

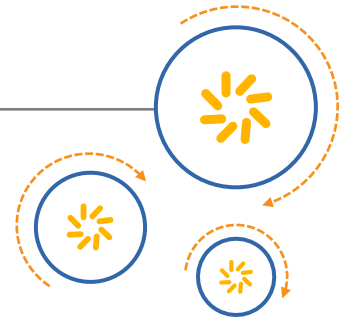
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IPQ4018/IPQ4028 AP.DK01

Setup Guide

80-Y9700-2 Rev. H

June 22, 2016

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Qualcomm Atheros, Inc.
1700 Technology Drive
San Jose, CA 95110
U.S.A.

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Revision history

Revision	Date	Description
A	July 2015	Initial release
B	July 2015	Section 2 AP.DK01 Full Running Configuration: Added subsection 2.1, subsection 2.2 title and renamed subsection 2.1 to 2.3
C	September 2015	<ul style="list-style-type: none"> Section 1.2 Overview: Added MT/s after 1066 for DDR3L feature Section 3.2 AP.DK01 reference design configuration: <ul style="list-style-type: none"> Changed Support later to Yes for “SPI NAND Flash” and No to Yes for “Boot – SPI NAND” in Table 3-1. Changed 600 MHz to 626 MHz in Current Frequency and Target Frequency columns for Cortex A7 *4 in Table 3-2. Section 5 Image Flashing Procedure from U-Boot: Added “sf probe” below the “tftp” line in step 1.
D	November 2015	<ul style="list-style-type: none"> Section 3.2 AP.DK01 reference design configuration: <ul style="list-style-type: none"> Changed Yes to No for “Boot - SPI NAND” in Table 3-1. Updated Figure 3-3, Figure 3-4 and Table 3-3. Added Sections 3.3 Jumper configuration and 3.4 Board configuration. Section 5 Image Flashing Procedure from U-Boot: <ul style="list-style-type: none"> Updated the address from 0x88000000 to 0x84000000. Added a note.
E	November 2015	<ul style="list-style-type: none"> Section 3.2 AP.DK01 reference design configuration: Changed 626 MHz to 710 MHz in Current Frequency and Target Frequency columns for Cortex A7 *4 in Table 3-2 AP.DK01 running frequency.
F	December 2015	Added section 2 Connecting AP.DK01 Serial Port, Enclosure Version and reorganized section 3 AP.DK01 Engineering Release Details .
G	May 2016	<ul style="list-style-type: none"> Section 1.2, Overview: Updated 1066 MT/s to 1075.2 MT/s for DDR. Section 3.2, AP.DK01 reference design configuration: Updated CPU frequency from 710 MHz to 716.8 MHz and DDR frequency from 533 MHz to 537.6 MHz in Table 3-2 AP.DK01 running frequency.
H	June 2016	<ul style="list-style-type: none"> Section 1.1, Purpose: Added the FCC Notice. Section 2, Connecting AP.DK01 Serial Port, Enclosure Version: Added step 4 to the end for verification. Section 4, Configuring the Host System COM Port: Added more explanations for clarification. Section 5, Image Flashing Procedure from U-Boot: Reworded step 2 for clarification. Section 6.1.2, DBDC in Open Security: Updated the code

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1 Introduction

1.1 Purpose

This document describes the AP.DK01 reference design configuration and the interface capabilities of IPQ4018 and IPQ4028 processors.

FCC NOTICE: This kit is designed to allow:

- (1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and
- (2) Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of the FCC's rules, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of the FCC's rules.

1.2 Overview

The IPQ4018/IPQ4028 is a highly integrated system-on-chip (SoC) designed for high-performance, power efficient, and cost-effective 2×2, 802.11ac, dual-band concurrent access point applications. The SoC incorporates a quad-core ARM Cortex A7 processor, two dual-band, concurrent 802.11ac Wave-2 Wi-Fi subsystems, and a five-port Gigabit Ethernet Layer2/3/4 multilayer switch supporting line rate Network Address Translation (NAT). It supports one USB3.0 and one USB2.0.

It also supports miscellaneous interfaces such as I²S, SPDIF, I²C, SMI, UART, and JTAG, which can be configured as general purpose I/O pins.

The AP.DK01 reference design board supports the following configurations:

- 4-layer board
- On-chip dual-band concurrent (DBDC) 2×2 2.4 GHz 802.11n (256QAM) and 2×2 5 GHz 802.11ac
- DC 12 V, 1 A power adapters
- DDR3L 1075.2 MT/s 16bits interface, supports up to 256 MB
- 14 GPIOs multiplex with function interfaces (SPI/I²C/JTAG/UART)
- Single 32 MB SPI NOR Flash
- 2 MB SPI NOR + 128 MB SPI NAND Flash

- JTAG
- UART
- One USB3.0 and one USB2.0 interface
- 5 GE Ethernet ports
- Two reset buttons
 - One for hardware reset
 - One for software reset/Manufactory default reset

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2 Connecting AP.DK01 Serial Port, Enclosure Version

For the demo board with enclosure, attention should be paid to the serial connections (see [Figure 2-1](#) and [Figure 2-2](#)).



Figure 2-1 Serial connection before connection

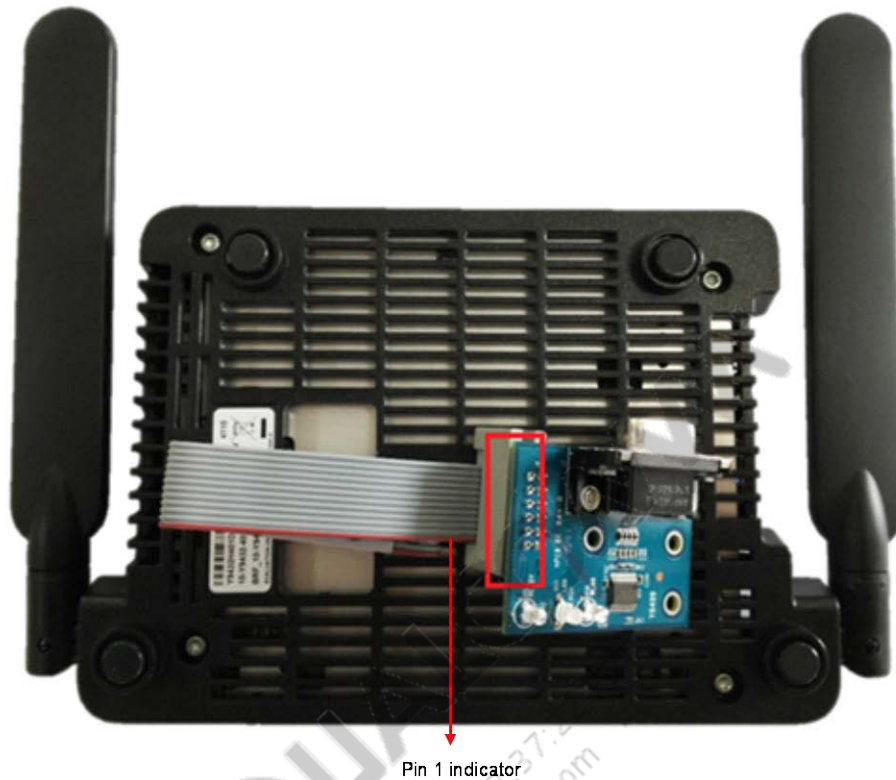


Figure 2-2 Serial connection after connection

WARNING: Incorrect orientation can cause damage to the adapter and the AP.DK01 reference design when power is applied.

1. Use a RS232 cable to connect the AP.DK01 to an available COM/USB port on the PC. Connect the other end of the RS232 cable to the RS232 adapter.

NOTE: If the PC has more than one COM port, note the COM port number connected to the cable.

2. Before powering up the AP, verify if all the connections are correct.
3. Connect the 12 V DC power adapter to the power port of the reference design.
4. Check the level shifter IC on the serial adapter board during first power on for excessive rapid temperature rise, and power off immediately if this is detected. This indicates a wrong connection orientation of the serial adapter board, which will be damaged by prolonged excessive temperature.

3 AP.DK01 Engineering Release Details

3.1 AP.DK01 engineering release assembly guidance



Figure 3-1 AP.DK01 before assembly

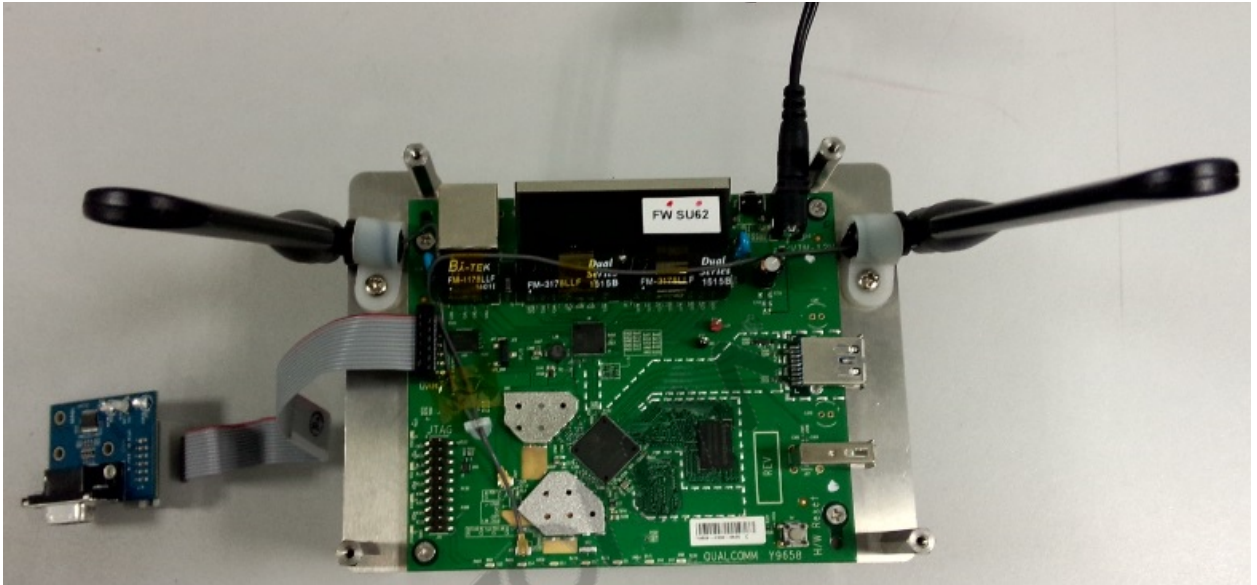


Figure 3-2 AP.DK01 after assembly

3.2 AP.DK01 reference design configuration

Table 3-1 AP.DK01 board feature mapping

Interface/ Function	AP.DK01
Device	IPQ4018/IPQ4028 14x14 mm DRQFN package
DDR3L Size	256 Mbyte
SPI NOR Flash	32 Mbyte
SPI NAND Flash	Yes
PSGMII	Yes
USB 3.0 *1	Yes
USB 2.0 *1	Yes
Boot - SPI NOR	Yes
Boot - SPI NAND	No
Boot - USB	No
Ethernet 5*GE	Yes
I ² C	Yes Connects to EEPROM Reserved need rework
UART (2-Wire UART)	Yes
JTAG	Yes
LED	Yes

Table 3-2 AP.DK01 running frequency

Blocks	Frequency
Cortex A7 *4	716.8 MHz
DDR3L	537.6 MHz

NOTE: The running configuration of the AP.DK01 can vary with new AP.DK01 software releases or new versions of the AP.DK01 reference design.

The AP.DK01 reference design kit includes:

- The AP.DK01 reference design
- 12V power adaptor
- RS232 UART adapter

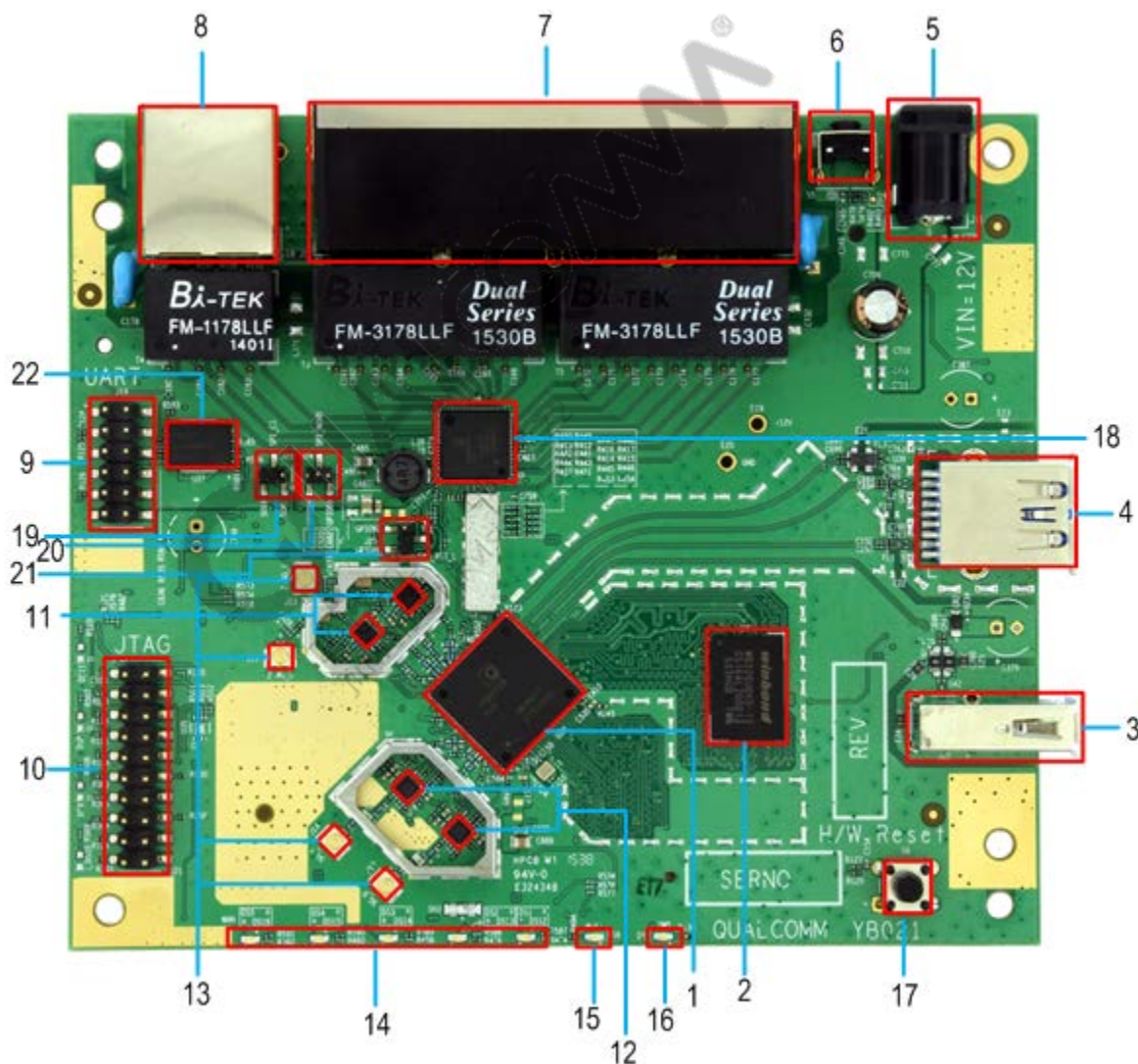


Figure 3-3 AP.DK01 reference design – front view

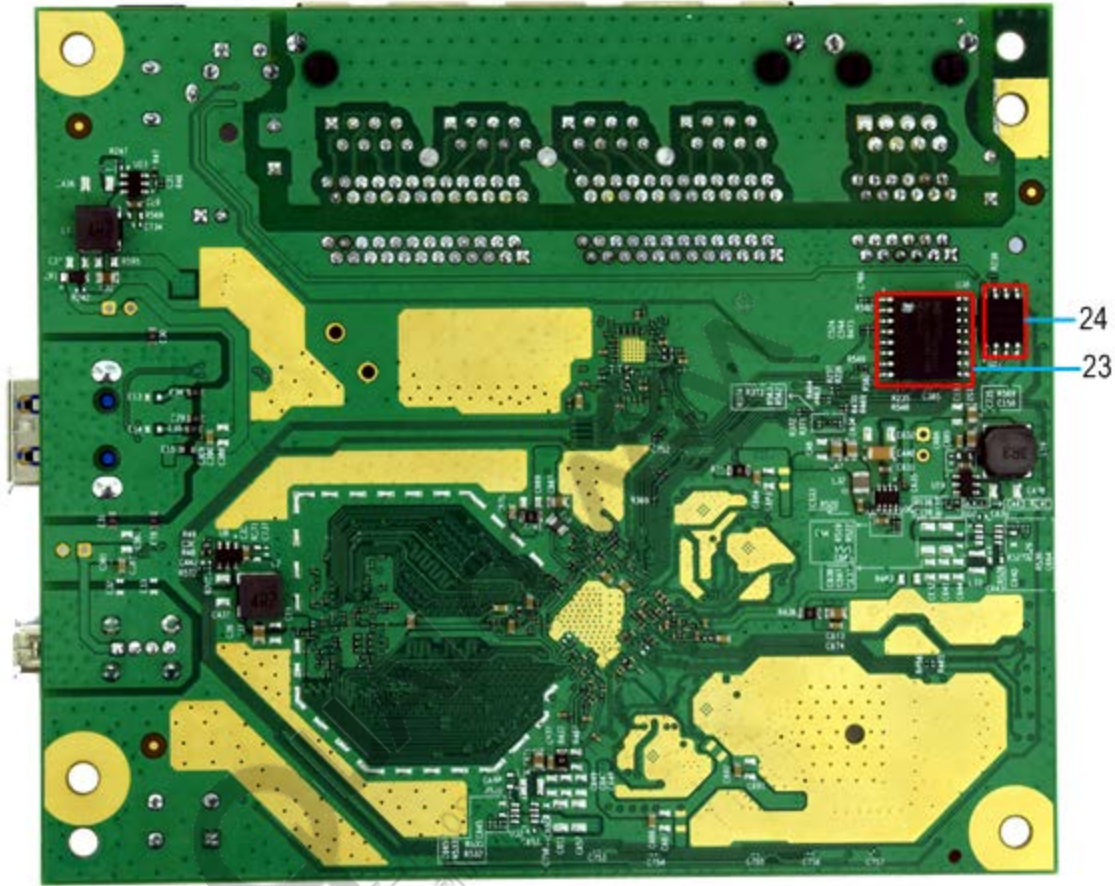


Figure 3-4 AP.DK01 reference design – bottom view

Table 3-3 AP.DK01 interface details

Item	Description
1	IPQ4018/IPQ4028
2	DDR3L
3	USB2.0
4	USB3.0
5	12V Power connector
6	Button: Software reset or Manufactory default reset Connects to GPIO63
7	LAN ports
8	WAN port
9	UART connector
10	JTAG connector
11	2.4 GHz FEM
12	5 GHz FEM

Item	Description
13	Antenna connector (from top to down): J13: 2.4 GHz Chain 1 J11: 2.4 GHz Chain 0 J14: 5 GHz Chain 1 J12: 5 GHz Chain 0
14	WAN/LAN3/LAN2/LAN1/LAN0 port LED from left to right
15	Wi-Fi LED from GPIO58
16	Power LED
17	Button: Hardware reset to chip power on reset
18	QCA8075 5-port GE PHY
19	Jumper 23 SPI NOR Flash chip select
20	Jumper 24 SPI NAND chip select
21	Jumper 25 QCA8075 reset
22	128 MB SPI NAND Flash
23	32 MB SPI NOR Flash
24	2 MB SPI NOR Flash

3.3 Jumper configuration

The AP.DK01 reference design includes three jumpers to select flash devices. By default the board mounts 32 MB NOR and 2 MB NOR flash devices. If 16 MB flash is preferred, the board needs rework to replace the 2 MB flash chip, see [Table 3-4](#).

Table 3-4 Jumper settings for flash selection

Flash select	J23 SPI_CS (NOR CS)	J24 SPI_NAND (NAND CS)	J25 SYS_RST_L (QCA8075 reset)
NOR 32 MB	SO16	Open	GPIO59
NOR (16 MB) + SPI NAND (128 MB)	SO8	GPIO59	GPIO62
NOR (2 MB) + SPI NAND (128 MB)	SO8	GPIO59	GPIO62
NOR (16 MB)	SO8	Open	GPIO62

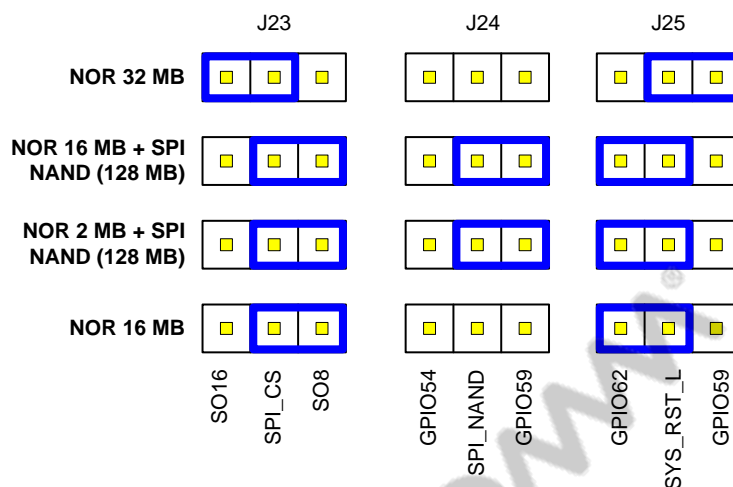


Figure 3-5 Jumper settings for flash selection

3.4 Board configuration

Table 3-5 Board configuration

Board/ configuration	Machine ID	Flash	Vendor/part #	Image name	Comment
AP.DK01.1-C1	8010000	NOR 32 MB	Macronix/MX25L25635FMI	nor- ipq40xx- single.img	
AP.DK01.1-C2	8010100	NOR 2 MB + SPI NAND (128 MB)	Gigadevice/GD25Q16CSIG (NOR) Gigadevice/GD5F1GQ4UCYIG (SPI NAND)	nornand- ipq40xx- single.img	
AP.DK01.1-S1	8010200	NOR 16 MB	Gigadevice/GD25Q128CSIG (NOR)	nor- ipq40xx- standard- single.img	Need board rework by changing 2 MB to 16 MB

NOTE: Refer to related Release Note for detailed information.

3.5 Lauterbach connection orientation

Connect the Lauterbach connector into the JTAG Connector (J21) on the AP.DK01 board.



Figure 3-6 Correct Lauterbach orientation

3.6 Serial Port Connection Details

Connect the RS232 adapter to the AP.DK01 UART connector (J19) (see [Figure 3-7](#)).



Figure 3-7 Correct UART orientation

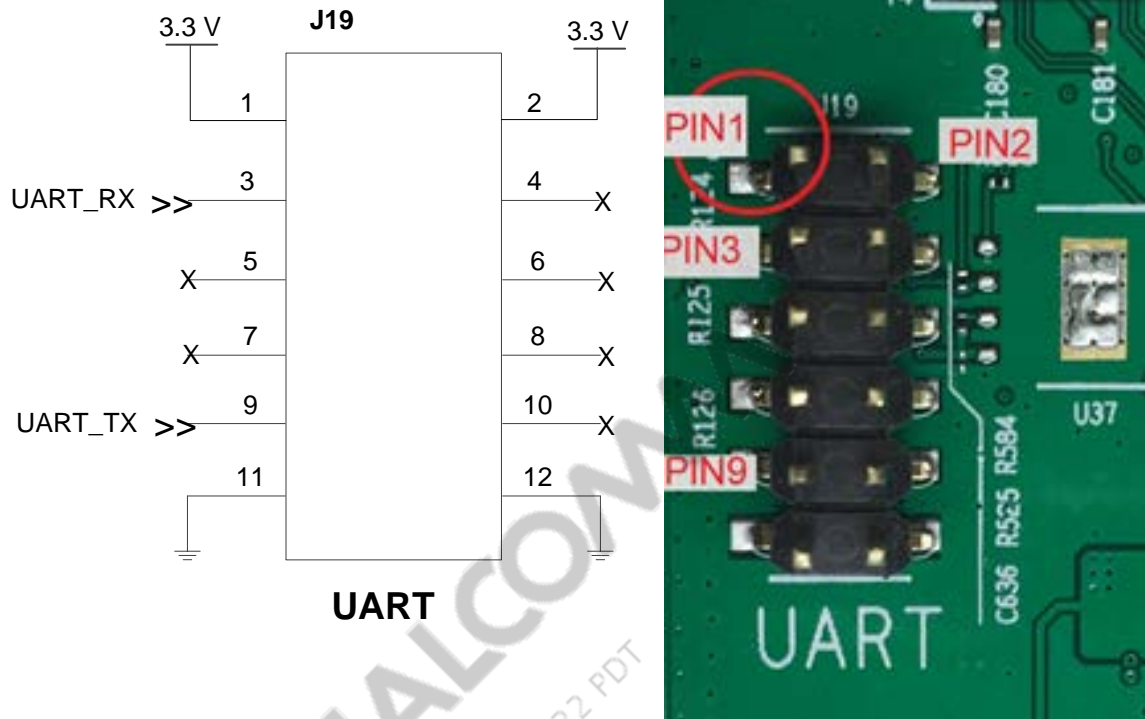


Figure 3-8 AP.DK01 UART connection pin definition

4 Configuring the Host System COM Port

Establish a console session to the AP with either of the following:

- A Telnet connection (not possible unless a complete image has been flashed and booted)
- A direct console connection (preferred)

Direct console via serial port is required for initial programming. Serial port settings are:

- ☐ Speed: 115200 bits per second
- ☐ 8 data bits
- ☐ 1 stop bit
- ☐ 0 parity bit
- ☐ No flow control

5 Image Flashing Procedure from U-Boot

1. On the opened console window, enter U-boot.

```
set ipaddr 192.168.1.1
set serverip 192.168.1.xx (tftpserver- Ipaddress)
tftpboot 0x84000000 nor-ipq40xx-single.img
sf probe
imgaddr=0x84000000
source $imgaddr:script
```

2. After image flashing has completed and console prompt is re-printed, power cycle the board.

NOTE: To change between different board configuration images (different board configurations, different Machine ID, and different Flash settings):

- a. Change the jumper setting and do the board rework.
- b. Set the Machine ID in uboot (e.g., set machid 8010000).
- c. Use the script in step 1 to update.
- d. For NOR + NAND image, after uboot is updated, reset the board and update image again.

For detailed information, refer to [3.3 Jumper configuration](#) and [3.4 Board configuration](#).

6 Installing and Configuring the IPQ4018/IPQ4028 Interfaces

6.1 Wi-Fi

NOTE: If Wi-Fi modules are not insmod'ed during the kernel boot-up, use this procedure.

```
cat > ins.sh << EOF
cd /lib/modules/3.4.0
insmod adf.ko && echo == adf done ==
insmod asf.ko && echo == asf done ==
insmod ath_hal.ko && echo == ath_hal done == && sleep 5
insmod ath_rate_atheros.ko && echo == ath_rate_atheros done ==
insmod ath_spectral.ko
insmod ath_dfs.ko
insmod ath_dev.ko && echo == ath_dev done ==
insmod umac.ko && echo == umac done ==
EOF
sh ins.sh
```

6.1.1 Finding the available wireless interface

Execute `cat /etc/config/wireless` on the AP.DK01 platform to show the state of all Wi-Fi interfaces.

```
config wifi-device 'wifi0'
    option type 'qcawifi'
    option channel 'auto'
    option macaddr '00:03:7f:12:13:13'
    option hwmode '11ng'
    option disabled '0'

config wifi-iface
    option device 'wifi0'
    option network 'lan'
    option mode 'ap'
    option ssid 'OpenWrt'
    option encryption 'none'

config wifi-device 'wifi1'
    option type 'qcawifi'
    option channel 'auto'
    option macaddr '00:34:56:78:83:83'
```

```
option hwmode '11ac'
option disabled '0'

config wifi-iface
    option device 'wifil'
    option network 'lan'
    option mode 'ap'
    option ssid 'OpenWrt'
    option encryption 'none'
```

6.1.2 DBDC in Open Security

```
uci set wireless.@wifi-device[0].disabled=0
uci set wireless.@wifi-device[1].disabled=0
uci commit wireless; wifi
```

6.1.3 DBDC in WPA2-PSK Security

```
uci set wireless.@wifi-device[0].disabled=0
uci set wireless.@wifi-device[0].htmode=VHT40
uci set wireless.@wifi-iface[0].ssid=sara2
uci set wireless.@wifi-iface[0].encryption=psk2
uci set wireless.@wifi-iface[0].key='123456789'
uci commit wireless; wifi
```

```
uci set wireless.@wifi-device[1].disabled=0
uci set wireless.@wifi-device[1].htmode=HT80
uci set wireless.@wifi-iface[1].ssid=sara1
uci set wireless.@wifi-iface[1].encryption=psk2
uci set wireless.@wifi-iface[1].key='123456789'
uci commit wireless; wifi
```

6.2 Ethernet interface

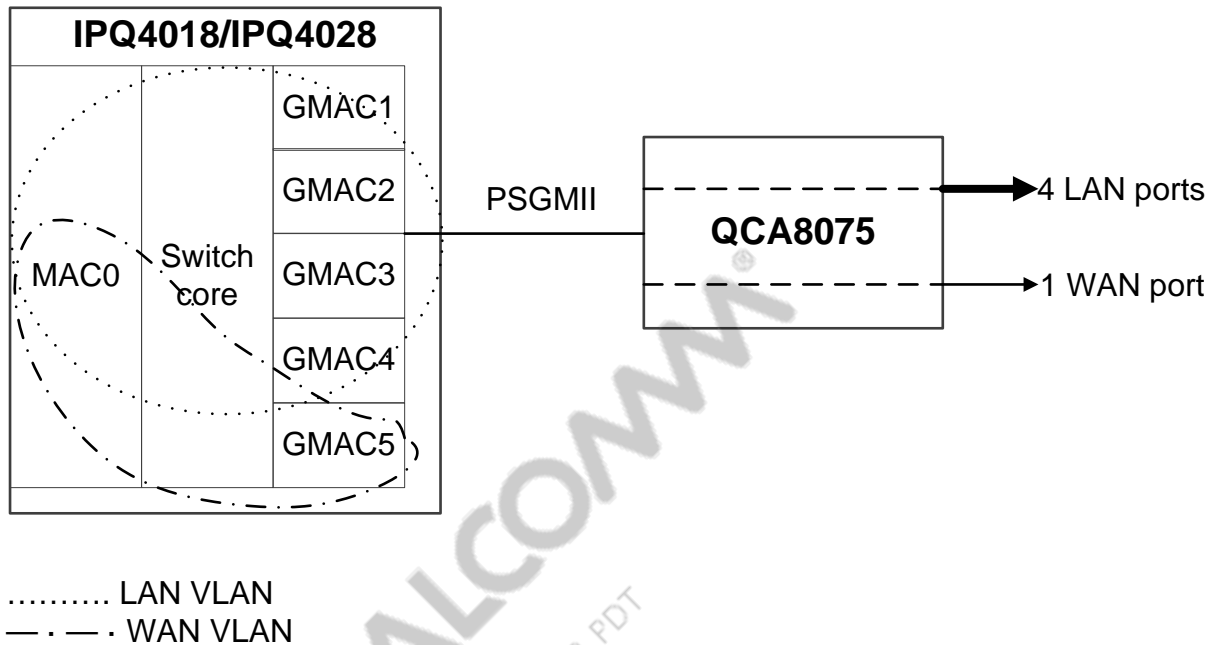


Figure 6-1 VLAN setting default

```

root@OpenWrt:cat /etc/config/network
config interface 'loopback'
    option ifname 'lo'
    option proto 'static'
    option ipaddr '127.0.0.1'
    option netmask '255.0.0.0'
config globals 'globals'
    option ula_prefix 'auto'
config interface 'lan'
    option ifname 'eth1'
    option type 'bridge'
    option proto 'static'
    option ipaddr '192.168.1.1'
    option netmask '255.255.255.0'
    option ip6assign '60'
config interface 'wan'
    option ifname 'eth0'
    option proto 'dhcp'
config interface 'wan6'
    option ifname '@wan'
    option proto 'dhcpv6'
config switch
    option name 'switch0'
    option reset '1'

```

```

        option enable_vlan '1'
config switch_vlan
    option device 'switch0'
    option vlan '1'
    option ports '0t 1 2 3 4'
config switch_vlan
    option device 'switch0'
    option vlan '2'
    option ports '0t 5'

root@OpenWrt:/# ifconfig
br-lan    Link encap:Ethernet  HWaddr 72:32:65:6E:52:B6
          inet addr:192.168.1.1  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::7032:65ff:fe6e:52b6/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:35 errors:0 dropped:0 overruns:0 frame:0
          TX packets:117 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:2989 (2.9 KiB)  TX bytes:14751 (14.4 KiB)

eth0      Link encap:Ethernet  HWaddr 6A:A6:C9:A8:28:68
          inet6 addr: fe80::68a6:c9ff:fea8:2868/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:288 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:111251 (108.6 KiB)

eth1      Link encap:Ethernet  HWaddr 72:32:65:6E:52:B6
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:123 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:14850 (14.5 KiB)

root@OpenWrt:/# brctl show
bridge name  bridge id      STP enabled  interfaces
br-lan       7fff.7232656e52b6    no           eth1

```

6.3 USB

The AP.DK01 supports one USB3.0 and one USB2.0 host ports.

1. Plug a USB device into the USB port to see whether the USB device is recognized.


```

usb 2-1: new SuperSpeed USB device number 8 using xhci-hcd
usb 2-1: Parent hub missing LPM exit latency info.  Power management
will be impacted.

```



```
usb-storage 2-1:1.0: USB Mass Storage device detected
scsi10 : usb-storage 2-1:1.0
scsi 10:0:0:0:Direct-Access Kingston DataTraveler 3.0 PMAP PQ: 0 ANSI: 6
sd 10:0:0:0: [sda] 30712320 512-byte logical blocks: (15.7 GB/14.6 GiB)
sd 10:0:0:0: [sda] Write Protect is off
sd 10:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't
support DPO or FUA
sda: sda1
sd 10:0:0:0: [sda] Attached SCSI removable disk
```

Or type the command **dmesg** to see whether the USB device is recognized. The **dmesg** command responds with whether the USB Flash drive is at sda/sdb.

2. When the USB device is mounted at sda1 or another block device, create a new directory under the / directory, use the **mount** command to mount the USB device to the newly created directory:

```
mkdir /tmp/usbl
mount -t vfat /dev/sda1 /tmp/usbl
```