深圳市四季宏胜科技有限公司
SHENZHEN INVINCIBLE FOUR SEASON TECHNOLOGY CO., LTD.

PAI-053 Module Spec

Version：20220120

Contents

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PAI-053 is a low-power embedded Wi-Fi module that POWER7 has developed. It consists of a highly integrated RF chip (BL2028N), a few peripherals, an embedded Wi-Fi network protocol stack, and rich library functions.

1 Overview

PAI-053 not only supports the AP and STA dual-network-connection manner but sup-ports the Bluetooth LE network connection manner.

It has a 32-bit MCU with a running speed of up to 120 MHz, 2Mbyte flash, and 256-KB RAM, so as to support the multi-cloud connection. The three 32-bit PWM output makes the chip very suitable for high-quality IOT control.

1.1 Features

- Embedded low-power 32-bit CPU, which can also function as an application processor
- The clock rate: 120 MHz
- Operating voltage: 3.0V to 3.6V
- Wi-Fi connectivity
  - 802.11 b/g/n
  - Channels 1-11@2.4GHz
  - Support WEP,WPA/WPA2,WPA/WPA2 PSK (AES) security modes
  - Up to + 16 dBm output power in 802.11b mode
  - Support STA/AP/STA+AP working mode
  - Support SmartConfig and AP network configuration manners for Android and iOS devices
  - Operating temperature：-30℃ to 75℃
- Bluetooth LE connectivity
  - 6 dBm transmit power in bluetooth mode
  - Complete bluetooth coexistence interface

1.2 Applications

- Intelligent building
- Smart household and home appliances
- Smart socket and light
- Industrial wireless control

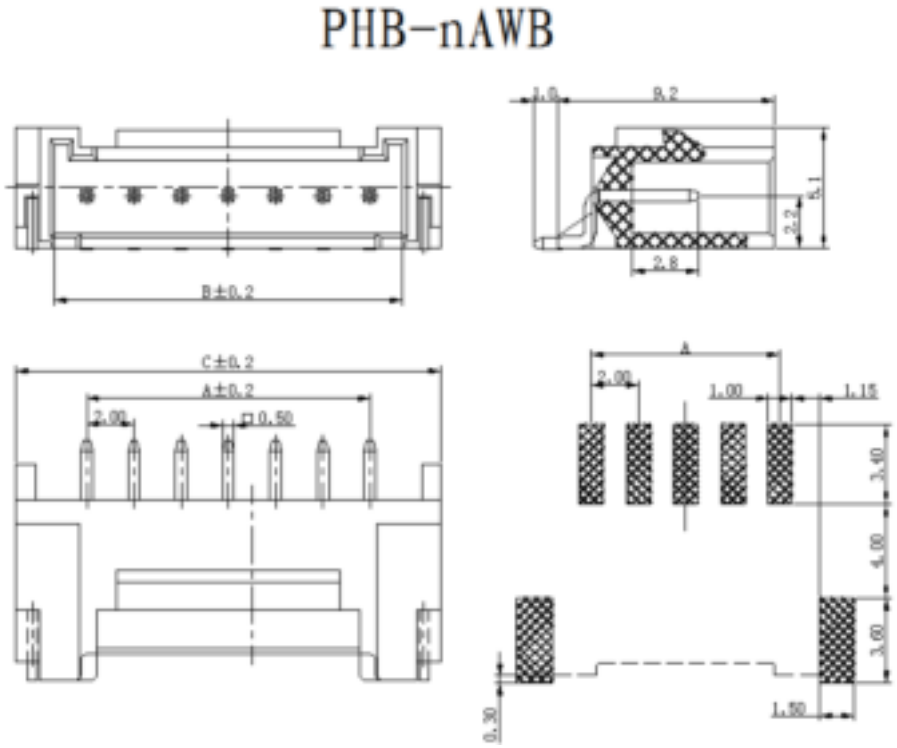
1.3Change history

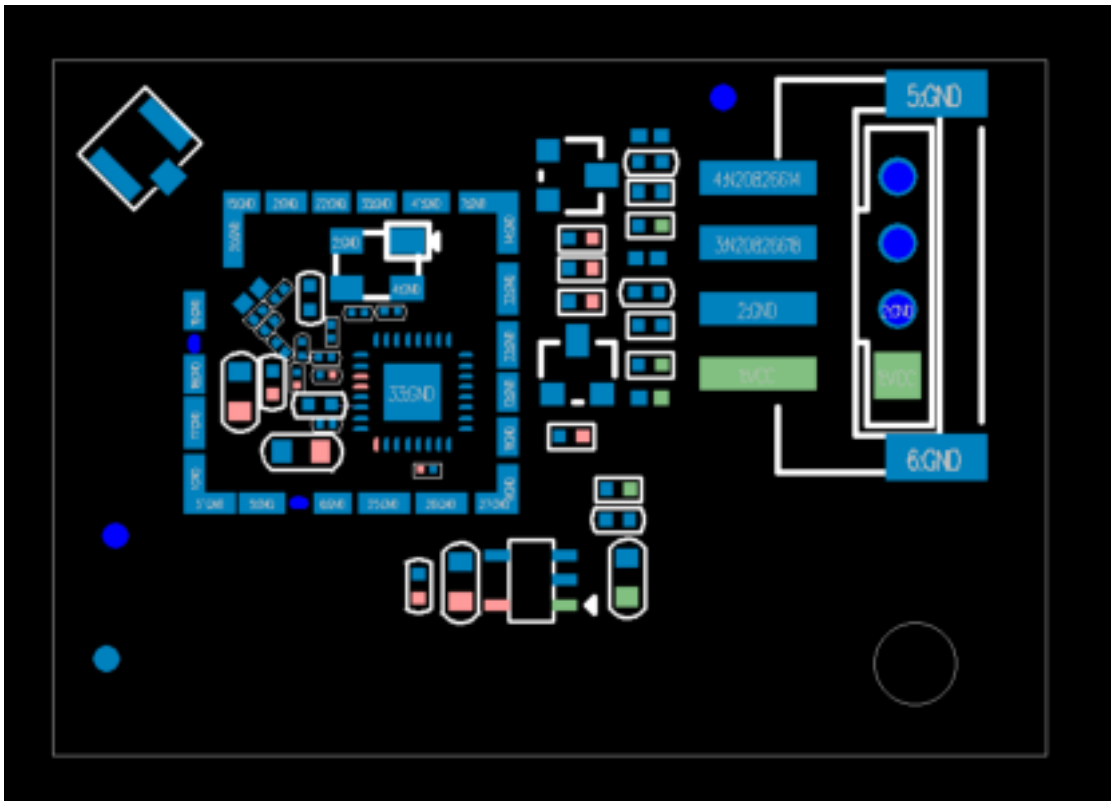
Update date	Updated content	Version after update
20220114	This is the first release	V1.0
20220119	Updated transmit power limit	V1.1

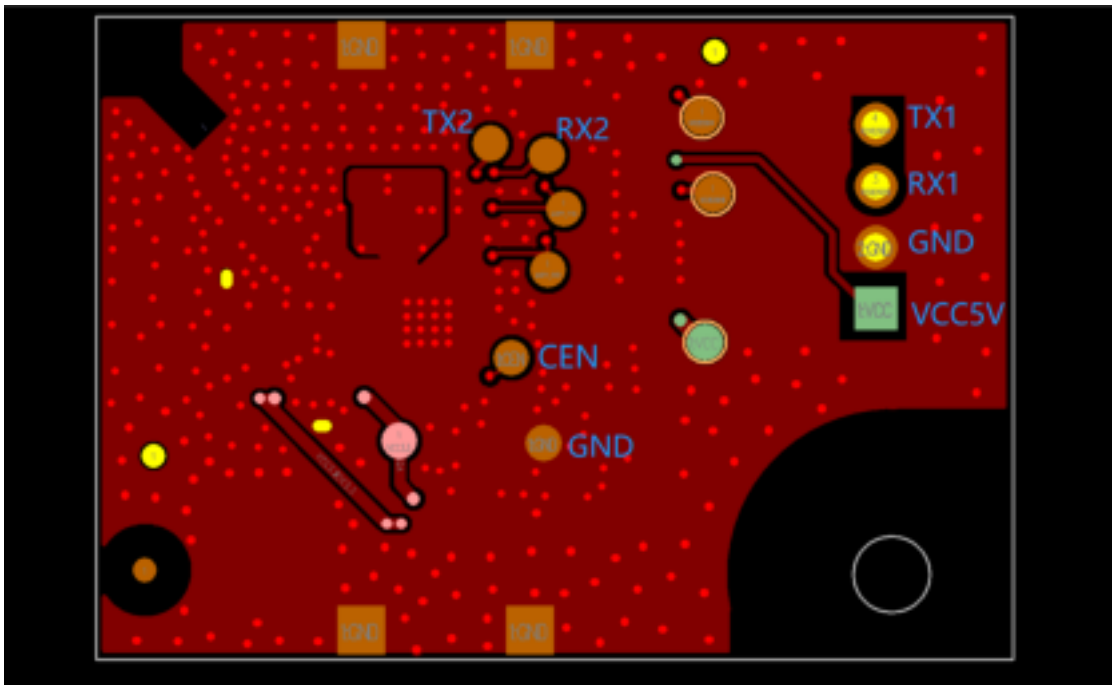
2 Module interfaces

2.1 Dimensions and package

The PAI-051 dimensions are：27±0.35mm (W)×38±0.35mm (L) ×4.5±0.15mm (H)(plastic+PCBA)。







2.2 Pin definition

Pin number	Symbol	IO type	Function
1	TX1	I/O	UART1_TX
2	RX1	I/O	UART1_RX

3	GND	P	Ground pin
4	VCC5V	P	Power supply pin
5	CEN	I	RST PIN
6	TX2	I/O	UART2_TX
7	RX2	I/O	UART2_RX

3 电气参数

3 Electrical parameters

3.1 Absolute electrical parameters

Parameter	Description	Minimum value	Maximum value	Unit
TS	Storage	-40	85	℃
VCC	Power supply	-0.3	6	V

3.2 Normal working conditions

Parameter	Description	Minimum	Typical	Maximum	Unit

		value	value	value	
TA	Operating temperature	-30		75	℃
VCC	Power supply voltage	4.5	5	5.5	V
VOL	I/O low level output	VSS		VSS+0.3	V
VOH	I/O high level output		3.3		V
Imax	I/O drive current		6	20	mA

3.3 RF power consumption

Working status	conditions	MIN	Typ	Max	Unit
Transmit	18dBm, 802.11b 11 Mbps		135		mA
Transmit	15 dBm, 802.11g 54 Mbps		120		mA
Receive	-10 dBm Input、802.11b 11 Mbps		35		mA
Receive	-10 dBm Input、802.11g 54 Mbps		40		mA
Normal standby current	The MCU stops running and the Modem is powered off. Procedure		30		uA
Low voltage standby current	MCU stops and enters low voltage		10		uA
Deep sleep current	All main logic is powered off, only AON counter is active		5		uA
Shut off the current	CEN=0		1		uA
Note: All measurements are made at room temperature and 5V voltage					

4 RF parameters

4.1 Basic RF features

Parameter	Description
Working frequency	2.412~2.462GHz
Wi-Fi standard	IEEE 802.11b/g/n(1-11 Channel)
Data transmission rate	11b:1,2,5.5,11(Mbps) 11g：6，9，12，18，24，36，48，56(Mbps) 11n:HT20 MCS0~MCS7
Antenna type	External antenna

4.2 Wi-Fi transmission performance

Parameter	MIN	TYP	MAX	Unit
802.11B 1M		18		dBm
802.11B 5.5M		18		dBm
802.11B 11M		18		dBm
802.11G 6M		15		dBm
802.11G 24M		15		dBm
802.11G 54M		15		dBm
802.11N MCS0		14		dBm
802.11N MCS4		14		dBm
802.11N MCS7		14		dBm
EVM@11Mbps,802.11b		-21	-19	dB
EVM@54Mbps,802.11g		-30	-27	dB
EVM@HT20,MCS7,802.11n		-31	-29	dB
The frequency error	-15		15	ppm

4.3 Wi-Fi receiving performance

Parameter	MIN	TYP	MAX	Unit
PER≤5%@802.11B 11M		-85		dBm
PER≤5%802.11G 54M		-73		dBm
PER≤5%802.11N MCS7		-69		dBm
LE_Receiver_Sensitivity		-92		dBm

4.3 Wi-Fi receiving performance

Parameter	MIN	TYP	MAX	Unit
PER≤5%@802.11B 11M		-85		dBm
PER≤5%802.11G 54M		-73		dBm
PER≤5%802.11N MCS7		-69		dBm
LE_Receiver_Sensitivity		-92		dBm

4.4 Bluetooth transmission performance

Parameter	MIN	TYP	MAX	Unit
Working frequency	2402		2480	MHz
Air rate		1		Mbps
Frequency error	-150		150	KHz

4.5 Bluetooth receiving performance

Parameter	MIN	TYP	MAX	Unit
RX sensitivity		-96		dBm
Maximum RF signal input	-10			dBm
Inter-modulation			-23	dBm
Co-channel suppression ratio		10		db

5 Antenna

5.1 Antenna type

PAI-053 Design for external antenna parameters as follows

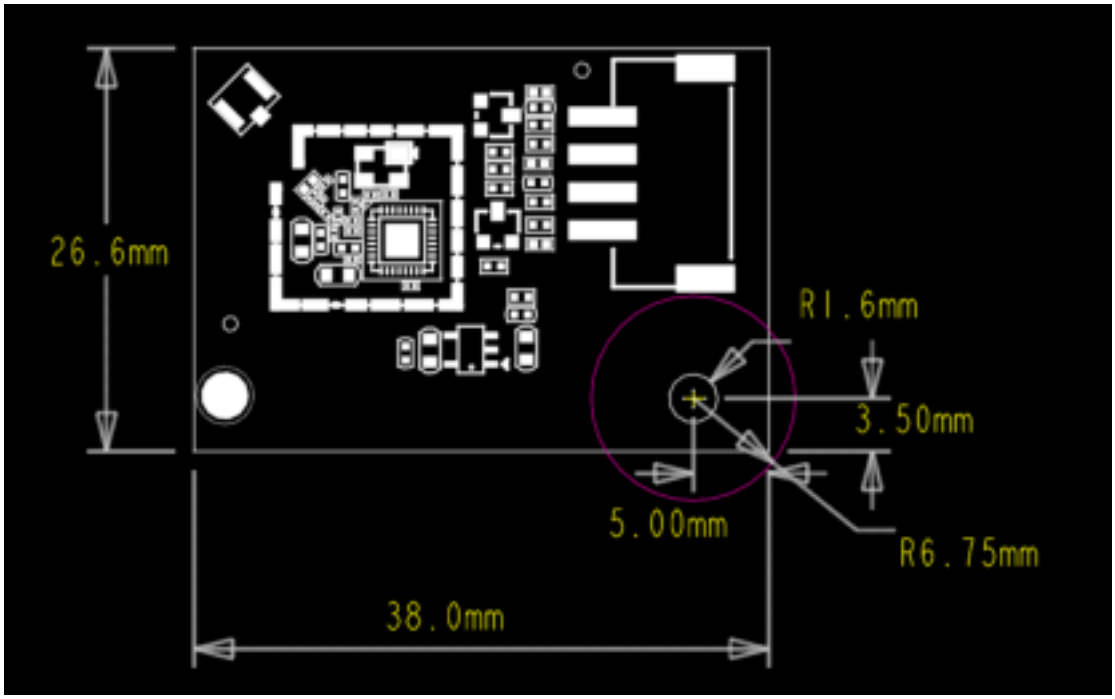
Parameter	MIN	TYP	MAX	Unit
Frequency	2400		2500	MHz
Impedance		50		Ω
VSWR			2.0	
Gain	2.5±0.5dBi			
Efficiency	60%-70%			

5.2 Antenna interference reduction

To ensure optimal Wi-Fi performance, it is recommended that the antenna be at least 15 mm away from other metal parts. To prevent an adverse impact on the antenna radiation performance, avoid copper or traces within the antenna area.

6 Packaging information and production instructions

6.1 Mechanical dimensions



6.2 Production guide

1.It is recommended to use wave soldering equipment for welding of the outgoing direct insert modules, and only use manual welding when wave welding equipment cannot be used for welding. After unpacking, welding is recommended to be completed within 24 hours, otherwise, it should be placed in a drying cabinet with humidity less than 10%RH, or vacuum packaging should be conducted again and the exposure time should be recorded. The total exposure time should not exceed 168 h.

2.Equipment and materials required for welding

- Wave soldering equipment
- Wave soldering fixture
- Thermostat soldering iron
- Tin strip, tin wire, flux
- Furnace temperature tester

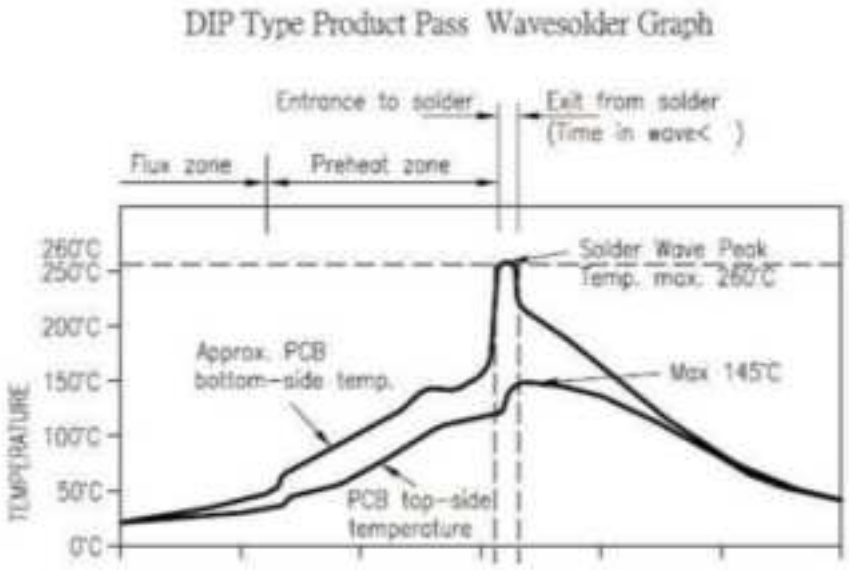
Instruments or equipment needed for baking

• Cabinet type baking box

• Anti-static high temperature tray

• Esd gloves and high temperature gloves

6.3 Recommended furnace temperature curves and temperature recommendations



6.4 Storage conditions

• Moisture-proof bag vacuum packaging stored in the temperature < 40 ° C, humidity < 90%RH environment.

• The shelf life of dry-packed products is 12 months from the date of sealing of the package.

• Humidity indicator card in sealed package:

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7 Module and packaging information

1Modular packaging

Product model	Each Box number（pcs）	Shipping packing method	Number of disks stored in each disk	Number of packing plates per carton
PAI-053	860	Blister tray	40	20

8 List of applicable FCC rules

FCC Part 15.247

8.1 RF exposure considerations

This equipment complies with the FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and any part of your body.

8.2 Label and compliance information

FCC ID label on the final system must be labeled with “Contains FCC ID: 2A3SYMBL02” or “Contains transmitter module FCC ID: 2A3SYMBL02”.

8.3 Information on test modes and additional testing requirements

Contact Hesung Innovation Limited will provide stand-alone modular transmitter test mode. Additional testing and certification may be necessary when multiple modules are used in a host.

8.4 Additional testing, Part 15 Subpart B disclaimer

To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Supplier’s Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements. Since this may depend on the details of how the module is integrated with the host, Hesung Innovation Limited shall provide guidance to the host manufacturer for compliance with the Part 15B requirements.

FCC Warning

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.

NOTE 1: Any changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance.

Note 1: This module certified that complies with RF exposure requirement under mobile or fixed condition, this module is to be installed only in mobile or fixed applications.

A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

A fixed device is defined as a device is physically secured at one location and is not able to be easily moved to another location.

Note 2: Any modifications made to the module will void the Grant of Certification, this module is limited to OEM installation only and must not be sold to end-users, end-user has no manual instructions to remove or install the device, only software or operating procedure shall be placed in the end-user operating manual of final products.

Note 3: The module may be operated only with the antenna with which it is authorized. Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator.

Note 4: 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.