RS9110-N-11-21 – Serial-to-Wi-Fi Module Datasheet

Redpine Signals, Inc.
2107 N. First Street, #680
San Jose, CA 95131.
Tel: (408) 748-3385
Fax: (408) 705-2019
Email: info@redpinesignals.com
Website: www.redpinesignals.com

Overview

Overview

The RS9110-N-11-21 module from Redpine's Connect-io-n™ family of products is a complete IEEE 802.11bgn Wi-Fi client device with a standard serial or SPI interface to a host processor or data source. It integrates a MAC, Baseband processor, RF transceiver with power amplifier, a frequency reference, an antenna, and all WLAN protocol and configuration functionality in embedded firmware to provide a self-contained 802.11n WLAN solution. No WLAN driver functionality is required on the host processor. It is designed to provide standards compliant wireless connectivity to devices and systems that have a serial port and implement a TCP/IP stack. It uniquely provides connectivity in the single stream 802.11n mode, preserving overall network throughput in the emerging enterprise environments.

Applications:

- Seamless Wi-Fi Connectivity for Applications Processors
- Point of Sale Terminals
- Metering (Parking Meters, Utility Meters, etc.)
- Warehousing, Logistics and Freight Management
- Several medical applications including Patient Monitoring, Remote Diagnostics

Device Features:

- Compliant to 802.11b/g and single stream 802.11n
- Does not require any WLAN driver on the host processor
- Supports WPA2-PSK, WEP (64 and 128 bits) and TKIP modes of security in infrastructure mode.
- Supports WEP (64 and 128 bits) mode of security in IBSS (ad-hoc) mode.
- Host interface through Serial Interface and SPI
- Terminates SLIP connections
- Configuration through UART/SPI
- Integrated antenna, frequency reference, and low-frequency clock. Option for external antenna through u.FL connector
- Ultra low power operation with power save modes
- Ad-hoc and infrastructure modes for maximum deployment flexibility
- Single supply 3.1 to 3.6V operation
- Device Dimensions 22mm X 28mm X 2.8mm

RS9110-N-11-21 System Block Diagram

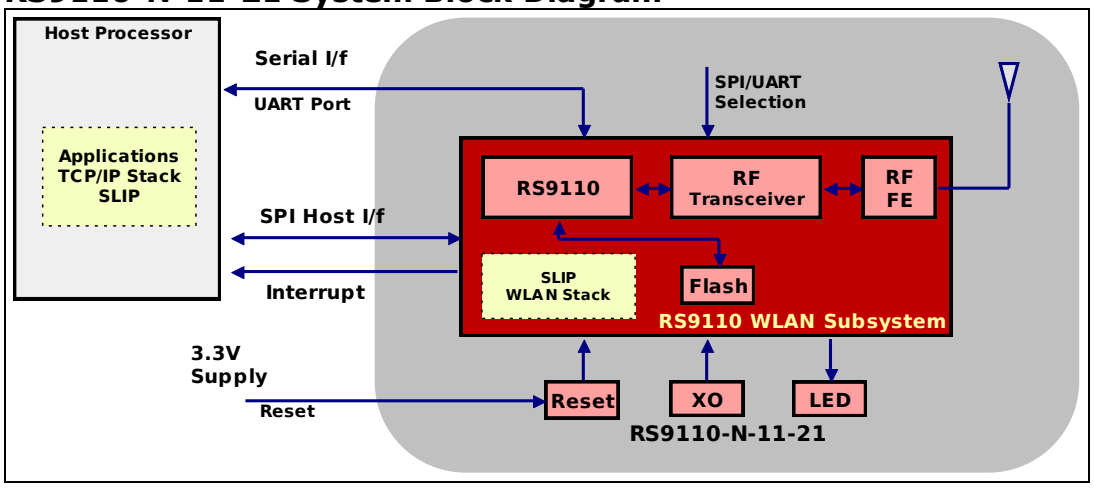

Table of Contents

Table of Figures

List of Tables

1 Detailed Feature List

1.1 Host Interfaces

UART:

The UART forms the physical layer of the TCP/IP stack carrying SLIP-encapsulated frames

The UART interface supports variable baud rates from 9600 to 3686400 bps

AT Command Interface for configuration and module operation

SPI:

Standard 4-wire SPI

Operation up to a maximum clock speed of 25 Mhz[1]

1.2 WLAN

1.2.1 MAC

Conforms to IEEE 802.11b/g/n standards for MAC

Dynamic selection of data rate based on channel characteristics

Infrastructure and Ad-hoc modes

WPA/WPA2-PSK, WEP

1.2.2 Baseband Processing

Supports DSSS (1, 2 Mbps) and CCK (5.5, 11 Mbps) modes

Supports all OFDM data rates (6, 9, 12, 18, 24, 36, 48, and 54 Mbps)

Supports IEEE 802.11n single-stream modes with data rates up to 65 Mbps

Supports long, short, and HT preamble modes

High-performance multipath compensation in OFDM, DSSS, and CCK modes

1.2.3 RF

Highly integrated 2.4 GHz transceiver and Power Amplifier with direct conversion architecture

Integrated frequency reference and antenna

1.3 Networking Protocols

SLIP

ARP

1.4 Configuration

The RS9110-N-11-21 module can be configured through UART or SPI. The following are some of the commands that can be given to the module:

Scan

[1] This frequency also depends on external delays.

Connect

Pre-shared Keys

SSID of hidden WLAN networks

Create/Join an IBSS (ad-hoc) network

1.5 Software

Sample Host driver for SPI on Linux

Configuration and management GUI for Windows XP for UART

Embedded software for complete WLAN functionality.

1.6 Compliance and Certification

Reference design is FCC, IC, and CE certified

RoHS (Restriction of Hazardous Substances) compliant

2 Package Description

2.1 Top View

Figure 1:Top View of the Module

2.2 Bottom View

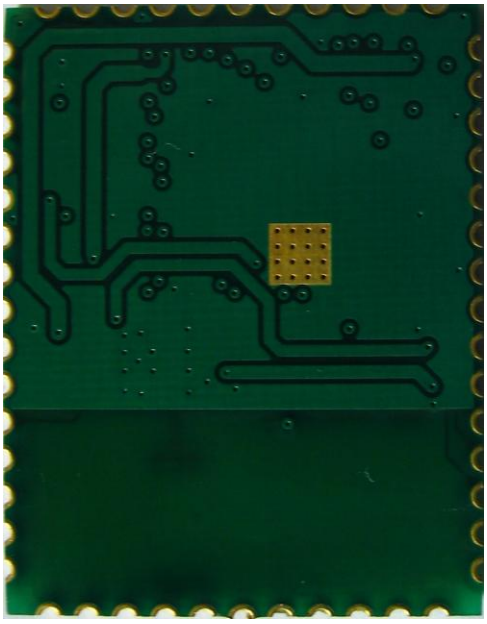

Figure 2:Bottom View of the Module

2.3 Package Dimensions

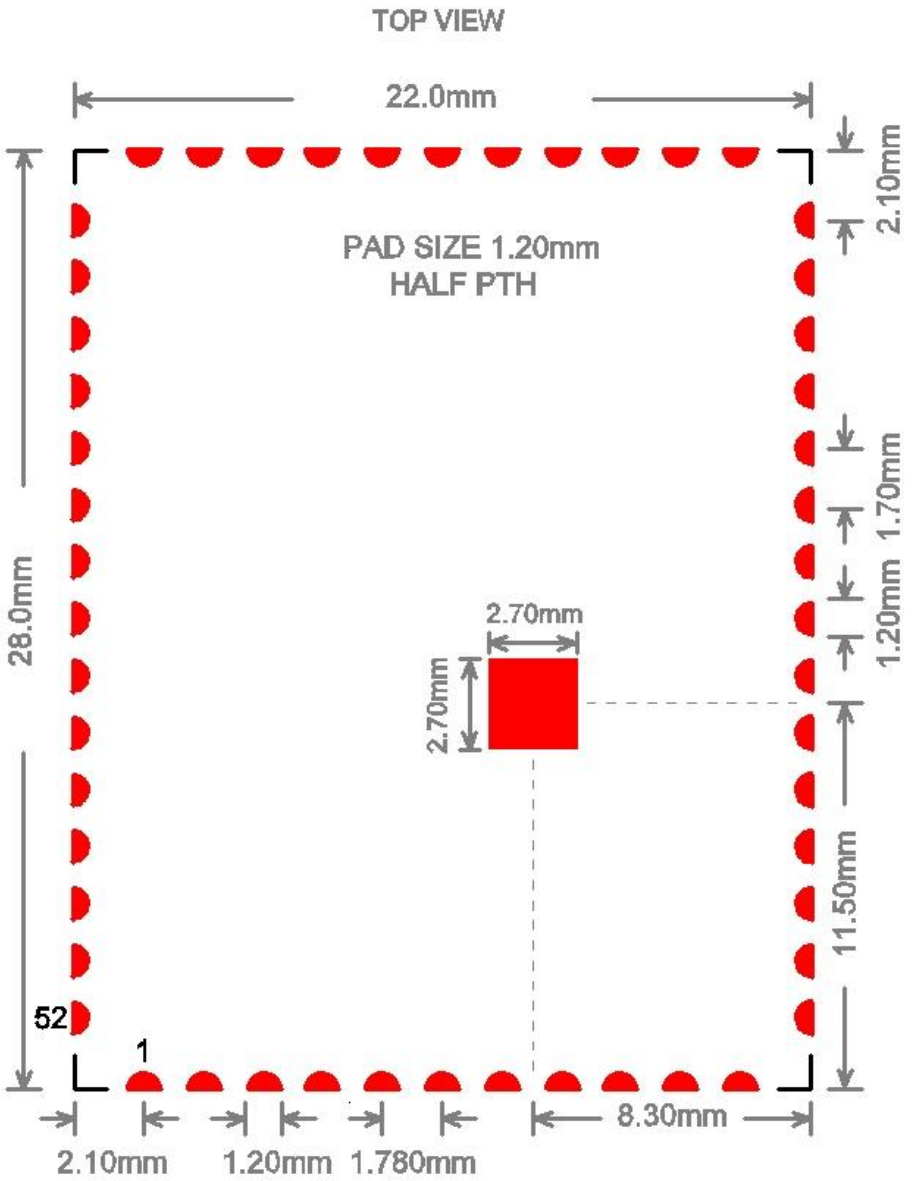

Figure 3: Module Package Dimensions

Module height = 2.8 mm

2.4 PCB Landing Pattern

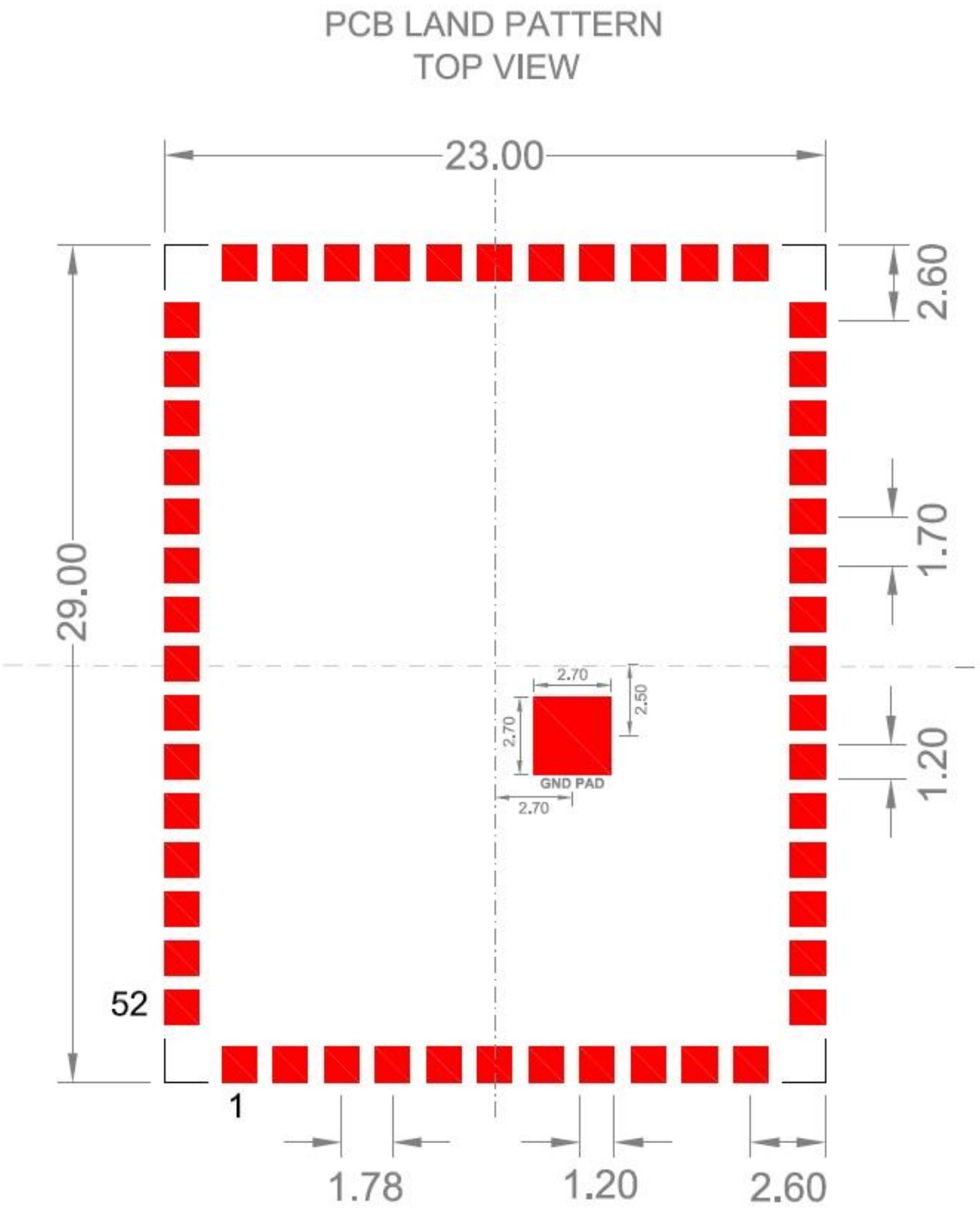

Figure 4:PCB Landing Pattern

2.5 Recommended Reflow Profile

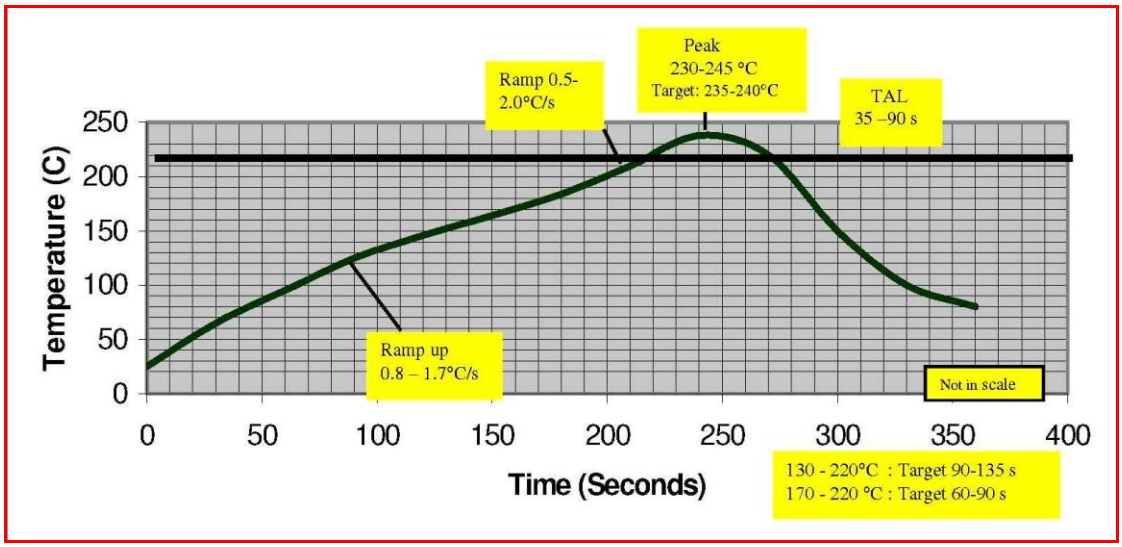

Figure 5:Reflow Profile

NOTE: The profile shown is based on SAC 305 solder (3% silver, 0.5% copper). We recommend the ALPHA OM-338 lead-free solder paste. This profile is provided mainly for guidance. The total dwell time depends on the thermal mass of the assembled board and the sensitivity of the components on it.

2.6 Baking Instructions

The RS9110-N-11-21 package is moisture sensitive and devices must be handled appropriately. After the devices are removed from their vacuum sealed packs, they should be taken through reflow for board assembly within 168 hours at room conditions, or stored at under 10% relative humidity. If these conditions are not met, the devices must be baked before reflow. The recommended baking time is nine hours at 125° C.

3 Pin Description

3.1 Module Pinout

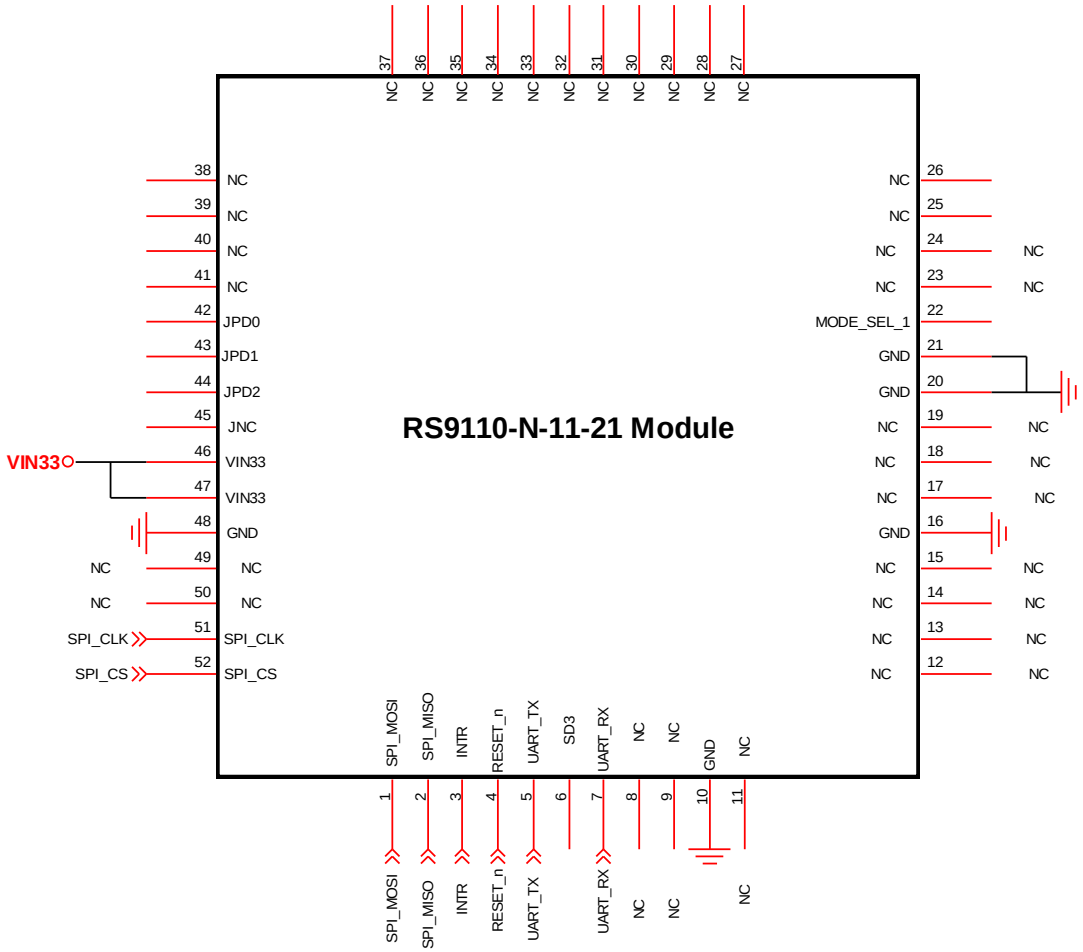

Figure 6:Pinout of the Module

3.2 Pin Description

Pin No.	Pin Name	Direction	Type	Description
1	SPI_MOSI	Input	LVCMOS 8mA	SPI Data Input. In UART mode, should be pulled down with resistor (1K to 10K Ohms)
2	SPI_MISO	Output	LVCMOS 8mA	SPI Data output. No connect in UART mode

Pin No.	Pin Name	Direction	Type	Description
3	INTR	Output	LVCMOS 8mA	Interrupt to the host. Active high, level triggered. Asserted by the module when: 1.The module has to transmit data to the host through SPI. 2.When the module wakes up from sleep mode
4	RESET_n	Input	LVCMOS	Power on reset. Active low, required to be active for at least 10 ms after power on, to reset the module.
5	UART_TX	Output	LVCMOS 4mA	UART output. No connect in SPI mode.
6	SD3	-		No connect in SPI mode. In UART mode, connect pull-down (1K to 10K Ohms).
7	UART_RX	Input	LVCMOS 4mA	UART Port input. No connect in case of SPI.
8	NC	-		No connect
9	NC	-		No connect
10	GND	Ground		Ground. Connect all the GND pins directly to a ground plane or copper ground fill
11	NC	-		No Connect
12	NC	-		No connect
13	NC	-		No connect
14	NC	-		No connect
15	NC	-		No connect
16	GND	Ground		Ground. Connect all the GND pins directly to a ground plane or copper ground fill
17	NC	-		No connect
18	NC	-		No connect
19	NC	-		No connect
20	GND	Ground		Ground. Connect all the GND pins directly to a ground plane or copper ground fill.
21	GND	Ground		Ground. Connect all the GND pins directly to a ground plane or copper ground fill
22	MODE_SEL_1	Input	LVCMOS 2mA	SPI Mode: Pull down resistor (3.9K to 4.7K Ohms)

Pin No.	Pin Name	Direction	Type	Description
				UART Mode: No connect
23	NC	-		No connect
24	NC	-		No connect
25	NC	-		No Connect
26	NC	-		No Connect
27	NC	-		No Connect
28	NC	-		No Connect
29	NC	-		No Connect
30	NC	-		No Connect
31	NC	-		No Connect
32	NC	-		No Connect
33	NC	-		No Connect
34	NC	-		No Connect
35	NC	-		No Connect
36	NC	-		No Connect
37	NC	-		No Connect
38	NC	-		No Connect
39	NC	-		No Connect
40	NC	-		No Connect
41	NC	-		No Connect
42	JPD0	-		Connect pull down of 1 K Ohms
43	JPD1	-		Connect pull down of 1 K Ohms
44	JPD2	-		Connect pull down of 1 K Ohms
45	JNC	-		No connect
46	VIN33	Power		3.3V Power supply, Recommend connecting these pins to a copper fill with bypassed capacitors as indicated in reference

Pin No.	Pin Name	Direction	Type	Description
				schematics. 10mV pk-pk maximum noise allowed.
47	VIN33	Power		3.3V Power supply, Recommend connecting these pins to a copper fill with bypassed capacitors as indicated in reference schematics. 10mV pk-pk maximum noise allowed.
48	GND	Ground		Ground. Connect all the GND pins directly to a ground plane or copper ground fill
49	NC	-		No connect
50	NC	-		No connect
51	SPI_CLK	Input	LVCMOS	SPI Clock input. In UART mode, should be pulled down with resistor (1K to 10K Ohms)
52	SPI_CS	Input	LVCMOS 8mA	Active low SPI Chip Select. In UART mode, should be pulled down with resistor (1K to 10K Ohms)

Table 1: Pin Description

Notes:

Some interfaces are not used in the default configuration or mode of operation. These may be used in custom applications with appropriate firmware.

Please contact Redpine Signals for application notes or for customization of a solution.

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Absolute maximum ratings in the table given below are the values beyond which the device could be damaged. Functional operation at these conditions or beyond these conditions is not guaranteed.

Parameter	Symbol	Value	Units
Input Supply voltage	Vin	3.6	V
Supply voltage for I/O Rail	DVDD33	3.6	V
Supply Voltage for the RF	VRF33	3.6	V
RF Input Level	RFIN	10	dBm
Storage temperature	T_{store}	-65 to 150	°C
Electrostatic discharge tolerance (HBM)	ESD_{HBM}	2000	V
Electrostatic discharge tolerance (MM)	ESD_{MM}	200	V
Electrostatic discharge tolerance (CDM)	ESD_{CDM}	500	V

Table 2: Absolute Maximum Ratings

4.2 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
Input Supply voltage	V_{IN}	3.1	3.3	3.6	V
Ambient temperature	T_a	-40	25	85	°C

Table 3: Recommended Operating Conditions

4.3 DC Characteristics – Digital I/O Signals

Parameter	Min.	Typ.	Max.	Units
Input high voltage	2	-	3.6	V
Input low voltage	-0.3	-	0.8	V
Output low voltage	-	-	0.4	V
Output high voltage	2.4	-	-	V
Input leakage current (at 3.3V or 0V)	-	-	±10	µA
Tristate output leakage current (at 3.3V or 0V)	-	-	±10	µA

Table 4: Input/Output DC Characteristics

4.4 AC Characteristics – Digital I/O Signals

4.4.1 SPI Interface

Parameter	Symbol	Min.	Typ.	Max.	Units
SPI_CLK Frequency	Fspi	0		25	MHz
SPI_CS to output valid	Tcs	3.5	-	7.5	ns
SPI CS setup time	Tcst	2	-		ns
SPI_MOSI setup time	Tsd	1	-		ns
SPI_MOSI hold time	Thd	1.5	-		ns
SPI_MISO clock to output valid	Tod	4	-	9.25	ns

Table 5: AC Characteristics – SPI Interface

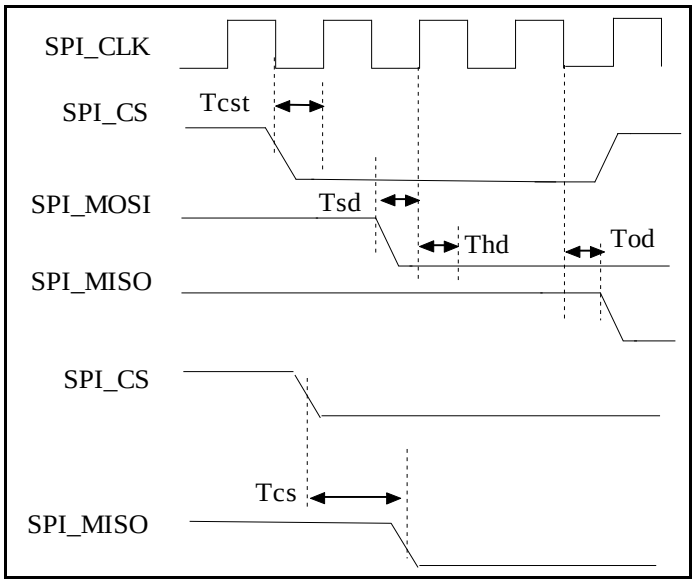

Figure 7:Interface Timings – SPI Interface

4.4.2 Reset Sequence and Timing

Following diagram shows the timing requirement for Reset_n input in two scenarios. This timing is valid for both UART and SPI based modules. The crystal oscillator output should be stable before releasing reset.

A. Powerup
B. Giving hard reset during module operation

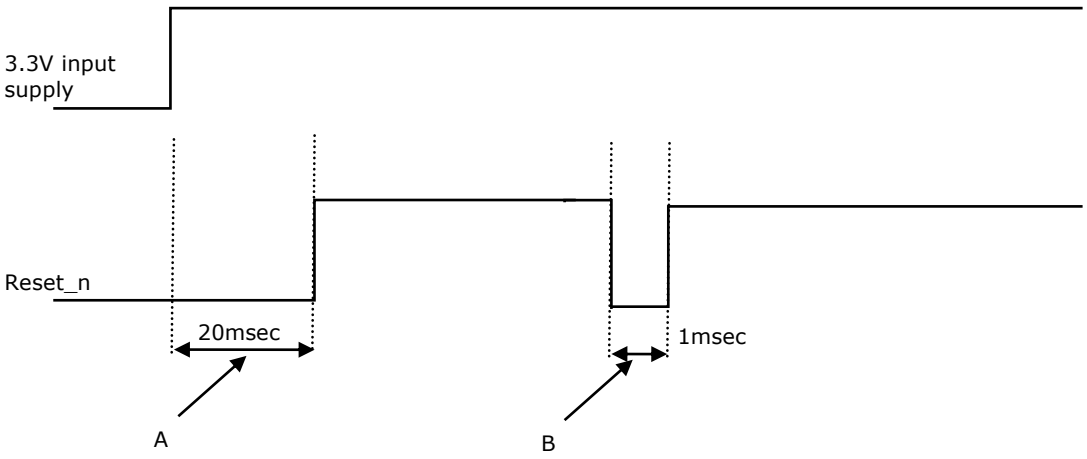

Figure 8:Reset Pin Timing Diagram

5 Performance Specifications

5.1 Wireless Specifications

Feature	Description
Frequency Band	2.400 – 2.500 GHz (2.4 GHz ISM band)
Modulation	OFDM with BPSK, QPSK, 16-QAM, and 64-QAM 802.11b with CCK and DSSS
Supported Data Rates	802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11b: 1, 2, 5.5, 11 Mbps
802.11n Features	MCS 0-7, STBC, RIFS, Greenfield Protection A-MPDU, A-MSDU Aggregation with Block-ack
Typical Transmit Power (+/- 2 dBm)	17 dBm for 802.11b DSSS 17 dBm for 802.11b CCK 15 dBm for 802.11g/n OFDM

Table 6: Wireless Specifications

5.2 Receive Characteristics

5.2.1 Sensitivity

Data Rate	Typical Sensitivity (+/- 1.5 dBm)	Sweep – PER Floor
1 Mbps	-97.0 dBm	< 0.1%
2 Mbps	-93.0 dBm	< 0.1%
11 Mbps	-88.0 dBm	< 0.1%
6 Mbps	-91.0 dBm	< 0.1%
54 Mbps	-75.0 dBm	< 0.1%
65 Mbps	-71.0 dBm	< 0.1%

Table 7: Receive Characteristics – Sensitivity

5.3 Range

Range varies with the conditions under with wireless communication is sought. For large office environments, in the presence of obstacles, a range of over 30 metres is observed, while in open, line-of-sight environments, over 300 metres is observed, with several Mbps throughput in both cases.

5.4 Standards Compliance

RS9110-N-11-21 is compliant with the requirements of IEEE 802.11b, 802.11g and 802.11n that include the following:

Transmit Spectral Mask

Transmit Center Frequency Leakage

Transmit Center Frequency Accuracy

Symbol Clock Frequency Tolerance

Transmit Constellation error

Receiver Adjacent Channel Interference Rejection

Receiver Non-adjacent Channel Rejection

Receiver Minimum Input Level

Receiver Maximum Input Level

6 Software Architecture Overview

The following figure depicts the software architecture of the RS9110-N-11-21 module.

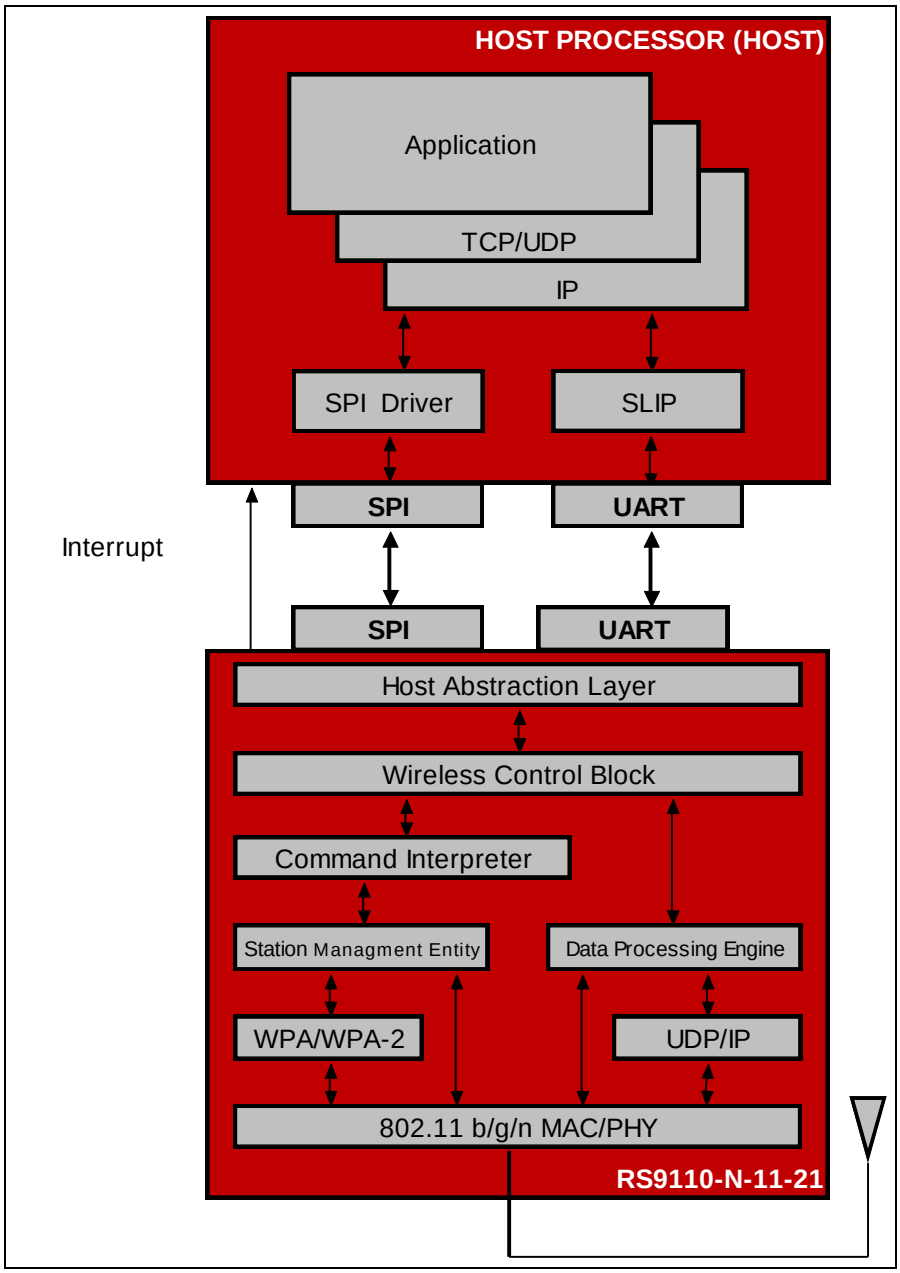

Figure 9:RS9110-N-11-21 Software Architecture Block Diagram

As shown in the figure above, the RS9110-N-11-21 module is integrated with the Host using either UART or SPI interfaces. The transmission and reception of the data to/from the Host depends on the interface used to connect the module as briefed below.

UART mode

The Host should transmit/receive IP packets using SLIP protocol when RS9110-N-11-21 is configured for UART mode.

SPI mode

Host should transmit/receive 802.3 packets when RS9110-N-11-21 is configured for SPI mode. A thin driver on the Host takes care of interacting with the Wi-Fi module through the SPI Host interface.

The following sections explain in brief the various components illustrated in Figure 9.

6.1 Host

The Host is any system that has a full-fledged TCP/IP stack and either a UART or SPI interface.

6.1.1 SLIP

The SLIP (Serial Line Internet Protocol) layer on the Host establishes a point-to-point serial network link with the RS9110-N-11-21 module. This helps to carry the IP data over the serial port to the RS9110-N-11-21. Host transmits/receives the IP packet to/from the module. The Host must have the support for SLIP interface configuration to interact with RS9110-N-11-21 module in UART mode.

6.1.2 UART

The UART on the Host side acts as the physical layer of the TCP/IP stack carrying SLIP-encapsulated frames. The UART is also used to configure various parameters and operate RS9110-N-11-21.

6.1.3 SPI

The SPI on the Host side acts as the physical layer of the TCP/IP stack carrying Wi-Fi specific frames. SPI on the Host acts as the master.

6.1.4 Thin SPI Driver

The SPI driver on the Host is a thin network driver through which the TCP/IP stack interacts with the Wi-Fi module. The driver uses the SPI host controller driver on the Host to send/receive the data to/from the RS9110-N-11-21 module over the SPI interface.

6.2 RS9110-N-11-21

The RS9110-N-11-21 module incorporates all Wi-Fi functionality to act as a serial to Wi-Fi Bridge. It handles all the wireless network connectivity. The following sections describe the software components of the RS9110-N-11-21 module in brief.

6.2.1 SPI

The SPI on the RS9110-N-11-21 acts the SPI slave. It is a standard 4-wire SPI and can support a maximum frequency of 25MHz.

6.2.2 UART

The UART on the RS9110-N-11-21 module is the physical layer which transmits/receives the data from the Host. It supports variable baud rates from 9600 to 3686400 bps. There is support for AT commands to configure and operate the module through UART interface.

6.2.3 Host Abstraction Layer (HAL)

The HAL abstracts the lower layers in the host interface with which the RS9110-N-11-21 module is connected. The HAL interacts with the Wireless Control Block layer for the processing of the frames obtained from or destined to the Host.

6.2.4 Wireless Control Block (WCB)

The data from/to the Host is classified as a control frame, an IP/802.3 frame or an application data frame. The WCB layer processes the frame obtained and acts accordingly. The functionality of the WCB module depends on the type of the frame, direction of the frame and the mode on which RS9110-N-11-21 is configured (UART or SPI) as described below.

Transmit Direction

In the transmit direction, the WCB layer either interacts with the AT command interpreter or the data processing engine depending on the type of the frame.

UART Mode: In UART mode, the WCB module receives SLIP-encapsulated data/control frames from the Host in the transmit path.

SPI Mode: In SPI mode, the WCB module receives data/control frames from the Host in the transmit path.

Receive Direction

In the receive direction, the WCB layer interacts with the HAL to transmit frames to the Host.

UART Mode: In UART mode, the WCB module receives SLIP-encapsulated data/response frames from the Station Management Entity or the Data Processing Engine in the receive path.

SPI Mode: In SPI mode, the WCB module receives data/response frames from the Station Management Entity or the Data Processing Engine in the receive path.

6.2.5 Command Interpreter

The control information from the Host is interpreted by the AT command interpreter. The AT command interpreter sets or gets the values of various configurable parameters for providing the Wi-Fi access.

6.2.6 Station Management Entity (SME)

The SME is the core layer which manages the Wi-Fi connectivity. The SME maintains the state machine to detect the activity on the Wi-Fi network and indicates to the user accordingly. It also performs re-association to the

configured access point in Infrastructure mode. It interacts with the WPA supplicant if Security is enabled in the Wi-Fi network.

6.2.7 WPA Supplicant

The WPA supplicant is used to initiate the 802.1x/EAP authentication if WPA/WPA2-PSK is used as the security parameter. It also plays a major part in performing the 4-way handshake to derive the PTK in WPA/WPA2-PSK modes.

6.2.8 Data Processing Engine (DPE)

The DPE processes data obtained from the Host or from the network. The functioning of the DPE depends on the direction and type of the frame.

If the frame obtained from the Host is an IP packet, then the packet is delivered to the ARP layer for the ARP resolution to be done.

If the frame is obtained from the network, the DPE encapsulates the data using the SLIP protocol before delivering the packet to the Host over the UART.

7 Ordering Information

7.1 Contact Information

For additional information, please contact Sales at Redpine Signals, Inc.

Redpine Signals, Inc.

2107 North First Street, Suite 680,

San Jose, CA 95131 USA

Phone: +1 408 748 3385

E-mail: sales@redpinesignals.com

Website: http://www.redpinesignals.com/

7.2 Device Ordering Information

The following table lists the part numbers to be used for ordering modules or evaluation boards (EVB).

Device Number	Description	Packaging	Qualification
RS9110-N-11-21-0	Part with UART as Host Interface	Tray	-40°C to +80°C
RS9110-N-11-21-01-0	Part with firmware for SPI as Host Interface	Tray	-40°C to +80°C
RS9110-N-11-21-02-0	Part with UART as Host Interface and external antenna connector	Tray	-40°C to +80°C
RS9110-N-11-21-03-0	Part with SPI as Host Interface and external antenna connector	Tray	-40°C to +80°C
RS9110-N-11-21-EVB	Evaluation board for part with UART as Host interface	Board	
RS9110-N-11-21-01-EVB	Evaluation board for part with SPI interface	Board	
RS9110-N-11-21-02-EVB	Evaluation board for part with UART as Host interface and with	Board	

	external antenna connector		
RS9110-N-11-21-03-EVB	Evaluation board for part with SPI as Host Interface and external antenna connector	Board	

Table 8: Device Ordering Information

7.3 Collateral

The following documentation and software are available along with the RS9110-N-11-21 module/Evaluation Board (EVB).

i. Embedded firmware for WLAN
ii. Programming Reference Manual
iii. Reference SPI driver
iv. Reference schematics and layout guidelines
v. EVB User Guide

8 Command Reference (AT commands and SPI commands)

AT Command Set (for UART interface) and SPI command set (for SPI interface) supports the following in RS9110-N-11-XX module. This is an indicative list and not a full list. Full list of commands available in Programming Reference Manual.

vi. Configure the band to 2.4GHz
vii. Initialize MAC and Baseband
viii. Scan for avialable networks
ix. Join an available network in infrastructure or ad-hoc modes
x. Configure IP addresses
xi. Open and close TCP and UDP sockets
xii. Send and receive data

***