edit View Terminal Tabs Help
GNU nano 5.4 /boot/extlinux/extlinux.conf
prompt 1
timeout 10

label l0
    menu label Debian GNU/Linux 11 (bullseye) 5.10.160-39-rk356x
    linux /boot/vmlinuz-5.10.160-39-rk356x
    initrd /boot/initrd.img-5.10.160-39-rk356x
    fdt /usr/lib/linux-image-5.10.160-39-rk356x/
    fdtoverlays /boot/dtbo/rk3568-npu-enable.dtbo
```

```
append root=UUID=e4dc7fb3-d6e7-4a53-8267-0b5688ac4ff3 console=ttyFIQ0,115200

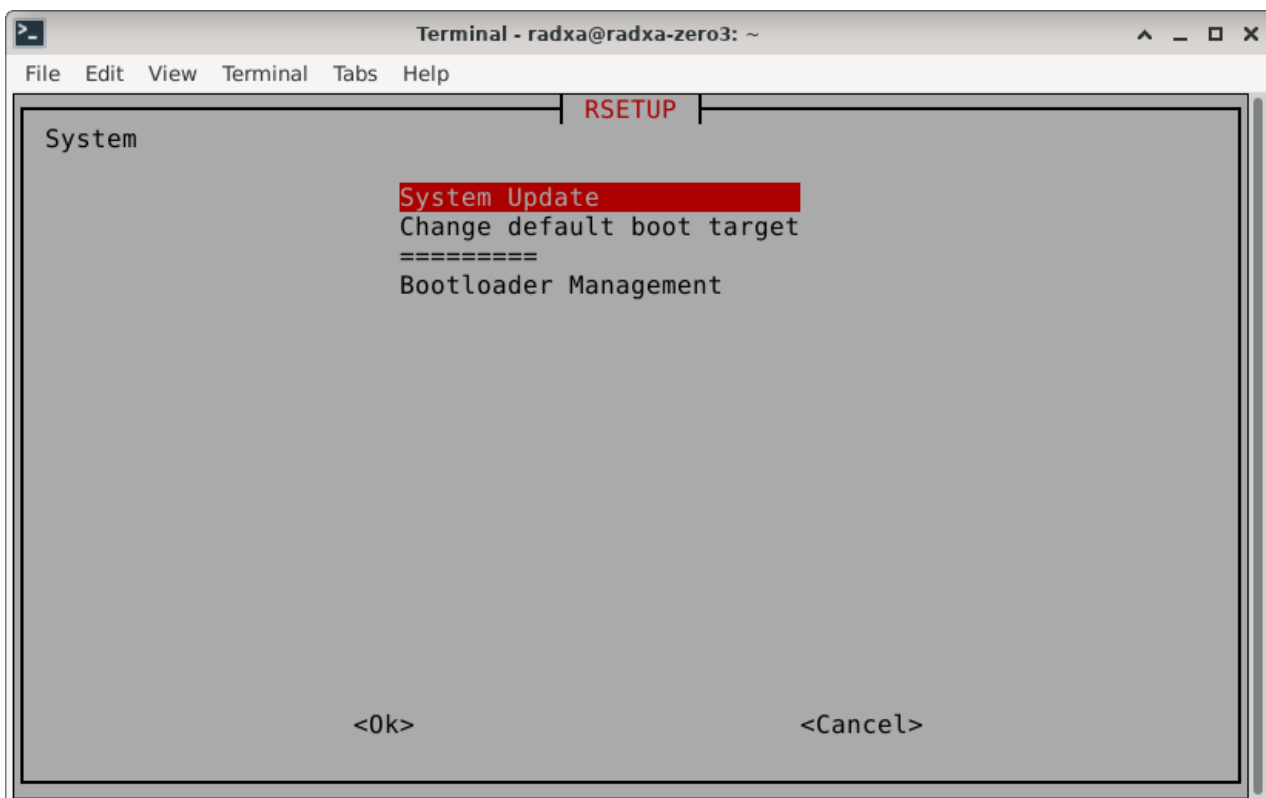
label l0r
menu label Debian GNU/Linux 11 (bullseye) 5.10.160-39-rk356x (rescue target)
linux /boot/vmlinuz-5.10.160-39-rk356x
initrd /boot/initrd.img-5.10.160-39-rk356x
fdtdir /usr/lib/linux-image-5.10.160-39-rk356x/
append root=UUID=e4dc7fb3-d6e7-4a53-8267-0b5688ac4ff3 console=ttyFIQ0,115200
```

**Terminal shortcuts:**

<b>^G</b> Help	<b>^O</b> Write Out	<b>^W</b> Where Is	<b>^K</b> Cut	<b>^T</b> Execute	<b>^C</b> Location
<b>^X</b> Exit	<b>^R</b> Read File	<b>^N</b> Replace	<b>^U</b> Paste	<b>^J</b> Justify	<b>^_</b> Go To Line

## Troubleshooting: NPU Not in the List?

If the NPU option is missing from `rsetup`, you may need to perform a **full system update**:



After updating, try running `rsetup` again and check if the NPU option is available.

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Troubleshooting: NPU Not in the List?

### Clone this wiki locally

<https://github.com/Qengineering/Radxa-Zero-3-NPU-Ubuntu22.wiki.git>

