

# Single Sub6 User Manual

---

## catalogue

|                                                                      |           |
|----------------------------------------------------------------------|-----------|
| <b>1 Product overview</b>                                            | <b>1</b>  |
| 1.1 Product appearance                                               | 1         |
| 1.2 technical specifications                                         | 3         |
| 1.2.1 Hardware specifications                                        | 3         |
| 1.2.2 business specifications                                        | 3         |
| 1.2.3 Environmental specifications                                   | 4         |
| <b>2.Configuration</b>                                               | <b>4</b>  |
| 2.1.0 Single sub6 gNB Interface Configuration                        | 4         |
| 2.1.1 Ip address configuration                                       | 5         |
| <b>3. Provisioning of execution and configuration</b>                | <b>6</b>  |
| 3.1.0 Provisioning of execution and configuration for RF             | 6         |
| 3.1.1 Execution of L1&L2                                             | 6         |
| 3.1.2 Perform following steps for opening configuration file: -      | 6         |
| 3.1.3 MIMO (multiple input, multiple output) configuration           | 7         |
| 3.1.4 Perform following steps to modify L1_NR.cfg configuration file | 8         |
| <b>4.TOOL</b>                                                        | <b>8</b>  |
| 4.1.0 Troubleshooting                                                | 8         |
| <b>5.UPGRADE</b>                                                     | <b>10</b> |
| 5.1.0 Prerequisite                                                   | 10        |
| 5.1.1REBOOT Gnb single sub6 Gnb                                      | 11        |
| 5.1.2 FCC Regulations                                                | 12        |

---

## 1 Product overview

### 1.1 Product appearance.



**Figure 1-1 Equipment appearance**

Table 1-1 shows the interface description of single sub6

| Interface name | number | Interface type | Interface definition                                                                          | remarks |
|----------------|--------|----------------|-----------------------------------------------------------------------------------------------|---------|
| MGT            | 1      | RJ45           | 1G, RJ45                                                                                      |         |
| DC SOCKET      | 1      | DC socket      | 12V DC                                                                                        |         |
| HDMI           | 1      | HDMI           | User interface display                                                                        |         |
| USB            | 2      | USB            | USB drives are commonly used for storage, data backup, and transferring files between devices |         |

**table 1-2 LC-2 LED/ indicator**

|     |                     |                                                                                                                                                                                                                                                 |
|-----|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LED | System LED          | Green: on, the system starts normally Green: off, system not started                                                                                                                                                                            |
|     | Alarm LED           | Red: on, any failure on gNB side                                                                                                                                                                                                                |
|     | LAN management port | 100 / 1000 adaptive, green and yellow LEDs<br>Green (link): on, light port works normally<br>Green (link): off, faulty or not working Red (ACT): flashing, with data transmission<br>Red (ACT): off, no data transmission<br>NOT support 10Mbps |
|     | Backhaul port       | Green (link): on, light port works normally<br>Green (link): off, faulty or not working                                                                                                                                                         |
|     | FR                  | When cell is up with usrp-1                                                                                                                                                                                                                     |
|     | sync                | When us attached with                                                                                                                                                                                                                           |
|     |                     |                                                                                                                                                                                                                                                 |

## 1.2 Technical Specifications

### 1.2.1 Hardware Specifications

| Project             | describe                    |
|---------------------|-----------------------------|
| Installation mode   | Indoor lab equipment        |
| Power dissipation   | 150W                        |
| Power module        | 12V DC                      |
| CPU Spec            | NUC i9 9 <sup>th</sup> GEN. |
| RF card             | B210                        |
| SSD                 | 256/500GB                   |
| RAM                 | 32GB                        |
| LAN management port | 1 1000Base-T, 1X1G RJ45     |

### 1.2.2 Business Specifications

| Project               | Description                                                                                                |         |           |
|-----------------------|------------------------------------------------------------------------------------------------------------|---------|-----------|
| Performance           | 1. Support 1 radiation surface                                                                             |         |           |
|                       | 2. Carrier bandwidth: single carrier 20MHz                                                                 |         |           |
|                       | 3. Backhaul: 1G Optical interface SFP+                                                                     |         |           |
| Compatible design     | Supports distributed base stations                                                                         |         |           |
| Synchronization mode  | 1. IEEE1588V2 synchronization                                                                              |         |           |
|                       | 2. SyncE synchronization                                                                                   |         |           |
| Key technology        | 1. High speed signal, RF requirements for PCB design                                                       |         |           |
|                       | 2. Large power consumption of the system, natural heat dissipation of the system                           |         |           |
| Band and bandwidth    | Support standard 5G-NR rel-15                                                                              |         |           |
|                       | Support FDD band n2, n5, n66 and Bandwidth: 10MHz & 20MHz                                                  |         |           |
| Modulation Scheme     | QPSK, 16QAM and 64QAM                                                                                      |         |           |
| Frequency Range (MHz) | n2                                                                                                         | n5      | n66       |
|                       | 1930-1990                                                                                                  | 869-894 | 2110-2200 |
| Tune up Tolerance     | +/- 2dB                                                                                                    | +/- 2dB | +/- 2dB   |
| Tx Spec               | For B210 USRP device has two TX/RX port.<br>For TX/RX port<br>TX power +9.31dBm max<br>RX power -15dBm max |         |           |
| Rx Spec               | For B210 USRP device has two RX port.<br>For RX port<br>RX power -15dBm max                                |         |           |

### 1.2.3 Environmental Specifications

| Project                        | Description                                                                                                                                                                                                                                     |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage temperature / humidity | The equipment shall be able to work or store normally within the following temperature and humidity range: Operating temperature: - 5 ° C to +45 ° C<br>Storage temperature: - 40 ° C to +70°C<br>Relative humidity: 5% ~ 95% (no condensation) |
| Heat dissipation mode          | Natural convection heat dissipation                                                                                                                                                                                                             |
| Atmospheric pressure           | 86 Kpa~106 Kpa                                                                                                                                                                                                                                  |
| Protection level               | IP30                                                                                                                                                                                                                                            |
| Surge                          | Indoor products, no surge requirements                                                                                                                                                                                                          |

## 2 Configuration

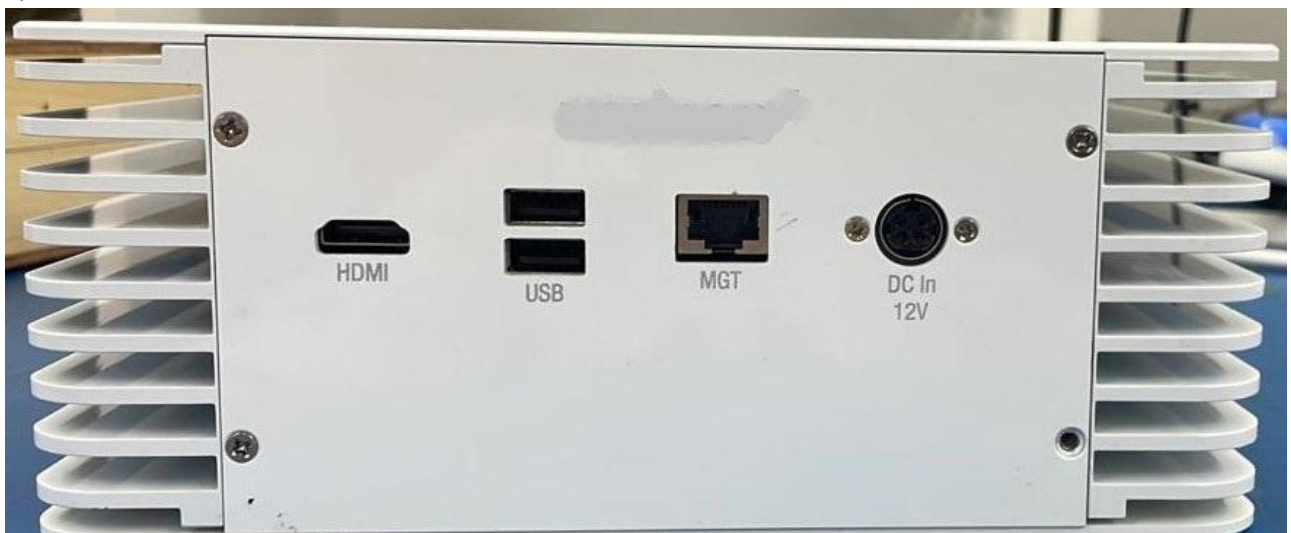
### 2.1.1 Single sub6 gNB Interface Configuration

The parameters of COM connecting sub6 gNB and PC should be configured as:

Baud rate:115200, Data : 8bit, Parity : none, Stop : 1bit, Flow control none Transmit delay : 1msec/char 0 & msec/line.

The IP of GE/FE of PC should be configured as: 192.168.1.100.

The IP of GE/FE of 5GmmW gNB should be configured as: 192.168.1.10 (default setting of the system)



### 2.1.2 Ip address configuration

The default configuration is static with IP address 192.168.2.15, and you can change this IP following below operations.

-> Login on board with SSH or serial tool user: user password: root123

-> Vi /etc/netplan/01-netcfg.yaml Edit 01-netcfg.yaml and enter the static IP address. Eth0 is for SFP interface Eth1 is for Ethernet interface.

-> Execute 'netplan apply' and 'sync' command will save this configuration.

DOCUMENT FOR CHANGE IP ADDRESSES

1. ssh to default ip : ssh [user@192.168.2.1xx](mailto:user@192.168.2.1xx)

2. Type Command: sudo -s

For IP Change:

vim /etc/netplan/00-installer-config.yaml

For Single Radio

```
# This is the network config written by 'subiquity'
network:
  version: 2
  renderer: networkd
  ethernets:
    enp109s0:
      optional: true
      addresses:
        - 192.168.20.1/24
      mtu: 9000
    ens1:
      optional: true
      dhcp4: no
      addresses:
        - 192.168.10.1/24
      mtu: 9000
    enp108s0:
      optional: true
      dhcp4: no
      addresses:
        - 192.168.6.252/24
        - 192.168.2.152/24
      nameservers:
        addresses: [8.8.8.8, 8.8.8.4]
      gateway4: 192.168.6.1
      mtu: 1500
```

Change and Save:

- Press i to write. Press esc key, Type :wq and enter to save and exit the file.
- Type Command: netplan apply

### 3 Provisioning of execution and configuration

#### 3.1.0 Provisioning of execution and configuration for RF

##### Provision

1. Open terminals as required (min 3)
  - i. Run the command in all the terminals  
**ssh root@192.168.2.15**  
**pass-root123**

#### 3.1.1 Execution of L1&L2

2. Perform following steps for run processes: -
  - i. To run L1 binary enter following command: -  
 -> Go to first tab of terminal and change path for L1  
**cd /opt/FCC\_DEV0/L1/script**  
 -> Run L1 script using the following command  
**./runL1.sh**
  - ii. To run MAC\_NR binary enter the following commands  
 -> Go to second tab and change path for MAC\_NR  
**cd /opt/FCC\_DEV0/L2/src**
  - iii. Enter ls command for checking binary.  
 -> If MAC\_NR binary is not available so you need to run **make** command and check again using ls Command .  
 -> Run MAC binary using the following command  
**./MAC\_NR 0**
  - iii. Wait for some time, when “**L1 is now live**” is visible on console then both processes are up.
  - iv. You are able to take observation as required.

##### Configuration

#### 3.1.2 Perform following steps for opening configuration file: -

- i. Go to the third tab of terminal
- ii. Enter **cd /opt/FCC\_DEV0/L2/cfg** for config path
- iii. Enter **vim config.cfg** to open config file in vim text editor.
- iv. After completion of vim command a list of parameters will appear as shown below.

```

#####
#####
#
#      Name      :      config.cfg
#
#      Description :      This is configuration data file for Initial Configuration of L1.
#                      It contain frequency parameters required for L1.
#
#####
# CONFIGURATION FOR L1
#####
# TDD = 0, FDD = 1
DuplexingMode=1
# Supported Band n2(FDD), n5(FDD), n66(FDD), n77(TDD)
Band=2
# SubcarrierSpacing 15KHz = 0, 30KHz = 1
SCS=0
# Downlink bandwidth, 10MHz BW = 0 , 20MHz BW = 1
DL_Channel_Bandwidth=0
# Range 0 - 1000
Tx_Gain=1000
# Downlink ARFCN pointA
Frequency_PointA=388000
# Downlink ARFCN SSB
Absolute_Frequency_Ssb=388360
# UL frequency needed if FDD is present
ulPointA_present=1
# Uplink ARFCN pointA if FDD is Present
ul_Frequency_pointA=372000
# modulation scheme QPSK = 0, 16-QAM = 1 64-QAM = 2
Modulation_Scheme=0
~
~
~
32,26 All

```

- Note : When you want to change frequency according to band, first edit config file of L2 of RF1 (above pic) then save it. After saving first run L1 of RF1 by using `./runL1.sh` and then L2 of RF1 by using `./MAC_NR 0`

### 3.1.2 Perform following steps to modify configuration file :-

- Go to the insert mode by pressing `i` key and edit the parameter.
- To save the file press `ESC` and type command `:wq` then press `ENTER`
- If don't want to save file, press `ESC` and enter command `:q!` then press `ENTER`

### 3.1.3 MIMO (multiple input, multiple output) configuration

Note : No need to change any parameter in this configuration file. AMT have updated all parameter here.

- open new terminal and run the command below
- `sudo vim /opt/FCC_DEV0/L1/cfg/L1_NR.cfg`

```

root@127:~# sudo vim /opt/FCC_DEV0/L1/cfg/L1_NR.cfg

```

- After running this command `L1_NR.cfg` file will open shown in the picture below

```

/*****
 * This file is subject to the terms and conditions defined in
 * file 'LICENSE'.
 *
 *****/

//Enables verbose binary logging. WARNING: very CPU intensive and creates potentially huge output files. Use with caution.
//LogLevel_verbose = "DEBUG";
logLevels = (
    { module = "Frontend"; logLevel_normal = "CRITICAL"; logLevel_verbose = "INFORMATIVE"; },
    { module = "Backend"; logLevel_normal = "CRITICAL"; logLevel_verbose = "INFORMATIVE"; }
    // { module = "Cell"; logLevel_normal = "CRITICAL"; logLevel_verbose = "DEVEL"; }

    //{ module = "PDCCH"; logLevel_normal = "CRITICAL"; logLevel_verbose = "DEVEL"; },
    //{ module = "PDSCH"; logLevel_normal = "CRITICAL"; logLevel_verbose = "DEVEL"; },
    //{ module = "SS-Block"; logLevel_normal = "CRITICAL"; logLevel_verbose = "DEVEL"; },
    //{ module = "PUCCH"; logLevel_normal = "CRITICAL"; logLevel_verbose = "DEVEL"; }
);

maxNumPdschLayers = 2;
//Enable 64-QAM support for PUSCH (license-specific)
maxPuschModOrder = 6;

//Enable radio unit emulation mode and define corresponding number of (emulated) antennas
//backEndMode = 0;
//numEmulTxAntennas = 2;
//numEmulRxAntennas = 2;
numTxAntennas = 2;
numRxAntennas = 2;
txGainScalingFactor = 0.05;
timingOffsetThreshold_nsec = 1000;
sdrSendAdvance_ns = 8000;

```

iv. As mention above in the picture the highlight portion, we can change MIMO configurations Here.

### 3.1.4 Perform following steps to modify L1\_NR.cfg configuration file :-

- i. Go to the insert mode by pressing i key and edit the parameter as required.
- ii. To save the file press ESC and type command :wq then press ENTER
- iii. If don't want to save file, press ESC and enter command :q! then press ENTER

## 4.TOOL

### 4.1.0 Troubleshooting

In any case if you are not able to do the ssh or getting trouble while accessing hardware connect monitor throght HDMI/VGA cable. You will get username window then enter Username as User and Password root123.

If you get blue screen then enter ctrl+alt+f3. Enter username as User and Password is root123. Once the authentication done enter command ifconfig for checking the IP address.



```

root@usermachine:/home/user# ifconfig

```

```

device memory 0x83400000-834fffff

enp11s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 9000
inet 192.168.20.1 netmask 255.255.255.0 broadcast 192.168.20.255
inet6 fe80::1e69:7aff:fed0:9959 prefixlen 64 scopeid 0x20<link>
ether 1c:69:7a:d0:99:59 txqueuelen 1000 (Ethernet)
RX packets 9 bytes 2328 (2.3 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 60 bytes 6806 (6.8 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp8s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 9000
inet 192.168.10.1 netmask 255.255.255.0 broadcast 192.168.10.255
inet6 fe80::230:93ff:fe10:2ec9 prefixlen 64 scopeid 0x20<link>
ether 00:30:93:10:2e:c9 txqueuelen 1000 (Ethernet)
RX packets 9 bytes 2232 (2.2 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 69 bytes 8453 (8.4 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enx00e04c6800f0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 192.168.40.1 netmask 255.255.255.0 broadcast 192.168.40.255
inet6 fe80::2e0:4cff:fe68:f0 prefixlen 64 scopeid 0x20<link>
ether 00:e0:4c:68:00:f0 txqueuelen 1000 (Ethernet)
RX packets 12 bytes 2383 (2.3 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 63 bytes 7310 (7.3 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 80 bytes 8120 (8.1 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 80 bytes 8120 (8.1 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

uetrafifo: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST> mtu 1500
inet 60.0.68.64 netmask 255.255.255.0 destination 60.0.68.64
inet6 fe80::87ff:5713:70d:cb5d prefixlen 64 scopeid 0x20<link>
unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00 txqueuelen 500 (UNSPEC)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@usermachine:/home/user#

```

Password is root123

```

user@usermachine:~$ sudo su
sudo: unable to resolve host usermachine: Temporary failure in name resolution
[sudo] password for user:
root@usermachine:/home/user# vi /etc/netplan/00-installer-config.yaml

```

If you want to change the ip then enter **vi /etc/netplan/00-network-manager-all.yaml**. Once you enter press insert and change the IP address mention in the below picture.

## 5 UHD UPGRADE

```
# This is the network config written by 'subiquity'
network:
  version: 2
  renderer: networkd
  ethernets:
    enp111s0:
      optional: true
      addresses:
        - 192.168.20.1/24
      mtu: 9000
    enp8s0:
      optional: true
      dhcp4: no
      addresses:
        - 192.168.10.1/24
      mtu: 9000
    enp110s0:
      optional: true
      dhcp4: yes
      addresses:
        - 192.168.2.102/24
      nameservers:
        addresses: [8.8.8.8, 8.8.8.4]
      gateway4: 192.168.2.1
      mtu: 1500
      #addresses:
      # - 192.168.6.251/24
    enx00e04c6800f0:
      optional: true
      dhcp4: no
      addresses:
        - 192.168.40.1/24
```

### 5.1.0 Prerequisite:

1. Sub\_6GHz Hardware should be connected with internet
2. Command: `vim /etc/resolv.conf` nameserver 127.0.0.53 change it to 8.8.8.8 save and close file.
3. Now check ping google.com it's output should be like below

64 bytes from del03s16-in-f14.1e100.net (172.217.167.46): icmp\_seq=1 ttl=117 time=7.05 ms

Steps to upgrade UHD

if your are facing error something like -:

```
{
Reading package lists... Done
Building dependency tree
Reading state information... Done
E: Unable to locate package uhd-packages
root@phluido-NUC9i9QNX:~# apt-get purge libuhd-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
You might want to run 'apt --fix-broken install' to correct these.
}
```

run this command -: `apt --fix-broken install`

run below given command

1. `sudo apt-get remove uhd-host`
2. `sudo apt-get remove --auto-remove uhd-host`
3. `sudo apt-get purge uhd-host`
4. `sudo apt-get purge --auto-remove uhd-host`

while running these commands it will ask for permission Y/n then enter Y.

- `dpkg -l | grep uhd`

`apt-get purge uhd-packages`

`vim /etc/apt/sources.list`

`deb https://ppa.launchpadcontent.net/ettusresearch/uhd/ubuntu bionic main`

`deb-src https://ppa.launchpadcontent.net/ettusresearch/uhd/ubuntu bionic main`

append above two lines, sva e& close files.

Now run command: `apt-get update`

while updating it sometimes throws error for key then

`apt-key adv --keyserver keyserver.ubuntu.com --recv-keys received keys`

Now again run `apt-get update`

run `apt-get install libuhd-dev uhd-host -y`

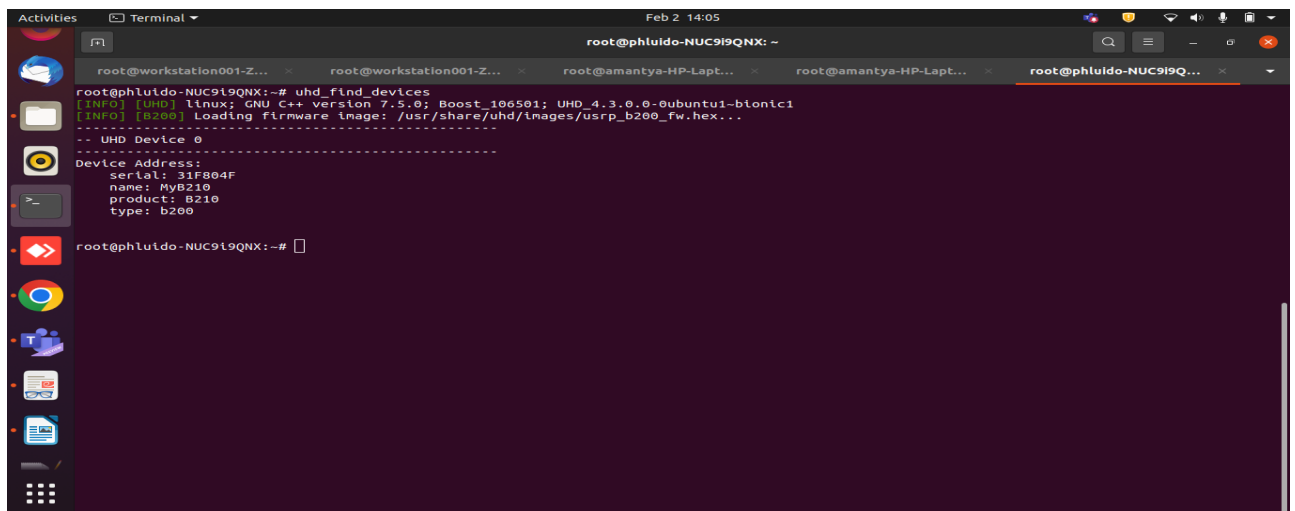
run `uhd_find_devices`

it's output should look like below screen shot:

`uhd_usrp_probe`

`vi /opt/serial.txt`

`sdrDeviceParams = "serial=3228543"`



```

root@phluido-NUC919QNX:~# uhd_find_devices
[INFO] [UHD] linux; GNU C++ version 7.5.0; Boost_106501; UHD_4.3.0.0-ubuntu1-bionic1
[INFO] [b200] Loading firmware image: /usr/share/uhd/firmware/uhd_usrp_fw.hex...
-- UHD Device 0
-----
Device Address: 31F804F
  Serial: 31F804F
   Name: MyB210
  Product: B210
   Type: b200

```

### 5.1.1 REBOOT Gnb single sub6

**Note:** In case you face the problem like that uhd is not found or you just want to restart the hardware

Run the below command for rebooting the hardware

-> `reboot -f`

### 5.1.2 FCC Regulations:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiated radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### RF Exposure Information

This device meets the government's requirements for exposure to radio waves.

This device is designed and manufactured not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission of the U.S. Government.

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 87cm (34 inches) during normal operation.

Amantya Technologies, inc  
Anuradha Gupta  
anuradha@amantyatech.com

This single sub6, model no: 5GTP202SSn256677 requires training professionals qualified by Service Provider to configure and install the product. This device complies with FCC rules and regulations for fixed-mounted on indoor permanent structure in commercial/business premises excluding private resident/property. This device is distributed through controlled distribution channel and requires that trained professionals to install this product, and this device will not be sold directly to the general public through retail stores.

This single sub6, model no5GTP202SSn256677 must be installed to provide at least 87cm separation distance from bystanders to comply with the General Population / Uncontrolled MPE limit and requirements. RF exposure compliance may need to be addressed at the time of licensing, as required by the responsible FCC bureau(s) including mitigation actions for fixed RF sources to the extent necessary to ensure compliance with FCC exposure limits per section §1.1307(b)(4)

