

Recovery a Router using a Serial Cable

There are times when you need to use a Serial cable to flash your router after something has gone wrong. This happens when the router's bootloader doesn't have a Recovery GUI and you can't flash it from the ROOter GUI. This can save a bricked router.

Prerequisites

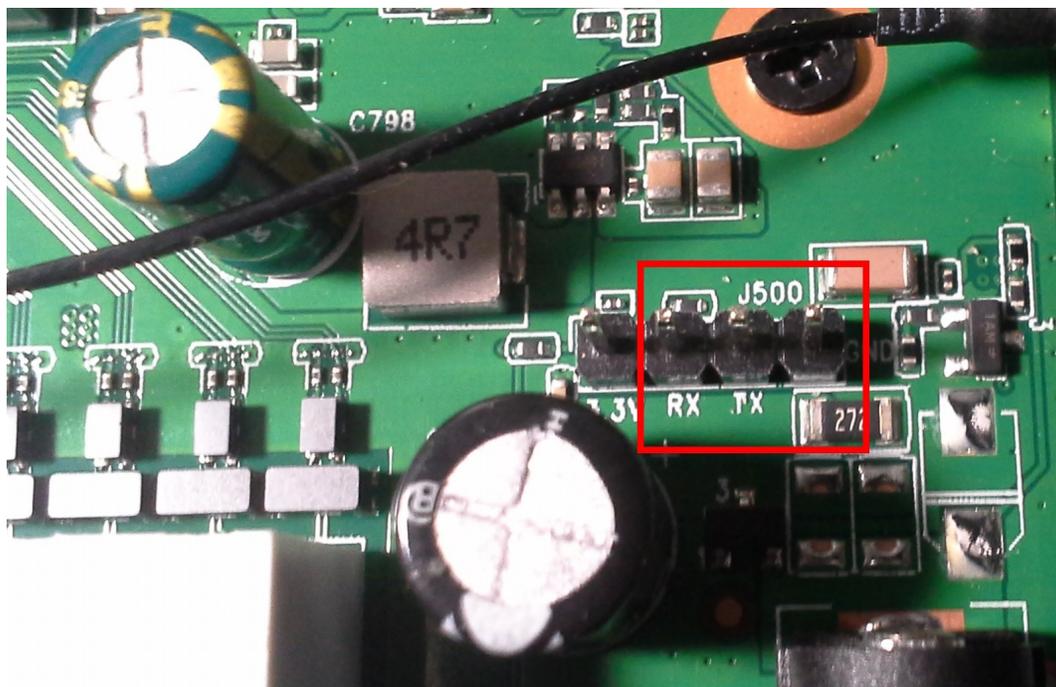
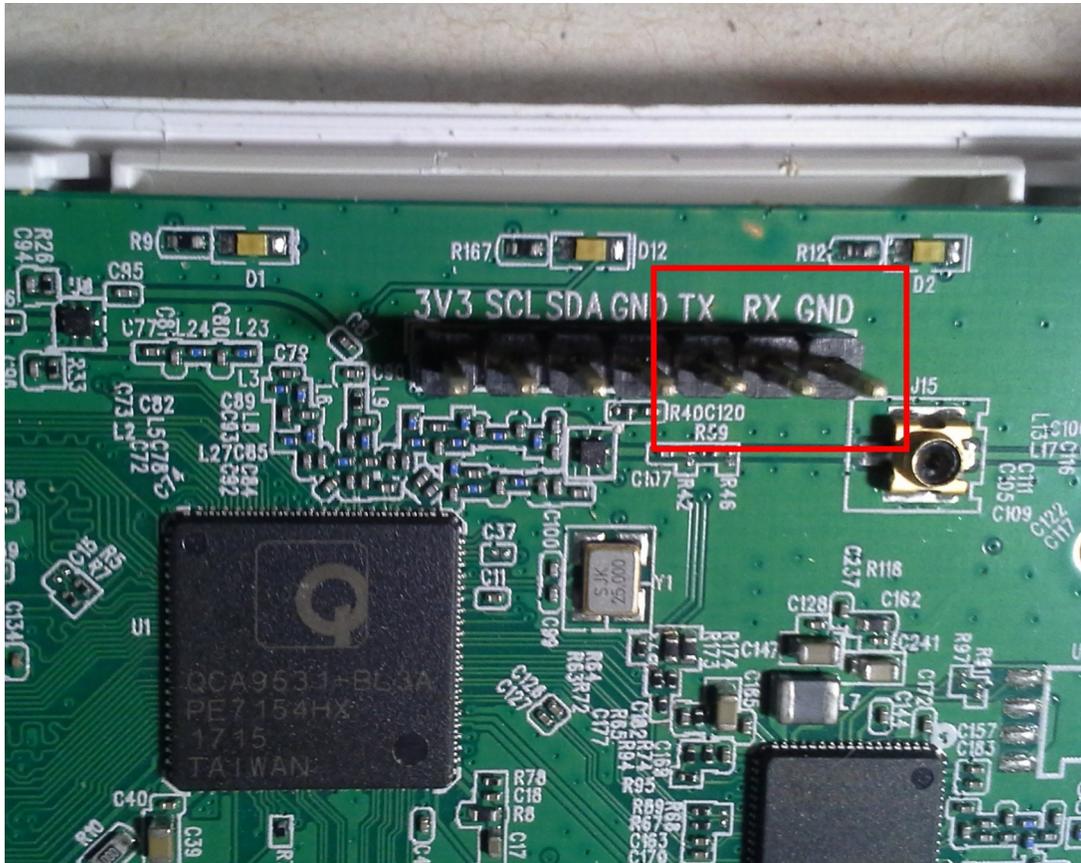
Some hardware and some software is need in order to do a Serial cable flash of the router.

You will need a PL2303 TTL serial adapter like this. Search Amazon for *PL2303 ttl* to find one.



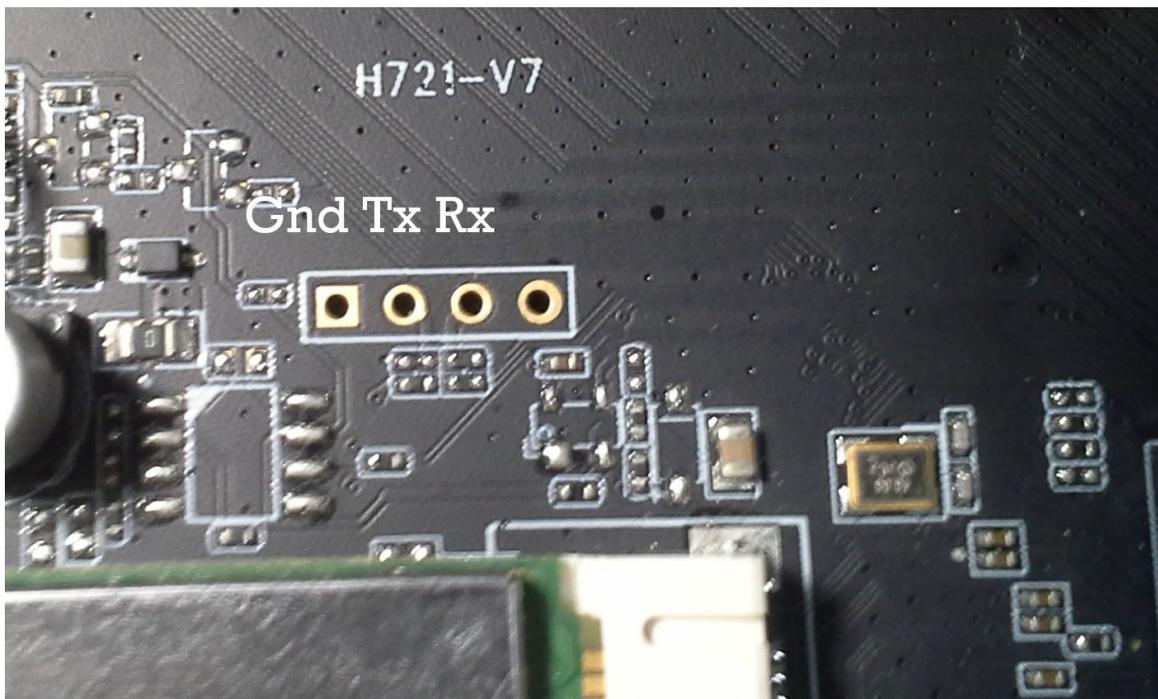
to connect the router to your computer via a USB port. Only the black, white and green wires are used. **Never use the red wire as this can destroy your adapter or your router.**

You have to open the router case to access the serial interface on the board. You are looking for a set of pins that look like this.



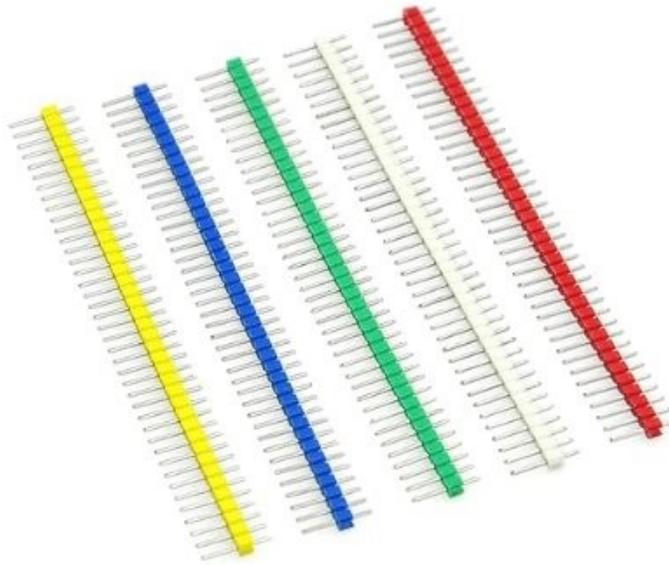
The pins should be marked GND, RX and TX. The other pins can be ignored. GND may not be marked but it is always on the end of the row of pins. The serial adapter connects the black wire to the GND, the white wire to TX and the green wire to RX. This is accomplished by slipping the wires over the proper pin.

In some cases you will find that the pins are either unmarked or missing, with just holes instead.



GND will always be the square pad with TX and RX next to it. If the pins are missing then you must solder pins in the holes before continuing. Search Amazon for *40 pin strip header 2.54mm* to find the needed pins. You get a lifetime of pins in these packages.

Later on, when you are running the Terminal to display the information from the bootloader you may find you get nothing from it. This usually means that the white and green wires need to be swapped.



This can happen if the pins or pads are not labelled. No harm comes from having the wires in the wrong position.

Once you have the Serial adapter connected to the router you need to install the necessary software. First up is the software that installs the drivers for the adapter.

Windows does not have a driver that works with most of the Serial adapters, especially if they use cloned PL2303 chips rather than official ones. However, there is a program available that will install a driver that will work with most any Serial adapter.

The program included in this package, *PL2303LegacyUpdaterSetup-1.1.0.exe*, will install a setup program that you then run to install the adapter driver. This may have to be done each time you use the adapter. Windows seems to replace the driver for no good reason at times. You will know you need to run the install program when you can't open the USB port of the adapter from the Terminal program.

Plug in the adapter to a USB port on your computer and run the install program. The router should be powered off at this time. This can be found at <C:/Program Files/PL2303 Legacy Updater/PL2303LegacyUpdater.exe>.

PL2303 Legacy Updater 1.1.0

PL2303 legacy USB drivers

For devices that use unsupported Prolific microchips. If the current driver is not shown below, connect your device and click Scan Drivers.

Current Driver

Prolific USB-to-Serial Comm Port (COM15) 3.3.11.152 12-03-2010

Scan Drivers

Select Driver

- Legacy PL2303 HXA/XA (current driver) 3.3.11.152 12-03-2010
- Legacy PL2303 TA/TB 3.8.36.2 12-05-2020
- Prolific 3.8.42.0 22-02-2023

PL2303 Legacy Updater 1.1.0

Driver update status

The driver is already installed

Current Driver

Prolific USB-to-Serial Comm Port (COM15) 3.3.11.152 12-03-2010

Information

You will need to run this program again if Windows Update changes your driver, or if you use other devices that require a different PL2303 driver.

PL2303 Legacy Updater 1.1.0

PL2303 Legacy Updater has completed

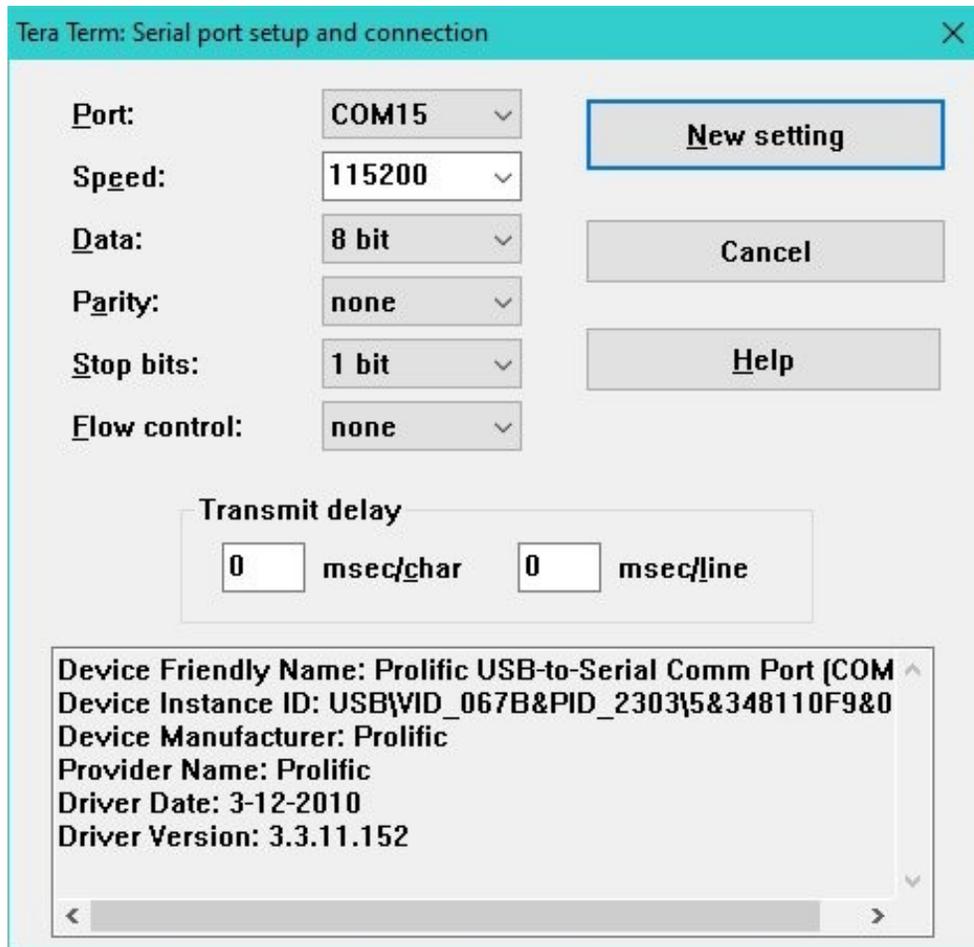
Run this program again if your driver has changed.

Click Finish to exit.

Finish

Next, install the Terminal program, *teraterm-5.0-alpha1.exe*. Once it is installed you are ready to use the Serial adapter on the router. The router must be powered off at this time and the adapter plugged into a USB port.

Run the *TetraTerm* program and setup the serial port to be used. Go to the *Setup* menu and the *Serial Port* submenu.

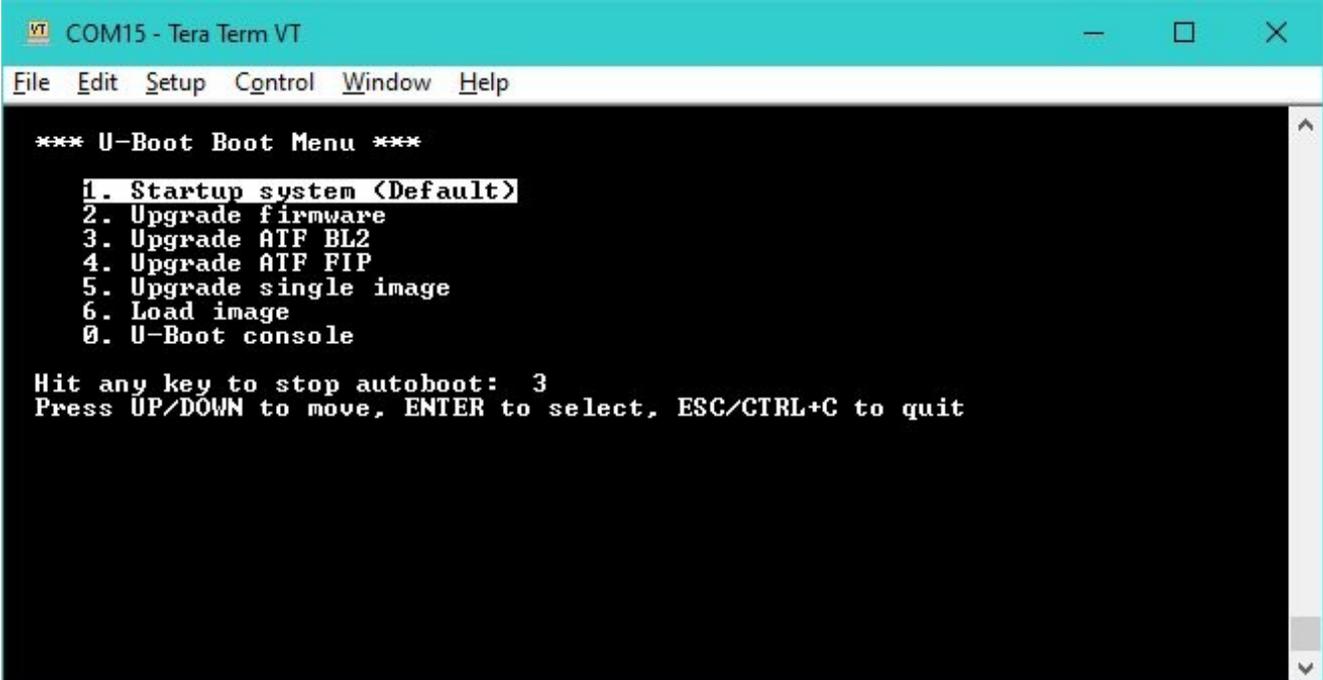


The Port is usually the highest COM port in the drop down list. The speed is normally 115200 but in some cases it may be 57600. Click *New Setting* to set these values for the current session. To make these your default settings go to the *Setup* menu and the *Save Settings* submenu.

You may find that you need to close the Terminal and unplug the Serial adapter to completely power down the router. Then plug it in again and run the Terminal.

You are now ready to check if everything works. Plug in the router and you should see something in the Terminal. If you see nothing then the green and white wires may need to be swapped. If you see gibberish then the Speed may have to be changed in the *Serial Port* menu.

There may be a bunch of unreadable text at the start but a boot menu will eventually appear. Unplug the router at this point so you can see what it says.

A screenshot of a terminal window titled "COM15 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal content shows a "U-Boot Boot Menu" with the following options: 1. Startup system (Default), 2. Upgrade firmware, 3. Upgrade ATF BL2, 4. Upgrade ATF FIP, 5. Upgrade single image, 6. Load image, and 0. U-Boot console. Below the menu, it says "Hit any key to stop autoboot: 3" and "Press UP/DOWN to move, ENTER to select, ESC/CTRL+C to quit".

```
COM15 - Tera Term VT
File Edit Setup Control Window Help
**** U-Boot Boot Menu ****
1. Startup system (Default)
2. Upgrade firmware
3. Upgrade ATF BL2
4. Upgrade ATF FIP
5. Upgrade single image
6. Load image
0. U-Boot console

Hit any key to stop autoboot: 3
Press UP/DOWN to move, ENTER to select, ESC/CTRL+C to quit
```

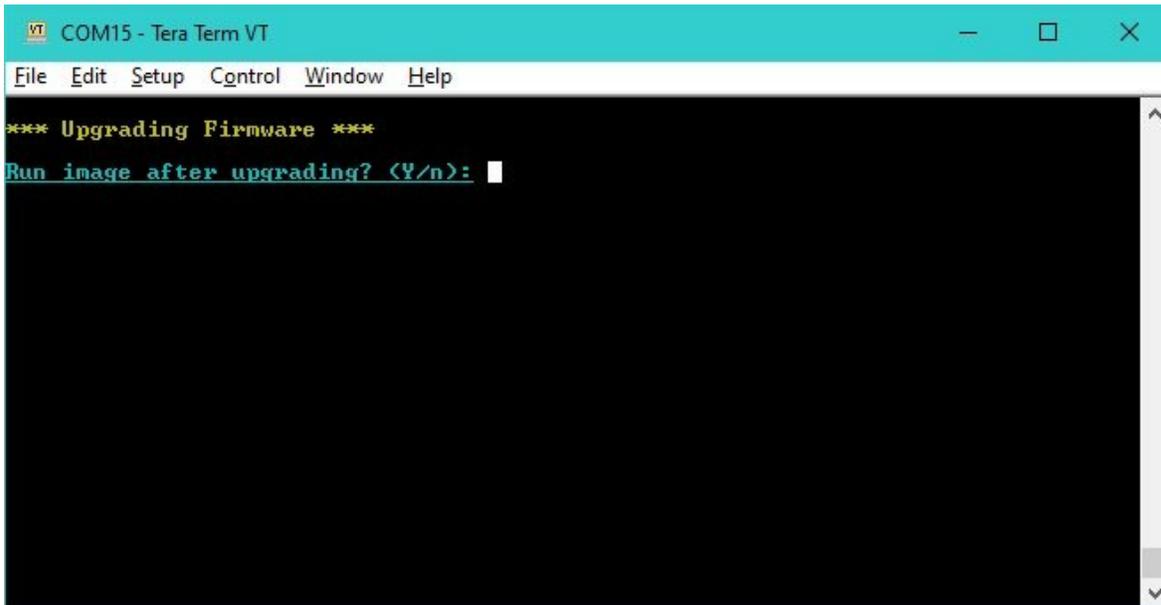
There are variations on this menu as different bootloaders have different designs. What you are looking for is a menu that is for upgrading the firmware. This example is for the ZBT Z8102AX.

In this case it is menu 2. When this menu appears press the '2' key on the keyboard to interrupt the boot process and have it enter TFTP flash mode. You usually have 3 seconds to do this in. Make sure the Terminal has the focus by first clicking on the console area.

Now that we know the menu we want for flashing the firmware, plug in the router once again and press 2 at the correct time. You may have to repeat this several times to interrupt the bootloader.

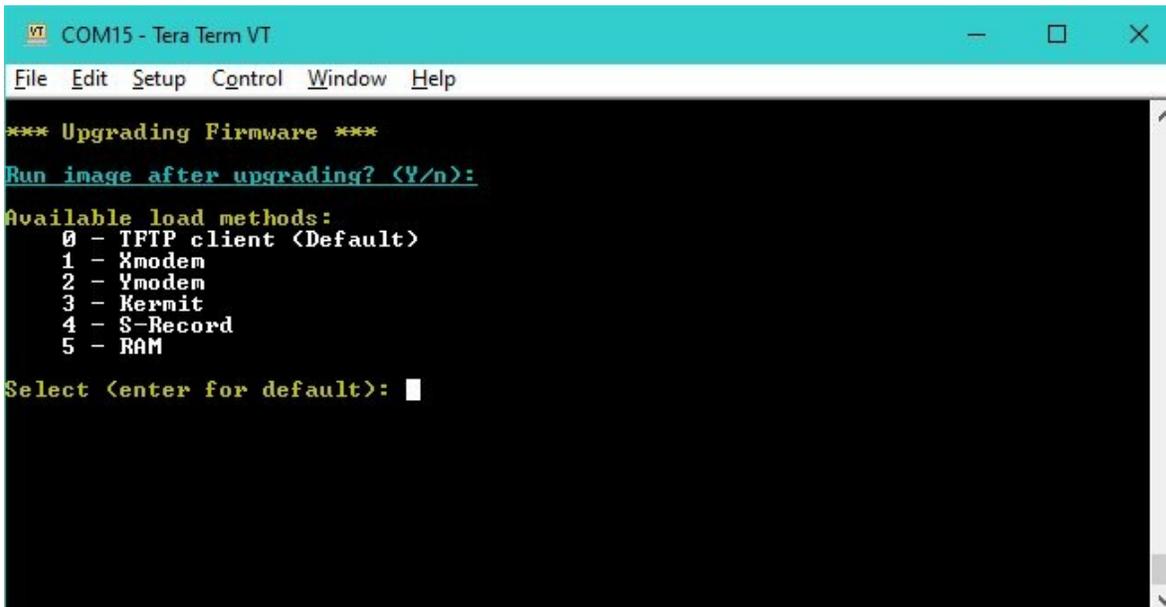
Once you have interrupted the bootloader and enter the Upgrade Firmware menu you have to determine what IP addresses and file name the router

expects when using TFTP to upload and flash the firmware. Follow the steps that appear in the Terminal.



```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help
*** Upgrading Firmware ***
Run image after upgrading? (Y/n):
```

Press *Enter* to allow rebooting the router after flashing.



```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help
*** Upgrading Firmware ***
Run image after upgrading? (Y/n):
Available load methods:
 0 - TFTP client (Default)
 1 - Xmodem
 2 - Ymodem
 3 - Kermit
 4 - S-Record
 5 - RAM
Select (enter for default):
```

Press *Enter* to chose TFTP as the method of uploading the firmware.

```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help

*** Upgrading Firmware ***
Run image after upgrading? <Y/n>:

Available load methods:
 0 - TFTP client <Default>
 1 - Xmodem
 2 - Ymodem
 3 - Kermit
 4 - S-Record
 5 - RAM

Select <enter for default>:
Input U-Boot's IP address: 192.168.1.1
```

Press *Enter* to define the router's IP address as 192.168.1.1. This is probably the best address to use. You may find that attempting to change any of the values in this menu will not work as Backspace can be a bit flaky.

```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help

*** Upgrading Firmware ***
Run image after upgrading? <Y/n>:

Available load methods:
 0 - TFTP client <Default>
 1 - Xmodem
 2 - Ymodem
 3 - Kermit
 4 - S-Record
 5 - RAM

Select <enter for default>:
Input U-Boot's IP address: 192.168.1.1
Input TFTP server's IP address: 192.168.1.10
```

This is the IP address of the computer used to upload the new firmware. You will have to set the computer to have this IP as a Static address.

```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help

*** Upgrading Firmware ***
Run image after upgrading? <Y/n>:

Available load methods:
 0 - TFTP client (Default)
 1 - Xmodem
 2 - Ymodem
 3 - Kermit
 4 - S-Record
 5 - RAM

Select <enter for default>:

Input U-Boot's IP address: 192.168.1.1
Input TFTP server's IP address: 192.168.1.10
Input IP netmask: 255.255.255.0
```

Press *Enter* to accept this Netmask.

```
VT COM15 - Tera Term VT
File Edit Setup Control Window Help

*** Upgrading Firmware ***
Run image after upgrading? <Y/n>:

Available load methods:
 0 - TFTP client (Default)
 1 - Xmodem
 2 - Ymodem
 3 - Kermit
 4 - S-Record
 5 - RAM

Select <enter for default>:

Input U-Boot's IP address: 192.168.1.1
Input TFTP server's IP address: 192.168.1.10
Input IP netmask: 255.255.255.0
Input file name: Z8102AX-nand-mt7981-DDR4-23.0711_101616.bin
```

This is the name of the firmware you wish to flash. You may need to rename the firmware to match this if you are unable to change the name.

At any point you can unplug the router and stop the flashing process without problems and start all over again.

Now that we have the needed information to use TFTP to upload the firmware, unplug the router so we can set up the TFTP server on the computer. The information we have about this is

- Router IP address – 192.168.1.1
- Computer IP address – 192.168.1.10
- Netmask – 255.255.255.0
- Firmware name – Z8102AX-nand-mt7981-DDR4-23.0711_101616.bin

Included in this package is the *tftpd32* TFTP server program. This will be used to upload the firmware to the router. The above information needs to be supplied to *tftpd32* so it will work with the router. This is done by editing the *tftpd32.ini* file with a text editor.

```
1  [DHCP]
2  Lease_NumLeases=0
3  IP_Pool=192.168.1.1
4  PoolSize=1
5  BootFile=Z8102AX-nand-mt7981-DDR4-23.0711_101616.bin
6  DNS=
7  DNS2=
8  WINS=
9  Mask=255.255.255.0
10 Gateway=192.168.1.1
11 Option42=
...
50 MD5=0
51 LocalIP=192.168.1.10
52 Services=15
53 TftpLogFile=
54 SaveSyslogFile=
55 PipeSyslogMsg=0
56 LowestUDPPort=0
57 HighestUDPPort=0
58 MulticastPort=0
59 MulticastAddress=
60 PersistantLeases=0
61 DHCP Ping=0
62 DHCP LocalIP=192.168.1.10
```

Change the *IP_Pool* and the *Gateway* to the router's IP address , make sure the *Mask* is the same as the Netmask and change *LocalIP* and *DHCP LocalIP* to the computer's IP address.

Save the file.

Copy the firmware you wish to flash into the folder that contains *tftpd32* and rename it to match the expected firmware name.

The computer must now be given a Static IP address that matches what the router expects. Set your computer to have a static IP address by going to *Network and Internet Settings* and *Change Adapter Options*. Select the *Local Area Connection* and then the *Properties* button. Next select the *Properties* for the Internet Protocol 4 entry. Change the data there to the following.

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically

Use the following IP address:

IP address: 192 . 168 . 1 . 10

Subnet mask: 255 . 255 . 255 . 0

Default gateway: 192 . 168 . 1 . 4

Obtain DNS server address automatically

Use the following DNS server addresses:

Preferred DNS server: 8 . 8 . 8 . 8

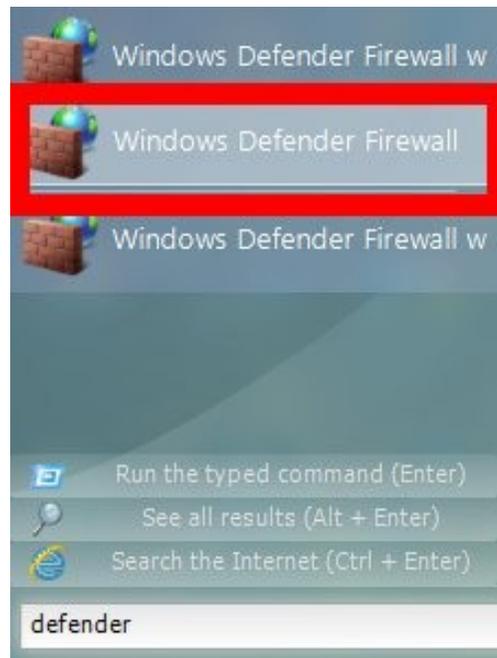
Alternate DNS server: . . .

Validate settings upon exit

Advanced...

OK Cancel

And lastly, before we attempt to flash the router, we must turn off the computer's Firewall. Go to the *Start* menu and search for *Defender*.



You will the have this pop up.



Go to the menu to turn off the Firewall.

Customize settings for each type of network

You can modify the firewall settings for each type of network that you use.

Private network settings



Turn on Windows Defender Firewall

Block all incoming connections, including those in the list of allowed apps

Notify me when Windows Defender Firewall blocks a new app



Turn off Windows Defender Firewall (not recommended)

Public network settings



Turn on Windows Defender Firewall

Block all incoming connections, including those in the list of allowed apps

Notify me when Windows Defender Firewall blocks a new app



Turn off Windows Defender Firewall (not recommended)

Click on *OK*. Remember that after you have finished flashing the router to turn the Firewall back on.

We are now ready to flash the router. Run *tftpd32.exe* to start the TFTP server. **Make sure the Ethernet cable from the computer is plugged into a LAN port on the router.**

Power up the router, interrupt the boot process and repeat the steps to set up for a flash via TFTP. Pressing *Enter* after the firmware name is entered will start the process. You will see something like this.

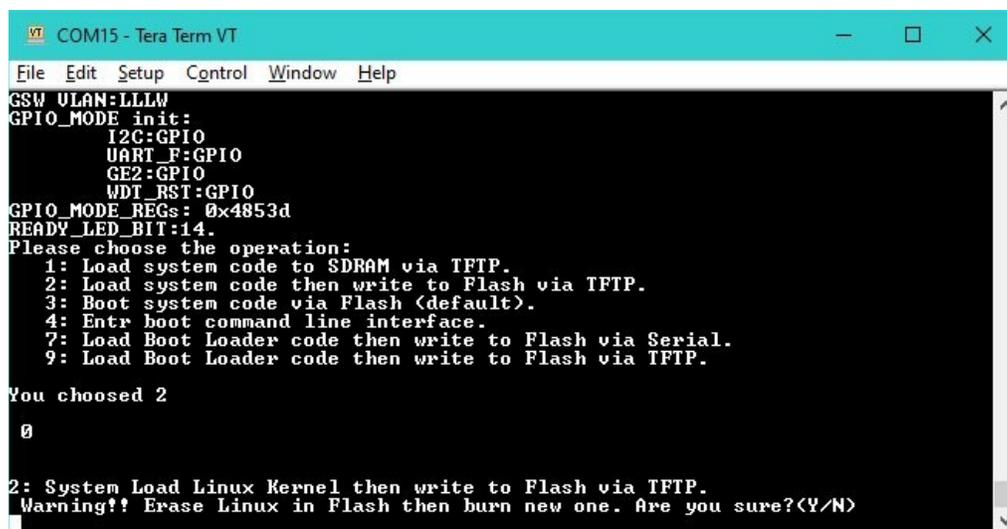
```
COM15 - Tera Term VT
File Edit Setup Control Window Help
*** Upgrading Firmware ***
Run image after upgrading? (Y/n):
Available load methods:
0 - TFTP client (Default)
1 - Xmodem
2 - Ymodem
3 - Kermit
4 - S-Record
5 - RAM
Select (enter for default):
Input U-Boot's IP address: 192.168.1.1
Input TFTP server's IP address: 192.168.1.10
Input IP netmask: 255.255.255.0
Input file name: Z81020X-nand-mt7981-DDR4-23.0711_101616.bin
Using ethernet@15100000 device
TFTP from server 192.168.1.10; our IP address is 192.168.1.1
Filename 'Z81020X-nand-mt7981-DDR4-23.0711_101616.bin'.
Load address: 0x46000000
Loading: █
```

Tftpd32 will show the file being uploaded to the router and the Terminal will show the progress as well. After the router has been flashed it will reboot and come up normally. You can see this on the Terminal.

Once this has happened you can exit *tftpd32* and turn the Firewall back on. The Serial cable recovery process is complete.

Other Bootloaders

The Huasifei WS1688.

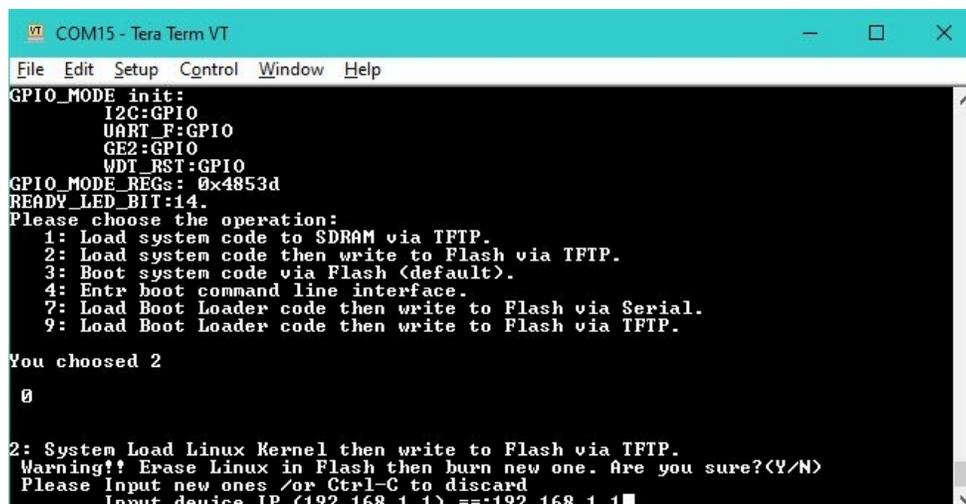


```
COM15 - Tera Term VT
File Edit Setup Control Window Help
GSW ULAN:LLW
GPIO_MODE init:
  I2C:GPIO
  UART_F:GPIO
  GE2:GPIO
  WDT_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.

You choosed 2
0

2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?(Y/N)
```

In this bootloader it is important that you enter 'Y' here rather than Enter. Otherwise the flash process is stopped and the router will reboot.



```
COM15 - Tera Term VT
File Edit Setup Control Window Help
GPIO_MODE init:
  I2C:GPIO
  UART_F:GPIO
  GE2:GPIO
  WDT_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.

You choosed 2
0

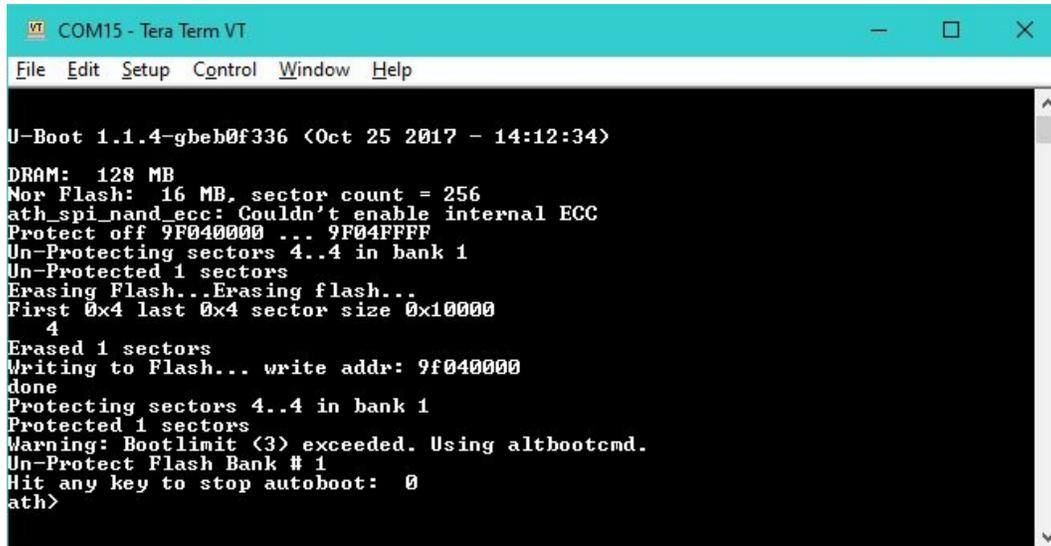
2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?(Y/N)
Please Input new ones /or Ctrl-C to discard
Input device IP (192.168.1.1) ==:192.168.1.1
```

```
COM15 - Tera Term VT
File Edit Setup Control Window Help
I2C:GPIO
UART_F:GPIO
GE2:GPIO
WDI_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.
You choosed 2
0
2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?(Y/N)
Please Input new ones /or Ctrl-C to discard
Input device IP <192.168.1.1> ==:192.168.1.1
Input server IP <192.168.1.100> ==:192.168.1.100
```

```
COM15 - Tera Term VT
File Edit Setup Control Window Help
UART_F:GPIO
GE2:GPIO
WDI_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.
You choosed 2
0
2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?(Y/N)
Please Input new ones /or Ctrl-C to discard
Input device IP <192.168.1.1> ==:192.168.1.1
Input server IP <192.168.1.100> ==:192.168.1.100
Input Linux Kernel filename <> ==:
```

In this case you can enter any firmware file name you like as long as *tftp32* points to it. After this the flash process is run.

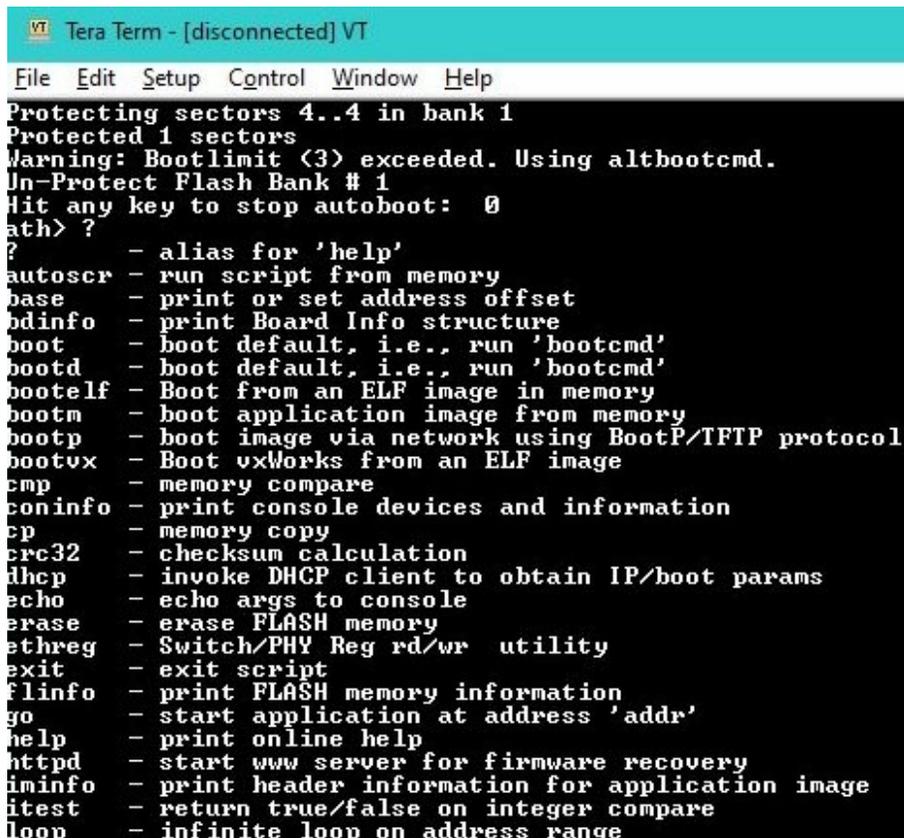
The Gl.iNet AR750.



```
COM15 - Tera Term VT
File Edit Setup Control Window Help

U-Boot 1.1.4-gbeb0f336 <Oct 25 2017 - 14:12:34>
DRAM: 128 MB
Nor Flash: 16 MB, sector count = 256
ath_spi_nand_ecc: Couldn't enable internal ECC
Protect off 9F040000 ... 9F04FFFF
Un-Protecting sectors 4..4 in bank 1
Un-Protected 1 sectors
Erasing Flash...Erasing flash...
First 0x4 last 0x4 sector size 0x10000
4
Erased 1 sectors
Writing to Flash... write addr: 9f040000
done
Protecting sectors 4..4 in bank 1
Protected 1 sectors
Warning: Bootlimit (3) exceeded. Using altbootcmd.
Un-Protect Flash Bank # 1
Hit any key to stop autoboot: 0
ath>
```

In this bootloader you press any key while it is booting up and it will take you to the bootloader console. There is no menu to choose from. The command to see all the other console commands is '?'.
ath> ?



```
Tera Term - [disconnected] VT
File Edit Setup Control Window Help

Protecting sectors 4..4 in bank 1
Protected 1 sectors
Warning: Bootlimit (3) exceeded. Using altbootcmd.
Un-Protect Flash Bank # 1
Hit any key to stop autoboot: 0
ath> ?
? - alias for 'help'
autoscr - run script from memory
base - print or set address offset
bdfinfo - print Board Info structure
boot - boot default, i.e., run 'bootcmd'
bootd - boot default, i.e., run 'bootcmd'
bootelf - Boot from an ELF image in memory
bootm - boot application image from memory
bootp - boot image via network using BootP/TFTP protocol
bootvx - Boot vxWorks from an ELF image
cmp - memory compare
coninfo - print console devices and information
cp - memory copy
crc32 - checksum calculation
dhcp - invoke DHCP client to obtain IP/boot params
echo - echo args to console
erase - erase FLASH memory
ethreg - Switch/PHY Reg rd/wr utility
exit - exit script
flinfo - print FLASH memory information
go - start application at address 'addr'
help - print online help
httpd - start www server for firmware recovery
iminfo - print header information for application image
itest - return true/false on integer compare
loop - infinite loop on address range
```

```

mct - simple RAM test
md - memory display
mii - MII utility commands
mm - memory modify (auto-incrementing)
mtest - simple RAM test
mw - memory write (fill)
nand - NAND sub-system
nandformat:format nand flash
nboot - boot from NAND device
nfs - boot image via network using NFS protocol
nm - memory modify (constant address)
pci - list and access PCI Configuration Space
ping - send ICMP ECHO_REQUEST to network host
pll cpu-pll dither ddr-pll dither - Set to change CPU & DDR speed
pll erase
pll get
printenv - print environment variables
progmact - Set ethernet MAC addresses
progmac2 - Set ethernet MAC addresses
protect - enable or disable FLASH write protection
rarpboot - boot image via network using RARP/TFTP protocol
reset - Perform RESET of the CPU
run - run commands in an environment variable
saveenv - save environment variables to persistent storage
setenv - set environment variables
sleep - delay execution for some time
test - minimal test like /bin/sh
tftpboot - boot image via network using TFTP protocol
version - print monitor version
ath>

```

The command you want here is *tftpboot*. This not a flash command but will boot the router using the specified file so you can then use the GUI to permanently flash it. Enter *tftpboot* in the Terminal.

```

Tera Term - [disconnected] VT
File Edit Setup Control Window Help
reset - Perform RESET of the CPU
run - run commands in an environment variable
saveenv - save environment variables to persistent storage
setenv - set environment variables
sleep - delay execution for some time
test - minimal test like /bin/sh
tftpboot - boot image via network using TFTP protocol
version - print monitor version
ath> tftpboot
Trying eth0
eth0 link down
FAIL
Trying eth1
eth1 link down
FAIL
*** Warning: no boot file name; using '0101A8C0.img'
Using eth0 device
TFTP from server 192.168.1.2; our IP address is 192.168.1.1
Filename '0101A8C0.img'.
Load address: 0x80800000
Loading: Tx Timed out

Abort
ath>

```

This tells us the parameters that the router expects.

- Router IP – 192.168.1.1
- Computer IP – 192.168.1.2
- File name – 0101A8C0.img

Once you have *tftpd32* set up with these values you can proceed as shown above. After the router reboots flash the firmware from the GUI.

The ZBT WG1608.

```

COM15 - Tera Term VT
File Edit Setup Control Window Help
GSW ULAN:LLW
GPIO_MODE init:
  I2C:GPIO
  UART_F:GPIO
  GE2:GPIO
  WDT_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.

You choosed 2
0

2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?<Y/N>

```

This has a menu that you select from with a key. In this case, it is '2'. Enter 'Y' to continue the flash process.

```

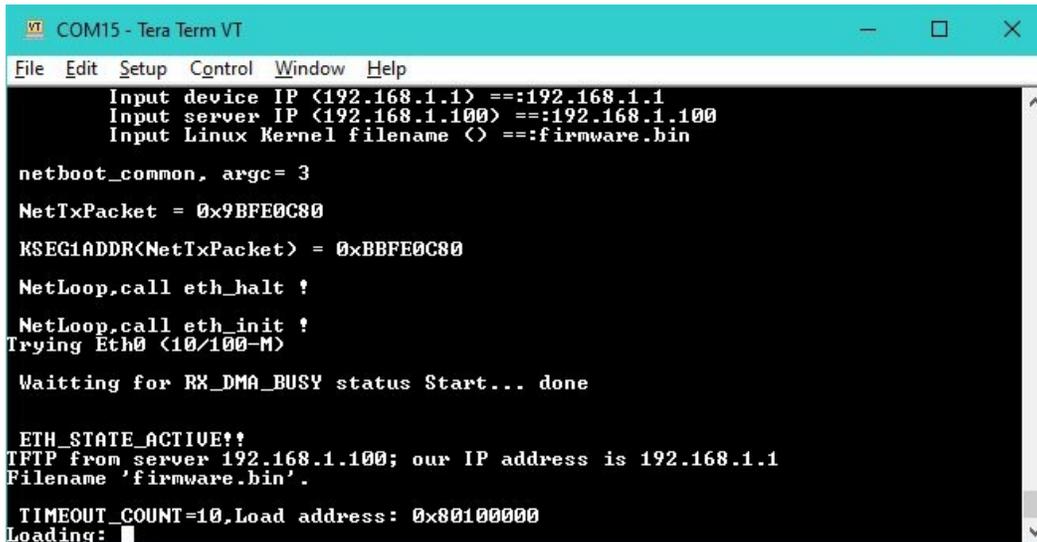
COM15 - Tera Term VT
File Edit Setup Control Window Help
  UART_F:GPIO
  GE2:GPIO
  WDT_RST:GPIO
GPIO_MODE_REGS: 0x4853d
READY_LED_BIT:14.
Please choose the operation:
  1: Load system code to SDRAM via TFTP.
  2: Load system code then write to Flash via TFTP.
  3: Boot system code via Flash (default).
  4: Entr boot command line interface.
  7: Load Boot Loader code then write to Flash via Serial.
  9: Load Boot Loader code then write to Flash via TFTP.

You choosed 2
0

2: System Load Linux Kernel then write to Flash via TFTP.
Warning!! Erase Linux in Flash then burn new one. Are you sure?<Y/N>
Please Input new ones /or Ctrl-C to discard
Input device IP <192.168.1.1> ==:192.168.1.1
Input server IP <192.168.1.100> ==:192.168.1.100
Input Linux Kernel filename <> ==:firmware.b

```

You may find that this doesn't display the entire default value so just hit *Enter* for the IP addresses. You have to enter the file name but it may not show all of it as well. Hitting *Enter* after the file name will tell us the parameters the router expects.



```
COM15 - Tera Term VT
File Edit Setup Control Window Help
Input device IP <192.168.1.1> ==:192.168.1.1
Input server IP <192.168.1.100> ==:192.168.1.100
Input Linux Kernel filename <> ==:firmware.bin

netboot_common, argc= 3

NetTxPacket = 0x9BFE0C80
KSEG1ADDR<NetTxPacket> = 0xBBFE0C80

NetLoop,call eth_halt !

NetLoop,call eth_init !
Trying Eth0 <10/100-M>

Waiting for RX_DMA_BUSY status Start... done

ETH_STATE_ACTIVE!!
TFTP from server 192.168.1.100; our IP address is 192.168.1.1
Filename 'firmware.bin'.

TIMEOUT_COUNT=10,Load address: 0x80100000
Loading: █
```

They are

- Router IP – 192.168.1.1
- Computer IP – 192.168.1.100
- File Name – firmware.bin.

As usual, proceed as normal from here.