PAN9320

Fully Embedded Stand-Alone Wi-Fi Module

Product Specification

Rev. 1.3

Overview

The PAN9320 is a 2.4 GHz ISM band
Wi-Fi-embedded module which includes a wireless
radio and an MCU for easy integration of
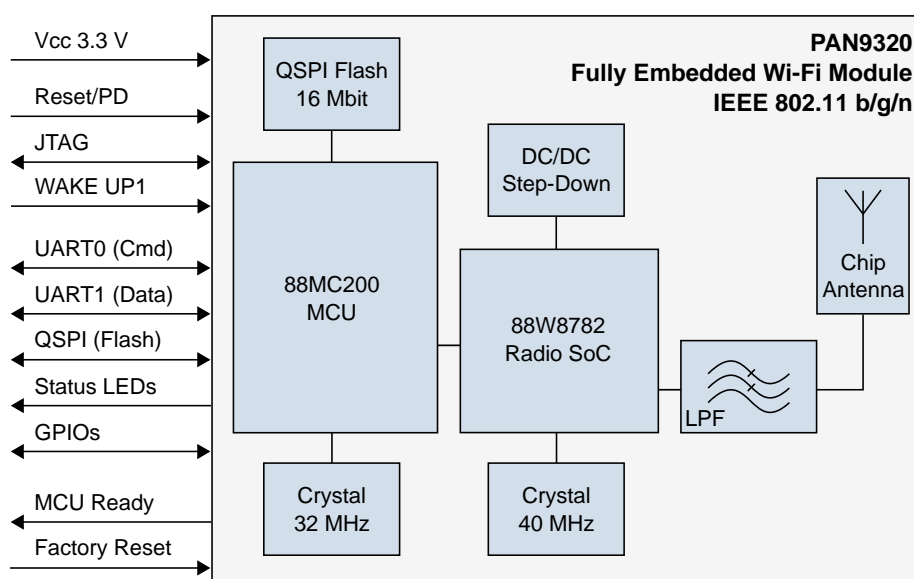Wi-Fi connectivity into various electronic devices.

Features

- Fully embedded: integrated full-featured network stack
- Contains all necessary IoT functionality (Place & Play)
- Integrated webserver with AJAX/JSON for web applications
- No stack or software implementation needed on a host MCU
- Simultaneous support of Access-Point & Infra-structure mode
- Fully automatical IP configuration
- DHCP server offers IP configuration in AP mode
- Access by names (http://yourdevice)
- Integrated TCP/IP network stack: IPv4, ARP, and AutoIP
- Supports TLS/SSL, https, and Wi-Fi security (WPA2) for secure data connection
- Over-the-Air firmware update
- Two UART interfaces (command and transparent data)

- Integrated QSPI flash memory for customer web contents and configuration file (externally extendable with additional 2 MByte)
- Coexistence interface for external co-located 2.4 GHz radios (e. g. Bluetooth)
- Programming via standard JTAG
- Evaluation Kit with pre-installed web application for quick prototyping available
- Evaluation and development tool WiFigurator for Windows
- Getting started tutorials, PC tool, quickstart guide
- Wide temperature range of -30 °C to 70 °C
- FCC-/IC-/CE-certified

Characteristics

- Surface Mount Type (SMT) 29.0 mm x 13.5 mm x 2.66 mm
- Marvell® 88W8782 WLAN System-on-Chip (SoC) and 88MC200 (MCU) inside
- Tx power up to +18 dBm @ IEEE 802.11b
- Rx sensitivity of -98 dBm @ IEEE 802.11b DSSS 1 Mbps
- 40 MHz channels up to 150 Mbps
- Power supply 3.0 to 3.6 V
- Current consumption 430 mA (Tx @ 11b, 11 Mbps) and 145 mA Rx
- Low power mode available

Block Diagram

Engineering Samples (ES)

If Engineering Samples are delivered to the customer, these samples have the status "Engineering Samples". This means that the design of this product is not yet concluded. Engineering Samples may be partially or fully functional, and they may differ from the published Product Specification.

Engineering Samples are not qualified and they are not to be used for reliability testing or series production.

Disclaimer

The customer acknowledges that samples may deviate from the Product Specification and may bear defects due to their status of development and the lack of qualification mentioned above.

Panasonic rejects any liability or product warranty for Engineering Samples. In particular, Panasonic disclaims liability for damages caused by:

- The use of the Engineering Sample other than for evaluation purposes, particularly the installation or integration in another product to be sold by the customer,
- Deviation or lapse in function of the Engineering Sample,
- Improper use of the Engineering Sample.

Panasonic Industrial Devices Europe GmbH disclaims any liability for consequential and incidental damages. In case of any queries regarding the Engineering Samples, please contact your local sales partner or the related product manager.

Table of Contents

1 About This Document

1.1 Purpose and Audience

This Product Specification provides details on the functional, operational, and electrical characteristics of the Panasonic PAN9310 and PAN9320 modules. It is intended for hardware design, application, and Original Equipment Manufacturers (OEM) engineers. The product is referred to as "the PAN9320" or "the module" within this document.

1.2 Revision History

Revision	Date	Modifications/Remarks
0.1	22.04.2015	1st preliminary version
1.0	26.11.2015	Panasonic code edited by adding model ENW49A02x3EF
		Information edited in the following chapters: 1.4 Related Documents, 2.1 Key Features, 7 WLAN Overview, 2 Overview, 10 Detailed Description, 3.6 General Features, 2.1 Block Diagram, 4.3.7 Host Interface Specification, 4.5 RF Electrical Characteristics, 3.1 Dimensions, 3.2 Footprint, 3.4 Case Marking, and 7.1 Ordering Information
		Chapters added: 2.4 Peripheral Bus Interface, 4.3.4 Power Up Sequence, 4.3.5 Firmware-Related Timing, 29 Software Versions, and 5.4 Regulatory Information
1.1	14.03.2016	Information edited in chapter 6.1.6 RF Exposure
1.2	09.06.2017	New document structure and layout
		Chapters removed: Data Sheet Status, Wireless Local Area Network Overview, Key Parts List, General Features, Software Versions
1.3	XX.XX.XXXX	European Conformity (according to RED) information edited
		Firmware description added

1.3 Use of Symbols

Symbol	Description
	Note Indicates important information for the proper use of the product. Non-observance can lead to errors.
	Attention Indicates important notes that, if not observed, can put the product's functionality at risk.
⇨ [chapter number] [chapter title]	**Cross reference** Indicates cross references within the document. **Example:** Description of the symbols used in this document ⇨ 1.3 Use of Symbols.

1.4 Related Documents

Please refer to the Panasonic website for related documents ⇨ 7.2.2 Product Information.

2 Overview

The PAN9320 is a 2.4 GHz 802.11 b/g/n embedded Wi-Fi module with integrated stack and API that minimizes firmware development and includes a full security suite. The module is specifically designed for highly integrated and cost-effective applications. The module includes a fully shielded case, integrated crystal oscillators, and a chip antenna.

The module combines a high-performance CPU, high sensitivity wireless radio, baseband processor, medium access controller, encryption unit, boot ROM with patching capability, internal SRAM, and in-system programmable flash memory. The module's integrated memory is available to the application for storing web content such as HTML pages or image data.

Parallel support of access point and infrastructure mode allows easy setup of simultaneous Wi-Fi connections from the module to smart devices and home network routers.

The pre-programmed Wi-Fi SoC firmware enables client (STA) and micro access point (µAP) applications. With the transparent mode, raw data can be sent from the UART to the air interface to smart devices, web servers, or PC applications.

The PAN9320 supports Over-the-Air firmware updates. In order to make use of this feature, the customer needs to ensure that the appropriate preconditions are fulfilled and that a suitable environment is provided, particularly with regard to:

- Module configuration
- Utilization of the related module interface commands
- Server infrastructure and application

Please refer to the Panasonic website for related documents ⇨ 7.2.2 Product Information.

Further information on the variants and versions ⇨ 7.1 Ordering Information.

2.1 Block Diagram

PAN9320
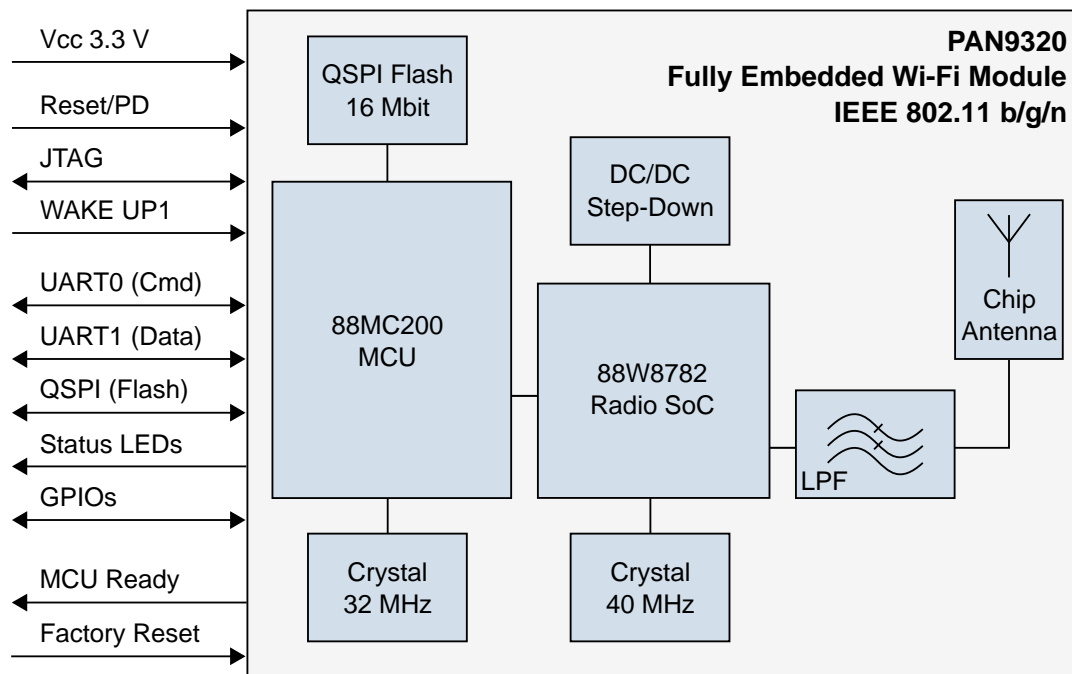
PAN9310
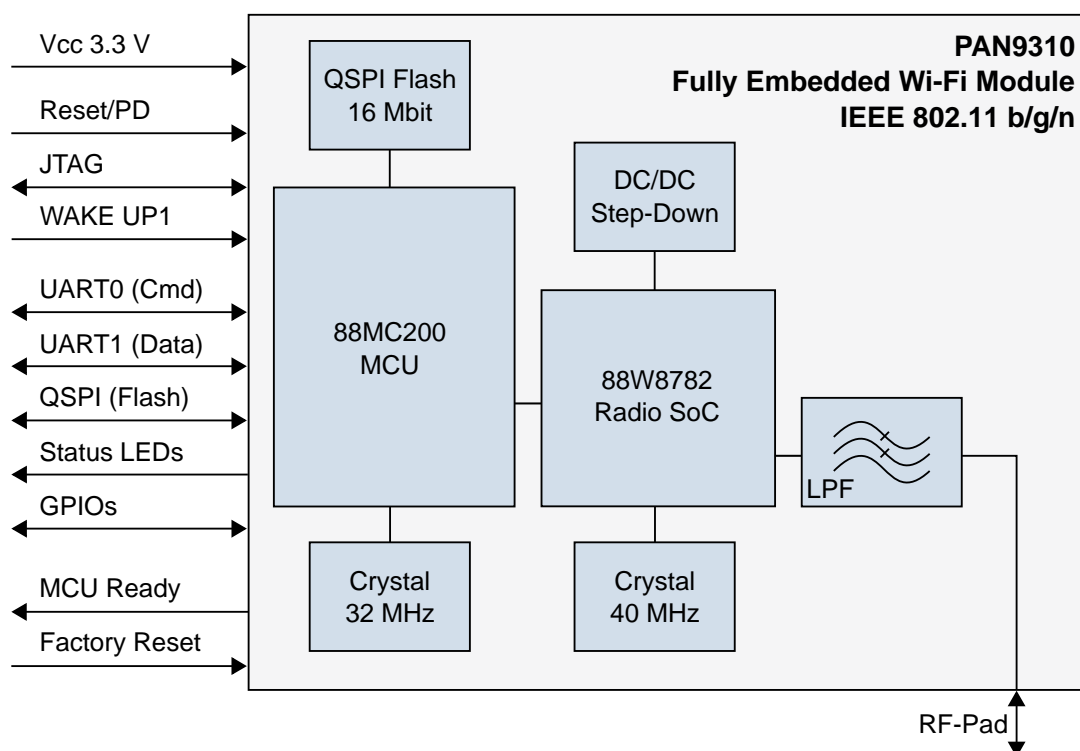
2.2 Pin Configuration

Pin Assignment

Top View
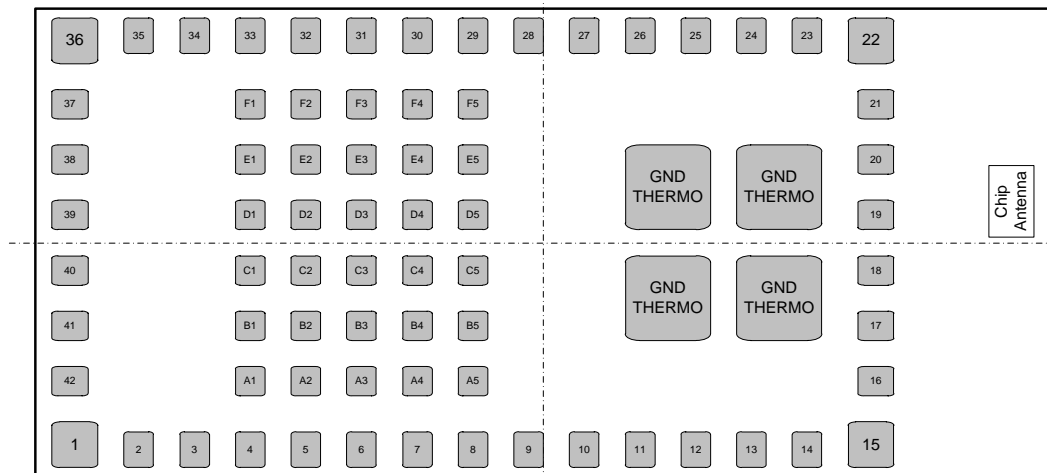
Pin Functions

No	Pin Name	Pin Type	Description
1	GND	Ground Pin	Connect to ground
2	GPIO44[1]	Digital I/O	Digital I/O #44
3	GPIO45[1]	Digital I/O	Digital I/O #45
4	USB AVDD 33	Power	Do not connect, for internal purposes only
5	NC	NC	Do not connect
6	NC	NC	Do not connect
7	3.3 V	Power	3.0 V-3.6 V power supply connection (typical 3.3 V)
8	3.3 V	Power	3.0 V-3.6 V power supply connection (typical 3.3 V)
9	UART1 CTS	Digital In	CTSn for UART1 (using hardware flow control)
10	UART1 RTS	Digital Out	RTSn for UART1 (using hardware flow control)
11	UART1 TXD	Digital Out	TXD for UART1
12	UART1 RXD	Digital In	RXD for UART1
13	QSPI CS2[2]	Digital Out	Chip select external flash (connect for usage of external QSPI flash memory)
14	GND	Ground Pin	Connect to ground

[1] All GPIOs are initially set to output with low level

[2] Only connect, if using an external QSPI flash memory; otherwise do not connect

No	Pin Name	Pin Type	Description
15	GND	Ground Pin	Connect to ground
16	NC/RF	NC/Analog IO	PAN9320: NC PAN9310: RF in/out over 50 Ω bottom pad
17	GND	Ground Pin	Connect to ground
18	GND	Ground Pin	Connect to ground
19	GND	Ground Pin	Connect to ground
20	GND	Ground Pin	Connect to ground
21	GND	Ground Pin	Connect to ground
22	GND	Ground Pin	Connect to ground
23	GND	Ground Pin	Connect to ground
24	GND	Ground Pin	Connect to ground
25	GND	Ground Pin	Connect to ground
26	W STAT LED	Digital Out	Connect to LED wireless (Wi-Fi) status, active low
27	UART0 TXD/DUAL STAT	Digital Out	TXD for UART0/UART1 state (transparent data or command)
28	UART0 RXD/DUAL SW	Digital In	RXD for UART0/UART1 toggle switch for the control of the state
29	GPIO4[1]	Digital I/O	Digital I/O #4
30	GPIO5[1]	Digital I/O	Digital I/O #5
31	GPIO6[1]	Digital I/O	Digital I/O #6
32	GPIO7[1]	Digital I/O	Digital I/O #7
33	STAT LED1	Digital Out	Connect to LED MCU status (heartbeat), active low
34	STAT LED2	Digital Out	Connect to LED IP connectivity (allocated IP), active low
35	STAT LED3	Digital Out	Connect to LED Error (active during booting), active low
36	GND	Ground Pin	Connect to ground
37	RESETn	Digital In	Reset MCU, active low (also option for flashing in production process)
38	WAKE UP0	Digital In	Do not connect, for internal purposes only
39	BOOT	Digital In	Boot option, high level → boot from internal flash memory[3]
40	GPIO28[1]	Digital I/O	Digital I/O #28
41	MCU READY	Digital Out	Connect to LED MCU ready (booting ready), active high
42	FACTORY RESET	Digital In	Factory reset (valid after 10 seconds), active high
A1	NC	NC	Do not connect
A2	NC	NC	Do not connect

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[3] Connect the BOOT pin over a 100 Ohm resistor to V_{CC}

No	Pin Name	Pin Type	Description
A3	NC	NC	Do not connect
A4	NC	NC	Do not connect
A5	NC	NC	Do not connect
B1	NC	NC	Do not connect
B2	BT FREQ	Input Signal	Information BT using channel which either overlaps Wi-Fi channel or not
B3	BT GRANTN	Output Signal	Indicate permission to transmit, low BT can transmit
B4	BT REQ	Input Signal	BT device request access to medium
B5	BT STATE	Input Signal	Information BT_REQ priority (1- or 2-bit) and direction BT RX/TX
C1	NC	NC	Do not connect
C2	NC	NC	Do not connect
C3	WAKE UP1[4]	Digital In	Wake up signal for WLAN SoC (Host-to-SoC), active high[4]
C4	QSPI CLK[2]	Digital Out	Clock for QSPI (connect for usage of external QSPI flash memory)
C5	QSPI D3[2]	Digital I/O	Data3 for QSPI (connect for usage of external QSPI flash memory)
D1	TDI	Digital In	TDI for JTAG (option for flashing in production process)
D2	TRSTn	Digital In	TRSTn for JTAG (option for flashing in production process)
D3	NC	NC	Do not connect
D4	QSPI D0[2]	Digital I/O	Data0 for QSPI (connect for usage of external QSPI flash memory)
D5	QSPI D1[2]	Digital I/O	Data1 for QSPI (connect for usage of external QSPI flash memory)
E1	TDO	Digital Out	TDO for JTAG (option for flashing in production process)
E2	TCK	Digital Out	TCK for JTAG (option for flashing in production process)
E3	TMS	Digital I/O	TMS for JTAG (option for flashing in production process)
E4	QSPI D2[2]	Digital I/O	Data2 for QSPI (connect for usage of external QSPI flash memory)
E5	QSPI CS[2]	Digital Out	Do not connect, for internal purposes only
F1	W PDn	Digital In	Do not connect, for internal purposes only (pull-up resistor internally)
F2	W RESETn	Input Signal	Do not connect, for internal purposes only (pull-up resistor internally)
F3	GND	Ground Pin	Connect to ground
F4	GND	Ground Pin	Connect to ground
F5	GND	Ground Pin	Connect to ground
GND THERMO		Thermal Pin	Connect to ground

[4] Connect to HOST MCU (wake up after shut-off mode, active high), use 10 kOhm resistor to GND at pin

No	Pin Name	Pin Type	Description
	GND THERMO	Thermal Pin	Connect to ground
	GND THERMO	Thermal Pin	Connect to ground
	GND THERMO	Thermal Pin	Connect to ground

2.3 Host Interfaces

UART0 Interface

- 2-wire data transfer (RX, TX)
- Programmable baud rate (300 bps to 1.5 Mbps)
- Data format (LSB first)
- Data bit: (5-8 bit)
- Parity bit: (0-4 bit)
- Stop bit: (1-2 bit)

UART1 Interface

- 4-wire data transfer (RX, TX, RTS, CTS)
- Programmable baud rate (300 bps to 1.5 Mbps)
- Data format (LSB first)
- Data bit: (5-8 bit)
- Parity bit: (0-4 bit)
- Stop bit: (1-2 bit)

Further information ⇨ 4.3.7 Host Interface Specification.

2.4 Peripheral Bus Interface

2.4.1 Embedded WLAN Radio (SoC)

Features	Characteristics
Clocked Serial Unit (CSU)	• 3-Wire, 4-Wire (3W4W) Interface • 2-Wire Serial Interface (TWSI) • 1-Wire Serial Interface

General Purpose I/O (GPIO) Interface	• Defined GPIOs, I/O configured to either input or output
	• GPIO "W STAT LED" with LED output functionality
	  – LED pulse stretching to observe short duration of status events
	  – Two software controlled blink rates to indicate events

2.4.2 Embedded MCU

Features	Characteristics
JTAG	Standard JTAG interface

Quad Serial Peripheral Interface	• Integrated QSPI controller (master) with synchronous serial peripheral for slave device connection
	• Integrated QSPI slave device with allocated firmware range and Web content
	  – 16 Mbit/2 Mbyte (1 Mbyte is reserved for customer Web content)
	  – 256 byte per programmable page with configurable length 1 to 256
	  – Uniform sector erase (4 kB)
	  – Uniform block erase (64 kB)
	  – Erase/Program suspend and resume
	  – Standard/Dual/Quad SPI Support
	  – Flash controller for fetching code or read-only data
	  – 200 Mbps max. serial data rate in quad mode with 50 MHz functional clock
	• Chip Select (CS2) for parallel operation of module internal and external QSPI flash
	• External QSPI slave device can be connected for customer Web content memory extension
	  – Macronix QSPI flash MX25L1633E supported
	  – Maximum 16Mbit/2MByte is supported by firmware

Wake Up	External signal for HOST-to-SoC wake-up after shut-off mode
General-Purpose I/O (GPIO) interface	• Defined GPIOs, I/O configured to either input or output (on/off) • GPIOs with LED status functionality (Ready, Heartbeat, IP-Connectivity, and Error)

Further information ⇨ 4.3.8 Peripheral Interface Specification.

2.5 WLAN Features

Type	Features
IEEE 802.11/ Standards	• 802.11 data rates 1 and 2 Mbps (DSSS) • 802.11b data rates 5.5 and 11 Mbps (CCK) • 802.11g data rates 6, 9, 12, 18, 24, 36, 48, and 54 Mbps (OFDM) • 802.11b/g performance enhancements • 802.11n-compliant with maximum data rates up to 72 Mbps (20 MHz channel) and 150 Mbps (40 MHz channel) • 802.11d international roaming [5] • 802.11i enhanced security (WEP, WPA, WPA2) • 802.11k radio resource measurement [5] • 802.11r fast hand-off for AP roaming [5] • 802.11w protected management frames [5] • Support clients (stations) implementing IEEE Power Save mode
WLAN MAC	• Ad-Hoc [5] and Infrastructure modes • RTS/CTS for operation und DCF • Hardware filtering of 32 multicast addresses and duplicate frame detection for up to 32 unicast addresses • WLAN SoC with TX and RX FIFO for maximum throughput • Open System and Shared Key Authentication services • A-MPDU RX (de-aggregation) and TX (aggregation) • 20/40 MHz channel coexistence • Reduced Inter-Frame Spacing (RIFS) bursting • Management Information Base (MIB) counter • Radio resource measurement counters • Block acknowledgement with 802.11n extensions • Transmit beam former support • Transmit rate adaptation • Transmit power control • Long and short preamble generation on a frame-by-frame basis for 802.11b frames • Marvell® Mobile Hotspot technology (MMH)

[5] Hardware-supported, not implemented in the pre-installed firmware stack

Type	Features
WLAN Baseband	802.11n 1x1 SISO (WLAN SoC with SISO RF radio) - Backward compatibility with legacy 802.11b/g technology - PHY data rates up to 150 Mbps (802.11n - MCS7) 20 MHz bandwidth/channel, 40 MHz bandwidth/channel, upper/lower 20 MHz bandwidth in 40 MHz channel, and 20 MHz duplicate legacy bandwidth in 40 MHz channel mode operation - Modulation and Coding Scheme MCS 0 ~ 7 and MCS 32 (duplicate 6 Mbps) - Radio resource measurement - Optional 802.11n SISO features: – 20/40 MHz coexistence – 1-stream Space-Time-Block-Coding (STBC) reception – Short Guard Interval – RIFS on receive path – Beamformer function and hardware acceleration – Greenfield TX/RX
WLAN Radio	20 and 40 MHz channel bandwidth - Embedded WLAN Radio SoC with the following features: – Direct conversion radio (no SAW filter) – 2.4 GHz TX/RX switch, Power Amplifier (PA) and Low Noise Amplifier (LNA) path – Gain selectable LNAs with optimized noise figure and power consumption – Power Amplifiers with power control – Closed loop power control (0.5 dB step increments) – Optimized TX gain distribution for linearity and noise performance – Fine channel step with AFC (adaptive frequency control)
WLAN Encryption	- Embedded WLAN Radio SoC with the following features: – WEP 64-bit and 128-bit encryption with hardware TKIP processing (WPA) – AES-CCMP hardware implementation as part of 802.11i security standard (WPA2) – Enhanced AES engine performance – AES-Cipher-Based Message Authentication Code (CMAC) as part of the 802.11w security standard[5]

3 Detailed Description

3.1 Dimensions

> ⓘ All dimensions are in millimeters.
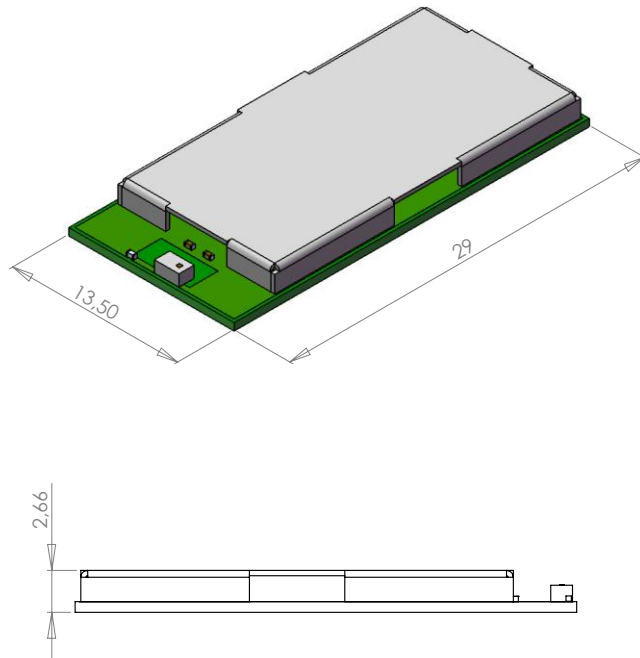
No.	Item	Dimension	Tolerance	Remark
1	Width	13.50	± 0.30	
2	Length	29.00	± 0.30	
3	Height	2.66	± 0.20	With case

3.2 Footprint

> (i) The outer dimensions have a tolerance of ±0.3 mm.

Top View
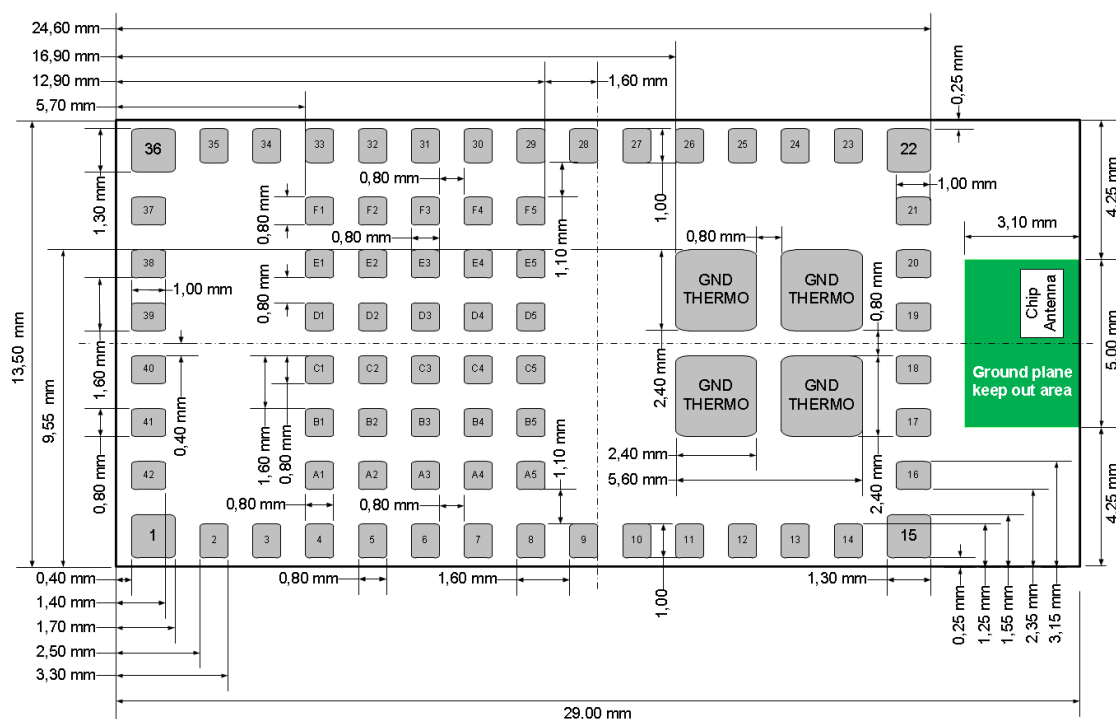
3.3   Packaging

The product is a mass production status product and will be delivered in the package described below.

3.3.1   Tape Dimensions

Ao	14.30 +/- 0.10
Bo	29.80 +/- 0.10
Ko	2.80 +/- 0.10
F	20.20 +/- 0.15
P1	20.00 +/- 0.10
So	40.40 +/- 0.10
W	44.00 +/- 0.30

Tooling Code : Flatbed - 08
Estimated max. length : 67 meter / 22B6 reel

(I)   Measured from centreline of sprocket hole
        to centreline of pocket.
(II)   Cumulative tolerance of 10 sprocket
        holes is ± 0.20 .
(III)   Measured from centreline of sprocket
        hole to centreline of pocket.
(IV)   Other material available.
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

3.3.2   Packing in Tape

Direction of unreeling (for customer)

trailer (empty)
1 x circumference /hub
(min 160mm)

component
packed area
standard
500pcs

leader (empty)
minimum 10 pitch

Top cover tape more
than 1 x circumference
plus 100mm to avoid
fixing of tape end on
sealed modules.

Empty spaces in the component packed area shall be less than two per reel and those spaces shall not be consecutive.

The top cover tape shall not be found on reel holes and it shall not stick out from the reel.

3.3.3   Component Direction
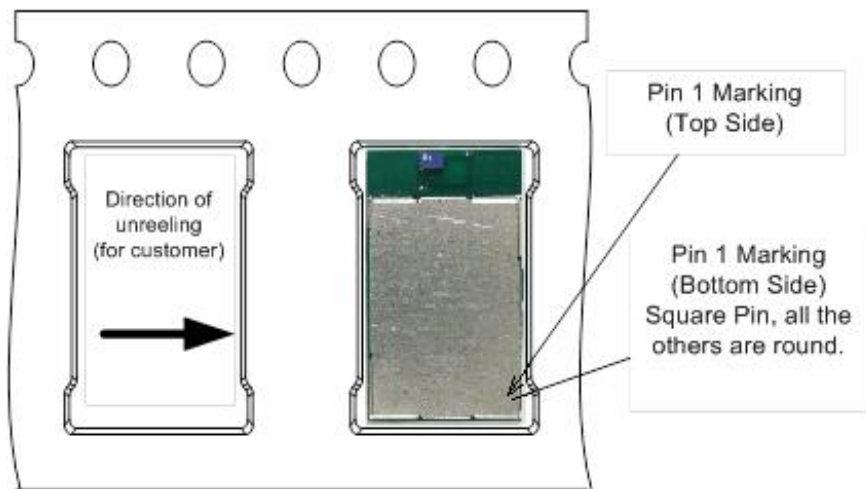
3.3.4   Reel Dimension
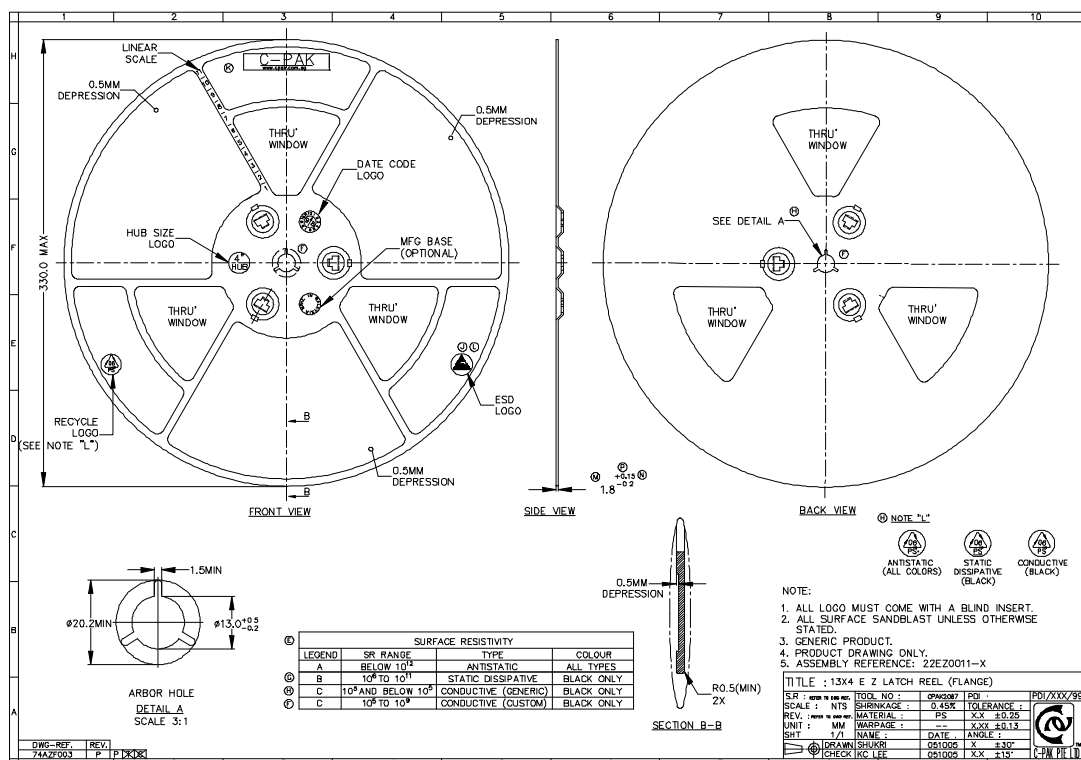
3.3.5 Package Label

Example
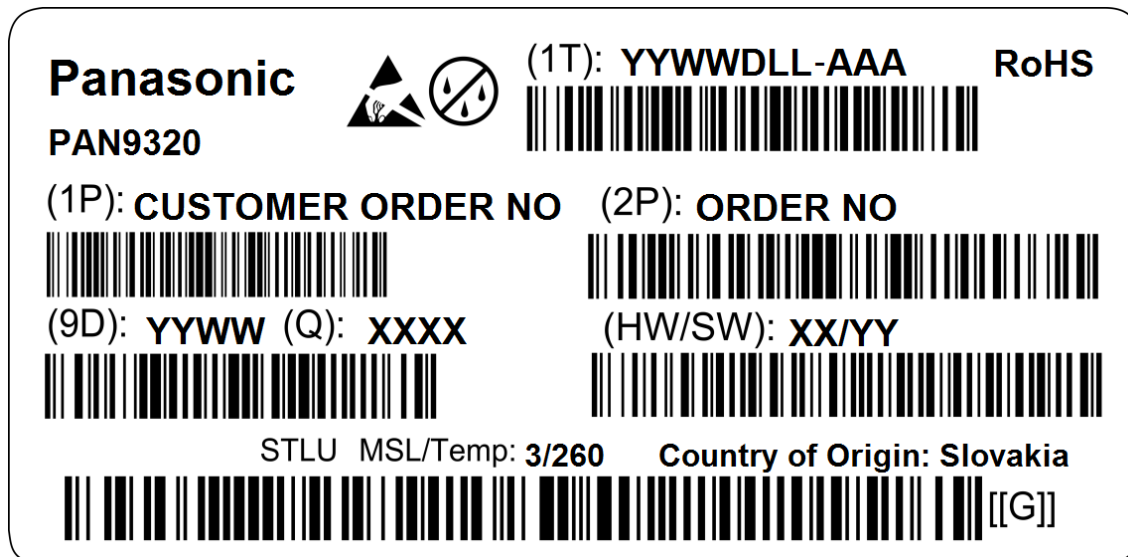
(1T)	Lot code
(1P)	Customer order number, if applicable
(2P)	Order number
(9D)	Date code
(Q)	Quantity
(HW/SW)	Hardware/Software version

3.3.6 Total Package

3.4 Case Marking

Example

```
②              ③
①  PAN9320  HW/SW   ES
④  M/N: ENW49A01A3EF
⑤  YYWWDLL
⑥  12345678
⑦  0013430B801E
⑧  FCC ID: T7V-9320
⑨    IC: 216Q-9320
   ●
                    ⑪
⑩
```
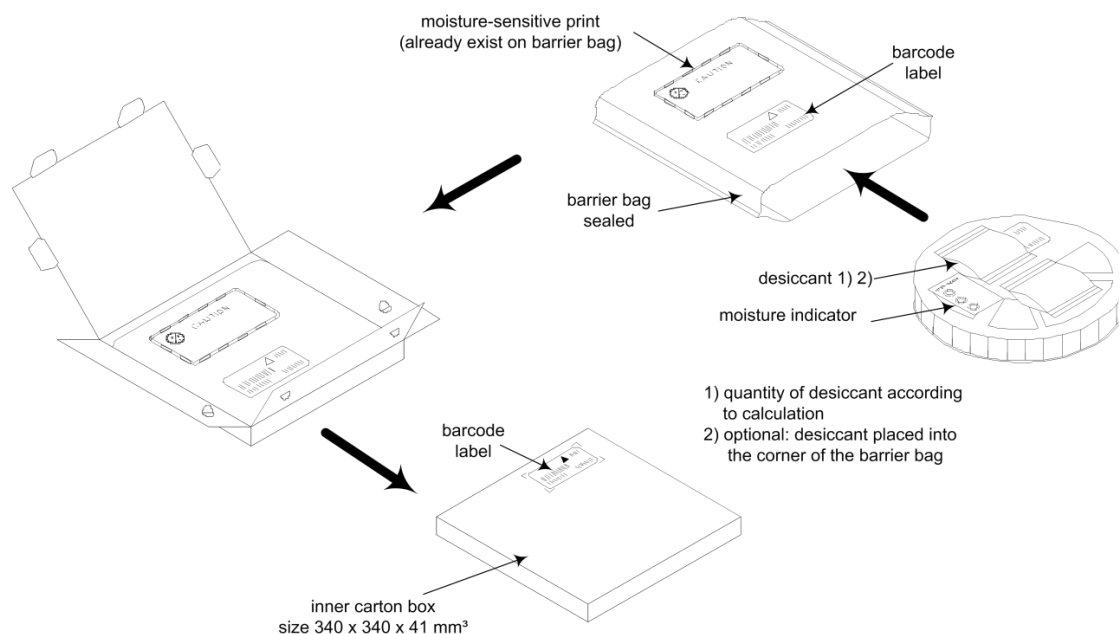
1	Brand name PAN9320/PAN9310
2	Hardware/Software version
3	Engineering Sample (optional)
4	Model Name/ENW number
5	Lot code
6	Serial number
7	WLAN MAC address
8	FCC ID
9	IC Canada
10	Marking for Pin 1
11	2D barcode, for internal usage only

4 Specification

> ℹ️ All specifications are over temperature and process, unless indicated otherwise.

4.1 Default Test Conditions

> ℹ️ Temperature: 25 ± 10 °C
> Humidity: 40 to 85 % RH
> Supply Voltage: 3.3 V

4.2 Absolute Maximum Ratings

> ⚠️ The maximum ratings may not be exceeded under any circumstances, not even momentarily or individually, as permanent damage to the module may result.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
T_{STOR}	Storage temperature		-40		+85	°C
V_{ESD}	ESD robustness	All pads, according to human body model (HBM), JEDEC STD 22, method A114			1 000	V
		According to charged device model (CDM), JEDEC STD 22, method C101			500	V
P_{RF}	RF input level				+20	dBm
V_{DDMAX}	Maximum voltage	Maximum power supply voltage from any pin with respect to V_{SS} (GND)	-0.3		3.6	V
V_{DIG}	Voltage on any digital pins	GPIOs, RESETn, UART, QSPI, Coex I/F	-0.3		V_{DDMAX}	V

4.3   Recommended Operating Conditions

> ⚠️ The maximum ratings may not be exceeded under any circumstances, not even momentarily or individually, as permanent damage to the module may result.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
T_A	Ambient operating temperature range	Extended grade	-30		+70	°C
V_{DD}	3V3 Supply voltage[6]	Voltage on pins 7, 8 (3.3 V) I/O supply voltage internally connected to V_{DD}/V_{CC}	3.0	3.3	3.6	V

4.3.1   Digital Pin Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{IH}	High level input voltage[7]	3.3 V operation ($V_{IO} = V_{DD}$)	0.7 V_{DD}		V_{DD} + 0.3	V
V_{IL}	Low level input voltage[7]	3.3 V operation ($V_{IO} = V_{DD}$)	-0.3		0.3 V_{DD}	V
I_{PS} @ 0.5 V_{DD}	Pull-up/down strength	$V_{Digital Pin} = 0.5 \times V_{DD}$	10		50	µA
I_{OH} @ V_{DD}-0.4 V	High level output current[7]	3.3 V operation ($V_{IO} = V_{DD}$)	4	8		mA
I_{OL} @ 0.4 V	Low level output current[7]	3.3 V operation ($V_{IO} = V_{DD}$)	4	8		mA

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[6] The supply current must be limited to max. 1A

[7] The capacitive load should not be larger than 50 pF for all I/Os when using the default driver strength settings. Large capacitance loads generally increase the overall current consumption.

4.3.2 Current Consumption

> The current consumption depends on the user scenario and on the setup and timing in the power modes.
>
> Assume V_{DD} = 3.3 V, T_{amb} = 25 °C, if nothing else stated.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
I_{TX}	Active Transmit[8]	P_{TX} = +18 dBm for 802.11b @ 11 Mbps		430		mA
		P_{TX} = +15 dBm for 802.11g @ 54 Mbps		370		mA
		P_{TX} = +13 dBm for 802.11n (20 MHz) @ 65 Mbps		350		mA
I_{RX}	Active Receive[9]	802.11b @ 11 Mbps		150		mA
		802.11g @ 54 Mbps		155		mA
		802.11n @ 65 Mbps		160		mA
I_{RXIdle}	Receive Idle[10]	Passive receive state, ready to receive packets, but no active decoding		145		mA
$I_{Shut-off}$	Shut-off	MCU and Radio in shut-off mode		27		mA

4.3.3 Internal Operating Frequencies

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
$f_{SYSCLK1}$	CPU/System/ Encryption clock speed	Refers to clock speed of WLAN SoC			128	MHz
$f_{SYSCLK2}$	CPU/System clock speed	Refers to clock speed of MCU			200	MHz
$f_{REFCLK1}$	WLAN SoC Crystal fundamental frequency	Frequency tolerance < ±10 ppm over operating temperature and process		40		MHz
$f_{REFCLK2}$	Microcontroller Crystal fundamental frequency	Frequency tolerance < ±10 ppm over operating temperature and process		32		MHz

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[8] Peak values for specified output power level and data rate with UDP traffic between the AP and Device (STA).

[9] Peak values for specified data rate with UDP traffic between the AP and Device (STA).

[10] The device is powered on and is ready to receive packets, but it is not actively decoding.

4.3.4 Power Up Sequence

ⓘ When the power is turned on, set reset signal to low (RESETn = low).

After the V_{DD} is stable, release the reset (RESETn = high).
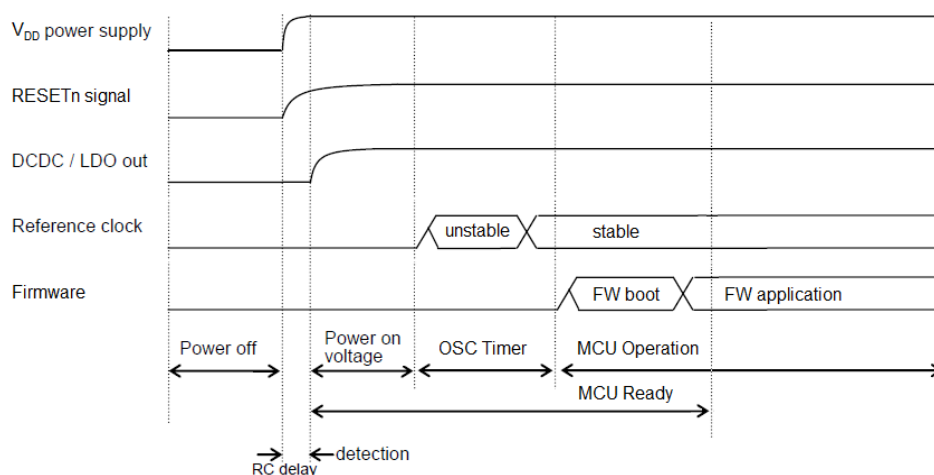
4.3.5 Firmware-Related Timing

Symbol	Parameter	Min.	Typ.	Max.	Units
T MCU READY	Time period from Power up or Reset until MCU READY pin is active		4	5	sec
T WAKE UP	Time period needed to set pin active to wake-up from shut-off mode (afterwards firmware is booting)			100	ms
T FACTORY RESET	Time period needed to set pin active to release factory reset (afterwards firmware is booting)		8	10	sec
T INFRA ASSO	Time period in Infrastructure mode from WLAN association request until association with selected Access-Point's SSID		4		sec
T DE-ASSO SCAN	Time period between de-association from AP until next scan is released		60		sec
T IP DHCP	Time period from IP DHCP request until IP assignment			90	sec

4.3.6 Coexistence Interface Specification

> (i) The Coexistence Interface pins are powered from the VIO voltage supply internally connected to $V_{DD} = 3.3$ V.

DC specification ⇨ 4.3.1 Digital Pin Characteristics.

Marvell® 3/4-Wire Timing Data

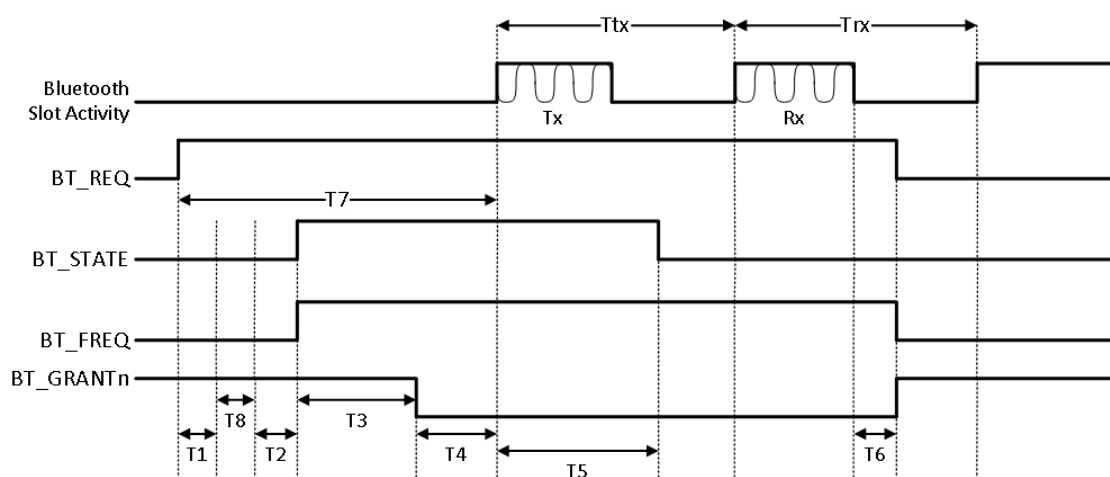| Symbol	Parameter	Min.	Typ.	Max.	Units
T1	Priority[0] info is valid in BT_STATE on and after T1 from BT_REQ rise.	0	1	100	µs
T2	TxRx Info is valid in BT_STATE on and after T2. The BT_STATE must hold until there is any change of direction in the next slots.	2	19	100	µs
T3	Time from TxRx Info valid to BCA grant decision (T3 = T7 – T4 – T2 – T8 – T1).	2	40	594	µs
T4	BT_GRANTn needs to be valid T4 time before the upcoming slot. BT_GRANTn indicates Tx grant, and may also indicate Rx grant. Once a slot is granted, the subsequent slots are also granted unless there is a change in direction from Rx to Tx. Rx to Tx change always re-arbitrates.	2	80	594	µs
T5	TxRx Info for the next slot is valid on and after T5 to the start of the next slot. If direction remains the same for the next slot, then BT_STATE must not change during the current slot. If the direction changes for the next slot, the BT_STATE must change only after the last bit of Bluetooth data is transferred; otherwise the transfer may be disrupted.	5	40	600	µs
T6	The BT_REQ signal de-asserts T6 time after the last bit of Bluetooth data is transferred.	0	15	25	µs
T7	Time from BT_REQ rise to first Bluetooth slot boundary. Bluetooth slot boundary is marked by first bit of Bluetooth data.	8	150	600	µs
T8	Optional Priority[1] information is valid in BT_STAT on and after T8. This time the parameter only exists if BCA is configured for 2-bit priority on the same BT_STATE pin. Otherwise, T2 would start after T1.	2	10	100	µs
Ttx	Slot time (fixed for Bluetooth)		625		µs
Trx	Slot time (fixed for Bluetooth)		625		µs

WL_ACTIVE 2/3/4-Wire Timing Data

Symbol	Parameter	Min.	Typ.	Max.	Units
T1	If WLAN can be stopped, WL_ACTIVE will de-assert prior to Bluetooth slot start (T1 < T2). If the Bluetooth device samples WL_ACTIVE before starting priority transfer, WL_ACTIVE needs to de-assert earlier than the sampling time.	0		499	µs
T2	Time from BT_PRIORITY rise to start of Bluetooth activity.	20	50	499	µs
T3	Time from end of Bluetooth activity to BT_PRIORITY fall.	0	0	499	µs
T4	Slot time (fixed for Bluetooth)		625		µs
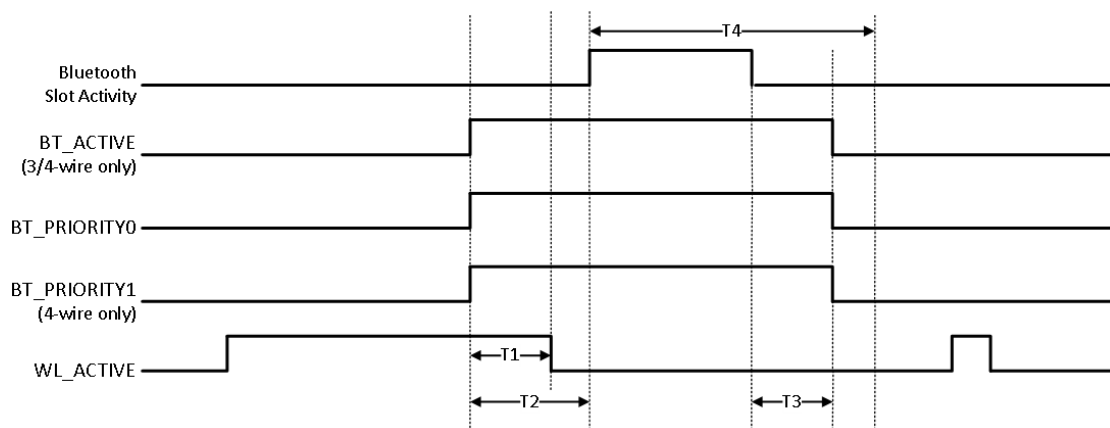
4.3.7 Host Interface Specification

4.3.7.1 UART0 Command Interface

Bus Signals

Module Pin No	Signal Name	Function	Description
27	UART0 TXD	Command	Transmit data output
28	UART0 RXD		Receive data input

Protocol

Item	Range	Default	Comment
Baudrate	300 ~ 1 500 000	115 200	Baud
Data bits	5 ~ 8 (LSB first)	8	LSB first
Parity bits	0 ~ 4	0	
Stop bit	1/1.5/2	1	

Supported Baud Rates

Baud								
300	600	1 200	2 400	4 800	9 600	14 400	19 200	28 800
38 400	56 000	57 600	115 200	128 000	256 000	520 000	780 000	1 500 000

UART0 Timing Diagram
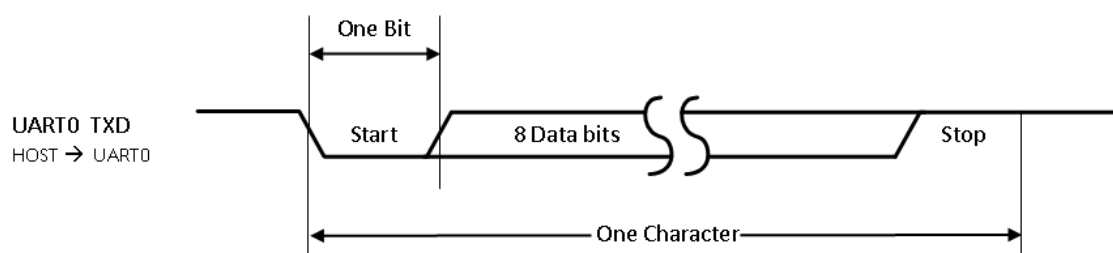
4.3.7.2 UART1 Transparent Data Interface

Bus Signals

Module Pin No		Signal Name	Function	Description
	9	UART1 CTS		Clear to send
	10	UART1 RTS	Transparent data	Request to send
	11	UART1 TXD		Transmit data output
	12	UART1 RXD		Receive data input

Protocol

Item	Range	Default	Comment
Baudrate	300 ~ 1 500 000	115 200	Baud
Data bits	5 ~ 8 (LSB first)	8	LSB first
Parity bits	0 ~ 4	0	
Stop bit	1/1.5/2	1	

Supported Baud Rates

Baud								
300	600	1 200	2 400	4 800	9 600	14 400	19 200	28 800
38 400	56 000	57 600	115 200	128 000	256 000	520 000	780 000	1 500 000

UART1 Timing Diagram
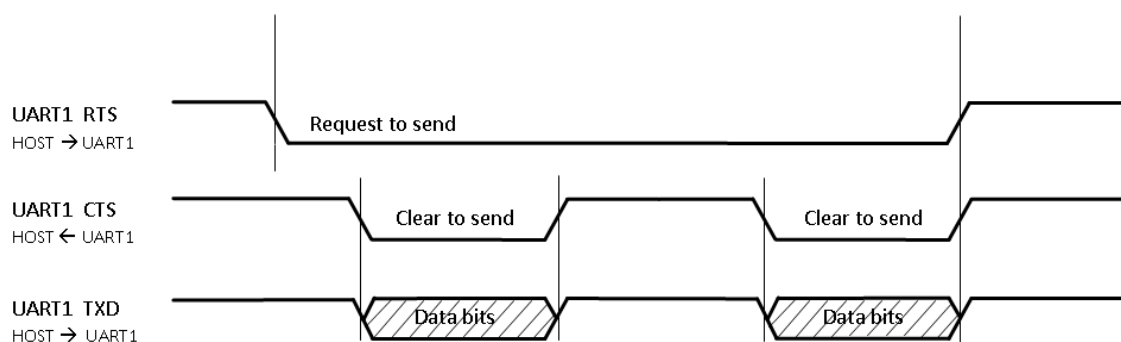
4.3.7.3   UART1 Dual Interface

Bus Signals

Module Pin No	Signal Name	GPIO Definition	GPIO Level Default	State Default	Description
9	UART1 CTS	OUT	-	-	Clear to send
10	UART1 RTS	IN			Request to send
11	UART1 TXD	OUT			Transmit data output
12	UART1 RXD	IN			Receive data input
27	DUAL STAT	OUT	HIGH	Transparent data	UART1 state condition (transparent or command)
28	DUAL SW	IN			UART1 toggle switch for transparent/command

Specification of protocol and supported baud rates ⇨ 4.3.7.2 UART1 Transparent Data Interface.

The usage of the UART1 dual interface needs to be configured in the Customer Config of the firmware. After booting, the MCU READY pin changes from low level to high level. As start condition, the DUAL SW input pin needs to be pre-set from the HOST by changing from high level to low level. The DUAL STAT output pin signals high level as transparent state. In this case, the HOST is able to transmit or receive transparent data.

To change from transparent to command state, the DUAL SW input pin needs to be toggled (low - high - low level change) from the HOST:

1. The change of state is initiated by changing the DUAL SW input pin from low to high level (set toggle switch).

2. After the DUAL STAT pin has changed the state from high level to low level, the Command state is active and the DUAL SW input pin can be reset from high level to low level (reset toggle).

3. The HOST is now able to send commands. After the commands have been sent, it is recommended to change back to transparent state by toggling the DUAL SW input pin again.

Bus and Control Timing Diagram
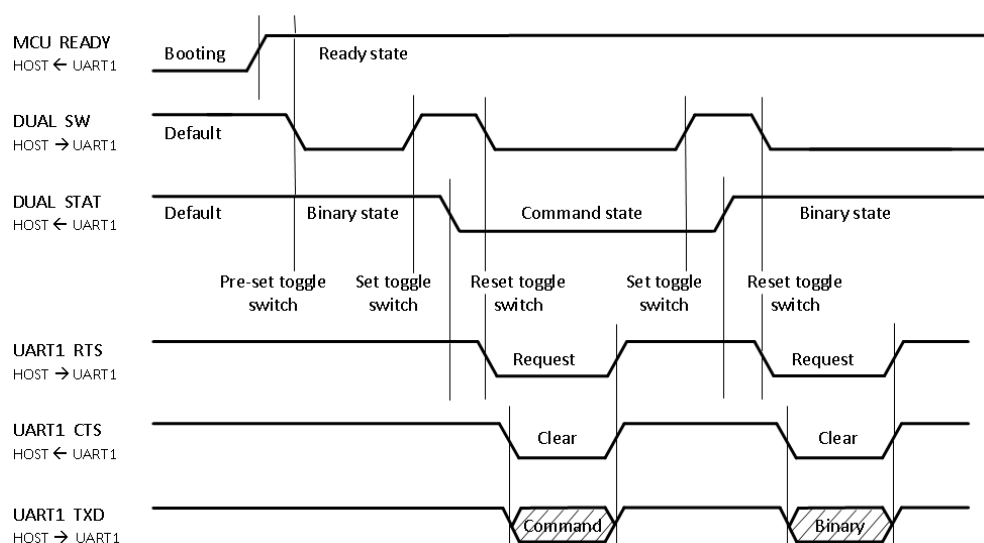
4.3.8　Peripheral Interface Specification

> ⓘ　The Peripheral Interface pins are powered from the VIO voltage supply internally connected to V_{DD} = 3.3 V.

DC specification ⇨ 4.3.1 Digital Pin Characteristics.

Configurable GPIOs

GPIO function	State	GPIO Pin Name						
		GPIO4	GPIO5	GPIO6	GPIO7	GPIO 28	GPIO 44	GPIO 45
Input IN	-	YES	YES	YES	YES	YES	YES	YES
Output OUT	ON	YES	YES	YES	YES	YES	YES	YES
	OFF	YES	YES	YES	YES	YES	YES	YES
Default by firmware	OFF	OUT	OUT	OUT	OUT	OUT	OUT	OUT

The functions of the configurable GPIOs are set by the firmware Default Config, but they can be reconfigured by using the host command interface (UART).

Firmware-Defined GPIOs

GPIO Pin Name	GPIO Definition		GPIO Level		Firmware State		
	Input	Out-put	Default	Active	Boot	Firmware Application Active	Firmware Function
STAT LED1	NO	YES	-	LOW	OFF	OFF: Shut-off BLINK (1sec): Firmware active	MCU status (heartbeat)
STAT LED2	NO	YES	-	LOW	OFF	OFF: no IP assigned ON: IP assigned	IP-Connectivity in Infrastructure mode
STAT LED3	NO	YES	-	LOW	ON	OFF: no error ON: error appeared	MCU firmware error
W STAT LED	NO	YES	-	LOW	OFF	OFF: no AP connection BLINK (0.3 s): Scanning for AP BLINK (1.2 s): WLAN Error ON: Associated with AP	WLAN connectivity in Infrastructure mode
MCU READY	NO	YES	-	HIGH	OFF	OFF: Shut-off ON: Firmware ready	Firmware application is ready
FACTORY RESET	YES	NO	LOW[11]	HIGH	inactive	Set active for min. 10 seconds	Restore firmware default
WAKE UP1	YES	NO	LOW[11]	HIGH	inactive	Set active for min. 100 ms	Wake up after shut-off
BOOT	YES	NO	HIGH[12]	HIGH	active	inactive after booting	Radio firmware to be loaded from internal flash memory

The functions of the firmware-defined GPIOs are fixed and cannot be changed.

---

[11] Set default level by using resistor with 10 kOhm to GND

[12] Set default level with resistor 100 Ohm to Vcc

4.4 Quad Serial Peripheral Interface (QSPI)

List of Supported Flash Memories

Part Name	Manufacturer	Memory Type	SPI Mode	SPI Clock	Memory Size	Page Size
MX25L1633E	Macronix	QSPI	1/2/4 I/O	104/85 MHz	16 Mbit	256 byte

Firmware-Supported QSPI Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units
t_{cyc}	QSPI clock cycle time	20			ns
t_W	Clock high and low time	$t_{cyc/2-6.67}$			ns
$t_{SU(RX)}$	Data input setup time	5.5			ns
$t_{h(RX)}$	Data input hold time	0			ns
$t_{out(TX)}$	Data output delay time	3.2			ns

QSPI Timing Diagram
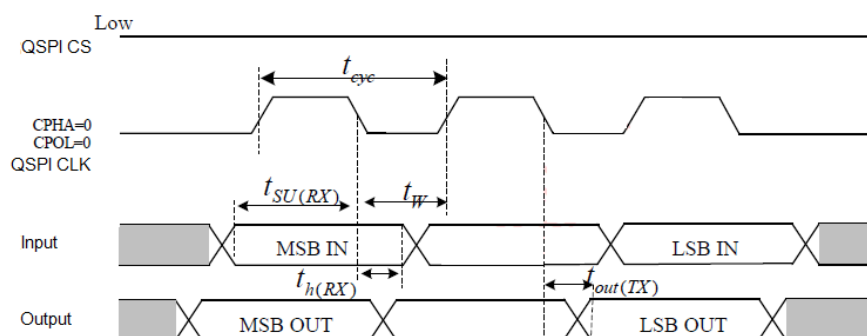
QSPI Command Set (Used by Firmware)

Command	Description	1st byte	2nd byte	3rd byte	4th byte	5th byte	Action
WREN	Write enable	06 (hex)					sets the (WEL) write enable latch bit
WRDI	Write disable	04 (hex)					resets the (WEL) write enable latch bit
RDID	Read identification	9F (hex)					outputs JEDEC ID: 1-byte Manufacturer ID & 2-byte Device ID
RDSR	Read status register	05 (hex)					reads out the values of the status register
WRSR	Write status register	01 (hex)	Values				writes new values of the status register
READ	Read data	03 (hex)	AD1 A23-A16	AD2 A15-A8	AD3 A7-A0		n bytes read out until CS# goes high
FAST READ	Fast read data	0B (hex)	AD1	AD2	AD3	Dummy	n bytes read out until CS# goes high
2READ	2 I/O read	BB (hex)	ADD(2)	ADD(2) & Dummy(2)			n bytes read out by 2 x I/O until CS# goes high
4READ	4 I/O read	EB (hex)	ADD(4) & Dummy(4)	Dummy(4)			n bytes read out by 4 x I/O until CS# goes high
PP	Page program	02 (hex)	AD1	AD2	AD3		programs the selected page
4PP	Quad page program	38 (hex)	AD1				quad input to program the selected page
Sector Erase	4 kB sector erase	20 (hex)	AD1	AD2	AD3		erases the selected sector
Block Erase	64 kB block erase	D8 (hex)	AD1	AD2	AD3		erases the selected block
Chip Erase	2 MB full chip erase	60 or C7 (hex)					erases whole chip

4.5 RF Electrical Characteristics

4.5.1 WLAN Radio Specification

Parameter	Operation Mode				Specification
Standard Conformance	IEEE 802.11/IEEE 802.11b				
	IEEE 802.11g				
	IEEE 802.11n				
Modulation	IEEE 802.11b				DSSS/CCK
	IEEE 802.11g				OFDM
	IEEE 802.11n				OFDM @ MCS0~7 and MCS32 (duplicate 6 Mbps)
Physical layer data rates	IEEE 802.11				1, 2 Mbps @ DSSS
	IEEE 802.11b				5.5, 11 Mbps @ DSSS / CCK
Supported data rates	IEEE 802.11g				6, 9, 12, 18, 24, 36, 48, 54 Mbps
	IEEE 802.11n	MCS0~7	HT20	LGI	6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps
				SGI	7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65, 72.2 Mbps
			HT40	LGI	13.5, 27, 40.5, 54, 81, 108, 121.5, 135 Mbps
				SGI	15, 30, 45, 60, 90, 120, 135, 150 Mbps
Supported bandwidth	IEEE 802.11n				20, 40 MHz (BW)
Supported channel mode operation	IEEE 802.11n				20 MHz BW/channel, 40 MHz BW/channel, upper/lower 20 MHz BW @ 40 MHz channel, 20 MHz duplicate legacy BW @ 40 MHz channel
Supported Guard Interval	IEEE 802.11n				400 ns (SGI), 800 ns (LGI)
Supported channel 2.4 GHz[13]	IEEE 802.11g	North America (US)			1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
		Canada (CA)			1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
		Europe (EU)			1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
		France (FR)			10, 11, 12, 13
		Japan MMK (JP)			1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
	IEEE 802.11n	North America (US)			1-5, 2-6, 3-7, 4-8, 5-9, 6-10, 7-11
		Canada (CA)			
		Europe (EU)			
		France (FR)			
		Japan MMK (JP)			-

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[13] In order to comply with the relevant regulatory requirements, please refer to the model's supported channels
⇨ 7.1 Ordering Information.

4.5.2 WLAN RF Characteristics

4.5.2.1 RF Characteristics for IEEE 802.11b

> (i) Assume V_{DD} = 3.3 V, T_{amb} = 25 °C, if nothing else stated.
>
> 50 Ohm terminal load connected to the RF connector.

Parameter		Condition	Min.	Typ.	Max.	Units
RF frequency range			2 400		2 483.5	MHz
Carrier frequency tolerance			-25		+25	ppm
Transmit output power				+18	+20	dBm
Spectrum mask	fC ± 11 MHz				-30	dBr
	fC ± 22 MHz				-50	dBr
Power-on/Power-down ramp					2	µs
RF Carrier suppression					-15	dB
Error Vector Magnitude (EVM)	Peak				35	%
Minimum Receive Sensitivity	1 Mbps (DSSS)	FER ≤ 8 %		-98	-86	dBm
	2 Mbps (DSSS)	FER ≤ 8 %		-95	-83	dBm
	5.5 Mbps (CCK)	FER ≤ 8 %		-91	-79	dBm
	11 Mbps (CCK)	FER ≤ 8 %		-88	-76	dBm
Maximum Input Level		FER ≤ 8 %	-10			dBm
Adjacent Channel Rejection		FER ≤ 8 %	35			dB

4.5.2.2 RF Characteristics for IEEE 802.11g

Assume V_{DD} = 3.3 V, T_{amb} = 25 °C, if nothing else stated.

50 Ohm terminal load connected to the RF connector.

Parameter		Condition	Min.	Typ.	Max.	Units
RF frequency range			2 400		2 483.5	MHz
Carrier frequency tolerance			-25		+25	ppm
Transmit output power	6 Mbps ~ 36 Mbps			+16	+18	dBm
	48 Mbps ~ 54 Mbps			+15	+17	dBm
Spectrum mask	fC ± 11 MHz				-20	dBr
	fC ± 20 MHz				-28	dBr
	fC ± 30 MHz				-40	dBr
Transmitter center frequency leakage					-15	dB
Transmitter Spectral Flatness			-2		+2	dB
Constellation Error (EVM)	BPSK, CR 1/2 (6 Mbps)				-5	dB
	BPSK, CR 3/4 (9 Mbps)				-8	dB
	QPSK, CR 1/2 (12 Mbps)				-10	dB
	QPSK, CR 3/4 (18 Mbps)				-13	dB
	16-QAM, CR 1/2 (24 Mbps)				-16	dB
	16-QAM, CR 3/4 (36 Mbps)				-19	dB
	64-QAM, CR 2/3 (48 Mbps)				-22	dB
	64-QAM, CR 3/4 (54 Mbps)				-25	dB
Minimum Receive Sensitivity	BPSK, CR 1/2 (6 Mbps)	PER ≤ 10 %		-91	-82	dBm
	BPSK, CR 3/4 (9 Mbps)	PER ≤ 10 %		-90	-81	dBm
	QPSK, CR 1/2 (12 Mbps)	PER ≤ 10 %		-89	-79	dBm
	QPSK, CR 3/4 (18 Mbps)	PER ≤ 10 %		-87	-77	dBm
	16-QAM, CR 1/2 (24 Mbps)	PER ≤ 10 %		-84	-74	dBm
	16-QAM, CR 3/4 (36 Mbps)	PER ≤ 10 %		-80	-70	dBm
	64-QAM, CR 2/3 (48 Mbps)	PER ≤ 10 %		-76	-66	dBm
	64-QAM, CR 3/4 (54 Mbps)	PER ≤ 10 %		-75	-65	dBm
Maximum Input Level		PER ≤ 10 %			-20	dBm
Adjacent channel rejection	BPSK, CR 1/2 (6 Mbps)	PER ≤ 10 %	16			dB
	64-QAM, CR 3/4 (54 Mbps)	PER ≤ 10 %	-1			dB

4.5.2.3 RF Characteristics for IEEE 802.11n (BW 20 MHz)

> ⓘ Assume V_{DD} = 3.3 V, T_{amb} = 25 °C, if nothing else stated.
>
> 50 Ohm terminal load connected to the RF connector.

Parameter	Condition	Min.	Typ.	Max.	Units
RF frequency range		2 400		2 483.5	MHz
Carrier frequency tolerance		-25		+25	ppm
Transmit output power	MCS0 ~ MCS2			+15	+17	dBm
	MCS3 ~ MCS4			+14	+16	dBm
	MCS5 ~ MCS7			+13	+15	dBm
Spectrum mask	fC ± 11 MHz			-20	dBr
	fC ± 20 MHz			-28	dBr
	fC ± 30 MHz			-45	dBr
Transmitter center frequency leakage				-15	dB
Transmitter Spectral Flatness		-2		+2	dB
Constellation Error (EVM)	BPSK, CR 1/2 (MCS0)			-5	dB
	QPSK, CR 1/2 (MCS1)			-10	dB
	QPSK, CR 3/4 (MCS2)			-13	dB
	16-QAM, CR 1/2 (MCS3)			-16	dB
	16-QAM, CR 3/4 (MCS4)			-19	dB
	64-QAM, CR 2/3 (MCS5)			-22	dB
	64-QAM, CR 3/4 (MCS6)			-25	dB
	64-QAM, CR 5/6 (MCS7)			-27	dB
Minimum Receive Sensitivity[14]	6.5 Mbps (MCS0)	PER ≤ 10 %		-91	-82	dBm
	13 Mbps (MCS1)	PER ≤ 10 %		-88	-79	dBm
	19.5 Mbps (MCS2)	PER ≤ 10 %		-86	-77	dBm
	26 Mbps (MCS3)	PER ≤ 10 %		-83	-74	dBm
	39 Mbps (MCS4)	PER ≤ 10 %		-79	-70	dBm
	52 Mbps (MCS5)	PER ≤ 10 %		-75	-66	dBm
	58.5 Mbps (MCS6)	PER ≤ 10 %		-74	-65	dBm
	65 Mbps (MCS7)	PER ≤ 10 %		-73	-64	dBm
Maximum Input Level		PER ≤ 10 %			-20	dBm
Adjacent channel rejection[15]	65 Mbps (MCS7)	PER ≤ 10 %	-2			dB

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[14] The Minimum Sensitivity levels apply only to non-STBC modes, MCS 0~7, 800 ns LGI, and BCC.

[15] The Adjacent Channel Rejection levels apply only to non-STBC modes, MCS 0~7, 800 ns LGI, and BCC.

4.5.2.4   RF Characteristics for IEEE 802.11n (BW 40 MHz)

> Assume V_{DD} = 3.3 V, T_{amb} = 25 °C, if nothing else stated.
>
> 50 Ohm terminal load connected to the RF connector.

| Parameter	Condition	Min.	Typ.	Max.	Units
RF frequency range			2 400		2 483.5	MHz
Carrier frequency tolerance			-25		+25	ppm
Transmit output power	MCS0 ~ MCS2			+13	+15	dBm
	MCS3 ~ MCS4			+12	+14	dBm
	MCS5 ~ MCS7			+11	+13	dBm
Spectrum mask	fC ± 21 MHz				-20	dBr
	fC ± 40 MHz				-28	dBr
	fC ± 60 MHz				-45	dBr
Transmitter center frequency leakage					-15	dB
Transmitter Spectral Flatness			-2		+2	dB
Constellation Error (EVM)	BPSK, CR 1/2 (MCS0)				-5	dB
	QPSK, CR 1/2 (MCS1)				-10	dB
	QPSK, CR 3/4 (MCS2)				-13	dB
	16-QAM, CR 1/2 (MCS3)				-16	dB
	16-QAM, CR 3/4 (MCS4)				-19	dB
	64-QAM, CR 2/3 (MCS5)				-22	dB
	64-QAM, CR 3/4 (MCS6)				-25	dB
	64-QAM, CR 5/6 (MCS7)				-27	dB
Minimum Receive Sensitivity[14]	13.5 Mbps (MCS0)	PER ≤ 10 %		-88	-79	dBm
	27 Mbps (MCS1)	PER ≤ 10 %		-85	-76	dBm
	40.5 Mbps (MCS2)	PER ≤ 10 %		-83	-74	dBm
	54 Mbps (MCS3)	PER ≤ 10 %		-80	-71	dBm
	81 Mbps (MCS4)	PER ≤ 10 %		-76	-67	dBm
	108 Mbps (MCS5)	PER ≤ 10 %		-72	-63	dBm
	121.5 Mbps (MCS6)	PER ≤ 10 %		-71	-62	dBm
	135 Mbps (MCS7)	PER ≤ 10 %		-70	-61	dBm
Maximum Input Level		PER ≤ 10 %			-20	dBm
Adjacent channel rejection[15]	135 Mbps (MCS7)	PER ≤ 10 %	-2			dB

4.6 Reliability Tests

The measurement should be done after the test device has been exposed to room temperature and humidity for one hour.

No.	Item	Limit	Condition
1	Vibration test	Electrical parameter should be in specification	• Freq.: 10~50 Hz; Amplitude: 1.5 mm; 20 min./cycle, 1 h each of XYZ axis • Freq.: 30~100 Hz, 6 G; 20 min./cycle, 1 h each of XYZ axis
2	Shock test	See above	Dropped onto hard wood from a height of 50 cm for 3 times
3	Heat cycle test	See above	-40 °C for 30 min. and +85 °C for 30 min.; each temperature 300 cycles
4	Moisture test	See above	+60 °C, 90 % RH, 300 h
5	Low temperature test	See above	-40 °C, 300 h
6	High temp. test	See above	+85 °C, 300 h

4.7 Recommended Soldering Profile

- Reflow permissible cycle: 2
- Opposite side reflow is prohibited due to module weight
- More than 75 percent of the soldering area shall be coated by solder
- The soldering profiles should be adhered to in order to prevent electrical or mechanical damage
- Soldering profile assumes lead-free soldering
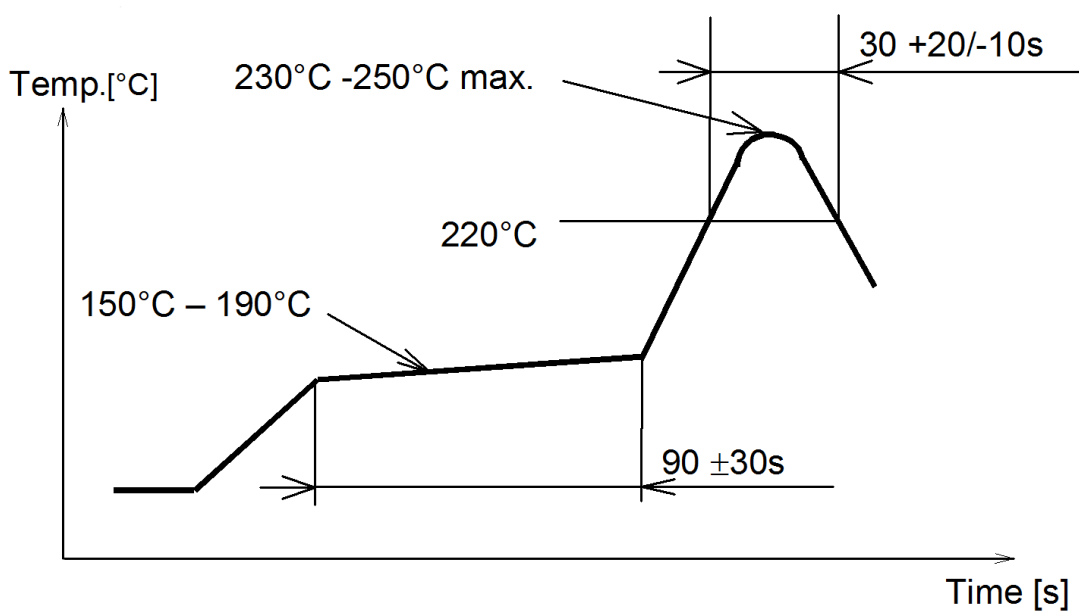
5 Cautions

⚠	Failure to follow the guidelines set forth in this document may result in degrading of the product's functions and damage to the product.

5.1 Design Notes

1. Follow the conditions written in this specification, especially the control signals of this module.

2. The supply voltage must be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47 µF directly at the module).

3. This product should not be mechanically stressed when installed.

4. Keep this product away from heat. Heat is the major cause of decreasing the life of these products.

5. Avoid assembly and use of the target equipment in conditions where the product's temperature may exceed the maximum tolerance.

6. The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.

7. Keep this product away from other high frequency circuits.

8. Refer to the recommended pattern when designing a board.

5.2 Installation Notes

1. Reflow soldering is possible twice based on the conditions set forth in
   ⇨ 4.7 Recommended Soldering Profile. Set up the temperature at the soldering portion of this product according to this reflow profile.

2. Carefully position the products so that their heat will not burn into printed circuit boards or affect the other components that are susceptible to heat.

3. Carefully locate these products so that their temperatures will not increase due to the effects of heat generated by neighboring components.

4. If a vinyl-covered wire comes into contact with the products, then the cover will melt and generate toxic gas, damaging the insulation. Never allow contact between the cover and these products to occur.

5. This product should not be mechanically stressed or vibrated when reflowed.

6. To repair the board by hand soldering, follow the conditions set forth in this chapter.

7. Do not wash this product.

8. Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the unit.

5.3 Usage Condition Notes

1. Take measures to protect the unit against static electricity.
    If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation befor assembly on the final products.

2. Do not use dropped products.

3. Do not touch, damage or soil the pins.

4. Follow the recommended condition ratings about the power supply applied to this product.

5. Electrode peeling strength: Do not add pressure of more than 4.9 N when soldered on PCB.

6. Pressing on parts of the metal cover or fastening objects to the metal cover will cause damage.

7. These products are intended for general purpose and standard use in general electronic equipment, such as home appliances, office equipment, information, and communication equipment.

5.4 Storage Notes

1. The module should not be stressed mechanically during storage.

2. Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:

    –   Storage in salty air or in an environment with a high concentration of corrosive gas, such as Cl2, H2S, NH3, SO2, or NOX,

    –   Storage in direct sunlight,

    –   Storage in an environment where the temperature may be outside the range of 5 °C to 35 °C, or where the humidity may be outside the 45 to 85 percent range,

    –   Storage of the products for more than one year after the date of delivery storage period: Please check the adhesive strength of the embossed tape and soldering after six months of storage.

3. Keep this product away from water, poisonous gas, and corrosive gas.

4. This product should not be stressed or shocked when transported.

5. Follow the specification when stacking packed crates (max. 10).

5.5 Safety Cautions

These specifications are intended to preserve the quality assurance of products and individual components.

Before use, check and evaluate the operation when mounted on your products. Abide by these specifications without deviation when using the products. These products may short-circuit. If electrical shocks, smoke, fire, and/or accidents involving human life are anticipated when a short circuit occurs, provide the following failsafe functions as a minimum:

1. Ensure the safety of the whole system by installing a protection circuit and a protection device.

2. Ensure the safety of the whole system by installing a redundant circuit or another system to prevent a single fault causing an unsafe status.

5.6 Other Cautions

1. Do not use the products for other purposes than those listed.

2. Be sure to provide an appropriate fail-safe function on your product to prevent any additional damage that may be caused by the abnormal function or the failure of the product.

3. This product has been manufactured without any ozone chemical controlled under the Montreal Protocol.

4. These products are not intended for uses other than under the special conditions shown below. Before using these products under such special conditions, carefully check their performance and reliability under the said special conditions to determine whether or not they can be used in such a manner:

   – In liquid, such as water, salt water, oil, alkali, or organic solvent, or in places where liquid may splash,

   – In direct sunlight, outdoors, or in a dusty environment,

   – In an environment where condensation occurs,

   – In an environment with a high concentration of harmful gas (e. g. salty air, HCl, Cl2, SO2, H2S, NH3, and NOX).

5. If an abnormal voltage is applied due to a problem occurring in other components or circuits, replace these products with new products because they may not be able to provide normal performance even if their electronic characteristics and appearances appear satisfactory.

6. When you have any question or uncertainty, contact Panasonic.

5.7 Life Support Policy

This Panasonic Industrial Devices Europe GmbH product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Panasonic customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic Industrial Devices Europe GmbH for any damages resulting.

6 Regulatory and Certification Information

6.1 Federal Communications Commission (FCC) for US

6.1.1 FCC Notice

> (i) The PAN9320, including the ceramic antenna (ENW49A01A3EF), and the PAN9310 SMD type (ENW49A01C3EF), and including the antennas, which are listed in ⇨ 6.1.5 Approved Antenna List, complies with Part 15 of the FCC Rules.

The device meets the requirements for modular transmitter approval as detailed in FCC public Notice DA00-1407. The transmitter 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.

The FCC identifier for ENW49A01x3EF[16] is **FCC ID: T7V-9320**.

6.1.2 Caution

> ⚠️ The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Panasonic Industrial Devices Europe GmbH may void the user's authority to operate the equipment.

> ⚠️ 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 or more 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.

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[16] x = „A" for PAN9320 and x = „C" for PAN9310 (e.g. ENW49A01A3EF → x = "A")

6.1.3 Label Requirements

> ⓘ The OEM must ensure that FCC labelling requirements are met. This includes a clearly visible label (laser marking) on the outside of the OEM enclosure specifying the appropriate Panasonic FCC identifier for this product as well as the FCC Notice above.
>
> The FCC identifier is **FCC ID: T7V-9320** for model ENW49A01x3EF[16].

This FCC identifier is valid for the PAN9320. The end product must in any case be labelled on the exterior with:

"Contains FCC ID: T7V-9320".

6.1.4 Antenna Warning

This antenna warning refers to the test device with the model number ENW49A01C3EF (PAN9310 with SMD pad) ⇨ Chapter 7.1 Ordering Information

The device is tested with a standard SMA connector and with the antenna listed below. When integrated into the OEM's product, these fixed antennas require installation preventing end users from replacing them with non-approved antennas. Any antenna not in the following table must be tested to comply with FCC Section 15.203 for unique antenna connectors and with Section 15.247 for emissions. The FCC identifier for the device with the antenna listed in ⇨ 6.1.5 Approved Antenna List is the same **(FCC ID: T7V-9320)**.

6.1.5 Approved Antenna List

Item	Part Number	Manufacturer	Frequency Band	Type	Gain (dBi)
1	ANT2012LL13R2400A	Yageo	2.4 GHz	Chip antenna	+0.8

Note: We are able to qualify your antenna and will add it to this list when the certification process is completed.

6.1.6 RF Exposure

> (i) To comply with FCC RF Exposure requirements, the OEM must ensure that only antennas from the Approved Antenna List are installed ⇨ 6.1.5 Approved Antenna List.
>
> The preceding statement must be included as a CAUTION statement in manuals for products operating with the approved antennas in the previous table to alert users on FCC RF Exposure compliance.
>
> Any notification to the end user of installation or removal instructions about the integrated radio module is not allowed.
>
> The radiated output power of the PAN9320 with a mounted ceramic chip antenna (**FCC ID: T7V-9320** for model ENW49A01A3EF) are fulfilled for mobile configuration. The installation of the module is restricted to mobile host devices. Nevertheless, the PAN9320 shall be used in such a manner that the potential for human contact during normal operation is minimized.
>
> End users may not be provided with the module installation instructions. OEM integrators and end users must be provided with transmitter operating conditions for satisfying RF exposure compliance.

6.2 Innovation, Science, and Economic Development (ISED) for Canada

English

PAN9320 and versions are licensed to meet the regulatory requirements of ISED.

License for M/N: ENW49A01x3EF[16]:   **IC: 216Q-9320**

License for M/N: ENW49A02x3EF[16]:   **IC: 216Q-9320**

Manufacturers of mobile, fixed, or portable devices incorporating this module are advised to clarify any regulatory questions and ensure compliance for SAR and/or RF exposure limits. Users can obtain Canadian information on RF exposure and compliance from www.ic.gc.ca.

This device has been designed to operate with the antennas listed in ⇨ 6.1.5 Approved Antenna List, having a maximum gain of +0.8 dBi. Antennas not included in this list or having a gain greater than +0.8 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 Ohm. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

French

PAN9320 (et ses versions) est garanti conforme aux dispositions règlementaires d'Innovation, Sciences et Développement économique (ISDE) Canada.

Licence pour M/N: ENW49A01x3EF[16]: **IC: 216Q-9320**

Licence pour M/N: ENW49A02x3EF[16]: **IC: 216Q-9320**

Il est recommandé aux fabricants d'appareils fixes, mobiles ou portables de consulter la réglementation en vigueur et de vérifier la conformité de leurs produits relativement aux limites d'exposition aux rayonnements radiofréquence ainsi qu'au débit d'absorption spécifique maximum autorisé.

Des informations pour les utilisateurs sur la réglementation Canadienne concernant l'exposition aux rayonnements RF sont disponibles sur le site www.ic.gc.ca.

Ce produit a été développé pour fonctionner spécifiquement avec les antennes listées dans le tableau ⇨ 6.1.5 Approved Antenna List, présentant un gain maximum de 0.8 dBi. Des antennes autres que celles listées ici, ou présentant un gain supérieur a 0.8 dBi ne doivent en aucune circonstance être utilises en combinaison avec ce produit. L'impédance des antennes compatibles est 50 Ohm. L'antenne utilisée avec ce produit ne doit ni être située à proximité d'une autre antenne ou d'un autre émetteur, ni être utilisée conjointement avec une autre antenne ou un autre émetteur.

6.2.1 IC Notice

English

The device PAN9320 and versions (⇨ 7.1 Ordering Information), including the antennas (⇨ 6.1.5 Approved Antenna List), comply with Canada RSS-GEN Rules. The device meets the requirements for modular transmitter approval as detailed in RSS-Gen.

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.

French

Le présent appareil PAN9320 (⇨ 7.1 Ordering Information), les antennes y compris (⇨ 6.1.5 Approved Antenna List), est conforme aux CNR-Gen d'ISDE applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

6.2.2 Labeling Requirements

English

> **ⓘ** **Labeling Requirements**
>
> The OEM must ensure that IC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Panasonic IC identifier for this product as well as the IC Notice above.
>
> The IC identifiers are:
>
> **IC: 216Q-9320** (for M/N: ENW49A01x3EF[16])
>
> **IC: 216Q-9320** (for M/N: ENW49A02x3EF[16])
>
> These IC identifiers are valid for all PAN9320 modules ⇨ 7.1 Ordering Information. In any case, the end product must be labelled on the exterior with:
>
> **"Contains IC: 216Q-9320"**

French

> **ⓘ** **Obligations d'étiquetage**
>
> Les fabricants d'équipements d'origine (FEO) – en anglais Original Equipment Manufacturer (OEM) – doivent s'assurer que les obligations d'étiquetage IC du produit final sont remplies. Ces obligations incluent une étiquette clairement visible à l'extérieur de l'emballage externe, comportant l'identifiant IC du module Panasonic inclus, ainsi que la notification ci-dessus.
>
> L' identifiant IC est:
>
> **IC: 216Q-9320** (pour M/N: ENW49A01x3EF[16])
>
> **IC: 216Q-9320** (pour M/N: ENW49A02x3EF[16])
>
> Cet identifiant est valide pour tous les modules PAN9320 ⇨ 7.1 Ordering Information. Dans tous les cas les produits finaux doivent indiquer sur leur emballage externe la mention suivante:
>
> **"Contient IC: 216Q-9320"**

6.2.3 European Conformity According to RED (2014/53/EU)

All modules described in this product specification comply with the standards according to the following LVD (2014/35/EU), EMC-D (2014/30/EU) together with RED (2014/53/EU) articles:

3.1a Safety/Health:	EN60950-1:2006+A11:2009+A1:2010+A12:2011+AC:2011+A2:2013
	EN62311:2008
3.1b EMC:	EN 301 489-1 V2.1.1:2017-02
	EN 301 489-17 V3.1.1:2017-02
3.2 Radio:	EN 300 328 V2.1.1:2016-11

As a result of the conformity assessment procedure described in 2014/53/EU Directive, the end customer equipment should be labelled as follows:

$$C \epsilon$$

> ⚠ The end customer has to assure that the device has a distance of more than 20 cm from the human body under all circumstances.
>
> The end customer equipment must meet the actual Safety/Health requirements according to RED.

PAN9320 and its model versions in the specified reference design can be used in all countries of the European Economic Area (Member States of the EU, European Free Trade Association States[Iceland, Liechtenstein, Norway]), Monaco, San Marino, Andorra, and Turkey.

6.3 RoHS and REACH Declaration

The latest declaration of environmental compatibility (Restriction of Hazardous Substances, RoHS and Registration, Evaluation, Authorisation and Restriction of Chemicals, REACH) for supplied products can be found on the Panasonic website in the "Downloads" section of the respective product ⇨ 7.2.2 Product Information.

7 Appendix

7.1 Ordering Information

The PAN9310/PAN9320 is delivered with a pre-installed firmware ⇨ 7.1.2 Firmware.

7.1.1 Variants and Versions

Order Number	Brand Name	Description	MOQ[17]
ENW49A01A3EF	PAN9320	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with a ceramic chip-antenna Firmware version: V1.9.0.1 Regulatory notice: FCC/IC[18] for US and for Canada Supported channel: Channel 1 ~ 11, 2412 ~ 2462 MHz	500
ENW49A01C3EF	PAN9310[19]	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with an RF bottom pad Firmware version: V1.9.0.1 Regulatory notice: FCC/IC[18] for US and for Canada Supported channel: Channel 1 ~ 11, 2412 ~ 2462 MHz	500
ENW49A02A3EF	PAN9320	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with a ceramic chip-antenna Firmware version: V1.9.0.1 Regulatory notice: ETSI[20] for EU and other Supported channel: Channel 1 ~ 13, 2412 ~ 2472 MHz	500
ENW49A02C3EF	PAN9310[19]	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with an RF bottom pad Firmware version: V1.9.0.1 Regulatory notice: ETSI[20] for EU and other Supported channel: Channel 1 ~ 13, 2412 ~ 2472 MHz	500

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[17] Abbreviation for Minimum Order Quantity (MOQ). The default MOQ for mass production is 500 pieces, fewer only on customer demand. Samples for evaluation can be delivered at any quantity via the distribution channels.

[18] The model with the Regulatory Domain FCC/IC (M/N: ENW49A01A3EF) is only intended to be used in the countries of US and Canada because only the channels 1 ~ 11 (2412 ~ 2462 MHz) are supported in the 2.4 GHz ISM band. It is not possible to change the pre-stored Region Code in order to change the Regulatory Domain. Thus the module labeling contains the FCC Grant ID.

[19] The models with the brand name PAN9310 do not have the chip antenna on module. The Grant IDs marked on the module labelling are referenced and only valid if the customer applies an antenna from the Approved Antenna List (⇨ 6.1.5 Approved Antenna List) including the reference design described in the PAN9310 manual for OEM Antenna Instructions according to KDB996369 question 11 (⇨ 7.2.2 Product Information). In this case, the customer can refer to the pre-qualified module's modular approval which needs to be finally approved by the certification body of the regulatory authority.

[20] The model with Regulatory Domain ETSI (M/N: ENW49A02A3EF) are mainly intended to be used in European countries because the channels 1 ~ 13 (2412 ~ 2472 MHz) are supported. The Region Code is pre-configured (using Default Config Content in Flash memory) to Regulatory Domain ETSI and thus the module labeling does not contain the FCC ID. At the end the customer is able to change applied Region Code by his own Customer Config Content to be stored during customer OEMs product production in the flash memory. It means the FCC Regulatory Domain can be configured as well, but the customer has to certify the end product by itself.

Order Number	Brand Name	Description	MOQ[17]
ENW49A01A5EF	PAN9320	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with a ceramic chip-antenna Firmware version: V1.9.6.4 Regulatory notice: FCC/IC[18] for US and for Canada Supported channel: Channel 1 ~ 11, 2412 ~ 2462 MHz	500
ENW49A01C5EF	PAN9310[19]	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with an RF bottom pad Firmware version: V1.9.6.4 Regulatory notice: FCC/IC[18] for US and for Canada Supported channel: Channel 1 ~ 11, 2412 ~ 2462 MHz	500
ENW49A02A5EF	PAN9320	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with a ceramic chip-antenna Firmware version: V1.9.6.4 Regulatory notice: ETSI[20] for EU and other Supported channel: Channel 1 ~ 13, 2412 ~ 2472 MHz	500
ENW49A02C5EF	PAN9310[19]	Fully embedded stand-alone Wif-Fi module IEEE 802.11 b/g/n with an RF bottom pad Firmware version: V1.9.6.4 Regulatory notice: ETSI[20] for EU and other Supported channel: Channel 1 ~ 13, 2412 ~ 2472 MHz	500

7.1.2 Firmware

Firmware Version	Key Features
1.9.0.1	• Simultaneous AP and station • Netcat TCP data tunnel • AJAX web server • Software update over-the-air
1.9.6.4	• Simultaneous AP and station • Netcat TCP data tunnel • AJAX web server • Software update over-the-air **In addition to V1.9.0.1:** • Webcat – WebSocket client/secure WebSocket client TLS1.2 • UDP Protocol support • Access Point IP Address configurable • Web server - automatic redirect/HTTP redirect

For further information please refer to our product documentation ⇨ 7.2.2 Product Information.

7.2 Contact Details

7.2.1 Contact Us

Please contact your local Panasonic Sales office for details on additional product options and services:

For Panasonic Sales assistance in the **EU**, visit

https://eu.industrial.panasonic.com/about-us/contact-us

Email: wireless@eu.panasonic.com

For Panasonic Sales assistance in **North America**, visit the Panasonic Sales & Support Tool to find assistance near you at

https://na.industrial.panasonic.com/distributors

Please visit the **Panasonic Wireless Technical Forum** to submit a question at

https://forum.na.industrial.panasonic.com

7.2.2 Product Information

Please refer to the Panasonic Wireless Connectivity website for further information on our products and related documents:

For complete Panasonic product details in the **EU**, visit

http://pideu.panasonic.de/products/wireless-modules.html

For complete Panasonic product details in **North America**, visit

http://www.panasonic.com/rfmodules

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