RTL8197D-11AC

AP/Router User's Manual

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USING THIS DOCUMENT

This document provides detailed user guidelines to achieve the best performance when implementing the Realtek 11n AP/Routers.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

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1. General Description

The RTL8197D is an integrated System-on-a-Chip (SoC) Application Specific Integrated Circuit (ASIC) L2 5-Port Ethernet switch. An RLX5281 CPU is embedded and the clock rate can be up to 660MHz. To improve computational performance, a 64Kbyte I-Cache, 32Kbyte D-Cache, 16Kbyte I-MEM, and 8Kbyte D-MEM are provided. A standard 5-signal P1149.1 compliant EJTAG test interface is supported for CPU testing and software development.

The RTL8197D provides five ports (ports 0~4), integrated with five physical layer transceivers for 10Base-T and 100Base-TX. Each port of the RTL8197D may be configured as a LAN or WAN port. Port 0 supports an external MAC interface that could be an GMII/RGMII/MII interface type to work with an external MAC or PHY transceiver.

The RTL8197D supports flexible IEEE 802.3x full-duplex flow control and optional half-duplex backpressure control. For full-duplex, standard IEEE 803.3x flow control will enable pause ability only when both sides of UTP have auto-negotiation ability and have enabled pause ability. The RTL8197D also provides optional forced mode IEEE 802.3x full-duplex flow control. Based on optimized packet memory management, the RTL8197D is capable of Head-Of-Line blocking prevention.

L2 Switch Features: The RTL8197D contains a 1024-entry address look-up table with a 10-bit 4-way XOR hashing algorithm for address searching and learning. Auto-aging of each entry is provided and the aging time is around 300~450 seconds.

The RTL8197D supports IEEE 802.3az, also known as Energy Efficient Ethernet (EEE). IEEE 802.3az operates with the IEEE 802.3 Media Access Control (MAC) Sublayer to support operation in Low Power Idle mode. When the Ethernet network is in low link utilization, EEE allows systems on both sides of the link to save power. Green Ethernet power saving provides: link-on and dynamic detection of cable length, and dynamic adjustment of power required for the detected cable length. This feature provides high performance with minimum power consumption. The RTL8197D also implements link-down power saving on a per-port basis, greatly cutting power consumption when the network cable is disconnected.

For peripheral interfaces, two 16550-compatible UARTs are supported, and a 16-byte FIFO buffer is provided. Both USB 2.0 host and USB OTG (On-The-Go) controllers are embedded in the RTL8197D to provide EHCI and OHCI 1.1 compliant host and OTG functionality. In addition, two USB PHYs are embedded in the RTL8197D.

An MDI/MDIX auto crossover function is supported. For accessing high-speed devices, the RTL8197D provides two PCI Express hosts to access a PCI Express interface. Up to two PCI Express devices are supported via this interface on the RTL8197D.

The RTL8197D requires only a single 25MHz crystal or 40MHz clock input for the system PLL. The RTL8197D also has two hardware timers and one watchdog timer to provide accurate timing and watchdog functionality. For extension and flexibility, the RTL8197D supports up to 46 GPIO pins.

The RTL8197D is provided in a Thermally Enhanced Thin Profile Plastic Quad Flat Package, 176-Lead (TQFP176 E-PAD) package. It requires a 3.3V and 1.0V external power supply.

2. Features

- SOC
  - Embedded RISC CPU, RLX5281 with 64Kbyte I-Cache, 32Kbyte D-Cache, 16Kbyte I-MEM, 8Kbyte D-MEM
  - Supports MIPS-1 ISA, MIPS16 ISA
  - Clock Rate: 500MHz~660MHz
  - Provides a standard 5-signal P1149.1 EJTAG test port
  - Supports RLX5281 CPU suspend mode
- L2 Capabilities
  - Five Ethernet MAC switch with five IEEE 802.3 10/100M physical layer transceivers
  - Supports one GMII/RGMII/MII port to connect to an external MAC or PHY (supports both PHY mode and MAC mode) for HomePlug or HomePNA applications on RTL8197D
  - Non-blocking wire-speed reception and transmission and non-head-of-line-blocking/forwarding
  - Internal 256Kbit SRAM for packet buffering
  - Internal 1024 entry 4-way hash L2 look-up table
  - Supports source and destination MAC address filtering
  - Bi-color LED display mode
- CPU Interface (NIC)
  - Supports BSD mbuf-like packet structure with adjustable cluster size (128-byte to 2Kbyte) to provide optimum memory utilization
  - The NIC DMA supports multiple-descriptor-ring architecture for QoS applications
- Peripheral Interfaces
  - Supports PCI Express Host with integrated PHY to connect up to two master devices
  - Two PCI Express PHY embedded

  Supports two-port USB
    - One is USB 2.0 host
    - One is USB 2.0 Host or Device
  - Two USB PHYs are embedded
  - Supports one I2S interface
  - Supports two 16550 UARTs
  - Supports up to 46 GPIO pins
- Memory Interfaces
  - Serial Flash (SPI Type)
    - Supports two banks and dual I/O channels for SPI Flash application
    - Each Flash bank could be configured as 256K/512K/1M/2M/4M/8M/16M Bytes
    - Boot up from SPI flash is supported

  NAND Flash
    - System supports up to 4 Gigabyte Flash memory space
  - SDR DRAM
    - Supports two SDR DRAM banks; each can be configured as 2M/4M/8M/16M/32M/64Mbyte
    - 16-bit SDR DRAM data bus supported. System totally supports up to 128Mbyte SDR DRAM memory space

- DDR1 DRAM
  - Supports one DDR1 DRAM bank that can be configured as 16M/32M/64M/128Mbytes
  - 16-bit DDR1 DRAM data bus supported. System totally supports up to 128Mbyte DDR1 DRAM memory space
- DDR2 DRAM
  - Supports one DDR2 DRAM bank that can be configured as 32M/64M/128Mbyte
  - 16-bit DDR2 DRAM data bus supported. System totally supports up to 128Mbyte DDR2 DRAM memory space

- Supports Green Ethernet
  - Cable length power saving
  - Link down power saving
- Supports IEEE 802.3az Energy Efficient Ethernet ability for 100Base-TX in full duplex operation and 10Base-T in full/half duplex mode
- Other Add-on-Value Features
  - Supports Link Down Power Saving in Ethernet PHYceivers
  - Supports two hardware timers and one watchdog timer
  - Per-port configurable auto-crossover function
  - Built-in internal ROM booting
  - Single 25MHz crystal or 40MHz clock input
- Built-in LDO

  LDO for DDR1/DDR2
  - DDR1 DRAM: 3.3V to 2.5V
  - DDR2 DRAM: 3.3V to 1.8V
- TQFP176-E-PAD package

3. System Applications

- IEEE 802.11b/g/n AP/Router
- Dualband Concurrent Router
- Network-Attached Storage (NAS)

4. Product specifications

4.1. Environmental

4.1.1. Operating

Operating Temperature: 0 to 70 °C
Relative Humidity: 5-90% (non-condensing)

4.1.2. Storage

Temperature: -55 to 125 °C
Relevant Humidity: 5-95% (non-condensing)

4.2. Functional Specifications

Table 1. Functional Specifications

Standards	IEEE 802.11a/b/g/n/e/i/h/k/r/draft-ac
Bus Interface	PCI Express
Form Factor	Half Size Mini Card
Data Rate	**802.11b:** 11, 5.5, 2, 1 Mbps; **802.11g:** 54, 48, 36, 24, 18, 12, 9, 6 Mbps **802.11n:** MCS 0 to 15 for HT20MHz; MCS 0 to 15 for HT40MHz **802.11ac:** MCS 0 to 8 for HT20MHz; MCS 0 to 9 for HT40MHz; MCS 0 to 9 for HT80MHz
Media Access Control	CSMA/CA with ACK
Modulation Techniques	***802.11b***: CCK, DQPSK, DBPSK ***802.11a/g/n***: 64 QAM, 16 QAM, QPSK, BPSK ***802.11ac***: 256QAM, 64 QAM, 16 QAM, QPSK, BPSK
Network Architecture	***WiFi***: Ad-hoc mode (Peer-to-Peer) Infrastructure mode

Operating Channel	***WiFi 2.4GHz:*** 11: (Ch. 1-11) – United States 13: (Ch. 1-13) – Europe 14: (Ch. 1-14) – Japan ***WiFi 5GHz:*** 20MHz band width : Ch 36, 40, 44, 48, Ch 52, 56, 60, 64, Ch 100, 104, 108, 112, 116, 120, 124, 128,132,136, 140, Ch 149,153, 157,161, 165. 40MHz band width : Ch 38, 46, Ch 54, 62, Ch 102, 110, 118, 126, 134, Ch 151, 159. 80MHz band width : Ch 42 Ch 58 Ch 105, 122 Ch 155.
Frequency Range	2.400GHz ~ 2.4835 GHz 5.1500GHz ~ 5.3500GHz 5.4700GHz ~ 5.7250GHz 5.7250GHz ~ 5.8500GHz
Security	WPA, WPA-PSK, WPA2, WPA2-PSK, WEP 64bit & 128bit, IEEE 802.11x, IEEE 802.11i
Operating Voltage	3.3 V ±9% I/O supply voltage

4.3. Warning

4.3.1 Federal Communication Commission Interference Statement

This equipment 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 radiate 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 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.

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.

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

IMPORTANT NOTE:
FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Operations in the 5.15-5.25GHz band are restricted to indoor usage only.
IEEE 802.11b or 802.11g operation of this product in the U.S.A. is firmware-limited to channels 1 through 11.

4.3.2 Industry Canada Statement

This device complies with RSS-210 of the Industry Canada Rules. Operation is subject to the following two conditions:
1) this device may not cause interference and
2) this device must accept any interference, including interference that may cause undesired operation of the device

French translation:
Ce dispositif est conforme à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

(The user manual of transmitter devices equipped with detachable antennas shall contain the following information in a conspicuous location:)
This device has been designed to operate with an antenna having a maximum gain of 2.39 dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

French translation:
(Le manuel d'utilisation de dispositifs émetteurs équipés d'antennes amovibles doit contenir les informations suivantes dans un endroit bien en vue:)

Ce dispositif a été conçu pour fonctionner avec une antenne ayant un gain maximum de 2.39 dBi. Une antenne à gain plus élevé est strictement interdite par les règlements d'Industrie Canada. L'impédance d'antenne requise est de 50 ohms.
Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peutfonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pourl'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectriqueà l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que lapuissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire àl'établissement d'une communication satisfaisante.

IMPORTANT NOTE:
IC Radiation Exposure Statement:
This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

French translation:

NOTE IMPORTANTE: (Pour l'utilisation de dispositifs mobiles)
Déclaration d'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

Caution: (DFS band usage-full bands)
(i) the device for operation in the band 5150-5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

(ii) the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall comply with the e.i.r.p. limit; and

(iii) the maximum antenna gain permitted for devices in the band 5725-5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

(iv) Users should also be advised that high-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

French translation:
Avertissement:

Le guide d'utilisation des dispositifs pour réseaux locaux doit inclure des instructions précises sur les restrictions susmentionnées, notamment :

(i) les dispositifs fonctionnant dans la bande 5 150-5 250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux;

(ii) le gain maximal d'antenne permis pour les dispositifs utilisant les bandes 5 250-5 350 MHz et 5 470-5 725 MHz doit se conformer à la limite de p.i.r.e.;

(iii) le gain maximal d'antenne permis (pour les dispositifs utilisant la bande 5 725-5 825 MHz) doit se conformer à la limite de p.i.r.e. spécifiée pour l'exploitation point à point et non point à point, selon le cas.

(iv) De plus, les utilisateurs devraient aussi être avisés que les utilisateurs de radars de haute puissance sont désignés utilisateurs principaux (c.-à-d., qu'ils ont la priorité) pour les bandes 5 250-5 350 MHz et 5 650-5 850 MHz et que ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna,

For all products market in Canada, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

French translation :

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne,
3) Pour tous les produits vendus au Canada, OEM doit limiter les fréquences de fonctionnement CH1 à CH11 pour bandes de fréquences 2.4G grâce aux outils de microprogrammation fournis. OEM ne doit pas

fournir d'outil ou d'informations à l'utilisateur final en ce qui concerne le changement de réglementation de domaine.

Tant que les 3 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the IC authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate IC authorization.

French translation:

NOTE IMPORTANTE:
Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC: 6317A-RTL8197D-11AC”.

French translation:

Plaque signalétique du produit final
Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 6317A-RTL8192DE ".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

French translation:

Manuel d'information à l'utilisateur final
L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

4.3.3 NCC 警語

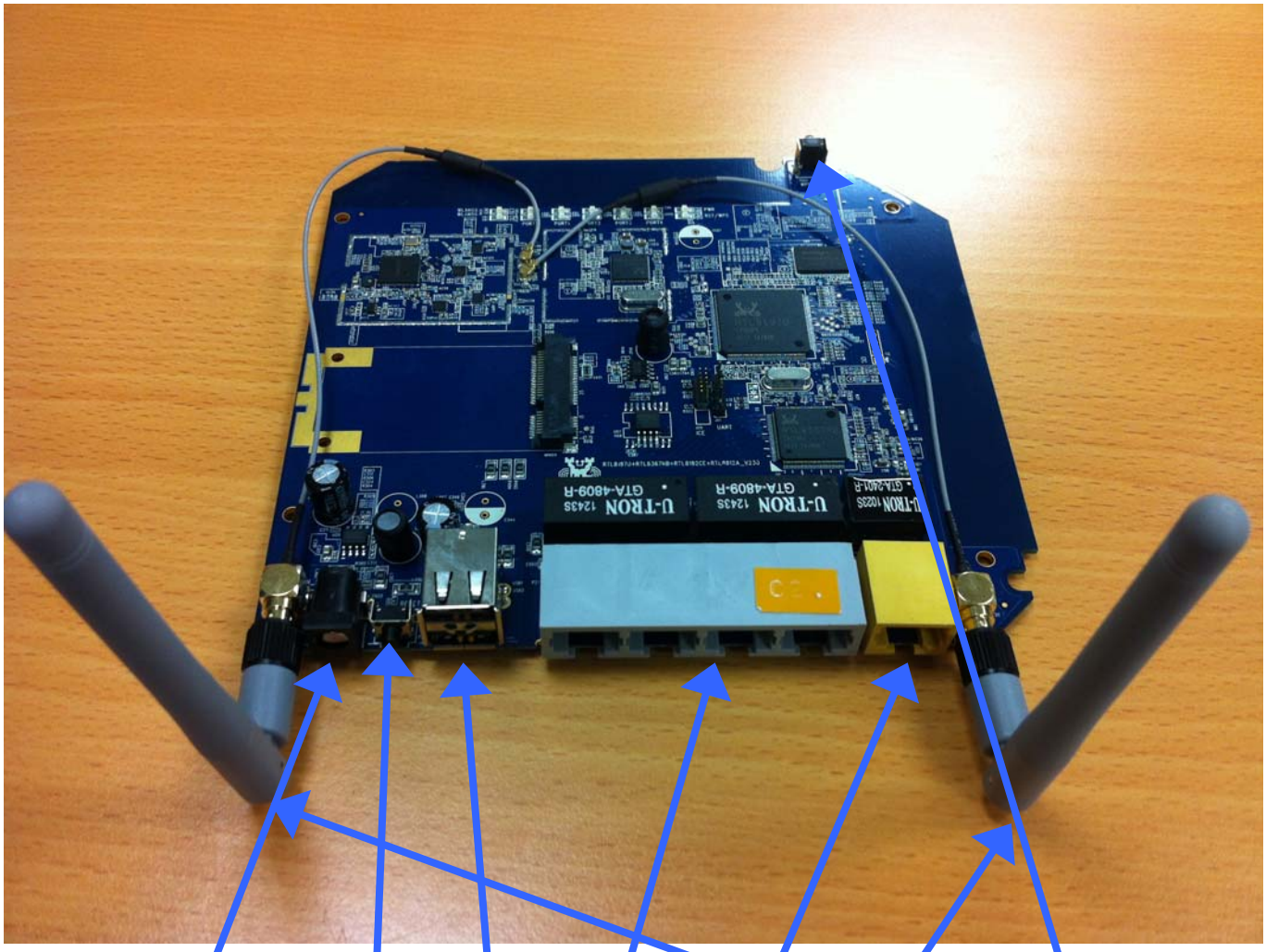
經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

在5.25-5.35GHz頻帶內操作之無線資訊傳輸設備，限室內使用。

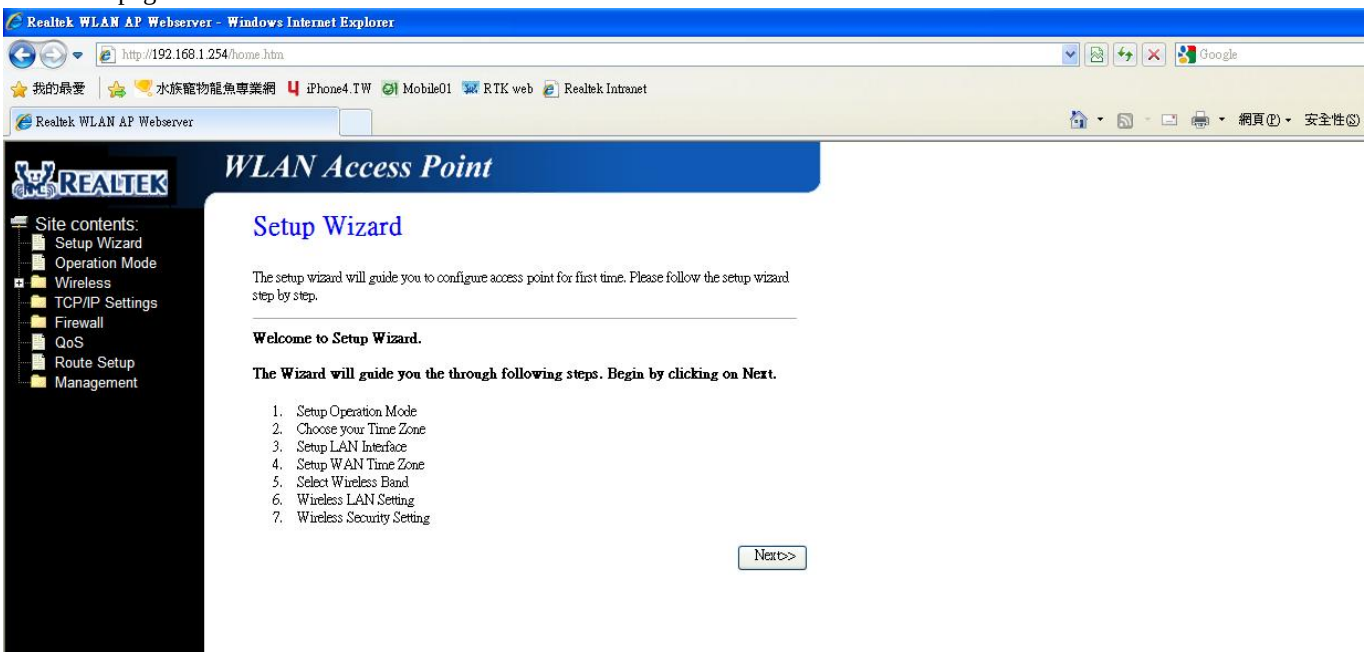
本模組於取得認證後將依規定於模組本體標示審合格籤，並要求平台上標示「本產品內含射頻模組：ID編號」

The Wireless AP/Router Hardware



Installing the Wireless PCIe miniCard module Software

1. EUT LAN IP：192.168.1.254
2. EUT WAN IP：172.1.1.1
3. Wireless SSID (2.4G)：RTK 11n AP 2.4G
   (5G)：RTK 11n AP 5G
4. Wireless IP：192.168.1.254
5. Webpage：



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