

REALTEK

RTL8191SU

PCI-Express miniCard User's Manual

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USING THIS DOCUMENT

This document is intended for the software engineer's reference and provides detailed programming information.

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. In that event, please contact your Realtek representative for additional information that may help in the development process.

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1. General Description

The Realtek RTL8191SU is a highly integrated single-chip MIMO wireless LAN (WLAN) solution for the wireless high throughput 802.11n draft specification. It combines a MAC, a 1T2R capable baseband, and RF in a single chip. The RTL8191SU provides complete solution for a high throughput performance wireless client.

The RTL8191SU baseband implements multiple input, multiple output (MIMO) orthogonal frequency division multiplexing (OFDM) with 1 transmit and 2 receive paths and is compatible with 802.11n Draft specification 2.0. Other features include one spatial streams transmission, up to two spatial streams reception, short guard interval (GI) of 400ns, spatial spreading, and transmission over 20 MHz and 40 MHz bandwidth. At the receiver, extended range and good minimum sensitivity is achieved by having receiver diversity up to 2 antennas.

For legacy compatibility, direct sequence spread spectrum (DSSS), complementary code keying (CCK) and OFDM baseband processing are included to support all IEEE 802.11b and 802.11g data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability, are available along with complementary code keying to provide the data rates of 1, 2, 5.5 and 11Mbps with long or short preamble. The high speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, and 64QAM modulation of the individual subcarriers and rate compatible punctured convolutional coding with coding rate of 1/2, 2/3, 3/4, and 5/6, provides the maximum data rate of 54 Mbps and 300 Mbps for IEEE 802.11g and 802.11n MIMO OFDM respectively.

The RTL8191SU builds in an enhanced signal detector, an adaptive frequency domain equalizer, and a soft-decision Viterbi decoder to alleviate the severe multi-path effects and mutual interference in the reception of multiple streams. For better detection quality, receive diversity with maximal-ratio-combine (MRC) applying up to 2 receive paths are implemented. Robust interference detection and suppression are provided to protect against bluetooth, cordless phone, and microwave oven. Receive vector diversity for multi-stream application is implemented for efficient utilization of MIMO channel. Efficient IQ-imbalance, DC offset, phase noise, frequency offset and timing offset compensations are provided for the radio frequency front-end impairments. Selectable digital transmit and receiver FIR filters are provided to meet the requirement of transmit spectrum mask and to reject the adjacent channel interference, respectively.

The RTL8191SU supports fast receiver automatic gain control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control function to obtain the better performance in the analog portions of the transceiver.

The RTL8191SU MAC supports 802.11e for multimedia applications, 802.11i for security, and 802.11n for enhanced MAC protocol efficiency. Using packet aggregation techniques such as A-MPDU with BA and A-MSDU, protocol efficiency is significantly improved. Power saving mechanisms such as U-APSD, APSD, and MIMO power saving reduces the power wasted during idle time, and compensates for the extra power required to transmit MIMO OFDM. The RTL8191SU provides simple legacy and 20Mhz/40Mhz co-existence mechanisms to ensure backward and network compatibility.

2. General Features

General

- 64-pin QFN
- CMOS MAC, Baseband MIMO PHY, and RF Single Chip for IEEE 802.11b/g/n compatible WLAN
- Complete 802.11n MIMO solution for 2.4GHz band
- 1x2 MIMO technology for extended reception robustness and exceptional throughput
- Maximum Tx/Rx PHY data rate up to 75M/150Mbps using 20Mhz bandwidth, 150M/300Mbps using 40Mhz bandwidth
- Compatible with 802.11n draft 2.0 specification
- Backward compatible with 802.11b/g devices while operating at 802.11n data rates

Host Interface

- Complies with PCI Express™ Base Specification Revision 1.1

Standards supported

- 802.11e QoS Enhancement (WMM, WMM-SA Client mode)
- 802.11h TPC, Spectrum Measurement
- 802.11k Radio Resource Measurement
- 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- Cisco Compatible Extensions (CCX) for WLAN devices

MAC Features

- Frame aggregation increase MAC efficiency (A-MSDU, A-MPDU)
- Low latency Immediate High-Throughput Block Acknowledgement (HT-BA)
- Long NAV for media reservation with CF-End for NAV release
- PHY-level spoofing to enhance legacy compatibility
- MIMO power saving mechanism
- Channel management and co-existence
- Multiple BSSID feature allowing RTL8191SU to assume multiple MAC identity when used as wireless bridge
- Supports Wake-On-WLAN via Magic Packet and wake-up frame
- TXOP SIFS bursting guarantees multimedia bandwidth

Peripheral Interface

- General Purpose Input/Output (8 pins)
- 4-wire EEPROM control interface (93C46)
- Configurable LED pins (2)
- Configurable Bluetooth Coexistence Interface

PHY Features

IEEE 802.11n draft 2.0 MIMO OFDM

- 1 transmit and 2 receive paths (1T2R).
- 20MHz and 40MHz bandwidth transmission.
- Short Guard Interval (400ns).

DSSS with DBPSK and DQPSK, CCK modulations with long and short preamble.

OFDM with BPSK, QPSK, 16QAM, and 64QAM modulations. Convolutional coding rate: 1/2, 2/3, 3/4, and 5/6.

Maximum data rate 54Mbps in 802.11g and 300Mbps in 802.11n.

OFDM receive diversity with MRC using up to 2 receive paths. Switch diversity used for DSSS/CCK.

Hardware antenna diversity.

Selectable digital transmit and receiver FIR filters

Programmable scaling in transmitter and receiver to trade quantization noise against increasing probability of clipping.

Fast receiver automatic gain control (AGC).

On-chip ADC and DAC.

3. Product specifications

3.1. Mini PCI Express Pin Assignment

Table 1. Mini PCI Express Pin Assignment

PIN#	Pin Name		PIN#	Pin Name	
1	WAKE#	NC	2	+3.3Vaux	YES
3	COEX1	NC	4	GND	YES
5	COEX2	NC	6	+1.5V	NC
7	CLKREQ#	NC	8	UIM_PWR	NC
9	GND	YES	10	UIM_DATA	NC
11	REFCLK-	NC	12	UIM_CLK	NC
13	REFCLK+	NC	14	UIM_RESET	NC
15	GND	YES	16	UIM_VPP	NC
17	RESERVED	NC	18	GND	YES
19	RESERVED	NC	20	W_DISABLE#	YES
21	GND	YES	22	PERST#	NC
23	PERn0	NC	24	+3.3Vaux	NC
25	PERp0	NC	26	GND	YES
27	GND	YES	28	+1.5V	NC
29	GND	YES	30	SMB_CLK	NC
31	PETn0	NC	32	SMB_DATA	NC
33	PETp0	NC	34	GND	YES
35	GND	YES	36	USB_D-	YES
37	GND	YES	38	USB_D+	YES
39	+3.3Vaux	NC	40	GND	YES
41	+3.3Vaux	NC	42	LED_WWAN#	NC
43	GND	NC	44	LED_WLAN#	YES
45	RESERVED	NC	46	LED_WPAN#	NC
47	RESERVED	NC	48	+1.5V	NC
49	RESERVED	NC	50	GND	YES
51	RESERVED	NC	52	+3.3Vaux	YES

3.2. Mechanical

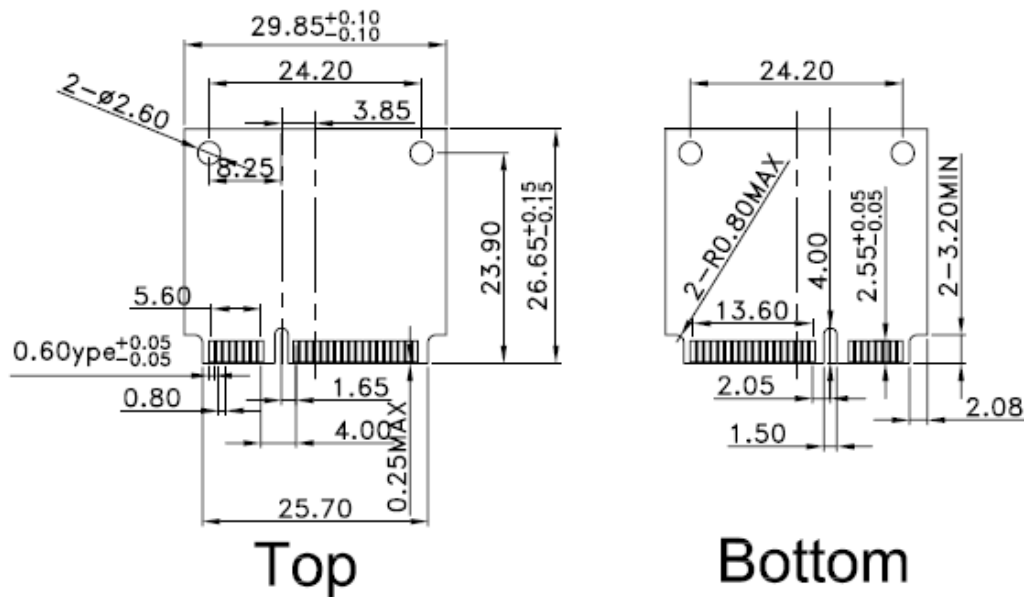


Figure 1. RTL8191SU miniCard Mechanical Specification

3.3. Environmental

3.3.1. Operating

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

3.3.2. Storage

Temperature: -20 to 85 °C
 Relevant Humidity: 5-95% (non-condensing)

3.4. Functional Specifications

Table 2. Functional Specifications

Standard	IEEE802.11b; IEEE 802.11g; Draft IEEE 802.11n
Bus Interface	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 7 for HT20MHz; MCS 0 to 7 for HT40MHz
Media Access Control	CSMA/CA with ACK
Modulation Techniques	802.11b: CCK, DQPSK, DBPSK

	802.11g: 64 QAM, 16 QAM, QPSK, BPSK 802.11n: BPSK, QPSK, 16-QAM, 64-QAM		
Network architecture	Ad-hoc mode (Peer-to-Peer) Infrastructure mode		
Operating Channel	2.4GHz 11: (Ch. 1-11) – United States 13: (Ch. 1-13) – Europe 14: (Ch. 1-14) – Japan (Ch14 optional)		
Frequency Range	2.400GHz ~ 2.4835 GHz		
Transmit Output Power – 1x2 (Tolerance: +1dBm, -1.5dBm)	802.11 b 11Mbps 16 dBm	802.11 g 54Mbps 14dBm	802.11 n MCS7 13 dBm (40MHz BW) 14 dBm (20MHz BW)
Receiver Sensitivity	802.11b -76dBm@11Mbps	802.11g -68@54Mbps	802.11 n -67dBm (MCS 7_HT20) -64dBm (MCS 7_HT40)
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		
OS supported	Windows XP/Vista		
Power Consumption	TX Mode: 330mA RX Mode: 220mA Stand by mode Connect to AP: 44mA Stand by mode no Connect to AP: 20mA Radio off mode: 20mA		
Antenna Type	Two antenna connectors; 1TX, 2RX antenna diversity		

3.5. Warning

4.5.1 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.

IEEE 802.11b or 802.11g operation of this product in the U.S.A. is firmware-limited to channels 1 through 11.

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

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

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

For all products market in US, 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 (for example, digital device emissions, PC peripheral requirements, etc.).

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 FCC authorization is no longer considered valid and the FCC 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 FCC authorization.

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 FCC ID: TX2-RTL8191SU".

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.

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

This device has been designed to operate with an antenna having a maximum gain of 3.95 dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the EIRP is not more than required for successful communication.

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.

4.5.2 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

This device has been designed to operate with an antenna having a maximum gain of 3.95dBi. Antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the EIRP is not more than required for successful communication.

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.

This device is intended only for OEM integrators

under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna.

As long as conduction above is 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 (for example, digital device emissions, PC peripheral requirements, etc.). The antenna must be installed such that 20 cm is maintained between the antenna and users.

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.

End Product Labeling

The final end product must be labeled in a visible area with the following: “Contains TX IC : 6317A-RTL8191SU”.

Manual Information That Must be Included

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 user's manual for OEM Integrators must include the following information in a prominent location “IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements. The antenna must not be co-located or operating in conjunction with any other antenna or transmitter”.

4.5.3 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。

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」

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