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CUSTOMER'S CODE PAN9320 / PAN9310	PANASONIC'S CODE ENW49A01x3EF & ENW49A02x3EF	DATE	26.11.2015

Product Specification

Applicant / Manufacturer Panasonic Industrial Devices Europe GmbH
Hardware Zeppelinstrasse 19
 21337 Lüneburg
 Germany

Applicant / Manufacturer Please refer to chapter 28. Ordering Information
Software

Software Version Please refer to chapter 29. Software Versions

By purchase of any of products described in this document the customer accepts the document's validity and declares their agreement and understanding of its contents and recommendations. Panasonic reserves the right to make changes as required without notification.

Power Electronics R&D Center Wireless Connectivity Panasonic Industrial Devices Europe GmbH	APPROVED	CHECKED	DESIGNED
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1. SCOPE OF THIS DOCUMENT

This product specification applies to Panasonic's Wi-Fi IEEE 802.11 b/g/n full embedded module with brand names PAN9320 and PAN9310.

2. HISTORY FOR THIS DOCUMENT

Revision	Date	Modification / Remarks
0.1	22.04.2015	1 st preliminary version
1.0	26.11.2015	Adapt Panasonic's Code by adding model ENW49A02x3EF Adapt information in chapter: 4 Related Documents, 5 Key Features, 7 WLAN Overview, 8 Description of the , 10 Detailed Description, 11 General Features, 15 Block Diagram, 18.9 Host Interface Specification, 19 RF Electrical Characteristics, 21 PAN9320 / PAN9310 Module Dimension, 22 PAN9320 / PAN9310 Footprint of the Module, 23 Case Marking (Example for PAN9320 – FCC Version) , and 28 Ordering Information Add chapter: 13 Peripheral Bus Interface, 18.6 Power Up Sequence, 18.7 Firmware related Timing, 29 Software Versions, and 31 Regulatory Information

3. DATA SHEET STATUS

This data sheet contains the PRELIMINARY specification. Supplementary data will be published at a later date.

Panasonic reserves the right to make changes at any time without notice.

Consult the most recently issued data sheet before initiating or completing a design.

4. RELATED DOCUMENTS

Search these homepages for documentation updates.

- [1] PAN9320 Flyer
[PAN9320 Download Page \(Flyer\)](#)
- [2] PAN9320 Design Guide
[PAN9320 Download Page \(Design Guide\)](#)
- [3] PAN9320 Quick Start Guide
[PAN9320 Download Page \(Quick Start Guide\)](#)
- [4] PAN9320 Communication Specification
[PAN9320 Download Page \(Communication Specification\)](#)
- [5] PAN9320 Application Note
[PAN9320 Download Page \(Application Note\)](#)
- [6] Semiconductor Datasheet
[88MC200 from Marvell®](#)
[88W8782 from Marvell®](#)
- [7] Application Note Land Grid Array
[Land Grid Array](#)
- [8] REACH and RoHS Certificate
[WM-REACH and RoHS directive](#)

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5. KEY FEATURES

- Surface Mount Type (SMT) measured 29.0 x 13.5 x 2.66 [mm]³
- Wireless Local Area Network (WLAN) module with integrated MCU and Radio
- Operating in the 2.4GHz ISM band
- Supports the following IEEE 802.11 standards:
 - IEEE 802.11b/g payload data rates
 - IEEE 802.11n high throughput data rates
 - IEEE 802.11i security: WEP and WPA/WPA2 (TKIP, AES-CCMP)
 - IEEE 802.11e Quality of Service (QoS)
- TX power up to +18dBm (for IEEE 802.11b)
- Outstanding RX sensitivity
 - -98dBm (IEEE 802.11b DSSS 1Mbps)
 - -75dBm (IEEE 802.11g OFDM 54Mbps)
 - -73dBm (IEEE 802.11n MCS7 HT20 65Mbps)
 - -70dBm (IEEE 802.11n MCS7 HT40 135Mbps)
- Marvell® 88W8782 WLAN System-on-Chip (SoC) and 88MC200 (MCU) inside
- High performance low power CPU core
- Coexistence interface for external co-located 2.4GHz radios (e.g. Bluetooth)
- Internal crystal oscillators for Radio (40MHz) and MCU (32MHz)
- Integrated memory flash for customer web contents and configuration file (1MByte)
- Memory extension with an external QSPI flash (2MByte) is optional
- Two UART interfaces (command and binary data)
- Integrated shielding to resist EMI
- Manufactured in conformance with RoHS
- Available with either integrated antenna (PAN9320) or dedicated RF pad for external antennas (PAN9310)

6. APPLICATIONS FOR THE PAN9320

All Embedded Wireless Applications

- | | |
|----------------------|--------------------|
| • White Good | • Printer |
| • Home Automation | • Smart Meters |
| • Internet of Things | • Media Player |
| • Fitness Equipment | • Sensors |
| • Lighting Control | • POS Terminal |
| • M2M Communication | • Patient Monitors |

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7. WIRELESS LOCAL AREA NETWORK OVERVIEW

A Wireless Local Area Network (WLAN) is a medium range, wireless network based on the IEEE 802.11 standard, and uses the ubiquitous ISM (Industrial, Scientific and Medical) frequency range of 2,4GHz. The 802.11 standard pertains to the first two layers of the OSI model, and covers Physical Layer (PHY), the Data Link Layer (DLL) with its two sub-layers: Logical Link Control (LLC), and Media Access Control (MAC). WLAN networks utilize two operating modes to connect stations (STAs) equipped with a wireless network adapter. The first is known as the Infrastructure Mode where the wireless STAs are connected via one or more access points (APs). An AP is a device that allows STAs to connect with each other or to a wired network. The second is the Ad-hoc mode, where wireless STAs are connected without any access point.

WLAN devices typically have a high transmit power, of 15 to 20 dBm, allowing them to reach a range of up to 100 meters. Furthermore, WLAN devices are commonly used to transmit high throughput data such as Audio or Video streaming using Orthogonal Frequency Division Multiplexing (OFDM) modulation. The Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) mechanism enables the parallel access of more than one device to the wireless medium of a IEEE 802.11 network. The following security mechanisms are deployed: 1. Advanced Encryption Standard (AES) with Counter Mode CBC-MAC Protocol (CCMP), 2. Cipher-Based Message Authentication Code (CMAC) and 3. Wired Equivalent Privacy (WEP) with Temporal Key Integrity Protocol (TKIP). Video, voice and multimedia applications are supported by the IEEE 802.11e Quality of Service amendment.

8. DESCRIPTION OF THE PAN9320

The PAN9320 module is a WLAN embedded module with a 2.4GHz ISM band wireless radio and an MCU for introduce WLAN connectivity into various electronic devices. A block diagram can be found in chapter 15.

The module is a cost-effective, low-power, fully embedded WLAN solution for the Internet of Things (IoT). It offers the customer an easy integration with a low bill-of-material. The module offers Internet functionality through HTML and JavaScript Web technologies. The PAN9320 combines advanced 802.11 wireless radio, baseband processor, medium access controller (MAC), encryption units, controlled by a powerful CPU. Furthermore, MCU offers an in-system programmable flash memory as well as many other powerful supporting features and peripherals. The module is suitable for wireless network systems based on IEEE 802.11 b/g/n 2.4GHz where small form factor, highly integration, high throughput data rates and low RF expertise are required. It supports simultaneous Access-Point and Infrastructure Mode.

The PAN9320 integrated MCU's firmware consists of software modules with TCP/IP Network Stack, TLS1.2 Security Suite, UDP Name Services and various applications like Web Server, SMTP(s) Client, HTTP(s) Client and Cloud Communication Client on top of the 802.11 WLAN stack with WPA/WPA2 Supplicant.

The integrated flash is used for customer web contents and configuration files with a usable memory size of 1 MByte. The memory size can be extended by using an external QSPI flash memory of 2 MByte. The radio driver, MCU firmware, configuration files and web content can be updated Over-The-Air (OTA).

Refer to Quick Start Guide^[1], Communication Specification^[1], Design Guide^[4] and chapter 28. Ordering Information.

Please contact your local sales office for further details on additional options and services:

www.panasonic.com/rfmodules for the US,

http://industrial.panasonic.com/eu/i/29606/wireless_modules/wireless_modules.html for EU

or write an e-mail to wireless@eu.panasonic.com.

9. DIFFERENCE PAN9320 TO PAN9310

The PAN9320 has an integrated antenna and the PAN9310 has a dedicated RF pad for external antenna connection.

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10. DETAILED DESCRIPTION

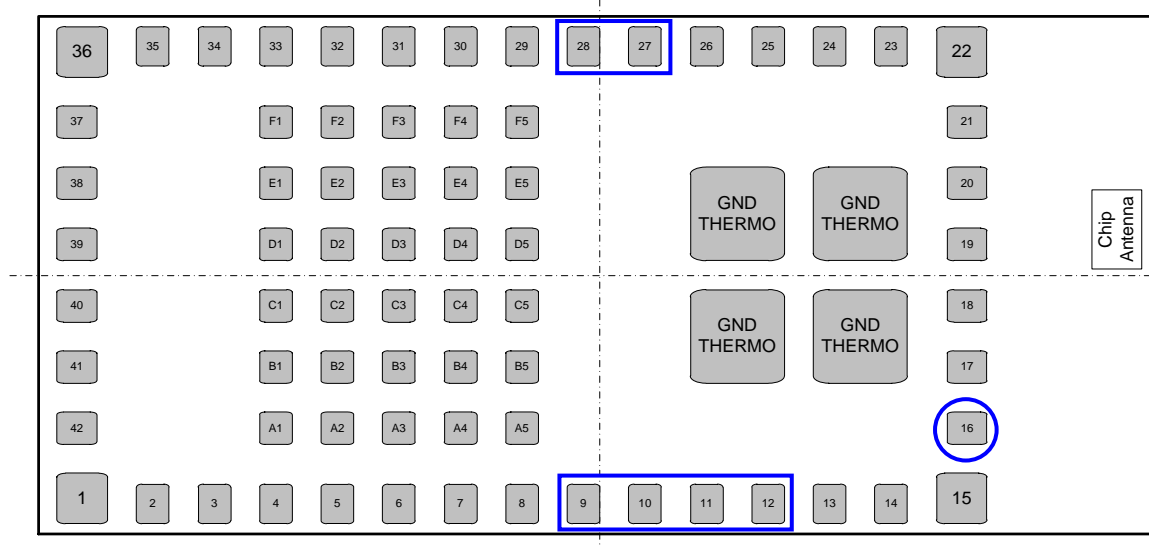
10.1. PAN9320 / PAN9310 TERMINAL LAYOUT

Top View, Application PCB

PAN9310 RF bottom pad is marked with a blue circle

Command UART0 (2 pads) and binary data UART1 (4 pads) are marked with a blue rectangular box

Top View



10.2. COMMON TERMINAL PIN-CONFIGURATION

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	Don't connect, only for internal purpose
5	NC	NC	Don't connect
6	NC	NC	Don't connect
7	3.3V	Power	3.0V – 3.6V power supply connection (typical 3.3V)
8	3.3V	Power	3.0V – 3.6V power supply connection (typical 3.3V)
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 ⁴	Digital Out	Chip select external flash (connect for usage of external QSPI flash memory)
14	GND	Ground Pin	Connect to Ground
15	GND	Ground Pin	Connect to Ground
16	NC / RF	NC / Analog IO	PAN9320: NC / PAN9310: RF in/out over 50Ω 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

¹ All GPIO's are initially set to output with low level

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No	Pin Name	Pin Type	Description
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 (WLAN) status, active low
27	UART0 TXD / DUAL STAT	Digital Out	TXD for UART0 / UART1 state (binary data or command)
28	UART0 RXD / DUAL SW	Digital In	RXD for UART0 / UART1 toggle switch for controlling 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	Don't connect, only for internal purpose
39	BOOT	Digital In	Boot option, high level → boot from internal flash memory ²
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	Don't connect
A2	NC	NC	Don't connect
A3	NC	NC	Don't connect
A4	NC	NC	Don't connect
A5	NC	NC	Don't connect
B1	NC	NC	Don't connect
B2	BT FREQ	Input Signal	Information BT using channel which overlaps WLAN 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	Don't connect
C2	NC	NC	Don't connect
C3	WAKE UP1 ³	Digital In	Wake up signal for WLAN SoC (Host-to-SoC), active high ³
C4	QSPI CLK ⁴	Digital Out	Clock for QSPI (connect for usage of external QSPI flash memory)
C5	QSPI D3 ⁴	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	Don't connect
D4	QSPI D0 ⁴	Digital I/O	Data0 for QSPI (connect for usage of external QSPI flash memory)
D5	QSPI D1 ⁴	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 ⁴	Digital I/O	Data2 for QSPI (connect for usage of external QSPI flash memory)
E5	QSPI CS ⁴	Digital Out	Don't connect, only for internal purpose
F1	W PDn	Digital In	Don't connect, only for internal purpose (pull-up resistor internally)
F2	W RESETn	Input Signal	Don't connect, only for internal purpose (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
	GND THERMO	Thermal Pin	Connect to Ground
	GND THERMO	Thermal Pin	Connect to Ground
	GND THERMO	Thermal Pin	Connect to Ground

² Connect the BOOT pin over a 100 Ohm resistor to V_{CC}

³ Connect to HOST MCU (wake up after shut-off mode, active high), use 10 kOhm resistor to GND at pin

⁴ Connect only in case of using external QSPI flash memory, otherwise do not connect

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11. GENERAL FEATURES

- Surface Mount Type (SMT) measured 29.0 x 13.5 x 2.66 mm³
- Wireless Local Area Network (WLAN) module with integrated MCU and Radio
- Supports IEEE 802.11 b/g/n in the 2.4 GHz ISM band
- TX power up to +18dBm (for IEEE 802.11b)
- Outstanding RX sensitivity -98dBm (for IEEE 802.11b DSSS 1Mbps)
- Marvell® 88W8782 WLAN System-on-Chip (SoC) and 88MC200 (MCU) inside
- Two internal crystal oscillators with 32MHz and 40MHz
- HOST communication interfaces UART0 (command) and UART1 (binary data)
- Integrated TCP/IP network stack: IPv4, ARP, and AutoIP
- UDP Name Services: DHCP, DNS, mDNS, and DNS-SD
- HTTP(s) server with AJAX technology using JavaScript (JSON)
- HTTP(s) client for integrated cloud communication
- SMTP(s) client for E-Mail notifications
- TLS1.2 security with user / group authentication including X.509 Certificate
- 802.11 supplicant: WEP, WPA, WPA2, and WPA2 mixed mode
- Wireless update of radio driver and MCU firmware with integrated boot loader
- Integrated QSPI flash memory for customer web contents up to 1 Mbyte (externally extendable)
- Evaluation and development software available for Windows
- Getting started tutorials, libraries, and APIs
- Easy-To-Use (ETU) evaluation board for quick development and reduced time to market
- Programming over standard JTAG
- Shielding to resist EMI

12. HOST INTERFACES

12.1. 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)

12.2. 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)

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13. PERIPHERAL BUS INTERFACE

- Embedded WLAN Radio (SoC) with following features:
 - 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
- Embedded MCU with following features:
 - 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 Kbytes)
 - ❖ Uniform block erase (64 Kbytes)
 - ❖ 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 is 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)

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14. WLAN FEATURES

14.1. 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 roaming⁵
- 802.11i enhanced security (WEP, WPA, WPA2)
- 802.11k radio resource measurement⁵
- 802.11r fast hand-off for AP roaming⁵
- 802.11w protected management frames⁵
- Support clients (stations) implementing IEEE Power Save mode

14.2. WLAN MAC

- Ad-Hoc⁵ 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)

14.3. 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

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

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14.4. WLAN RADIO

- 20 and 40 MHz channel bandwidth
- Embedded WLAN Radio SoC with following features:
 - Direct conversion radio (no SAW filter)
 - 2.4GHz 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)

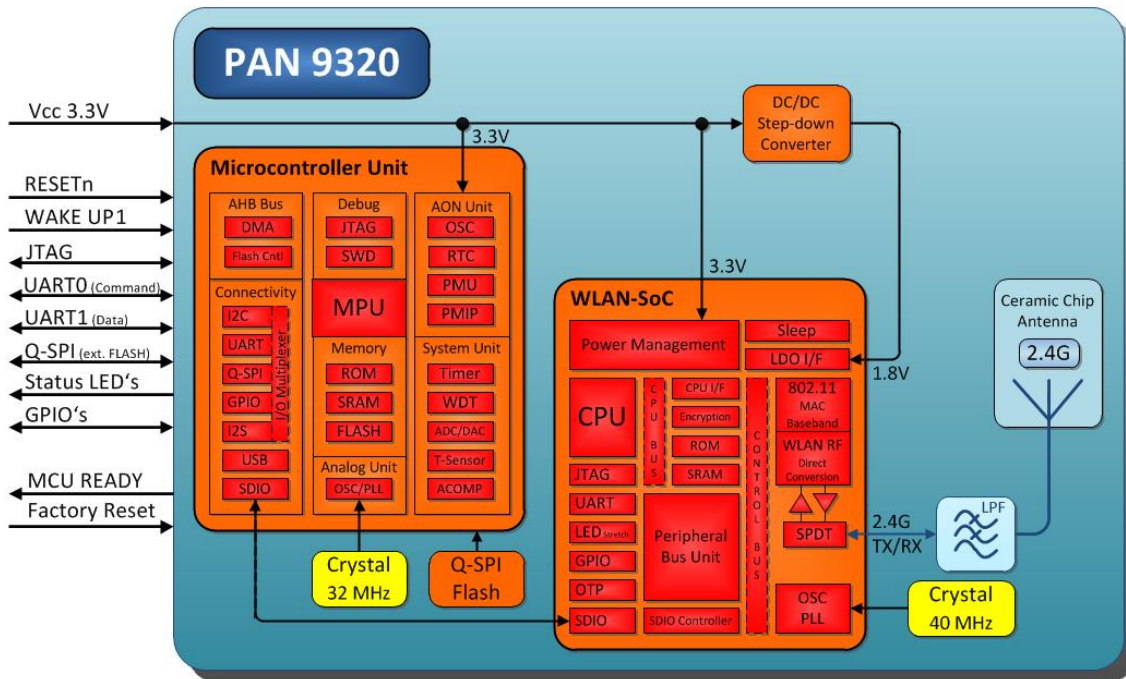
14.5. WLAN ENCRYPTION

- Embedded WLAN Radio SoC with 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 standard⁵

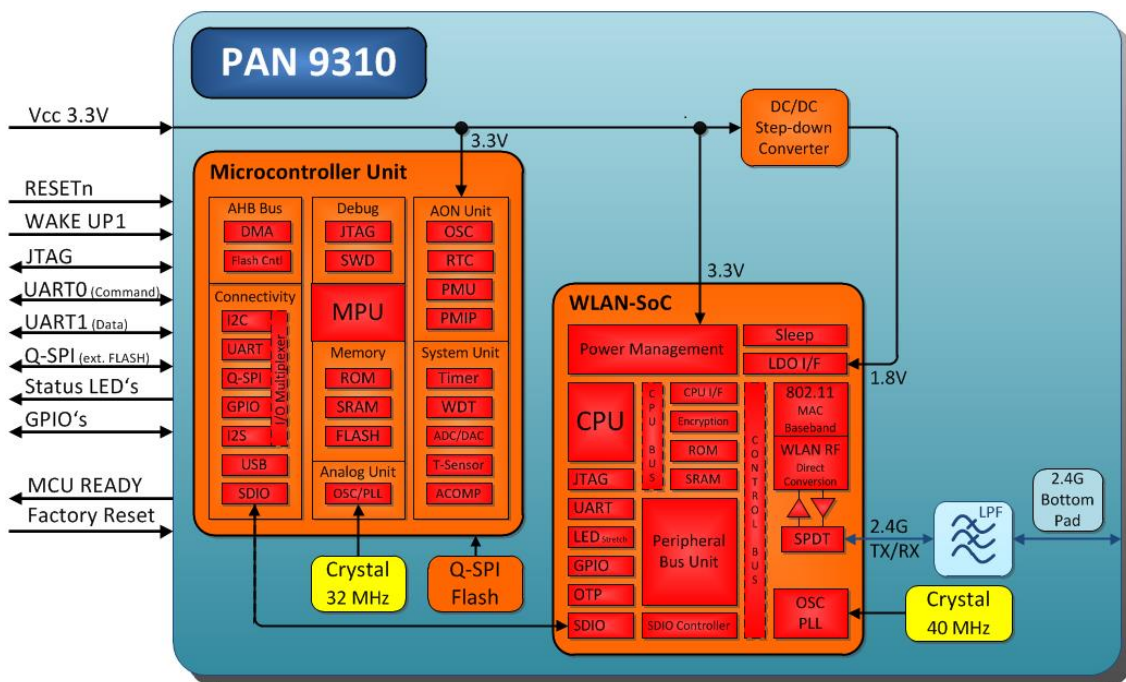
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15. BLOCK DIAGRAM

15.1. PAN9320



15.2. PAN9310



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16. KEY PARTS LIST

Part Name	Material
P.W.Board	Glass cloth epoxy resin with gold plating
Casing	Material: C7521, thickness 0.30mm
IC (WLAN SoC)	88W8782 (Marvell®, www.marvell.com)
IC (Microcontroller Unit)	88MC200 (Marvell®, www.marvell.com)
IC (QSPI flash memory)	MX25L1633E (Macronix®, http://www.macronix.com)

17. TEST CONDITIONS

Measurements shall be made under operating free-air temperature range unless otherwise specified.

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

18. GENERAL REQUIREMENTS AND OPERATION

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

18.1. ABSOLUTE MAXIMUM RATINGS

The maximum ratings may not be exceeded under any circumstances, not even momentarily and individually, as permanent damage to the module will 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, JEDEC STD 22, method A114			1000	V
		According to charged-device model, 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

18.2. RECOMMENDED OPERATING CONDITIONS

The maximum ratings may not be exceeded under any circumstances, not even momentarily and individually, as permanent damage to the module will 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 (3.3V) I/O supply voltage internally connected to V _{DD} / V _{CC}	3.0	3.3	3.6	V

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

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18.3. DIGITAL PIN CHARACTERISTICS

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

18.4. ELECTRICAL CHARACTERISTICS

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

18.4.1. Current Consumption

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 (20MHz) @ 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

18.5. 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

⁷ The capacitive load should not be larger than 50 pF for all I/O's when using the default driver strength settings. Generally, large capacitance loads increase the overall current consumption.

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

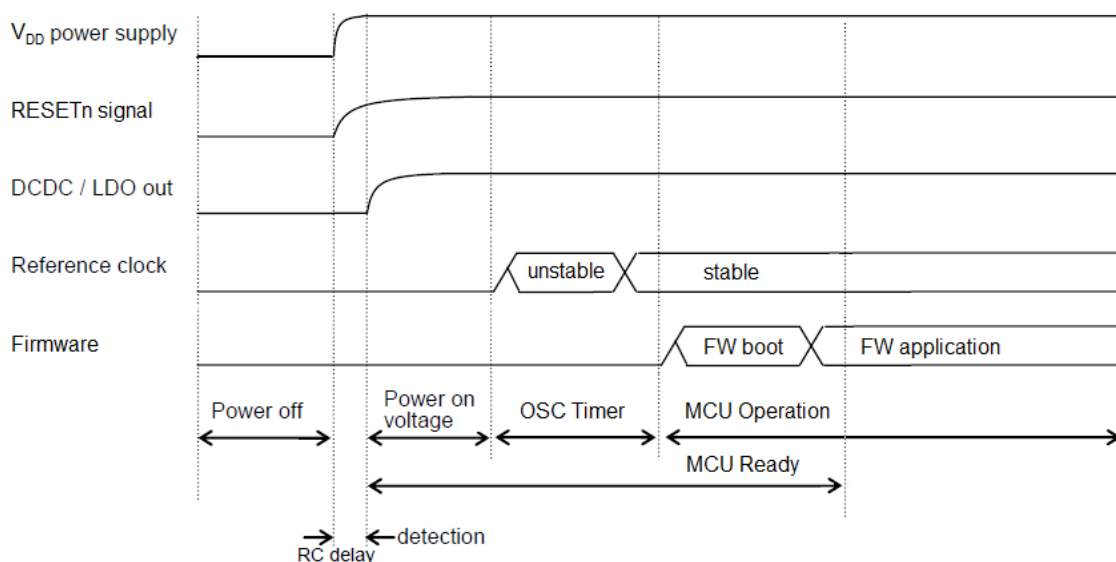
⁹ Peak values for specified data rate with UDP traffic between the AP and Device (STA).

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

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18.6. 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).



18.7. 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 need to set pin active to wake-up from shut-off mode (afterwards firmware is booting)			100	ms
T _{FACTORY RESET}	Time period need 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

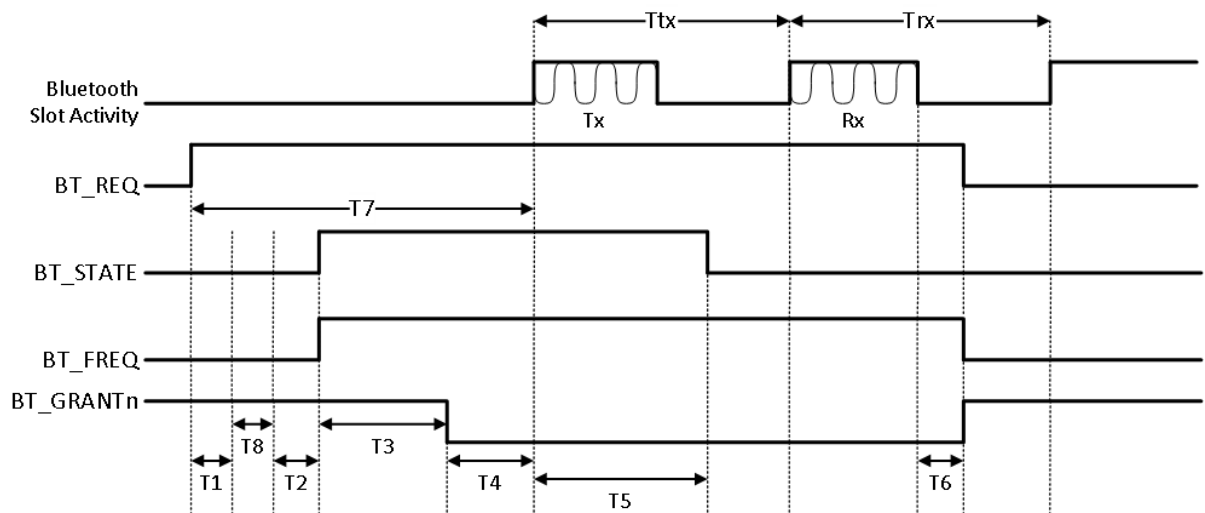
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18.8. COEXISTENCE INTERFACE SPECIFICATION

The Coexistence Interface pins are powered from the VIO voltage supply internally connected to $V_{DD} = 3.3V$. See Chapter 18.3 Digital Pin Characteristics for DC specification.

18.8.1. Marvell® 3/4-Wire Timing Data

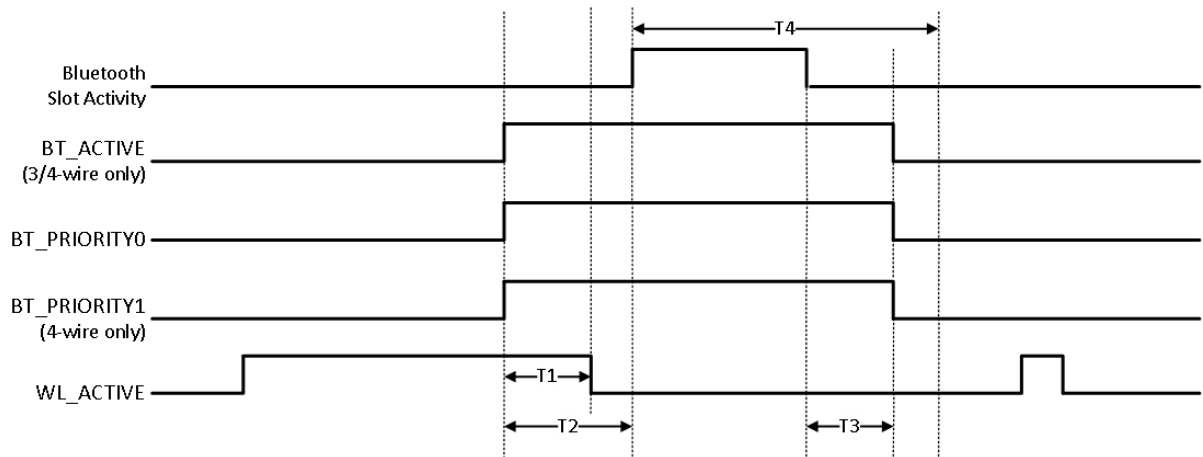
Symbol	Parameter	Min.	Typ.	Max.	Units
T1	Priority[0] info is valid in BT_STATE on and after T1 from BT_REQ rise.	0	1	100	μs
T2	TxRx Info is valid in BT_STATE on and after T2. The BT_STATE must hold until there is any change of direction in the next slots.	2	19	100	μs
T3	Time from TxRx Info valid to BCA 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 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 parameter only exists if BCA is configured for 2-bit priority on same BT_STATE pin. Otherwise, the start of T2 would come after T1.	2	10	100	μs
Ttx	Slot time (fixed fpr Bluetooth)		625		μs
Trx	Slot time (fixed fpr Bluetooth)		625		μs



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18.8.2. WL_ACTIVE 2/3/4-Wire Timing Data

Symbol	Parameter	Min.	Typ.	Max.	Units
T1	<ul style="list-style-type: none"> 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



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18.9. HOST INTERFACE SPECIFICATION

18.9.1. UART0 Command Interface

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

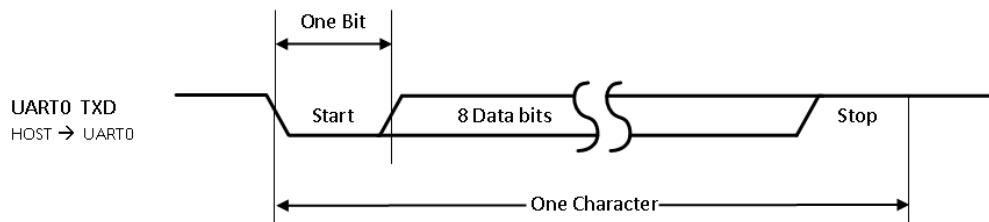
Protocol:

Item	Range	Default	Comment
Baudrate	300 ~ 1500000	115200	
Data Bits	5 ~ 8 (LSB first)	8	LSB first
Parity Bits	0 ~ 4	0	
Stop Bit	1 / 1,5 / 2	1	

Supported Baud Rates:

Item	Baud									
Baudrate	300	600	1200	4800	9600	14400	19200	28800	38400	
	56000	57600	115200	128000	256000	520000	780000	1500000		

UART0 timing diagram:



18.9.2. UART1 Binary Data Interface

UART1 binary data interface bus signals:

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

Protocol:

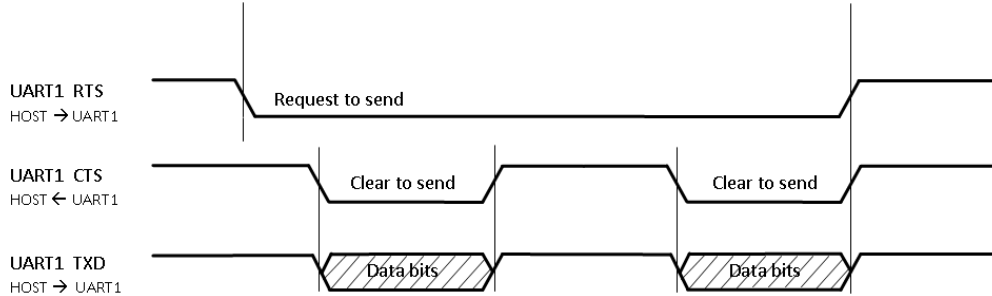
Item	Range	Default	Comment
Baudrate	300 ~ 1500000	115200	
Data Bits	5 ~ 8 (LSB first)	8	LSB first
Parity Bits	0 ~ 4	0	
Stop Bit	1 / 1,5 / 2	1	

Supported Baud Rates:

Item	Baud									
Baudrate	300	600	1200	4800	9600	14400	19200	28800	38400	
	56000	57600	115200	128000	256000	520000	780000	1500000		

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UART1 timing diagram:



18.9.3. UART1 Dual Interface

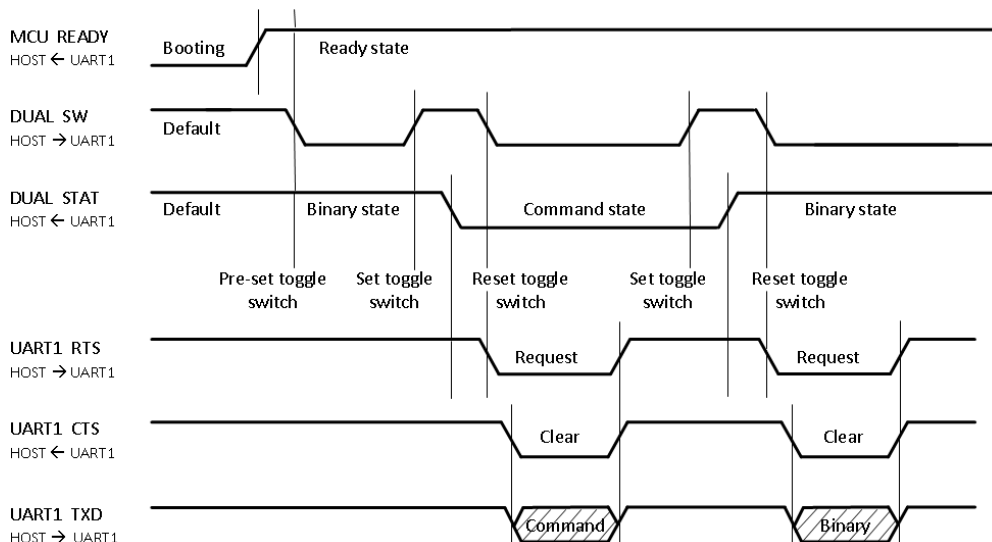
UART1 dual interface bus signals:

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	IN			Transmit data output
12	UART1 RXD	OUT			Receive data input
27	DUAL STAT	OUT	HIGH	Binary data	UART1 state condition (binary or command)
28	DUAL SW	IN			UART1 toggle switch for binary / command

See Chapter 18.9.2 UART1 Binary Data Interface for specification of protocol and supported baud rates.

The usage of the UART1 dual interface needs to be configured at the customer content of firmware. After booting the MCU READY pin is changing from low to high level. For start condition the DUAL SW input pin needs to be pre-set from the HOST by changing from high to low level. The DUAL STAT output pin is signalling high level as Binary state. In this case the HOST is able to transmit or receive binary data. To change from Binary 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 is changing the state from high to low level the Command state is active and the DUAL SW input pin can be reset from high to low level (reset toggle). 3. The HOST is now able to send commands. After the commands are sent it is recommended to change back to Binary state by toggling the DUAL SW input pin again.

UART1 dual interface bus and control timing diagram:



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18.10. PERIPHERAL INTERFACE SPECIFICATION

The Peripheral Interface pins are powered from the VIO voltage supply internally connected to $V_{DD} = 3.3V$. See Chapter 18.3 Digital Pin Characteristics for DC specification.

18.10.1. Configurable GPIOs

GPIO function	State	GPIO pin name						
		GPIO4	GPIO5	GPIO6	GPIO7	GPIO28	GPIO44	GPIO45
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 function of the configurable GPIOs are set by firmware default, but can be reconfigured by HOST command interface (UART).

18.10.2. Firmware defined GPIOs

GPIO pin name	GPIO definition		GPIO level		Firmware state		Firmware function
	Input	Output	Default	Active	Boot	Firmware application active	
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 (0.3s): Scanning for AP BLINK (1.2s): 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	Re-store 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 function of the firmware defined GPIOs are fixed and can't be changed.

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

¹² Set default level with resistor 100 Ohm to Vcc

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18.10.3. Quad Serial Peripheral Interface (QSPI)

18.10.3.1. List of supported Flash Memories

QSPI flash memory supported:

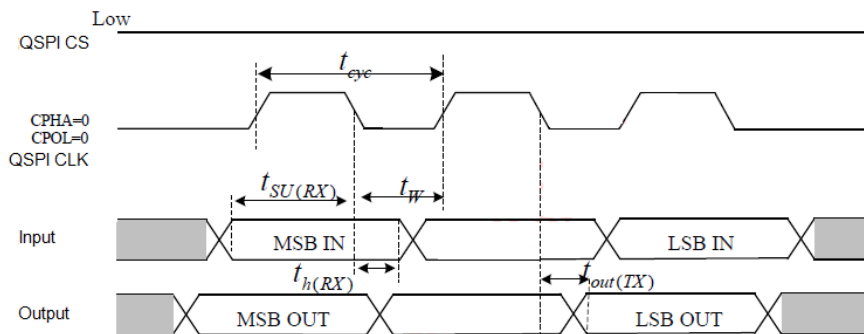
Parts Name	Manufacturer	Memory type	SPI Mode	SPI Clock	Memory size	Page size
MX25L1633E	Macronix	QSPI	1 / 2 / 4 I/O	104 / 85 MHz	16Mbit	256 byte

18.10.3.1. Firmware supported QSPI Characteristic

QSPI characteristic:

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	1 st byte	2 nd byte	3 rd byte	4 th byte	5 th 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)					to read out the values of the status register
WRSR	Write status register	01 (hex)	Values				to write 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		to program 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		to erase the selected sector
Block Erase	64 KB block erase	D8 (hex)	AD1	AD2	AD3		to erase the selected block
Chip Erase	2 MB full chip erase	60 or C7 (hex)					to erase whole chip

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19. RF ELECTRICAL CHARACTERISTICS

19.1. 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
	IEEE 802.11n	MCS0~7	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 2.4GHz 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)			

¹³ In order to comply with relevant regulatory requirements, for the model's supported channels please refer to the chapter 28. Ordering Information

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19.2. WLAN RF CHARACTERISTICS

19.2.1. RF Characteristics for IEEE 802.11b

Assume $V_{DD} = 3.3V$, $T_{amb} = 25^{\circ}C$ if nothing else stated
50 Ohm terminal load connected to the RF connector

Parameter	Condition	Min.	Typ.	Max.	Units	
RF frequency range		2400		2483.5	MHz	
Carrier frequency tolerance		-25		+25	ppm	
Transmit output power			+18	+20	dBm	
Spectrum mask	$f_c \pm 11$ MHz			-30	dBr	
	$f_c \pm 22$ MHz			-50		
Power-on / Power-down ramp				2	μ s	
RF Carrier suppression				-15	dB	
Error Vector Magnitude (EVM)	Peak			35	%	
Minimum Receive Sensitivity	1 Mbps (DSSS)	FER \leq 8%		-98	-86	dBm
	2 Mbps (DSSS)	FER \leq 8%		-95	-83	dBm
	5.5 Mbps (CCK)	FER \leq 8%		-91	-79	dBm
	11 Mbps (CCK)	FER \leq 8%		-88	-76	dBm
Maximum Input Level		FER \leq 8%	-10		dBm	
Adjacent Channel Rejection		FER \leq 8%	35		dB	

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19.2.2. RF Characteristics for IEEE 802.11g

Assume $V_{DD} = 3.3V$, $T_{amb} = 25^{\circ}C$ if nothing else stated
50 Ohm terminal load connected to the RF connector

Parameter	Condition	Min.	Typ.	Max.	Units
RF frequency range		2400		2483.5	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	$f_c \pm 11$ MHz			-20	dBr
	$f_c \pm 20$ MHz			-28	dBr
	$f_c \pm 30$ 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 \leq 10%		-91	dBm
	BPSK, CR 3/4 (9 Mbps)	PER \leq 10%		-90	dBm
	QPSK, CR 1/2 (12 Mbps)	PER \leq 10%		-89	dBm
	QPSK, CR 3/4 (18 Mbps)	PER \leq 10%		-87	dBm
	16-QAM, CR 1/2 (24 Mbps)	PER \leq 10%		-84	dBm
	16-QAM, CR 3/4 (36 Mbps)	PER \leq 10%		-80	dBm
	64-QAM, CR 2/3 (48 Mbps)	PER \leq 10%		-76	dBm
	64-QAM, CR 3/4 (54 Mbps)	PER \leq 10%		-75	dBm
Maximum Input Level	PER \leq 10%			-20	dBm
Adjacent channel rejection	BPSK, CR 1/2 (6 Mbps)	PER \leq 10%	16		dB
	64-QAM, CR 3/4 (54 Mbps)	PER \leq 10%	-1		dB

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19.2.3. RF Characteristics for IEEE 802.11n (BW 20 MHz)

Assume $V_{DD} = 3.3V$, $T_{amb} = 25^{\circ}C$ if nothing else stated
50 Ohm terminal load connected to the RF connector

Parameter	Condition	Min.	Typ.	Max.	Units
RF frequency range		2400		2483.5	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	$f_C \pm 11$ MHz			-20	dBr
	$f_C \pm 20$ MHz			-28	dBr
	$f_C \pm 30$ 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 \leq 10%	-91	-82	dBm
	13 Mbps (MCS1)	PER \leq 10%	-88	-79	dBm
	19.5 Mbps (MCS2)	PER \leq 10%	-86	-77	dBm
	26 Mbps (MCS3)	PER \leq 10%	-83	-74	dBm
	39 Mbps (MCS4)	PER \leq 10%	-79	-70	dBm
	52 Mbps (MCS5)	PER \leq 10%	-75	-66	dBm
	58.5 Mbps (MCS6)	PER \leq 10%	-74	-65	dBm
	65 Mbps (MCS7)	PER \leq 10%	-73	-64	dBm
Maximum Input Level	PER \leq 10%			-20	dBm
Adjacent channel rejection ¹⁵	65 Mbps (MCS7)	PER \leq 10%	-2		dB

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.

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19.2.4. RF Characteristics for IEEE 802.11n (BW 40 MHz)

Assume $V_{DD} = 3.3V$, $T_{amb} = 25^{\circ}C$ if nothing else stated
50 Ohm terminal load connected to the RF connector

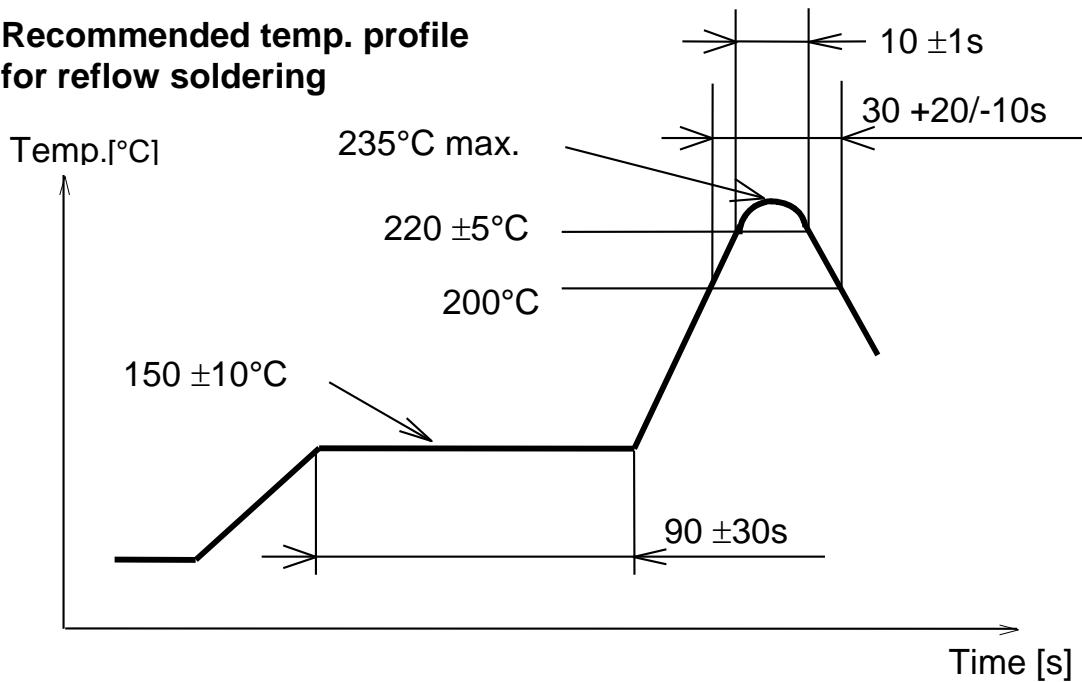
Parameter	Condition	Min.	Typ.	Max.	Units
RF frequency range		2400		2483.5	MHz
Carrier frequency tolerance		-25		+25	ppm
Transmit output power	MCS0 ~ MCS2		+13	+15	dBm
	MCS3 ~ MCS4		+12	+14	dBm
	MCS5 ~ MCS7		+11	+13	dBm
Spectrum mask	$f_c \pm 21$ MHz			-20	dBr
	$f_c \pm 40$ MHz			-28	dBr
	$f_c \pm 60$ 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 \leq 10%	-88	-79	dBm
	27 Mbps (MCS1)	PER \leq 10%	-85	-76	dBm
	40.5 Mbps (MCS2)	PER \leq 10%	-83	-74	dBm
	54 Mbps (MCS3)	PER \leq 10%	-80	-71	dBm
	81 Mbps (MCS4)	PER \leq 10%	-76	-67	dBm
	108 Mbps (MCS5)	PER \leq 10%	-72	-63	dBm
	121.5 Mbps (MCS6)	PER \leq 10%	-71	-62	dBm
135 Mbps (MCS7)	PER \leq 10%	-70	-61	dBm	
Maximum Input Level	PER \leq 10%			-20	dBm
Adjacent channel rejection ¹⁵	135 Mbps (MCS7)	PER \leq 10%	-2		dB

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20. SOLDERING TEMPERATURE-TIME PROFILE (FOR REFLOW SOLDERING)

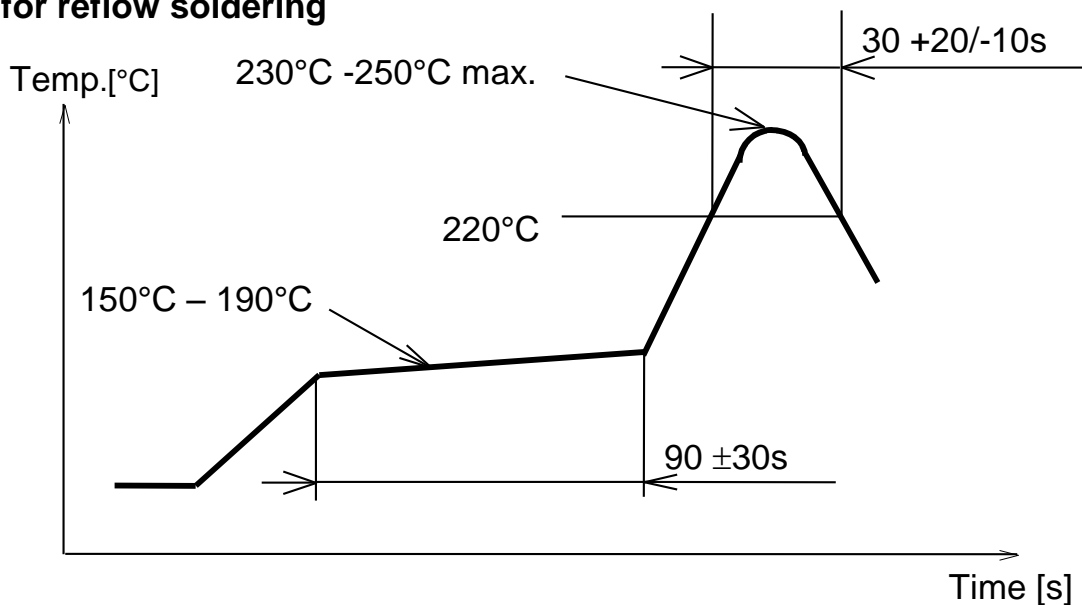
20.1. FOR LEAD SOLDER

Recommended temp. profile for reflow soldering



20.2. FOR LEADFREE SOLDER

Our used temp. profile for reflow soldering

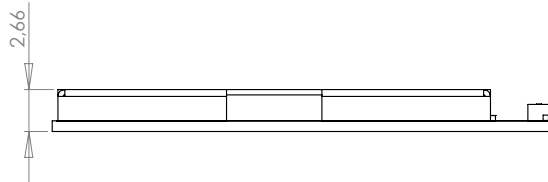
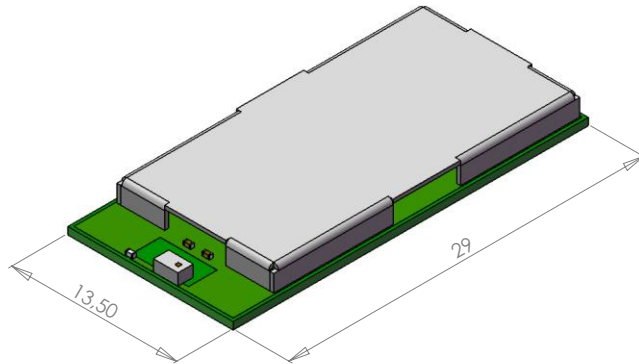


Reflow permissible cycle: 2
Opposite side reflow is prohibited due to module weight.

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21. PAN9320 / PAN9310 MODULE DIMENSION

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



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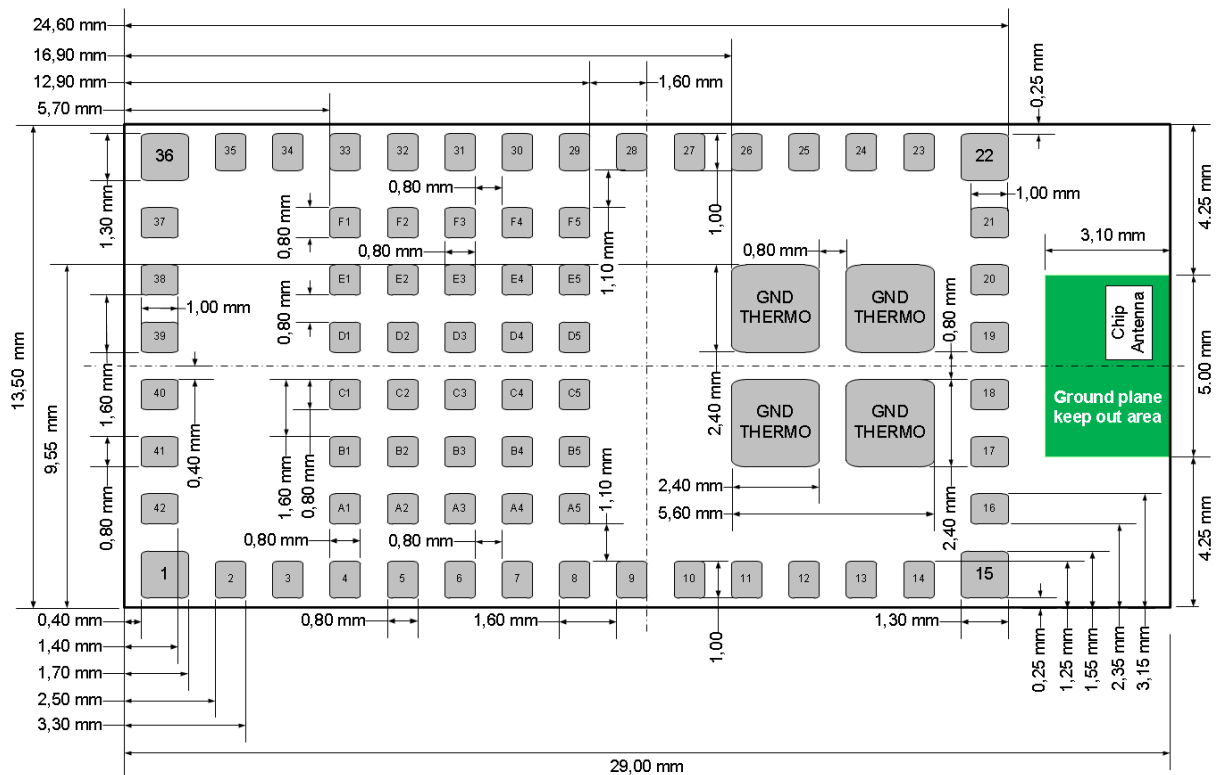
22. PAN9320 / PAN9310 FOOTPRINT OF THE MODULE

All dimensions are in millimeters.

The outer dimensions have a tolerance of $\pm 0.3\text{mm}$.

Top view, Application PCB

Top View



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23. CASE MARKING (EXAMPLE FOR PAN9320 – FCC VERSION)



No.	Remark
1	PAN9320 or PAN9310 (Brand Name), see chapter 28. Ordering Information
2	Hardware / Software version
3	Model Name, see chapter 28. Ordering Information
4	Lot code: YearYear, WeekWeek, Day, LotLot
5	Serial Number (8 digits)
6	WLAN MAC address (12 digits)
7	FCC ID, refer to chapter 31.1 FCC for US
8	IC Canada, refer to chapter 31.2 Industry Canada Certification
9	Marking for Pin 1 (Circle 0,15 mm)
10	2D-Code, for internal usage only and can be change without any notice

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24. MECHANICAL REQUIREMENTS

No.	Item	Limit	Condition
1	Solderability	More than 75% of the soldering area shall be coated by solder	Reflow soldering with recommendable temperature profile
2	Resistance to soldering heat	It shall be satisfied electrical requirements and not be mechanical damage	See chapter 20.2

25. RELIABILITY TESTS

The measurement should be done after being exposed to room temperature and humidity for 1 hour.

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

26. 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.

26.1. 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 47uF 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 products' 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.

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26.2. INSTALLATION NOTES

- (1) Reflow soldering is possible twice based on the conditions in chapter 15.
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) Refer to the recommended pattern when designing a board.
- (9) Pressing on parts of the metal cover or fastening objects to the metal will cause damage to the unit.
- (10) For more details on LGA (Land Grid Array) soldering processes refer to the application note ^[7].

26.3. USAGE CONDITIONS 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 before 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 4.9N 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.

26.4. 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 NO_x
 - Storage in direct sunlight
 - Storage in an environment where the temperature may be outside the range of 5°C to 35°C range, or where the humidity may be outside the 45 to 85% 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 6 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).

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26.5. 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, then 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.

26.6. OTHER CAUTIONS

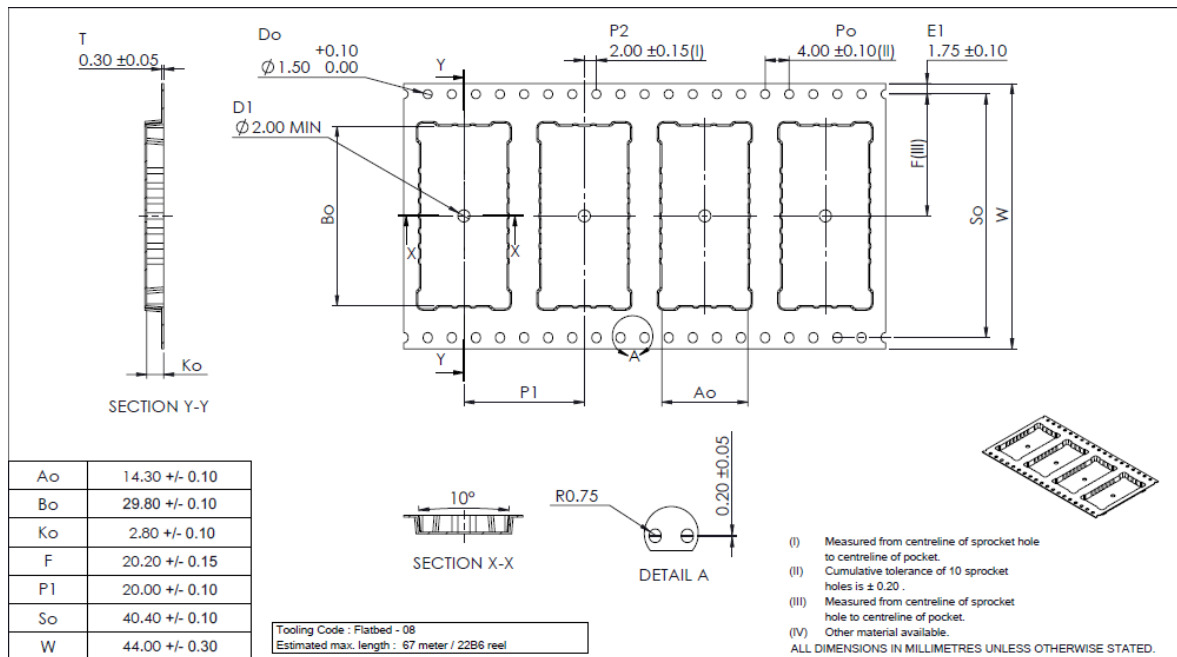
- (1) This specification sheet is copyrighted. Do not disclose it to a third party.
- (2) Do not use the products for other purposes than those listed.
- (3) Be sure to provide an appropriate fail-safe function on your product to prevent an additional damage that may be caused by the abnormal function or the failure of the product.
- (4) This product has been manufactured without any ozone chemical controlled under the Montreal Protocol.
- (5) These products are not intended for other uses, other than under the special conditions shown below. Before using these products under such special conditions, check their performance and reliability under the said special conditions carefully 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 NO_x)
- (6) 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.
- (7) When you have any question or uncertainty, contact Panasonic.

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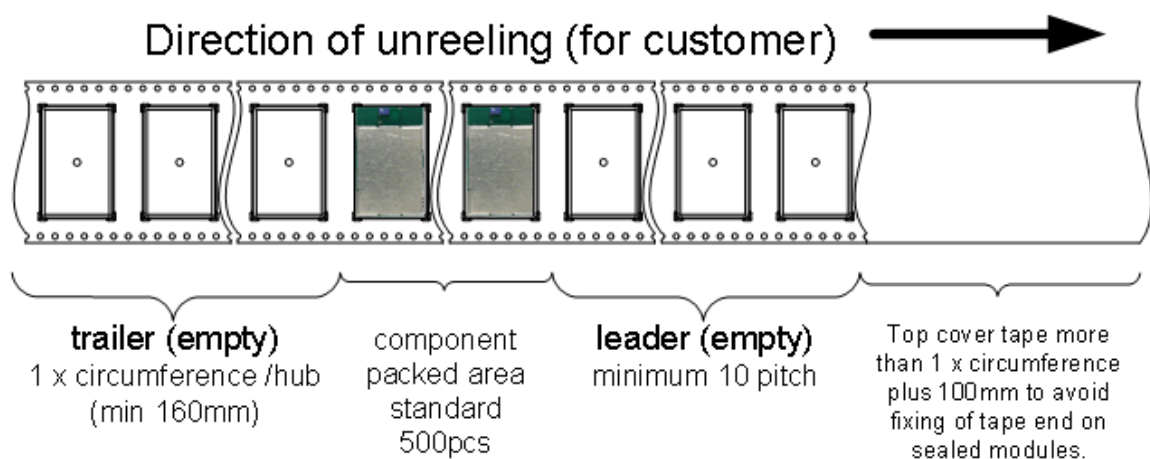
27. PACKAGING

Mass production status product -- as indicated in Chapter 3 -- will be delivered in the package described below.

27.1. TAPE DIMENSION



27.2. PACKING IN TAPE

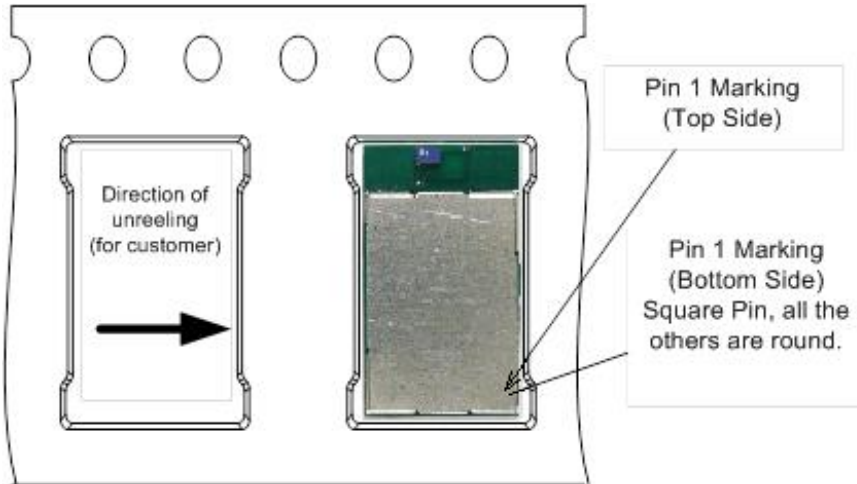


Empty spaces in component packed area shall be less than two per reel and those spaces shall not be consecutive.

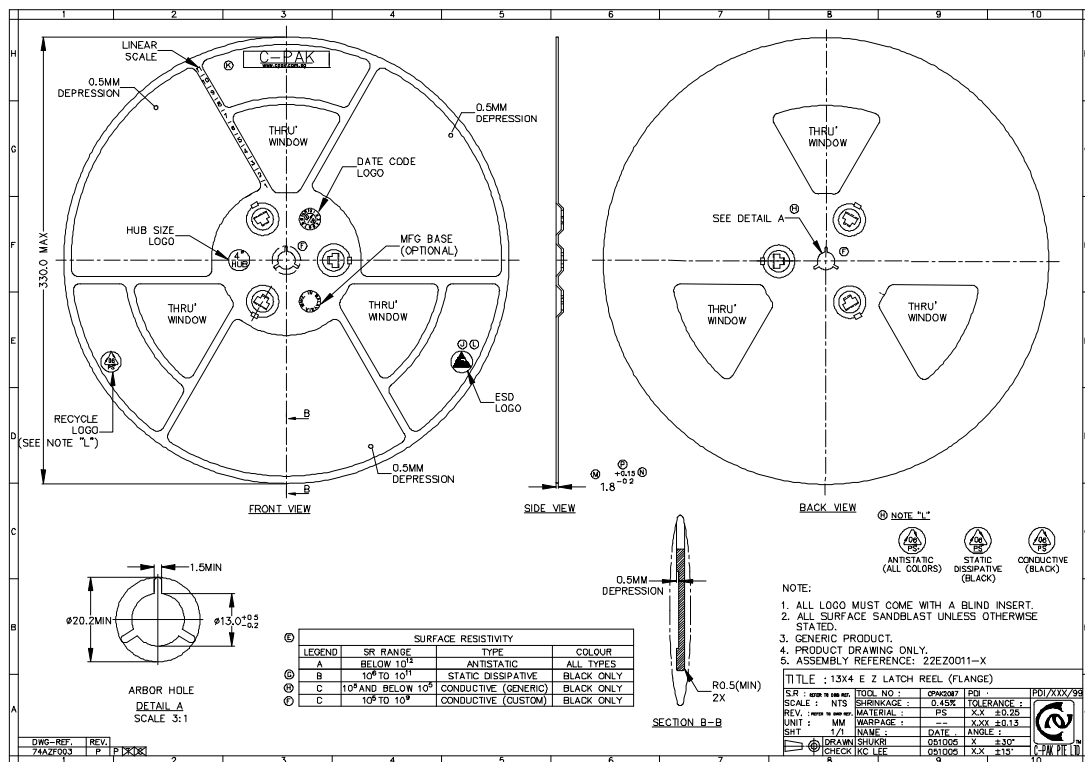
Top cover tape shall not be found on reel holes and shall not stick out from reel.

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27.3. COMPONENT DIRECTION



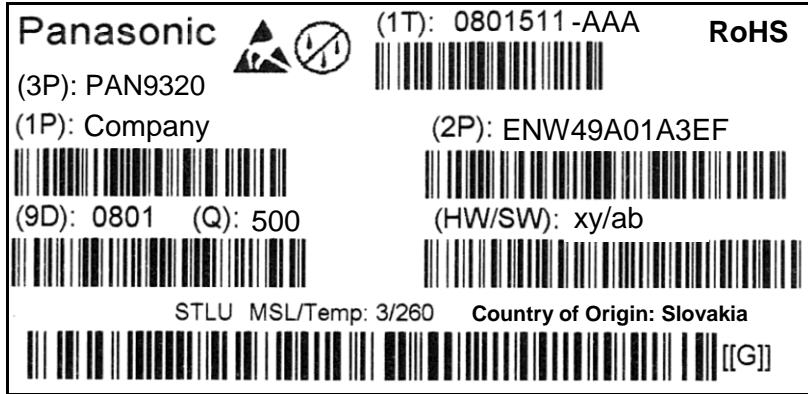
27.4. REEL DIMENSION



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27.5. LABEL FOR PACKAGE

The picture shows an example from similar product.



(1T) Lot code [YYWDDL-AAA]

YY year
 WW normal calendar week
 D day
 L line identifier, if more as one
 L lot identifier per day
 AAA number of the reel (example 001, 002, ..., 999)

Example from above:

printed 08
 printed 01
 printed 5 (Friday)
 printed 1
 printed 1
 printed 001

(1P) Customer Order Code, if any, otherwise company name will be printed

(2P) Panasonic Order Code: ENW49A01A3EF (see chapter 28 Ordering Information)

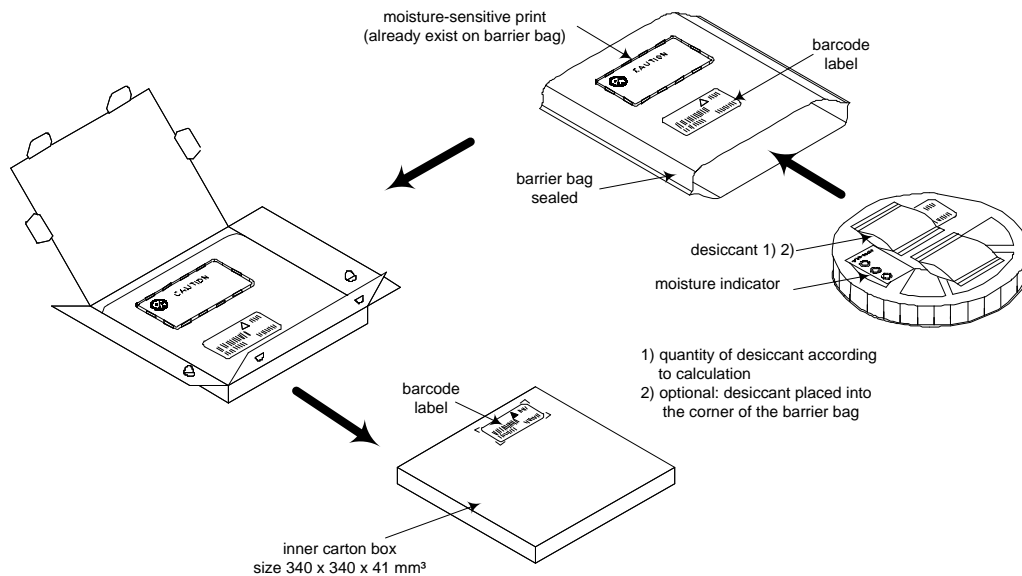
(3P) Model type (see chapter 28. Ordering Information)

(9D) Date code as [YYWW]

(Q) Quantity [XXXX], variable max. 500

(HW/SW) Hardware/Software Release

27.6. TOTAL PACKAGE



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28. ORDERING INFORMATION

Model Name	Brand Name	Regulatory	Supported Channel	Description	MOQ ⁽⁴⁾
ENW49A01A3EF	PAN9320	FCC / IC ⁽¹⁾ for US and for Canada	Channel 1 ~ 11 2412 ~ 2462 MHz	WLAN IEEE 802.11 b/g/n 2.4GHz Full Embedded Module with ceramic chip-antenna	500
ENW49A01C3EF	PAN9310 ⁽³⁾			WLAN IEEE 802.11 b/g/n 2.4GHz Full Embedded Module with RF bottom pad	500
ENW49A02A3EF	PAN9320	ETSI ⁽²⁾ for EU and other	Channel 1 ~ 13 2412 ~ 2472 MHz	WLAN IEEE 802.11 b/g/n 2.4GHz Full Embedded Module with ceramic chip-antenna	500
ENW49A02C3EF	PAN9310 ⁽³⁾			WLAN IEEE 802.11 b/g/n 2.4GHz Full Embedded Module with RF bottom pad	500

The PAN9320 / PAN9310 will be delivered with a pre-installed firmware, see PAN9320 Communication Specification ^[3] and PAN9320 Design Guide ^[1].

Notes:

- (1) The model with Regulatory Domain FCC / IC (M/N: ENW49A01A3EF) are 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 2.4GHz 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.
- (2) 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 doesn't 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.
- (3) The models with brand name PAN9310 don't have the Chip antenna on module. The Grant ID's marked on module labelling are referenced and are only valid in case of customer is applying the same antenna (listed in 31.1.5) including the reference design described in the Design Guide ^[1]. In this case the customer can refer to the pre-qualified module's modular approval which needs finally to be approved by the certification body of regulatory authority.
- (4) Abbreviation for Minimum Order Quantity (MOQ). The standard 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.

29. SOFTWARE VERSIONS

The version numbers of the embedded MCU firmware and WLAN SoC firmware can be read out by UART commands which are specified in the PAN9320 Communication Specification ^[3] and listed below:

No.	Item	UART Command	Response example
1	MCU firmware version	get system firmware	get system firmware 0 1.9.0.1
2	WLAN SoC firmware version	get system wifi_ver	get system wifi_ver 0 "w8782-B0, RF878X, FP69, 14.69.12.p40"

30. ROHS DECLARATION

Declaration of environmental compatibility for supplied products:

Hereby we declare to our best present knowledge based on declaration of our suppliers that this product does not contain the following substances which are banned by Directive 2002/95/EC (RoHS) or contains a maximum concentration of 0.1% by weight in homogeneous materials for

- Lead and lead compounds
- Mercury and mercury compounds
- Chromium (VI)
- PBB (polybrominated biphenyl) category
- PBDE (polybrominated biphenyl ether) category

And a maximum concentration of 0.01% by weight in homogeneous materials for

- Cadmium and cadmium compounds

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31. REGULATORY INFORMATION

31.1. FCC FOR US

31.1.1. FCC Notice



The PAN9320, including the ceramic antenna (ENW49A01A3EF) and the PAN9310 SMD type (ENW49A01C3EF), including with the antennas, which are listed in 31.1.5, 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. 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**

31.1.2. 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

31.1.3. Label Requirements



The Original Equipment Manufacturer (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 PAN9320, for details see the Chapter 28 Ordering Information. In any case the end product must be labelled exterior with

"Contains FCC ID: T7V-9320"

31.1.4. Antenna Warning

The related model number for the device is ENW49A01C3EF (PAN9310 with SMD pad). For details, see the Chapter 28 Ordering Information. The device is tested with a standard SMA connector and with the antenna listed below. When integrated in the OEMs 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 Section 15.247 for emissions. The FCC identifier for the device with the antenna listed in chapter 31.1.5 is the same (**FCC ID: T7V-9320**).

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

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31.1.5. Approved Antenna List

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

Note: We are able to qualify your antenna and will add to this list as that process is completed.

31.1.6. RF Exposure



To comply with FCC RF Exposure requirements, the Original Equipment Manufacturer (OEM) must ensure that the approved antenna in the previous table must be installed.

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 PAN9320 with mounted ceramic chip antenna (**FCC ID: T7V-9320** for model ENW49A01A3EF) are far below the FCC radio frequency exposure limits. 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.

31.2. INDUSTRY CANADA CERTIFICATION

PAN9320 and versions are licensed to meet the regulatory requirements of Industry Canada (IC),

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 31.1.5 above, having a maximum gain of +0.8dBi. Antennas not included in this list or having a gain greater than +0.8dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Due to the model size the IC identifier is displayed in the installation instruction only and can't be displayed on the modules label due to the limited size.

31.2.1. IC Notice



The device PAN9320 and versions, for details refer to Chapter 28. Ordering Information, including the antennas, which are listed in 31.1.5, complies 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.

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31.2.2. Labeling Requirements



The Original Equipment Manufacturer (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⁾)

This IC identifier is valid for all PAN9320, for details, see the Chapter 28 Ordering Information. In any case the end product must be labelled exterior with:

"Contains IC: 216Q-9320"

Les fabricants d'équipements (OEM) doivent s'assurer que les obligations d'étiquetage 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.

Les identifiants IC sont: **IC: 216Q-9320** (pour M/N: ENW49A01x3EF⁽¹⁶⁾)
IC: 216Q-9320 (pour M/N: ENW49A02x3EF⁽¹⁶⁾)

Ces identifiants sont valides pour tous les PAN9320 (28 Ordering Information). Dans tous les cas les produits finaux doivent indiquer sur leur emballage externe une des mentions suivantes:

"Contient IC: 216Q-9320"

31.3. EUROPEAN R&TTE DECLARATION OF CONFORMITY

All modules described in this data sheet comply to the standards according R&TTE article:

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 V1.8.1:2008-04
EN 301 489-17 V2.2.1:2012-09

3.2 Radio: EN 300 328 V1.8.1:2012-06

As a result of the conformity assessment procedure described in Annex III of the Directive 1999/5/EC, the end-customer equipment should be labelled as follows:



The end-customer has to assure that the device has a distance of more than 20cm from the human body under all circumstances.

The end-customer equipment must meet the actual Safety/Health requirements according R&TTE.

PAN9320 and their model versions in the specified reference design can be used in the following countries: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Netherland, the United Kingdom, Switzerland, and Norway.

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32. GENERAL INFORMATION

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This product description does not lodge the claim to be complete and free of mistakes.

Please contact the related product manager in every case.

If ES samples are delivered to the customer, these samples have the status Engineering Samples. This means, the design of this product is not yet concluded. Engineering Samples may be partially or fully functional, and there may be differences to be published Data Sheet.

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

Disclaimer:

Customer acknowledges that samples may deviate from the Data Sheet 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 Customer,
- Deviation or lapse in function of Engineering Sample,
- Improper use of Engineering Samples.

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

33. 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. 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.